



**ASSOCIATED TECHNOLOGIES PRIVATE LTD.**

## **720 MW KAROT HYDROPOWER PROJECT**



## **FEASIBILITY STUDY REPORT**

### **VOLUME – 13 ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT**

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## **ABBREVIATIONS**

|       |   |
|-------|---|
| ADB   | Asian Development Bank                              |
| APs   | Affected Persons                                    |
| ATL   | Associated Technologies (PVT) Ltd)                  |
| AJK   | Azad Jammu and Kashmir                              |
| BHU   | Basic Health Unit                                   |
| BOD   | Biochemical Oxygen Demand                           |
| CBO   | Community Based Organization                        |
| CDO   | Chemically Dissolved Oxygen                         |
| COD   | Chemical Oxygen Demand                              |
| Db    | Desi Bell   |
| DHQ   | District Head Quarter                               |
| DRU   | District Reconstruction Unit                        |
| EGC   | Engineering General Consultants                     |
| EIA   | Environment Impact Assessment                       |
| EMC   | Environment Monitoring Cell                         |
| EMIS  | Education Monitoring Information System             |
| EMPP  | Environment Management and Protection Plan          |
| EPA   | Environment Protection Act\Agency                   |
| FAO   | Food and Agriculture Organization                   |
| FWO   | Frontier Works Organization                         |
| GOP   | Government of Pakistan                              |
| GTZ   | German Agency for Technical Cooperation             |
| HEPO  | Hydro Electric Planning Organization                |
| ICID  | International Commission on Irrigation and Drainage |
| IEE   | Initial Environmental Examination                   |
| IUCN  | International Union for Conservation of Nature      |
| LHV   | Lady Health Visitor                                 |
| LOI   | Letter of Interest                                  |
| LAA   | Land Acquisition Act                                |
| MECO  | Montreal Engineering Co                             |
| MAES  | Mirza Associates Engineering Services (Pvt.) Ltd    |
| NCS   | National Conservation Strategy                      |
| NEQS  | National Environment Quality Standards              |
| NGO   | Non Government Organization                         |
| NSDWQ | National Standards of Drinking Water Quality        |
| PEPA  | Pakistan Environmental Protection Act               |
| PEPC  | Pakistan Environment Protection Council             |
| PEPO  | Pakistan Environmental Protection Ordinance         |
| PMF   | Probable Maximum Flood                              |
| PNCS  | Pakistan National Conservation Strategy             |

|       |   |
|-------|---|
| PPIB  | Private Power Infrastructure Board          |
| RAP   | Resettlement Action Plan                    |
| RHC   | Rural Health Center                         |
| SCO   | Special Communication Organization          |
| SHA   | Synergic Hydro Asia                         |
| SMEC  | Snowy Mountains Engineering Corporation     |
| SOP   | Survey of Pakistan                          |
| TAC   | Technical Advisory Committee                |
| UC    | Union Council                               |
| UNDP  | United Nation Development Program           |
| USDA  | United States Department of Agriculture     |
| USEPA | United States Environment Protection Agency |
| WAPDA | Water and Power Development Authority       |
| WEC   | WAPDA Environment Cell                      |
| WHO   | World Health Organization                   |

## **Executive Summary**

Karot hydropower project is a proposed run of the River Jhelum hydropower project located at Karot village, Tehsil Kahuta District Rawalpindi. This project will have an installed capacity of 720 MW and generate, on the average, about 3436 GWh per year of electrical energy. The Water and Power Development Authority (WAPDA) is the proponent of the project. This project forms part of WAPDA's strategic vision program to the year 2025. The aim of Vision 2025 is to improve hydropower generation capacity in the country to meet the ever growing electricity demands and expansion of economic activities. Pakistan has got one of the largest growth rate areas in the world for electric power. The electricity production from various sources till year 2008 in Pakistan is hydropower 6555 MW, Thermal public sector 4900 MW, Thermal private 6048 MW and Nuclear 325 MW. Still the country is short of the required demand for power in domestic and industrial sectors. An accelerated power production especially hydroelectric generation is under focus through medium term power generation projects. Private sector is being encouraged to make investment to develop and produce hydropower wherever such potential exist in the country.

Karot Hydropower Project scheme was taken over by Private Power Infrastructure Board (PPIB) to be offered as an Investment Power Project (IPP) to the private sector in 2007. Letter of Interest (LOI) was awarded to a group of Pakistani and Chinese sponsors after an international competitive selection process in March 2007. M/S. Associated Technologies (PVT.)Ltd.(ATL) were the main sponsors. A contract was signed on August 21, 2007, after International Competitive Bidding (ICB) with the consortium of consultants (SMEC, MAES, EGC) for carrying out the feasibility study.

The major Project feature consists of the construction of a concrete gravity dam on River Jhelum about 500 meters downstream of the Gohra Village. This will be a 78 meters high Dam from the river bed and will create a reservoir extending up to 27 km upstream of the Dam Site. The reservoir is planned to be contained within the narrow river canyon and it will submerge neither natural vegetation nor any productive land significantly.

The power intake structure will be constructed on the right bank of the river immediately upstream of the Dam Site. This power intake structure will be largely submerged and located at the right bank of the proposed reservoir and divert river water into the four headrace tunnels. From the headrace tunnel the water is dropped through an underground vertical shaft, connected to a horizontal tunnel entering into a cavern powerhouse accommodating all the electricity generating equipment. After passing through the turbines, the water will be discharged back to the Jhelum River through a tailrace channel located at the right bank of the River Jhelum at the confluence of the tributary immediately downstream of the Karot village.

Access to the dam site will be the existing Kahuta-Kotli Road which will require widening and realignment in order to carry construction traffic and project equipment. The proposed widening of the Kahuta-Kotli Road, excavation of the dam foundations and underground openings will produce large amount of surplus material. Some of this material, after crushing and sorting may be used as concrete aggregate. The remaining excavated material will have to be disposed off in suitable selected disposal areas. An area of flood-prone wasteland on the banks of the River Jhelum on the north-west outskirts of Karot village has been identified that could be raised and levelled using this surplus material.

About 75 % of the energy will be generated during the summer months when there is high flow in River Jhelum between April to August. During these months, the power plant will generate energy on a full time basis with the exception of maintenance periods. During the low flow winter months, the power plant would generate energy only during the evening hours when the electricity demand is at its peak which would be equivalent to about four(4) hours per day.

The existing environment depicts that the residents of the Project Area use the valley for traditional dwelling, crop cultivation and animal husbandry, timber production and fuel wood cutting. There are no industrial units or other economic activities from which the population of project area can make their living. The major portion of household income is earned by male family members who work as unskilled labor in the construction or transport sectors outside the valley. The other large income portion is from traditional subsistence agriculture i.e. growing maize, wheat, vegetables, fruit and by keeping a few domestic animals. Most of the valley inhabitants are illiterate. Even schools for boys are often not functional for various reasons. Girls are rarely educated. Adequate medical facilities are also not available.

Rain-fed meadows are located in the valley at higher elevations (about 400 meters above sea level). The forests in the valley and on the plateaus of the foothills are exploited for timber, grazing of domestic animals and fire-wood collection in summer. There is thick plantation around the Project Area in the form of broad leaved forest. Due to lower evaporation, the forests located on the east, north and south west of the Project Area facing slopes are in a better condition. Compared with the lower alluvial zone, the slopes are less valuable from a biodiversity and wildlife point of view. Due to the impact of human activities and impact on both vegetative cover and wild life, the Project Area is currently not rich in biodiversity, when compared with uninhabited forest regions in the higher elevation. Several plant species were recorded in the Project Area including some species of Pteridophytes (fern), belonging to the vascular family.

Similarly, due to availability of suitable food and nesting habitats, some important bird species were recorded in the Project Area, however none of them is included in the IUCN Red Data Book for Pakistan or in the Birdlife list of endangered species. The presence of Asiatic Jackal (*Canis aureus*), Indian porcupine (*Hystrix indica*) and Jungle cat (*Felis chaus*) in upper parts of the catchments far beyond the Project Area could be presumed. In

nutshell, the Project Area has very little significance from the perspective of wildlife availability, because none of the species recorded have a high conservation status / value.

The natural conditions in the Project Area for either spawning or feeding are favorable for variety of fish. A few species have been observed in the proposed reservoir section of the project area. The water temperatures are quite low. The Jhelum River bed gradients cause constant turbulence and high water velocity resulting in an unstable river bed; however some locations in shallow water near the Nullahs/streams are likely to be suitable for spawning. It is envisaged that overall the hydropower project will have beneficial impacts as below:-

- The Project on completion will generate 720 MW of electrical power and 3,436 GWh (Gigawatt-hours) of electrical energy per year for a period of 50 years to meet the ever increasing energy demands of the country.
- The Project will be clean energy production without harmful gases and reduce dependence on imported fossil fuels for power generation.
- During operation, the Project is expected to be credited for displacing the otherwise likely emissions of just over 200,000 tones of CO<sub>2</sub> on the average every year.
- The project will be completed in four (4) years and is expected to generate employment opportunity for several hundred local population.
- Improved road infrastructure will be developed and it will facilitate local population in traveling to other places.

The proposed construction of the main project structures like the dam and relevant structure will not have any major adverse impacts on the environment and human activities. However, some of the salient impacts of this Project on the local inhabitants, during the construction and operation phase, are identified as follows:-

- i. The project is likely to impact and relocate upto 10 households with 70 affected persons.
- ii. Loss of approximately 15 acres of productive agricultural land in Gorah Village on the right bank of River Jhelum/upstream of the dam;
- iii. Temporary loss of some 25 acres within the Karot village, for the establishment of the contractor's camps and accommodation facilities during the construction phase of the dam and headrace tunnel.
- iv. Submergence of about 7 km Kahuta-Azad Pattan gravel road
- v. Submergence of bridge, namely the Azad Pattan Bridge (RCC) and two link bridges and one suspension bridge.

- vi. Relocation of one timber saw machine.

The construction of the underground waterways and powerhouse would not effect forests, animals or houses but some broad leave forest growing on upper foothills could potentially be affected during the excavation of the dam foundations across the bed of the river. Care must be taken to minimize the impact on broad leave vegetation and downstream pollution from sediment and cement. However, short time pollution will not have impact on the long term fish stocks in the river. Those fish stocks are otherwise very small in number and will be quickly replenished by migration from other reaches of the Jhelum River.

The significant impact during the operational life of the Powerhouse will be on about 0.7 Km long reach of the river near the Karot village. It is proposed that at least a flow of 5 cumecs (5 m<sup>3</sup>/s) should continuously be released to meet the requirement of the residents of this reach. This represents only about 2.5 % of the mean river discharge during the low flow months of December and January. The creation of reservoir may have following impacts:-

Increase in humidity; better fishery development; Increase in recreational activities due to reservoir; Increase seepage slightly through rock bed of the river/ reservoir; First impoundment of the reservoir during hibernation period (winter) of the Agama reptile population living among the rocks and boulders around the dam site and in the canyon may be impacted.

The important measures to mitigate adverse impacts during construction will be as follows:

- Proper selection of the alignment of the upgraded village road, thereby avoiding relocation of houses and loss of productive land.
- Proper selection of the locations for construction facilities, camps, offices and colonies for the staff.
- Careful selection of the disposal site for disposing off excavated material.

Any household that suffers permanent relocation or loss of productive land should be compensated properly and timely on existing market rates. Reclamation of currently unused land may be possible by judicious placement, compaction and leveling of excavated spoil. The job opportunities to displaced persons if any may be provided on the Project to avoid the adverse impact.

A discharge of 5 m<sup>3</sup>/s will be ensured in the River Jhelum downstream of the dam during all times. This amount is sufficient to satisfy the current aquatic life requirements and indeed it should also be sufficient to meet moderate future growth in the domestic and agricultural requirements in terms of river abstraction. The reduced dilution of wastes (both human and animal) may affect the water quality to such an extent that water treatment is required. The mitigation measures need to be adopted are:-

- Providing grid electricity, at preferential rates and conditions, to the population in the Karot village and Gorah Rajgan village.
- Providing effective wastewater treatment for communities living in Karot and Gorah village.
- Creating small pools along the river in which fish can better thrive.
- Avoiding first filling of the reservoir during the hibernation period (winter months) of the Agama reptile.

The project area residents were consulted and a preliminary inventory has been prepared for the land, houses, and private properties. However its land ownership will be established by the Revenue Department for compensation purposes. In general, awareness and acceptance of the Project within Karot Village are positive. The affectees of the project likely support the proposed works especially with the anticipation that additional job opportunities will be available to the local residents. The compensation for lost houses, land, trees, and infrastructure if any, should be promptly made and in a transparent way.

For settlement of the issues / problems / a brief Resettlement Plan (RP) has been prepared addressing compensation for the lost land, houses and properties, and land acquisition procedures. It also addresses that the Rehabilitation and Resettlement of the affectees be made in accordance with international donors and Govt. of Pakistan resettlement policies and guidelines. The Environmental Management Plan (EMP) focuses on mitigating measures to protect the physical, biological and social environment.

The selection of dam site has been made on merit keeping in view all the parameters, having least possible impact on the environment. Necessary mitigation measures have been proposed and made as a part of the plan to enhance benefits and reduce negative impacts.

A number of alternative schemes were considered for making the most appropriate use of the natural topography, including waterway systems on right flanks, different dam sites and both surface and underground powerhouses. Compared to previous hydropower projects in Pakistan, the main components of the finally selected layout are relatively small in size and comparatively harmless in impact and only an insignificant number of residents will be relocated and a small productive land will be affected as a result of the project. Those impacts can be minimized by appropriate and careful design techniques / approach. It is important to note that this project will utilize renewable and indigenous energy source and will not deplete natural resources resulting in non-emission of harmful and toxic gases.

Based on clean energy production source this project is strongly recommended for implementation.

Environment monitoring is an important and essential component of any development project so internal and external monitoring during construction and operational phases have been addressed in the EIA. During the construction, operation and maintenance of the project the funds are also imperative for mitigation of the physical, biological and socio-economic problems / issues, arising due to the implementation of the project.

The cost of the environmental management and resettlement is assessed in the light of guidelines, objectives and policies made by Pakistan Environmental Protection Agency and other international donors and its cost amounts to Rs. 995 millions.

## **SECTION 13.1**

### **13.1 INTRODUCTION**

#### **13.1.1 General**

Pakistan is facing an acute crisis in the energy sector and in the year 2008 serious shortfall in power supply occurred and it continued to increase well into the year 2009 and likely to persist further. The production cost of thermal power due to escalation in oil and gas prices, has doubled. So to keep the electricity tariff within affordable limits of consumers, it is necessary to inject cheap hydel power projects. The development of low-cost energy is extremely important to the country for meeting its energy needs of the population and industry. In 1975, under a grant from the Canadian International Development Agency (CIDA) Water and Power Development Authority (WAPDA) initiated a ranking study of cost effective hydropower sites, with a view to meet the long-term power needs of the country. The study was conducted by an integrated interdisciplinary team consisting of specialists of the Consultants staff of Montreal Engineering Consultants (MONENCO) and that of WAPDA from its Hydropower wing.

Karot Hydropower Project has been proposed on the River Jhelum upstream of Mangla Dam. The Project area is spread from about 700 m downstream of the Karot Bridge to about 7 kilometers (km) upstream of Azad Pattan, with a reservoir length of approximately 27 km. The site is accessible from Islamabad via Kahuta- Kotli road.

#### **13.1.1.1 Project Background**

In November 1984, Karot Hydropower Scheme was identified and proposed by WAPDA's Consultants for conducting feasibility studies. In a Technical Report in 1994 titled "Comprehensive Planning of Hydropower Resources on River Jhelum" prepared by WAPDA (HEPO) and GTZ Germany, a 240 MW run-of-the-river scheme just downstream of Karot Bridge was proposed. No further work on this proposal was however carried out leaving it as a raw site. In later years, the scheme was taken over by the Private Power Infrastructure Board (PPIB) to be offered as an Investment Power Project (IPP) to the private sector in 2007. A group of Pakistani and Chinese sponsors was awarded the Letter of Interest (LOI) after an international competitive selection process in March 2007. M/s. Associated Technologies (Pvt.) Ltd. (ATL) were the main sponsors. They signed a contract on August 21, 2007, after International Competitive Bidding (ICB), with the consortium of consultants for carrying out the feasibility study and preparation of a bankable feasibility report.

#### **13.1.1.2 Project Concept**

The Karot Hydropower Project concept, as the subject of this EIA, results from several years of studies by various agencies. A comprehensive study of the Jhelum River above Mangla Reservoir identified a series of potential hydropower projects to capture the available hydroelectric potential (WAPDA, 1992). The Government of Pakistan (GOP), while encouraging private investment in the electricity sector, has awarded development concessions for the potential projects, in a pre-defined segment of the Jhelum River. This EIA addresses the Karot Hydropower Project, which would develop the hydroelectric potential of the Jhelum River from the upstream limit at El. 461 masl on the right bank 500 meters down stream the village of Gohra to a proposed powerhouse near the village of Karot with in the district Rawalpindi.

#### **13.1.1.3 Scope of Works**

The scope of work for this study consists of carrying out an Environmental Impact Assessment (EIA), suitable for use in obtaining environmental clearances from Pakistan Environmental Protection Agency (PEPA), and suitable for use in supporting the other project development work, including project financing.

#### **13.1.1.4 Project Developers**

International competitive selection process was carried out by Private Power & Infrastructure Board (PPIB) and consequently, a letter of interest (LOI) was issued to a group of Pakistani and Chinese Sponsors in March 2007. M/s Associated Technologies (Pvt.) Ltd. (ATL) is the main Sponsor.

#### **13.1.1.5 Consultants**

After international competitive bidding (ICB), M/s, Associated Technologies (Pvt.) Ltd. Had signed a Contract Agreement on August 21, 2007 with a consortium of consultants for carrying out Feasibility Study and for the preparation of a Feasibility Report for the Karot Hydropower Project. The said Consortium consists of the following International and Local Companies:

- M/s SMEC International (Pty.) Ltd., Australia (SMEC).
- M/s Mirza Associates Engineering Services (Pvt.) Ltd., Pakistan (MAES).
- M/s Engineering General Consultants (Pvt.) Ltd., Pakistan (EGC)

The EIA has been prepared by the above consortium, which will be referred to as Consultants.

#### **13.1.2 Report Structure**

This EIA is a component of the Feasibility Report prepared by the Consultants for M/s, Associated Technologies under the terms of the Letter of Interest. This EIA, although designated as an appendix to the project Feasibility Report, is prepared as a stand-alone document to be furnished to the appropriate agencies of the Government of Pakistan for environmental review and clearance. The EIA Report forms an essential part of the overall development process leading to the eventual implementation of the Karot Hydropower Project.

This EIA Report is aimed to form the basis for planning and implementing of the Karot Hydropower Project with respect to environmental management. The EIA outlines the environmental baseline conditions, the anticipated environmental impacts, proposed mitigation measures, anticipated land acquisition and relocation measures, environmental monitoring parameters and associated costs. After obtaining the necessary clearance from the relevant agencies, the EIA Report is intended for use in guiding the future activities related to project impact mitigation, monitoring, and relocation measures.

This EIA Report mainly consists of the following sections:

- Section 13.1: Introduction
- Section 13.2: Legal and Institutional Framework
- Section 13.3: Project Description
- Section 13.4: Baseline Study
- Section 13.5: Environmental Impact Assessment
- Section 13.6: Mitigation and Remedial Measures For Social and Environmental Impacts
- Section 13.7: Environmental Management and Protection
- Section 13.8: Resettlement Action plan
- Section 13.9: Environmental and Resettlement Cost
- Section 13.10: Conclusions and Recommendations

## **SECTION 13.2**

### **13.2. LEGAL AND INSTITUTIONAL FRAMEWORK**

#### **13.2.1 Environmental Legislation in Pakistan**

##### **13.2.1.1 IEE and EIA**

Legal requirements for carrying out the Environmental Impact Assessment of the Karot Hydropower Project arise due to the enforced Environmental regulations in Pakistan namely:

- Pakistan Environmental Protection Act, 1997.
- Review of IEE and EIA Regulations, 2000.

The Pakistan Environmental Protection Act Section 12 stipulates the basic requirements and procedures for the Initial Environmental Examination and Environmental Impact Assessment. The act proclaims that “No proponent of a project shall commence construction or operation unless he has filed an IEE with the Government Agency designated by the Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause a significant adverse environmental effect, an Environmental Impact Assessment (EIA), be submitted and approval o the same has been obtained from the Government Agency in respect thereof”.

The Government of Pakistan in the year 2000 adopted, the Regulations for the Review of IEE and EIA, henceforth cited as (“the Review Regulations”). Under the Review Regulations, the Environmental Protection Agency (EPA) stipulated relevant procedures for the proponents to be compliance with environmental quality requirements for the preparation of the environmental assessment studies (either IEE or EIA). The Review Regulations define the role of the Federal Environmental Protection Agency, Provincial EPA’s as the approving governmental agencies for according approval to the various EIA / IEE Studies after ascertaining that appropriate level of Public Consultation was made and stake holders feedback was incorporated.

##### **13.2.1.2 Pakistan Environmental Assessment Procedures**

Under the Pakistan Environmental Protection Act, 1997, the Federal Environmental Protection Agency subsequently developed and issued number of documents, with the aim of providing a set of “comprehensive procedures and guidelines for environmental assessment in Pakistan” including the following:

- Pakistan Environmental Legislation & National Environmental Quality

Standards (NEQS).

- Policy and Procedures for Filing and Approval of Environmental Assessment.
- Guidelines for the Preparation and Review of Environmental Reports.
- Guidelines for Public Consultation.
- Guidelines for Sensitive and Critical Areas.
- Sectoral Guidelines for major thermal power stations, major chemical and manufacturing plants, water supply projects, industrial estates, new township development, major roads, sewerage schemes, and oil and gas exploration.

In addition, the guideline documents list some other sectoral guidelines, which at the time of preparation of this report are reportedly under preparation i.e., guidelines for Irrigation and drainage, dams, forestry, and municipal waste disposal. Sectoral guidelines for dams have not been prepared.

## **13.2.2 Legally Relevant Issues for Environmental Approvals**

### **13.2.2.1 Categorisation of Projects**

The “Review of IEE and EIA, Regulations 2000” stipulated in line with the international practices of the World Bank and other international financial institutions.”

The Karot Hydropower Plant falls under Schedule II requiring an EIA.

### **13.2.2.2 Submission and Approval of EIA Study**

According to IEE/EIA, Regulations 2000, the proponent of a Project is obligated to submit 10 hard copies and two electronic (soft) copies of the EIA Report to EPA Pakistan for their review and approval. Also according to Schedule iv of that law it is required to submit an application and the copy of the receipt showing payment of the Review Fee.

The EIA Report will be prepared in English language and submitted to Federal EPA. Although there is no such requirement in the legal documents, the Consultant suggests translating the full EIA Study into Urdu, due to the reason that most of the literate residents are conversant in Urdu in the Project Area.

The Federal EPA is required to confirm within 10 working days that the submitted documents are complete, or additional information is required. There is also the possibility for the agency to return the study report for revision, indicating the matters to be improved or changed, as the case may be.

The “Pakistan Environmental Protection Act” in Paragraph 12(2), addresses the need for reviewing the EIA or respective IEE study. The procedure of reviewing is further explained in Para 11 of the “Review of IEE and EIA, Regulations, 2000”. The maximum review period for an IEE is 45 days, whereas the EIA review should be made within a maximum of 90 days after issuing confirmation of the completeness of the study.

This review, in accordance with Paragraph 11(4) “shall be based on quantitative and qualitative assessment of the documents and data furnished by the proponent, comments from the public and Government Agencies received under Regulation 10, and views of the committees formulated for that purpose. The “Regulations, 2000” include the possibility to constituting an “Environmental Assessment Advisory Committee” under Federal EPA for the review of EIA Report(s). Its tasks include constituting a committee to inspect the site of the project and submit its report on such matters as may be specified.

The conditions of approval are stipulated in Para 13 of the Regulations as follows:

“Every approval of an IEE and EIA shall, in addition to such conditions as may be imposed by the Federal Agency, be subject to the condition that the project shall be designed and constructed, and mitigation and other measures adopted, strictly in accordance with the IEE/EIA, unless any variation thereto has been specified in the approval of the Federal Agency”.

The “Pakistan Environmental Protection Act” Paragraph 12(2b) stipulates the conditions under which it is required to re-submit the EIA study in the case where the project activities are contrary to environmental objectives. Paragraph 12(4) of the “Pakistan Environmental Protection Act” addresses the need for the EPA to communicate the approval within four months after submission of the complete study of either the IEE or EIA. If approval within this period has not been formally corresponded to the proponent, the project and the study is deemed to have failed to satisfy the requirements. In section however there is an exception provided that the appropriate government agency “may in a particular case extend the aforementioned period of four months if the nature of the project so warrants”.

### **13.2.2.3 Legislation Regarding Resettlement Action Plan (RAP)**

Paragraph 13 of the Regulations also addresses the issue of mitigation and other compensation measures as part of the EIA Study. The mitigation measures for relocation of the Project Affected Persons (PAP's) are laid out in World Bank guidelines OP. 4.12 and BP 4.12 "about Involuntarily Resettlement", if the number of relocated persons exceeds 200, it is required to prepare a formal Resettlement Action Plan (RAP).

Where only a few residents i.e., less than 200 individuals are to be relocated, appropriate compensation for assets, logistical support for moving, and provision of a relocation grant may suffice. However, the principles on which compensation is to be based are the same as for larger groups of relocated persons.

Those international guidelines are mainly incorporated in the "Project Implementation and Resettlement of the Affected Persons Ordinance – 2001" adopted by the Government of Pakistan.

#### **13.2.2.4 Legislation on Environmental Management Plan (EMP)**

EPA Guidelines "Policy and Procedures for the filing, review and approval of environmental assessments" (September 1997), describe in detail what has to be done for the preparation of an EMP. The EMP is defined as a "document designed to ensure that the commitments in the Environmental Report, subsequent review reports, and Environmental Approval conditions are fully implemented". The EPA Guidelines further highlight that the EMP is "a comprehensive document which is usually finalised during or following detailed design of the proposal, after Environmental Approval of the development application".

#### **13.2.2.5 Institutional Requirements**

##### **13.2.2.5.1 Approving Authority Environmental Protection Agency (EPA)**

There are two levels of EPA at the Federal level and the Provincial EPA's. The Pakistan Environmental Protection Act, 1997 stipulates in Para 5; the structure, rights and obligations of the EPA in general, and the functions of both the Federal EPA and the Provincial EPA's respectively. The Act defines the overall objective of the EPA as being: "to exercise the powers and perform the functions assigned to it under this act".

In accordance with the Review Regulations, the EIA for the Karot Hydropower Project is to be submitted to the Federal EPA as part of the project development process. At the time of submission, M/s, Associated Technologies will be required to pay the necessary fee. According to the Pakistan EPA regulations (SRO 339 (I)/2000 Schedule III) this fee is Rs. 30,000 for projects costing over Rs. 10 million (and hence the maximum fee will apply in this case).

### **13.2.3 Regulations for Environmental Assessment**

Pak EPA regulations states that an EIA is required for: dams and reservoirs with a volume of 50 million cubic meters or more, or surface area of 8 square kilometres or more; and irrigation drainage projects serving 1500 hectares or more. EIAs are also required in cases where projects are to be implemented in environmentally sensitive areas, or are likely to cause adverse environmental impact.

#### **13.2.3.1 Land Acquisition Procedure**

Under the Land Acquisition Act (1894), matters relating to land use and ownership are outside the jurisdiction of the Federal Government. Consequently, the Provincial Revenue Departments are empowered to carry out the acquisition of private land or built-up property for public purposes, including on behalf of a federal agency or a private developer such as M/s, Associated Technologies. The acquisition of land and payment of compensation as such will be managed by M/s, Associated Technologies or its implementing agency (Revenue Department).

#### **13.2.3.2 Wildlife Act of 1975**

In addition to empowering the Wildlife Department to establish game reserves, parks, and wildlife sanctuaries, the Act regulates hunting and disturbance of wildlife. While reviewing the EIA, the EPA may consult the Wildlife Department if the project has an impact on wildlife.

#### **13.2.3.3 Antiquities Act of 1975**

The Antiquities Act of Pakistan relates to the protection, preservation and conservation of archaeological and historical sites and monuments. It prohibits construction (or any other damaging) activity within 200 meters of such sites unless prior permission is obtained from the Federal Department of Archaeology and Museums. The Antiquities Act would as such require that M/s, Associated Technologies notify the Department if anything of archaeological value is excavated or discovered during project construction.

#### **13.2.3.4 Local Government Ordinance of 2001**

The Government of Pakistan has issued ordinances related to 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.

### **13.2.3.5 Regulation of Mines and Oil Fields and Mineral Development Act of 1948**

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

### **13.2.3.6 Motor Vehicles Ordinance of 1965**

The Motor Vehicles Ordinance of 1965 was extended to the whole of Pakistan in 1978. The Ordinance deals with the powers of 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 the specific 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 the district level to monitor road transport, licensing requirements, and compensations for death or injury to passengers on public carriers. M/s, Associated Technologies would be required to coordinate with related agencies during design and construction stages, so that the requirements relating to the safety and management of traffic on the roads are observed.

### **13.2.3.7 Factories Act of 1934**

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

### **13.2.3.8 Highways Safety Ordinance of 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.

### **13.2.3.9 Pakistan Penal Code of 1860**

Pakistan Penal Code (PPC) 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 residents. In the context of environment, the PPC empowers the local authorities to control noise, noxious emissions and disposal of effluent. (NEQS enforced by the EPAs supersede the application of this legislation to industries and municipalities). The Penal Code, however, can provide a basis for M/s, Associated

Technologies to co-ordinate their activities with the local authorities so that the construction activities do not become a cause of public nuisance or inconvenience.

#### **13.2.3.10 Explosives Act of 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. In the context of Karot Hydropower Project, this will be of particular relevance for tunnelling and major excavation activities.

#### **13.2.3.11 Environmental Tribunal Rules of 1999**

According to those rules, the tribunal shall make every effort to dispose of a complaint or an appeal or other proceeding within 60 days of its filing. The regulations were prepared by the Federal EPA and issued on March 10, 2000.

#### **13.2.3.12 Forest Regulation Rules 2 of 1930**

Based on those regulations, registration of Fuel Wood Depot Rules was framed in August 1990. These rules state that carriage of purchased stock from one forest to another shall not be allowed, except with the special permission of the Divisional Forest Officer, and in case of interdivisional transaction, by the Conservator of Forest.

#### **13.2.4 Entitlement and Compensation Matrix**

After reviving the Land Acquisition Act (LAA 1894) and policy framework (World Bank OP 4.12) and consultations / discussions during field visits with local population, going to be effected during the construction and operation of the project the Entitlement and Compensation Matrix (Table 13.8.1) is prepared keeping in view the nature / extent of losses, the entitlements and the implementation issues. During consultation and discussions different questions were asked related to compensation, entitlement of different affectees, status of non title and title holders, costs of affected assets / infrastructures, costs of the assets to be paid to the affectees, time frame for compensation payment etc. The Entitlement and Compensation Matrix framework fully covers all the issues / problems related with the affectees. It also covers the affected land and land based assets, livelihood restoration measures to avoid any adverse impacts on the project affectees.

## **SECTION 13.3**

### **13.3. PROJECT DESCRIPTION**

#### **13.3.1 Project Location**

Karot Hydropower Project is proposed to be built on River Jhelum, upstream of Mangla Dam near village Karot in Kahuta Tehsil of Rawalpindi District. The site is accessible from the Federal Capital Islamabad via Kahuta-Kotli Road and lies at an approximate distance of 65 kilometres south-east of Rawalpindi. The site has GPS coordinates 33-36-N and 73-36 E. Above the Proposed Hydropower project, Jhelum River is joined by its main tributaries i.e., Kunhar, Neelam and Mahl Rivers. A location map of Jhelum River and Karot Hydropower Project Area is presented in Figure- 13.3.1.

#### **13.3.2 River Jhelum and Plant Capacity**

River Jhelum originates from the south- western extremity of Pir Panjal Range as a small rivulet in the Indian Occupied Kashmir. Flowing in a North-westerly direction, through highly intersected plains of the Kashmir Valley, it is joined by many streams before reaching Wular Lake and its surrounding marshy area with its complex maze of channels. On its way downstream below Wular Lake at Sopar, the River gains substantial runoff, and flows in a south-easterly direction. The river valley starts narrowing downstream of Baramula. At Chakothi, when the River enters Azad Jammu and Kashmir (AJK) territory the river flows in a narrow gorge taking a turn to a north-westerly direction. All along its way to the proposed dam site, the river is joined by a large number of streams and nalahs. On its steep gorgy course, the river takes a very sharp bend at Domel and then flows in a generally southward direction along with its tributaries namely Neelum (Kishanganga) River and Kunhar River.

The Project Area comprises locations in the AJK (reservoir left Bank only) and in the Province of Punjab, on Jhelum River upstream of the existing Mangla Reservoir, near the village of Karot (Figure 13.3.2) and selected project layout is presented in Figure 13.3.3. The satellite imagery of the project area are in Figure 13.3.4 -13.3.7.

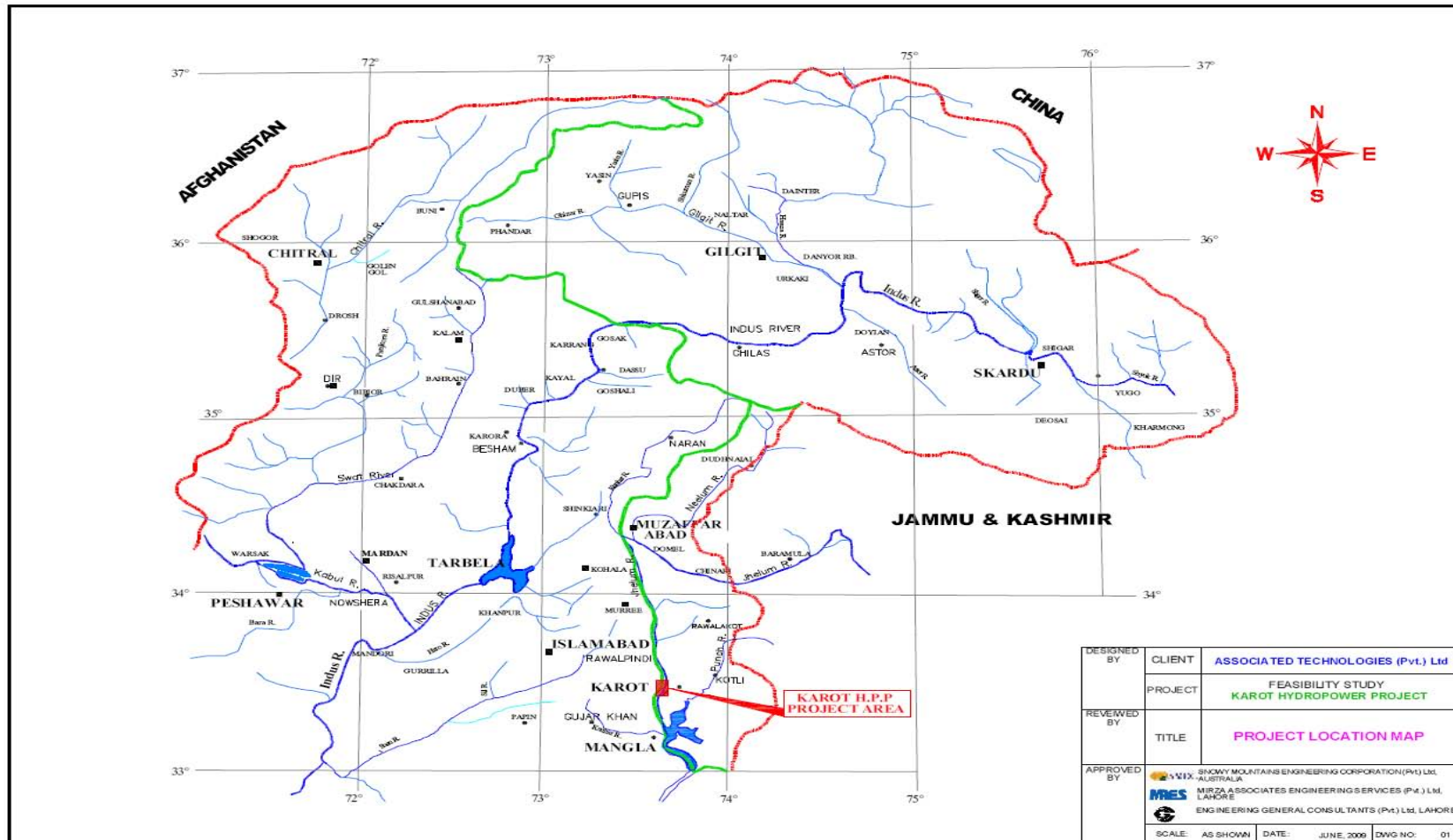


Figure 13.3.1: Project Location

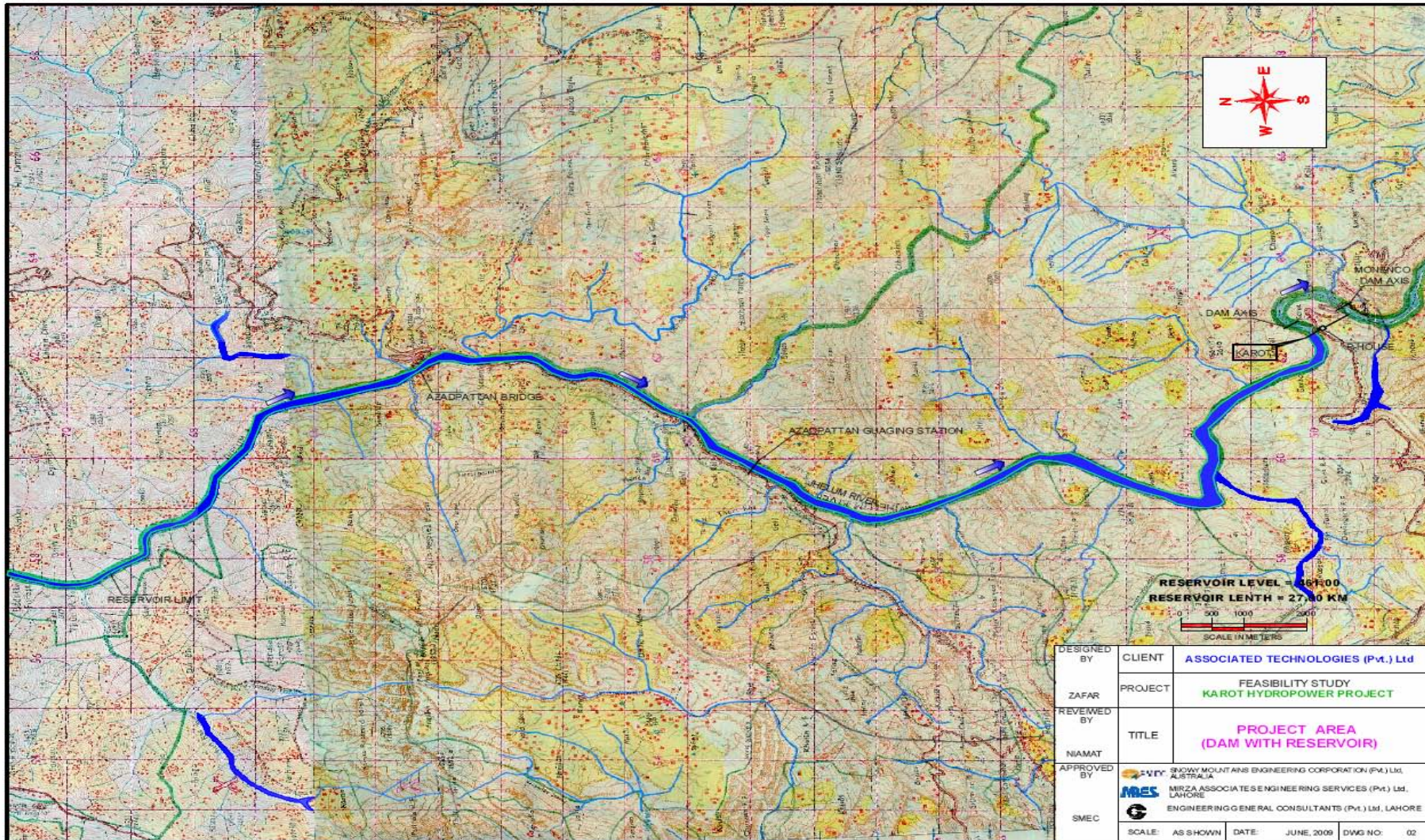
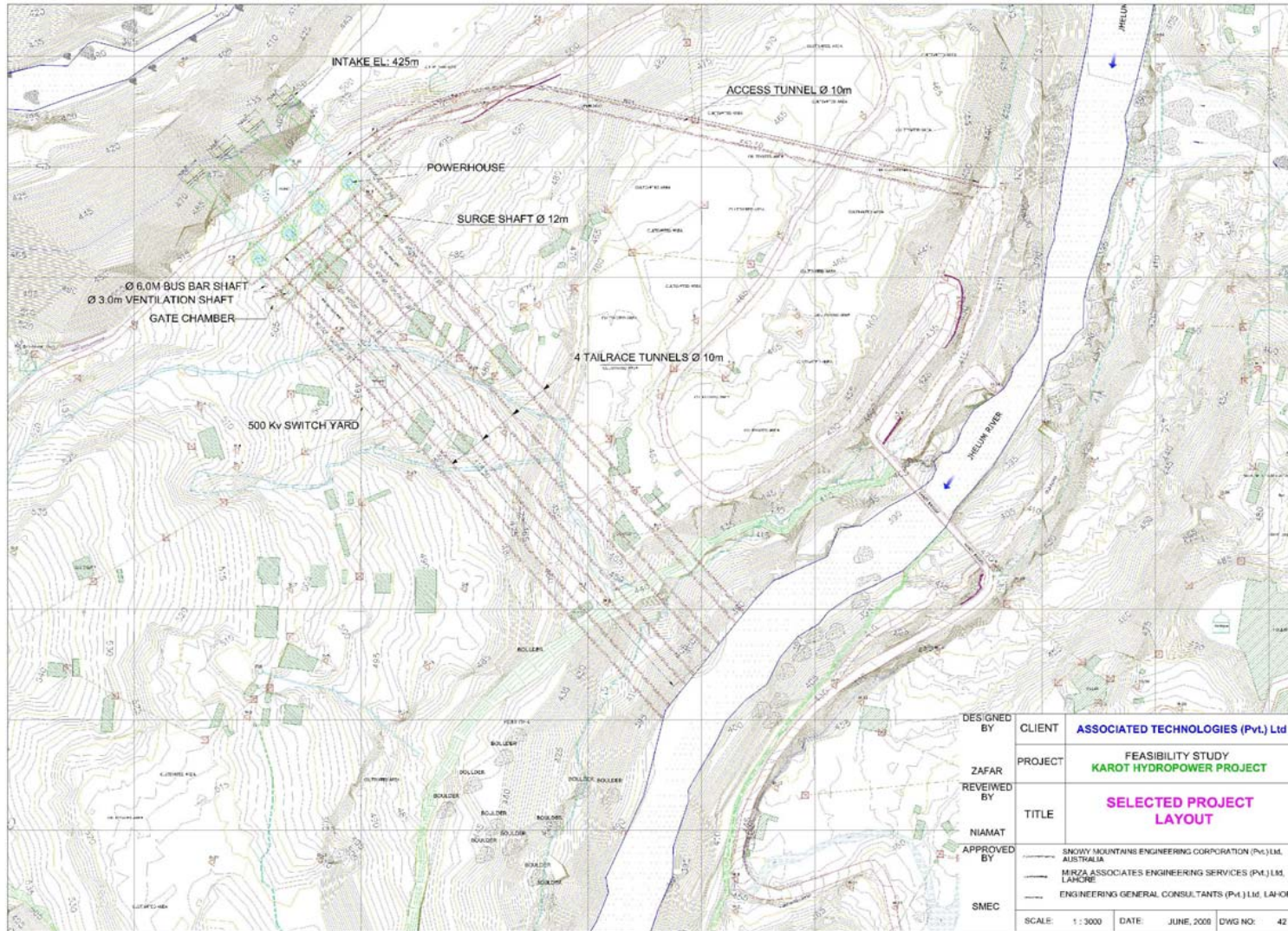


Figure 13.3.2: Project Area



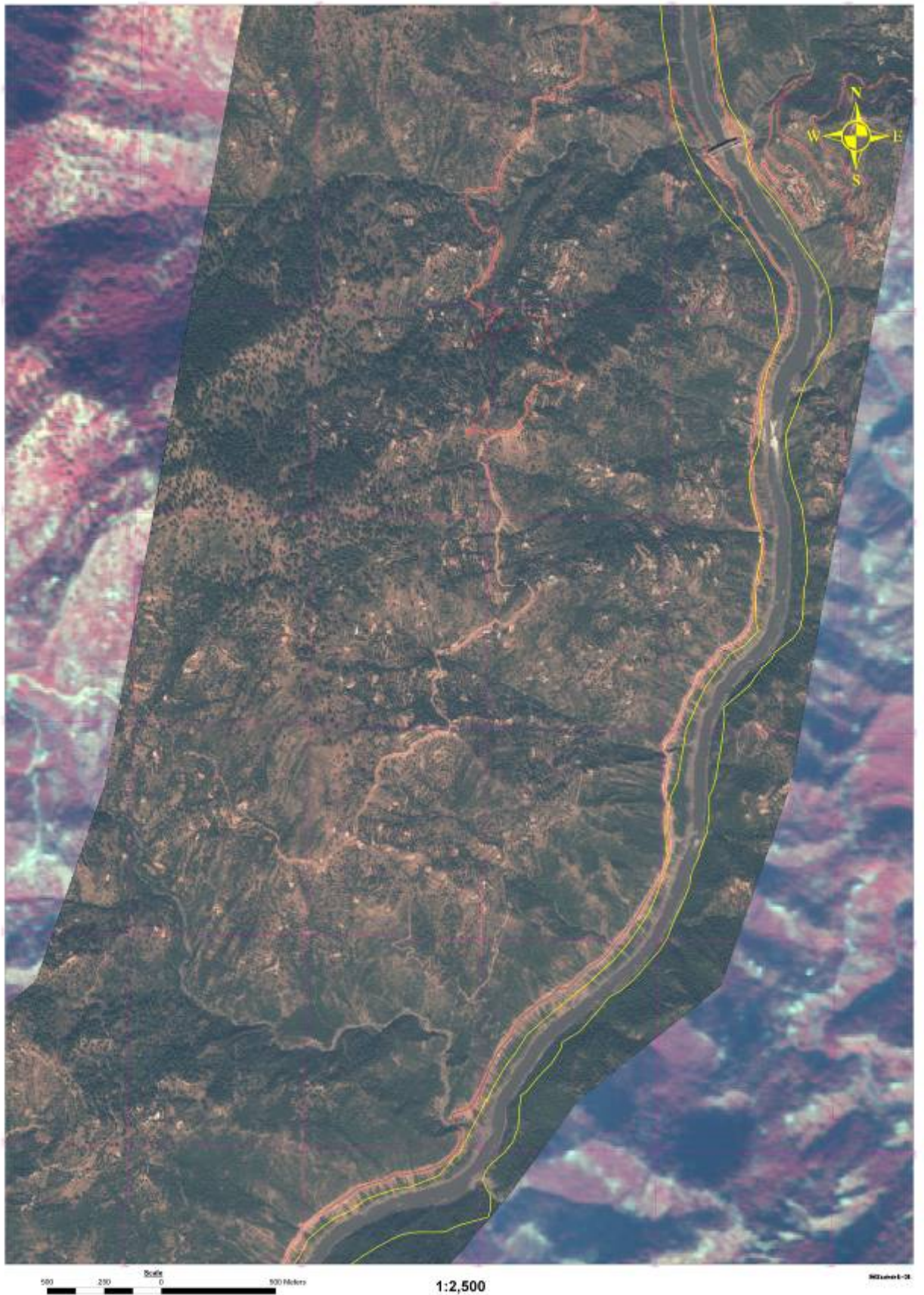
**Figure 13.3.3: Selected Project Layout**



**Figure 13.3.4: Satellite Imagery (Part 1)**



**Figure 13.3.5: Satellite Imagery (Part 2)**



**Figure 13.3.6: Satellite Imagery (Part 3)**



**Figure 13.3.7: Satellite Imagery (Part 4)**

The project's operational concept will be to generate up to 720 Mega Watts of electric power using the Jhelum River flows. The estimated average annual electrical energy production is 3,436 GWh, with the production fluctuating between higher and lower values depending on river flow conditions, affected by rainfall, snowfall and snow melt within the catchment. In comparison with the alternative of generation by furnace oil-burning thermal stations, 3,436 GWh of hydropower energy represents the saving of more than a half million barrels of oil fuel annually.

### 13.3.3 Salient Features of the Karot Hydropower Project

Salient features of the Karot Hydropower Project are presented in Table 13.3.1:

**Table 13.3.1: Salient Features of the Proposed Project**

| <b>General Features</b>         | <b>Specifications</b>      |
|---------------------------------|----------------------------|
| Design discharge                | 1200 m <sup>3</sup> /s     |
| Reservoir conservation Level    | 461 m.a.s.l                |
| Max. gross head                 | 79 m                       |
| Dam height                      | 91 m, above foundation     |
| Dam type                        | Concrete Gravity Dam       |
| Design flood                    | 28,500 m <sup>3</sup> /s   |
| Installed capacity              | 720 MW                     |
| Operating capacity              | 720 MW                     |
| Mean annual energy (Gross)      | 3436 GWh                   |
| Plant factor                    | 54.48%                     |
| Auxiliary consumption           | 1 %                        |
| <b>Spillway</b>                 |                            |
| Spillway Type                   | Overflow with radial gates |
| No of gates                     | 8 Nos                      |
| Gate size                       | 7 x 15 m                   |
| Spillway discharging capacity   | 28500 cumecs (PMF)         |
| <b>Low level Sluicing Gates</b> |                            |
| No of gates                     | 6                          |
| Gates type                      | Radial                     |
| Gate size                       | (6.2m X 11 m) each         |

|                                |                    |
|--------------------------------|--------------------|
| <b>Diversion Tunnels</b>       |                    |
| No of tunnels                  | 2                  |
| Tunnel dia                     | 10 m               |
| Tunnel length                  | 450 m              |
| <b>Head Race Power Tunnels</b> |                    |
| No of tunnels                  | 4                  |
| Tunnel diameter                | 10.0 m             |
| Tunnel length                  | 160 m              |
| No of pressure shaft           | 4                  |
| Diameter                       | 7.4 m              |
| <b>Tail Race Tunnels</b>       |                    |
| Dia                            | 10 m               |
| Length                         | 470 m              |
| <b>Powerhouse</b>              |                    |
| Powerhouse type                | Cavern/underground |
| Switchyard                     | Open outdoor       |
| <b>Turbines</b>                |                    |
| No of units                    | 4                  |
| Type of Turbines               | Francis            |
| Capacity                       | 183 MW, each unit  |
| <b>Electrical Works</b>        |                    |
| Transmission line capacity     | 500 KV             |
| Generator                      | 4 Nos. Turbo Units |
| Generator capacity             | 180 MW/200 MVA     |
| Generation voltage             | 18 KV              |
| <b>Economic and Financial</b>  |                    |
| Project capital cost           | US\$ 1470 Million  |

#### **13.3.4 Project Alternatives**

Evaluation of alternatives is an important element of the EIA. Based on the World Bank Operational Policies (OP-4.02), six main parameters were considered in the analysis of Karot project alternatives. Those included: 1) number of project affected persons; 2) number of religious sites; 3) degree of willingness to relocate; 4) presence of sensitive entities; 5) strategic security of the dam structure; 6) and construction cost of the project.

Two alternatives were developed for comparative evaluation, identification, analysis, and selection of the preferred alternative. This exercise led to the selection of Alternative 2 comprising a dam at Karot with four power tunnels and an underground powerhouse at Karot village. However, all the alternatives were examined from an environmental viewpoint to ensure that the selected option is appropriate for minimizing environmental impacts and does not have foreseeable flaws that would prevent the successful implementation of the Project.

The Karot project is being developed by ATL, a private developer, under the Government of Pakistan's (GOP's) power development policy, and under an agreement specifically entrusting ATL with the responsibility to study and implement the Karot Hydropower Project on the Jhelum River. This does not empower or require ATL to study the whole river basin or power sector as would be the case in a public sector project study. Thus, if the Karot Hydroelectric Project is not developed, the alternative course of action is the responsibility of some other business or government entity, and the alternatives to undertaking of the proposed project are neither under the control of, nor the responsibility of ATL.

The direct yield of the project will be 720 MW of electrical power and some 3436 GWh of electrical energy on the average per year. In the wet summer months of May, June, July and August, the plant will generate the full installed capacity almost around the clock. From October to February, the plant will operate at upto full capacity for only 4 hours per day. During the intervening months of September and March the hours of generation at maximum capacity will fall/rise as per river flow fluctuation.

The proposed hydropower plant exploits a renewable energy source. It will neither deplete Pakistan's reserves of natural resources nor will produce any harmful gases and it will not increase the nation's dependence on imported fossil fuels. The generation of electricity from conventional fossil fuel fired power stations produces huge amounts of CO<sub>2</sub> - a greenhouse gas associated with global warming. The Karot hydropower plant will not emit any CO<sub>2</sub> during its operation and is thus credited with displacing that quantity of CO<sub>2</sub> that would otherwise be emitted into the

atmosphere by a thermal power plant generating the equivalent amount of electricity. This will amount to around 203,000 tones of CO<sub>2</sub> per year.

#### **13.3.4.1 Carbon Credits**

The Karot Hydropower Project will generate on the average 3436 GWh per year of electrical energy without producing any CO<sub>2</sub>. The reservoir area is devoid of vegetation thus CH<sub>4</sub> will also not be produced during the project life. The quantity of CO<sub>2</sub> that would otherwise be emitted by thermal power plant to generate 3436 GWh per year is credited to the Karot Project.

The pattern of generation by the Karot HPP is base energy during the summer and peak energy during the winter and this pattern of generation broadly matches the pattern of consumption.

Presently in Pakistan, base energy is generated by hydropower plant, steam thermal plant and combined cycle gas turbines, while peak energy is generated by hydropower plants and gas turbines. A combined cycle gas turbine (CCGT) is the only thermal plant that can generate both base and peak energy at competitive prices. During summer, the gas turbine and steam plant would operate in combined cycle mode to generate base energy. In winter, only the gas turbine plant would operate in open cycle mode to generate short term peak energy. These CCGT plants can be fired with different fuels. For the present assessment, natural gas has been adopted. A CCGT will produce CO<sub>2</sub> as follows:

##### **Combined cycle mode (for base energy):**

|                                   |   |                         |
|-----------------------------------|---|-------------------------|
| Natural gas consumption by volume | = | 230 m <sup>3</sup> /MWh |
| Natural gas density               | = | 0.717 kg/m <sup>3</sup> |
| Natural gas consumption by mass   | = | 165 kg / MWh            |

##### **Open cycle mode (for peak energy):**

|                                   |   |                         |
|-----------------------------------|---|-------------------------|
| Natural gas consumption by volume | = | 314 m <sup>3</sup> /MWh |
| Natural gas density               | = | 0.717 kg/m <sup>3</sup> |
| Natural gas consumption by mass   | = | 225 kg/MWh              |

Assuming that natural gas is methane (CH<sub>4</sub>), the complete combustion of 1kg of natural gas will result in the emission of 2.75 kg of CO<sub>2</sub>.

Therefore, the CO<sub>2</sub> emission rates are as follows:

Combined cycle mode (for base energy)= 454kg CO<sub>2</sub>/MWh (450 t CO<sub>2</sub>/GWh).

Open cycle mode (for peak energy) = 619kg CO<sub>2</sub>/MWh (620 t CO<sub>2</sub>/GWh).

On average, the Karot HPP will generate annually 358 GWh of base energy during summer and 68 GWh of peak energy during winter. The implementation of the Karot Project will thus avoid the annual emissions from a natural gas fired CCGT of:

Combined cycle mode (base energy) = 358GWh×450t/GWh = 161,000 t CO<sub>2</sub>,

Open cycle mode (peak energy) = 68 GWh × 620 t/GWh = 42,000 t CO<sub>2</sub>.

Total CO<sub>2</sub> avoidance annum = 203,000 t CO<sub>2</sub>

Construction of the project will take about 4 years and provide employment and career opportunities for several hundred local residents. The improved Karot access road will improve the transport link between the Upper Karot village and the Tehsil Headquarter at Kahuta. This in turn will stimulate local trade, business and improve the quality of life for the local communities and around Karot village.

### **13.3.5 Environmentally Relevant Design and Operation Features**

#### **13.3.5.1 Dam, Reservoir and Power Intake**

The proposed dam will be located downstream of the village of Gorah, about 700 meters upstream of Karot Bridge. During construction, the foundation of the dam and power intake will cover an area centered on the river bed between the upstream and downstream cofferdams. The footprint covers bare unproductive rock and river bed.

The dam will have a height of 91 meters above river bed level and will impound 760 million cubic meters (MCM) of water. When full, this reservoir will extend upstream upto 16050 Sq. meter (m<sup>2</sup>) into the narrow canyon and submerge the bare and unproductive river bed. The Environment Impact Assessment Construction Facilities are presented in Figure 13.3.8.

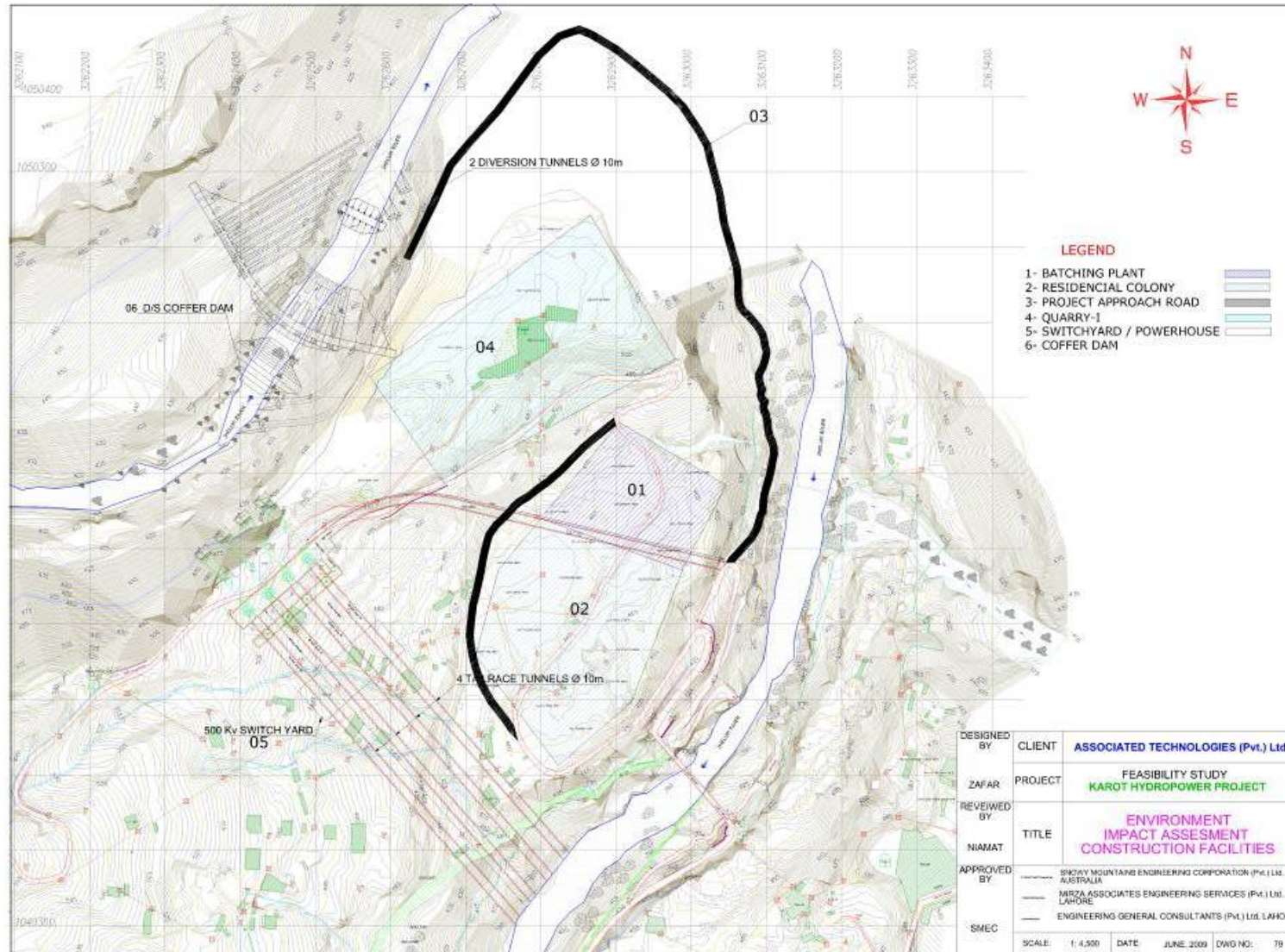


Figure 13.3.8: Environment Impact Assessment (Construction Facilities)

#### **13.3.5.2 Construction Facilities at the Dam Site**

Facilities such as labour camp, workshops, storage yards, aggregate crushing plant, concrete batching plant and material stockpiles are needed to support the dam's construction works. Areas for the labour camp, workshops and storage yards must not be located in the immediate vicinity of the dam, and could be located on unused land in the vicinity of the village of Karot. However, the aggregate crushing plant, concrete batching plant and material stockpiles must be located close to the site of construction. For the aggregate crushing plant, concrete batching plant and material stockpiles an area of some 47,000 m<sup>2</sup> (about 12 acres) would be required. The land would be formed into larger terraces in order to take the various components of plant. This land would be temporarily occupied for about 4 years at least.

#### **13.3.5.3 Headrace Tunnels**

Four headrace tunnels will convey up to 300 m<sup>3</sup>/s each of water from the power intake on the right bank to the powerhouse tailrace system.

#### **13.3.5.4 Pressure Shaft, Pressure Tunnel and Powerhouse**

From the downstream end of the headrace tunnel, water will be dropped through the deep pressure shafts, along the short pressure tunnel to the powerhouse. This powerhouse would be located in the right flank of the Jhelum River at Karot. The discharge from the turbines will run through a 470 meters long tailrace tunnel to the Jhelum River. All material excavated from the pressure shaft, pressure tunnel, powerhouse and transformer caverns and tailrace open channel will be mucked out from the main access tunnel and the tailrace open channels both close to the Jhelum River.

#### **13.3.5.5 Switchyard and Transmission Line**

The energy generated from the project will be fed into the national grid at the switchyard via a switchyard at the Karot powerhouse through 132kV transmission line. This Karot switchyard will be located near the powerhouse at a distance of about 200 meters. The switchyard has been proposed to the south of the proposed powerhouse near seasonal nullah.

The environment, within which the switchyard and transmission line will be developed, comprises the village of Karot, which is bounded on the east by the Jhelum River and on the west by Kahuta-Kotli Road.

The Karot switchyard will be located on the piece of land located to the north of the village. This land area is located outside the main village on the upper right bank of the Jhelum River and is presently unused. It is located at the foot of the steep

Jhelum River slope, yet appears to be well above the maximum flood level of the river, and comprises large surface boulders embedded in river sands and gravels.

#### **13.3.5.6 Access Road**

Access to the dam site will be through a road originating from the Kahuta Road running along the right flank of the Karot village up to the dam site and beyond, to the proposed construction facilities at Karot. This road will as much as possible follow the route of the existing vehicle track. The traffic on this road at night is negligible and during day time it is not very considerable. The road is generally less than 4 meters wide and as such will have to be widened to facilitate movement of construction machinery and equipment. However it will require realignment and widening in some sections of the old road being used currently.

#### **13.3.5.7 Excavated Material and Spoil Disposal**

Large quantities of material will be excavated from surface foundations and underground operations. The major part of this excavated material will be used for construction of main dam, coffer dams, power house cavern and widening of road etc. the remaining excavated material need to be disposed off at proper place to avoid any inconvenience to the local project area population. Furthermore, its removal from this place is essential to maintain the reservoir capacity and avoid the environmental problems. The topography around the powerhouse portal and switchyard, comprising the upper terraces of the Jhelum River banks, offers a large area for disposal of excavated material. Indeed, if the material is placed, compacted and drained, then the resulting land could accommodate housing, commercial properties or even agricultural fields. The land thus created can provide livelihood to some families of the project affected population.

#### **13.3.5.8 Operation**

In the wet months of May, June, July and August, the power intake will divert up to 1200 m<sup>3</sup>/s from the reservoir into the power house water channel and thereby generate electricity up to the full installed capacity level almost round the clock. During this time, the reservoir level will vary slightly remaining at or close to Full Supply Level. From October to February, river flows will be stored in the reservoir for diversion into the power house channel during the peak demand hours of the system. As such, the plant will generate electricity at its full capacity for at least 4 hours per day and the reservoir level will vary accordingly over a 24 hour period between Minimum Operating Level and Full Supply Level. During the intervening months of September and March the hours of power generation at maximum capacity will fall/rise according to the fluctuations in the river discharge.

In order to ensure that current users of the river water downstream of the diversion dam continue to receive some flow for their needs. For this purpose a discharge of 5 m<sup>3</sup>/s will be released continuously through out the year.

#### **13.3.5.9 Sediment Flushing**

During the operation of the hydropower plant, sediments will be flushed from the reservoir through the low-level gates installed in the dam. Flushing of the reservoir through the low-level gates in the dam will generally occur during the flood flows. This operation will be aimed at discharging bed load from the reservoir, but suspended load will also be released. The aim of the gate operation will be to lower the reservoir level in order to create conditions in the reservoir that will flush, as much as possible, the incoming sediments through the reservoir and dam. As such, this reservoir flushing procedure endeavors to replicate sediment transport before construction of the dam. Therefore, over a longer term, the downstream reaches of the River Jhelum will continue to receive more or less same quantities of suspended and bed sediment at the same times of the year after construction of the dam. The sediment and water concentrations flushed from the reservoir should not differ significantly from the concentrations without the dam.

The overall sediment balance of the River Jhelum should not be disturbed to a greater extent. However, during the summer season, finer sediments will tend to accumulate along the river reach immediately downstream of outlet gates during the periods between floods. During floods, those accumulated sediments would be re-suspended and transported downstream.

## **SECTION 13.4**

### **13.4 BASELINE STUDY**

#### **13.4.1 Introduction**

Several field surveys and consultations were conducted in the process of preparing this EIA and in assessing stake holder's views. This section describes the data collected and procedures used. The results of the data collection effort are described as under:-

Standard methods were used to investigate and survey relocation issues and the environmental aspects. A blend of analytical, community-based consultations, participatory methods, and observation and interview tools were used. The following two main sources, Secondary and primary sources of data collection were adopted. The use of surveys and actual responses helped to an accurate understanding of the views and concerns of the stakeholders.

##### **13.4.1.1 Secondary Sources**

The available published and unpublished information related to the project area, relevant policies, guidelines, legal documents, previous environmental resettlement assessment studies; district population census reports for the concerned district and map prepared by the government department non-governmental organizations (NGOs) was obtained and reviewed to identify the potential and various parameters related to determine the feasibility of the proposed project.

##### **13.4.1.2 Primary Sources**

Primary sources data comprise on field surveys, inventories, including site investigations related to the aspects of relocation/ resettlement of affected persons; socio-economics; and biological studies of the project area. The investigations were conducted through structured, semi-structured questionnaires (Annexure 13.1), focus census and public consultations. The consultants undertook the following survey for the sociological/resettlement study. The public consultations meetings were held in the common place of the villages in connection with consultation with the local population, so as the maximum residents could participate and give their views regarding the proposed project. The photolog, showing public consultations / discussions, the agriculturally productive land, the flora fauna, the dam axis site, Kahuta-Karot-Kotli Road, the block factory, the historical Karot wall plaque, the mosque and shrine in the project area, is presented as Annexure 13.2.

#### **13.4.1.3 Building Inventory Survey**

This survey was carried out to prepare inventory of buildings and to assess their value for acquisition and compensation purposes. Parameters considered included on the covered area, type of construction, construction quality, including a categorization of building; number of rooms, toilet/bathroom and occupants status, i.e., owner or tenant/ renter; type of usage (residential, commercial, communal assets and livestock, etc.), available facilities, and estimation of building cost.

#### **13.4.1.4 Business Loss Survey**

This survey was undertaken to identify and assess the existing commercial activities of the potential PAPs. The specific focus of the survey included the type of potentially lost business, mode of transactions involved, experience of the affected businessmen, number of family members involved in the business, number of employee in the specific business, average number of customers on daily basis, and financial value of the businesses.

#### **13.4.1.5 Land and Related Inventory Survey**

This survey was undertaken to collect the data regarding land holding size, type of cultivated lands (irrigated or rain-fed), tenure arrangements, major crops for Rabi and Kharif seasons, crop yields, and number of fruit and non-fruit trees. The assessment also included annual income from fruit trees, current value of the non-fruit trees, and value of land.

#### **13.4.1.6 Vulnerable Persons Survey**

This survey was undertaken to collect the data on vulnerable individuals – those without the resources or means to survive without the direct assistance of others. Vulnerable individuals included widows, homeless, disabled, without guardians, squatters, elders living alone, and marginalized farmers/ tenants.

#### **13.4.1.7 Village Profile and Public Community Facilities Survey**

This investigation focused on identification of available religious, cultural and community resources. The information regarding the presence of health, communication, educational infrastructures and civic facilities, including sources of drinking water, electricity, gas, drainage and sewerage system etc.

### 13.4.1.8 Community Participation Survey

This survey was carried out to determine how the community was organized, prevailing internal dynamics, the community participation pattern and representative structure, influential individuals, and the presence of disputes resolution system.

### 13.4.1.9 Stakeholder Consultation

The Consultant's had organized the consultations meetings with the concerned Government representatives and potential PAPs. Besides individual and group meetings were also conducted in the project villages like Gorah, Karot and Tandal. There were two main objectives of those consultations. The first objective was to obtain the views of Project affected persons and government officials on relocation issues, with a focus on identifying potential negative impacts on social, religious and cultural aspects of the Project Area. The second objective was to brief the key government officials about the project and to elicit their support regarding the smooth functioning of the project activities, especially in connection with the data collection from the official records and it is presented in Table 13.4.1.

**Table 13.4.1: Consultation with Project Stake holders**

| S. No. | Village Name/ Venue | Date       | No of Participant | Main Concerns/suggestions of Stakeholders  | Expectations   |
|--------|---------------------|------------|-------------------|--|--|
| 1      | Karot               | 18/06/2009 | 17                | <ul style="list-style-type: none"> <li>• Livelihood will be affected severely due to acquiring of Agriculture land.</li> <li>• The compensation will not be provided at par with the current market rate.</li> <li>• The locals must be involved during the project implementation, so as to make the project more effective.</li> <li>• The residential colony must be avoided here, as it will severely affect on their privacy</li> <li>• Homeless due to acquiring residential structures</li> </ul> | <ul style="list-style-type: none"> <li>• More employment opportunities will be created</li> <li>• Land value will be boosted up,</li> <li>• Will get rid of the power failure</li> </ul> |
| 2      | Gorah               | 19/06/2009 | 14                | <ul style="list-style-type: none"> <li>• The compensation will not be provided at par with the current</li> </ul>  | <ul style="list-style-type: none"> <li>• The Project will have positive</li> </ul>   |

| S. No.       | Village Name/<br>Venue | Date       | No of Participant | Main Concerns/suggestions of Stakeholders   | Expectations  |
|--------------|------------------------|------------|-------------------|---|---|
|              |                        |            |                   | <p>market rate.</p> <ul style="list-style-type: none"> <li>• Reduction in livestock rearing will happen due to acquiring of agricultural land.</li> <li>• Livelihood may be disturbed due to acquiring of agricultural land</li> <li>• The increase in the height of the dam may cause the inundation of the area</li> <li>• Privacy will be disturbed during the construction stage of project</li> <li>• Jobs must be given on priority basis to the affected population</li> <li>• Dam height must be reduced to minimum possible level</li> </ul> | <p>impact on the national economy</p>   |
| 3            | Tandal                 | 19/06/2009 | 8                 | <ul style="list-style-type: none"> <li>• The construction of dam may cause the effect on their livelihood.</li> <li>• The project must be replaced with the power project only instead of dam construction</li> <li>• Agriculture land will be acquired which will affect their livelihood.</li> <li>• The affectees must be given the compensation with the market value.</li> <li>• The vulnerable population must be included in the compensation package.</li> <li>•</li> </ul>   | <ul style="list-style-type: none"> <li>• The residents may get the power continually and also on cheaper cost.</li> <li>• The project will help to uplift the socio-economic condition of the area</li> </ul> |
| <b>Total</b> |                        |            | <b>39</b>         |   |   |

During the consultation and discussion process (Table No. 4.1) most of the Project area residents showed their willingness for the construction of the Project. However, they expressed their fears that they might not be properly compensated for their land and land based assets. There might also be some problems in the payment of compensation according to the laws of the country and donors guidelines, if any. They were assured that there will be no such problem in the assessment of properties values and payment of compensation. It was further explained that there will be a Grievance Redress Committee including the members from the affected population who will look after such issues. The methodology for the payment of compensation will be transparent and nobody will be deprived off from his actual losses occurred during the process of construction and operation and maintenance of the project.

#### **13.4.1.10 Study of Flora and Fauna**

This study was focused on gathering information on plants, birds, reptiles and mammals. Information on the identification of the species of flora and fauna of “special interest” was also gathered.

#### **13.4.1.11 Perception Survey on Relocation/Resettlement**

This survey was designed to gather perceptions of key officials/representatives in the Project Area on the basis of past experience on similar projects, especially the Mangla Relocation experience (to learn from past experience) and identification of constraints to a Karot Project relocation program. In addition, the survey focused on definition of the project affected persons (PAP’s); relocation preferences, compensation approach; degree of willingness to relocate; transparency in compensation; anticipated negative and positive environmental impacts and adoption of mitigation measures in case of project adverse impact and areas of special environmental interest.

### **13.4.2 Physical Environment**

#### **13.4.2.1 Topography.**

The Project Area is located on both sides of the River Jhelum and is gently sloping towards the South. The maximum conservation level of the proposed dam site is 461 meters above sea level. However, there are variations of topographic levels at various locations in the Project Area.

#### **13.4.2.2 Geology of Project Area**

The geological formation of the Dam Site at Karot consists of Siwalik formation of thick, massive sandstones and clay interbeds. The beds dip upstream at 10 to 20

degree. A continuous major bedding joint divides the main sandstone bed equally. This is an unloading feature and is common in thick sandstone. On the left bank of the river, about 50 meters above normal river level, there is a flat bench with thick overburden cover. This bench continues for 200 meters before meeting a steep rock face.

Banks of the stream on both sides are covered with stream sediment material having some gravel on the surface. Apparently there are no signs of major slides/slips which could create some problems after reservoir is filled. No structural weakness / zones like faults are visible at the dam site.

#### **13.4.2.3 Seismology**

The Karot Hydropower Project lies in the Jhelum fault, which has length of 120 Km. The Jhelum fault yields maximum magnitude potential  $M_w = 7.5$ . The maximum potential magnitude for Himalayan Frontal Thrust (HFT) was selected equal to the magnitude  $M_w = 7.6$  of recent Kashmir earthquake. This is considered the characteristic (maximum) for that fault. The ground acceleration of 0.31 g is adopted for the design basic earthquake (DBE) for Karot Hydropower Project.

#### **13.4.2.4 Soils**

Soils of the Project Area are predominantly of calcareous sandstone origin. Most of the soils are formed by alluvial or alluvial deposits. Soils of the uplands are generally deep to moderately deep and well drained. They are leached and therefore generally non calcareous, soils in the piedmont plains are of medium to light textured and well to excessively drained.

#### **13.4.2.5 Climate**

Climate of Indo Pakistan sub-continent, in which the project catchments lies, can be divided into four seasons; namely the North-East Monsoon (December to February), Hot Weather Period (March to May), South-West Monsoon (June to September) and Transition Period (October to November). The distribution of rain during the year depends principally on topography of the area and season. Summer rainfall in particular varies significantly in time and place.

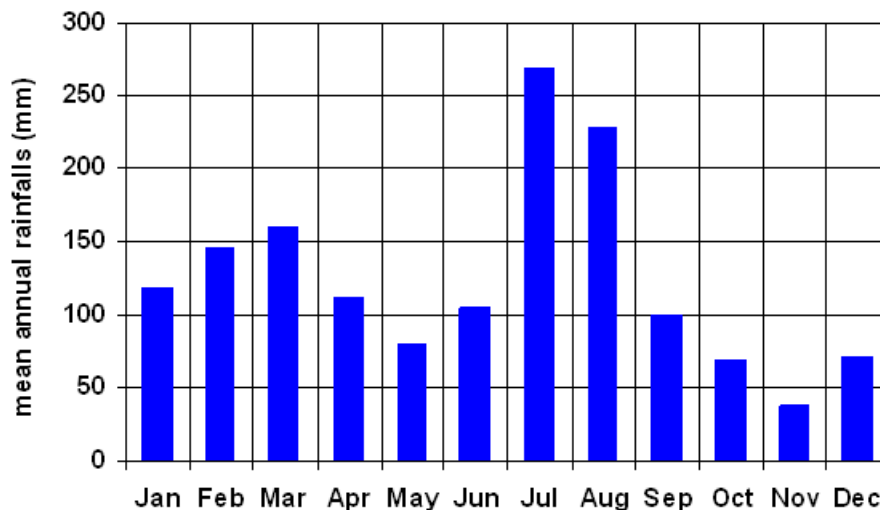
#### **13.4.2.6 Hydrology**

The generated daily flows at the dam site for 35 years from 1969 to 2004 (as data for 1993 at Azad Pattan is not published), the absolute minimum, average and maximum daily flows were found as 106, 821 and 10,900 m<sup>3</sup>/s, respectively. The minimum, average and maximum daily flows based on the averages for 35 years

data are 203, 817 and 1792 m<sup>3</sup>/s, respectively. The minimum, mean and maximum 10-daily flows at the dam site were computed as 209, 803 and 1758 m<sup>3</sup>/s, respectively on the basis of 35 years data record. The minimum, mean and maximum monthly flows at the dam site were computed as 218, 816 and 1706 m<sup>3</sup>/s, respectively. The minimum, mean and maximum annual flows at the dam site were computed as 382, 821 and 1300 m<sup>3</sup>/s, respectively.

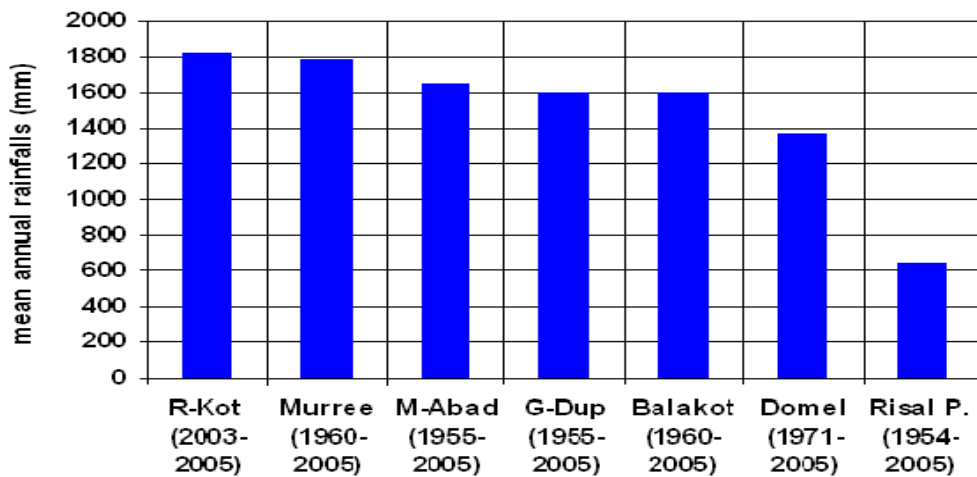
**13.4.2.7 Rainfall**

Mean monthly precipitation of various rain gauging stations is presented in Figure 13.4.1. The mean monthly precipitation for the watershed area is 124.5 mm. The data presented in Figure 13.4.1 indicate that the temporal monthly distribution of the rainfall is bi-modal; the first peak appears in the month of March and second in July, however, the second peak is the highest.



**Figure 13.4.1: Mean Monthly Precipitations at Various Rain Gauging Stations**

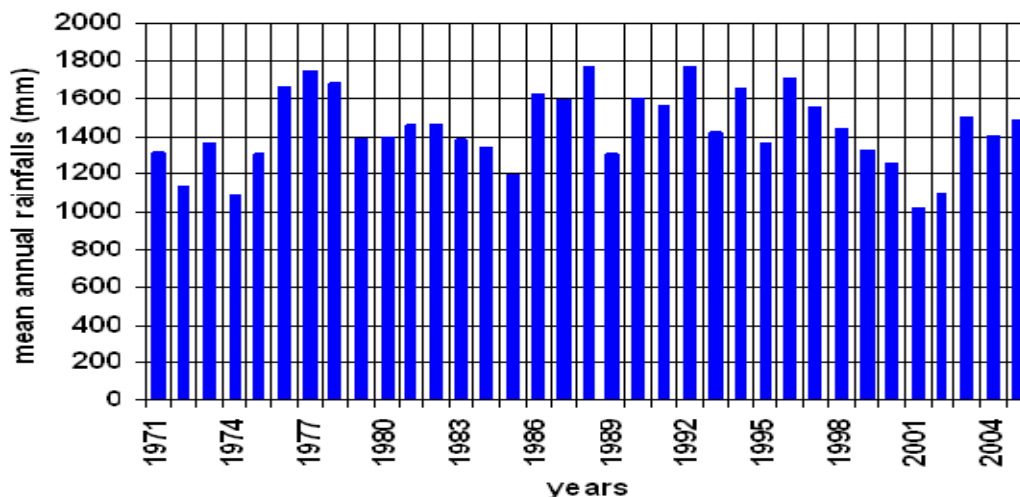
Average annual rainfalls were computed for each climatological station and are presented in Figure 13.4.2 with total length of data records used for estimation of averages. The Figure 13.4.2 shows that Rawlakot has maximum annual average rainfall (1824 mm), whereas, Risalpur carries minimum average annual rainfall i.e. 636 mm. The mean annual rainfall for the watershed based on available stations data is 1442 mm.



**Figure 13.4.2: Mean Annual Precipitations for the Watershed**

Mean annual precipitations were also computed for the watershed and are presented in Figure 13.4.3. The average maximum and minimum annual precipitations over the watershed was estimated as 1769 mm in 1988 and 1022 mm in 2001, respectively. The results of average precipitations are based on 35 years (1971-2005) data record of seven climatological stations namely Balakot, Garhi Dupatta, Muzaffarabad, Murree, Risalpur, Rawlakot and Domel.

**Figure 13.4.3: Average Annual Precipitations for the Watershed**



### 13.4.2.8 Evaporation

Evaporation is a significant component of hydrologic cycle, especially in northern hilly areas of Pakistan. The Mangla Reservoir station data were utilized to carry out evaporation analysis for the reservoir area as it is closer to project area. The type of pan which is used for gathering evaporation data at Mangla Reservoir is "Surface Evaporation Pan". The mean monthly distribution of Evaporation is shown in Figure 13.4.4 which shows that the highest evaporation takes place in the month of May with a value of 322 mm, whereas it is minimum in the month of December with a

value of 62 mm. The monthly mean evaporation at the project site is estimated to be 168 mm.

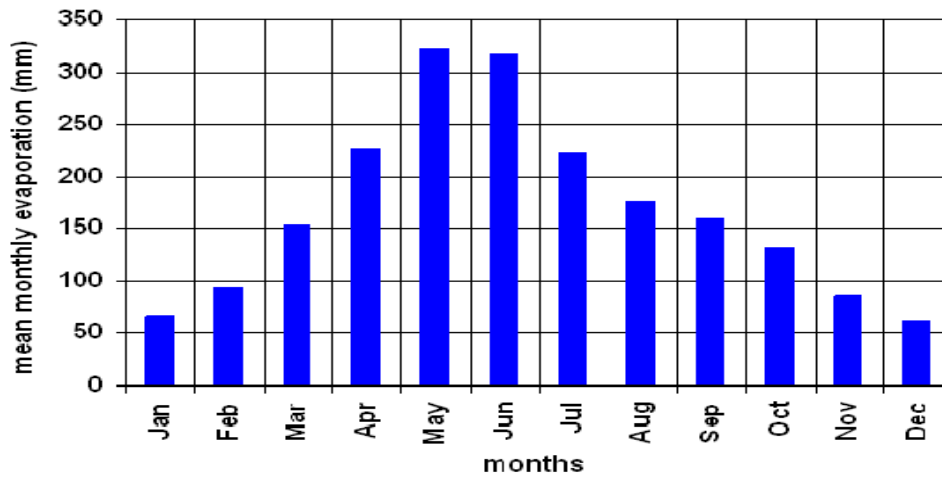


Figure 13.4.4: Mean Monthly Evaporation at Mangla Reservoir

#### 13.4.2.9 Air Temperature

The mean monthly temperature at Mangla Reservoir is presented in Figure 13.4.5. The data in Figure 13.4.5 show that the highest temperatures are observed in the months of June and July, which is 28.62°C on the average. The lowest average daily temperature is 9.17°C and is observed in the month of January. On average, the results reveal that January is the coldest and June is the hottest month.

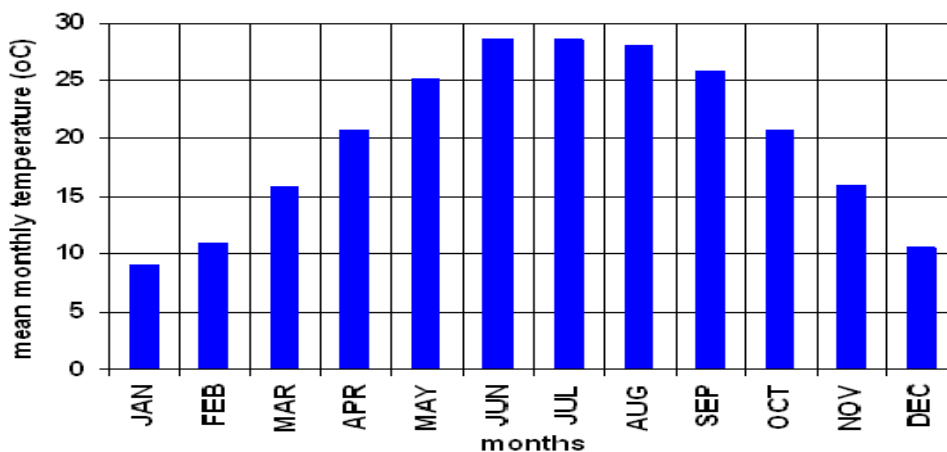


Figure 13.4.5: Mean Monthly Temperature at Mangla Reservoir

The mean annual air temperatures from 1968 to 2005 are presented in Figure 13.4.6, which shows that the mean air temperature of 1968 was the highest with a numerical value of 23.9°C and then mean annual temperatures almost remain same with slight variations.

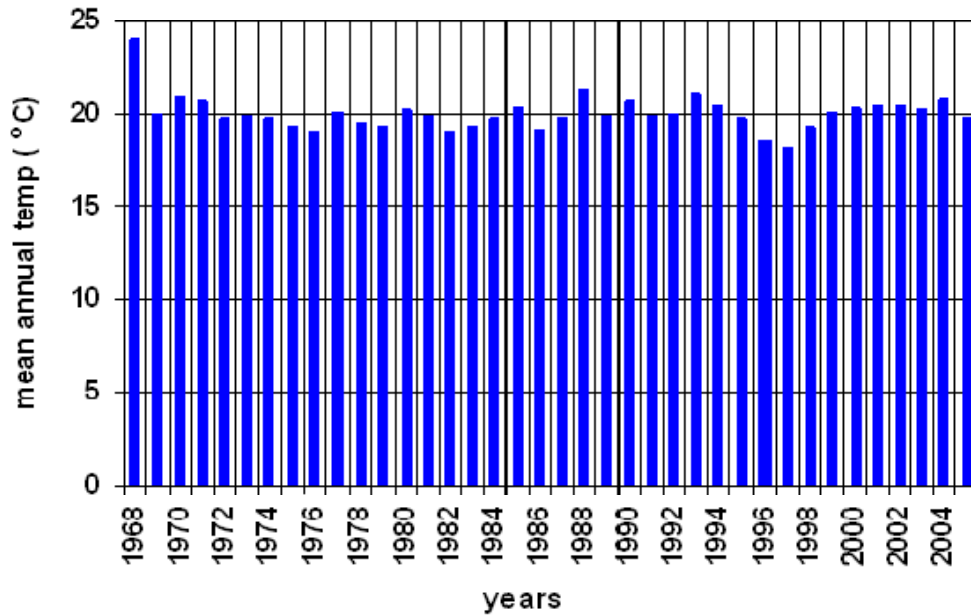


Figure 13.4.6: Mean Annual Air Temperatures at Domel

#### 13.4.2.10 Wind Speed

Mean monthly wind speed distribution over Domel climatological station is shown in Figure 13.4.7. Data indicate that March is most windy on average basis, from January to July Domel site is relatively windy with maximum average wind velocity of 23.8 km/hr, whereas August to December are calmer months. The month in which wind blows with lowest speed is the December with a value of 9.5 km/hr.

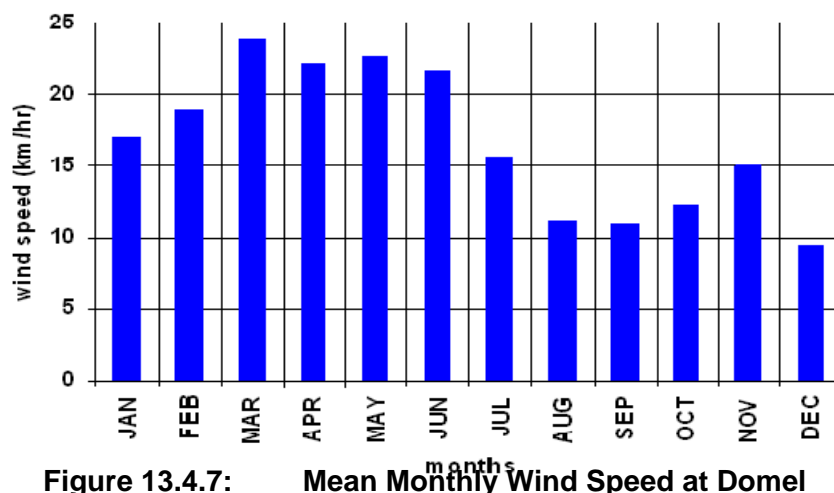


Figure 13.4.7: Mean Monthly Wind Speed at Domel

The data presented in Figure 13.4.8 show the average annual wind speeds from 1968 to 2005 (35 years), which reveals that the wind speed variation is significant from year to year. In general, average annual wind speeds are decreasing over Domel area.

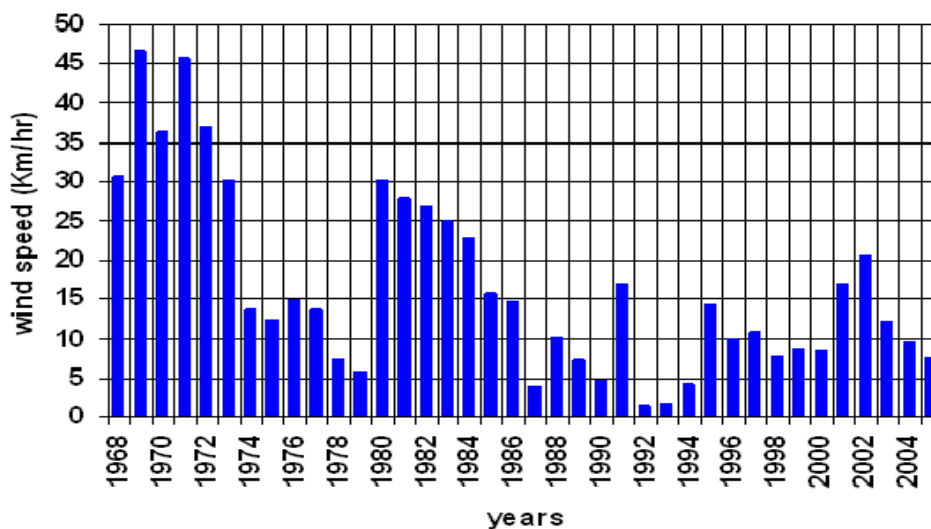


Figure 13.4.8: Mean Annual Wind Speed at Domel

### 13.4.2.11 Hydrological Stations

Nine main hydrological stations were available in the study area watershed from where flow, instantaneous peaks and sediment discharge data were made available; all those stations were setup and are being maintained by the SWHP, WAPDA. Those gauging stations include Chinari, Hattian Bala, Domel, Chattar Kallas, Karot, Azad Pattan and Karot on River Jhelum; whereas Garhi Habibullah and Muzaffarabad stream gauging stations are situated on Rivers Kunhar and Neelum, respectively.

For dam site flow and flood study, Karot and Azad Pattan gauging stations data were found appropriate as the Karot gauging station is situated at the dam site and Azad Pattan is located slightly upstream the dam site. Different meteorological stations from where climatological and hydrological data for different periods were collected and presented in Table 13.4.2 and 13.4.3 respectively.

Table 13.4.2: Climatological Data

| Station  | Temperature | Relative Humidity | Pan Evaporation | Wind Velocity | Rainfall    |
|----------|-------------|-------------------|-----------------|---------------|-------------|
| Domel    | 1968-2005   | 1968-2005         | 1968-2005       | 1968-2005     | 1968 - 2005 |
| Balakot  | 1970-1979   | 1970-1979         | 1970-1979       | 1970-1979     | 1970 - 2005 |
| Naran    | 1970-2005   | 1970-2005         | 1988-2005       | 1988-2005     | 1970 - 2005 |
| Rawlakot | 1970-2005   | 1970-2005         | -               | -             | 1970 - 2005 |
| Bagh     | 1970-2005   | 1970-2005         | -               | -             | 1970 - 2005 |

| Station       | Temperature            | Relative Humidity | Pan Evaporation        | Wind Velocity                  | Rainfall               |
|---------------|------------------------|-------------------|------------------------|--------------------------------|------------------------|
| Palandri      | 1970-2005              | 1970-2005         | -                      | -                              | 1970 - 2005            |
| Dhudnial      | -                      | -                 | -                      | -                              | 1985 - 1995            |
| Balakot       | 1960-1967<br>1971-2005 | -                 | 1960-1967<br>1971-2005 | 1960-<br>1967<br>1971-<br>2005 | 1960-1967<br>1971-2005 |
| Garhi Dupatta | 1955-2005              | -                 | 1955-2005              | 1955-<br>2005                  | 1955-2005              |
| M-Abad        | 1955-2005              | -                 | 1955-2005              | 1955-<br>2005                  | 1955-2005              |
| Murree        | 1960-2005              | -                 | 1960-2005              | 1960-<br>2005                  | 1960-2005              |
| Risalpur      | 1954-2005              | -                 | 1954-2005              | 1954-<br>2005                  | 1954-2005              |
| Rawlakot      | 2003-2005              | -                 | 2003-2005              | 2003-<br>2005                  | 2003-2005              |
| Mangla        | -                      | -                 | 1984-2007              | -                              | -                      |

**Table 13.4.3: Hydrological Data**

| Sr. No. | Gauging Station  | River                 | Flow data              | Sediment Data          |
|---------|------------------|-----------------------|------------------------|------------------------|
| 1       | Chinari          | Upper Jhelum          | 1970-1996              | 1970-1996              |
| 2       | Hattian Bala     | Upper Jhelum          | 1997-2004              | 1997-2004              |
| 3       | Domel            | Upper Jhelum          | 1976-2004              | 1976-2004              |
| 4       | Muzaffarabad     | Neelum                | 1963-2004              | 1963-2004              |
| 5       | Garhi Habibullah | Kunhar                | 1960-2004              | 1960-1995              |
| 6       | Karot            | Lower Jhelum          | 1965-1995              | 1965-1995              |
| 7       | Chattar Kallas   | Lower Jhelum          | 1997-2004              | 1997-2004              |
| 8       | Azad Pattan      | Jhelum U/S Mangla Dam | 1979-1992<br>1994-2004 | 1979-1992<br>1994-2004 |
| 9       | Karot            | Jhelum U/S Mangla Dam | 1969-1979              | 1969-1979              |

#### 13.4.2.12 Water Resources

Hand pumps are available to a limited number of families in the Project Area. Most of the villagers use untreated water from natural streams, springs and channels. The

surface water is contaminated by human activities, animal dung and rotting of organic matter like leaves etc. Some villages have ground water. Some house holds have boreholes for drinking water. Ground water is available at a depth of about 120 – 150 feet.

### 13.4.2.13 River Water Quality in Project Area

The project is located in a very thinly populated area and there are no major sources of pollution in and around the area. But during construction the pollution may occur due to increase in sedimentation, deposition of hazardous waste material and discharge of the domestic and industrial waste waters into the water bodies. Water Samples were collected by the SGS from dam and powerhouse site from July 24 to 26, 2009 and analyzed for 26 parameters. The analysis results are presented in Table 13.4.3.

The data presented in Table 13.4.4 indicate that presently the water quality is good as all the quality parameters except total suspended solids are well below the National Environmental Quality Standards (Annexure 13.3).

**Table 13.4.4: Water Quality of River Jhelum**

| Sr. No | Parameters                    | Method Used                | Unit | LDL<br>Lowest<br>Detection<br>Limit | Results<br>of<br>(Power<br>house)<br>Area | Results<br>of<br>Dam<br>Site area | Limits as<br>per NEQS |
|--------|-------------------------------|----------------------------|------|-------------------------------------|---|-----------------------------------|-----------------------|
| 1      | Temperature                   |                            | °C   | -                                   | 13  | 12                                | =<40                  |
| 2      | pH                            | APHA-4500H <sup>+</sup> B  |      | -                                   | 7.78                                      | 7.92                              | 06-09                 |
| 3      | Biochemical<br>Oxyge          | ASTM5210                   | mg/L | 5.0                                 | 21  | 10                                | 80.00                 |
| 4      | Chemical<br>Oxygen<br>Demand  | APHA-5220 D                | mg/L | 5.0                                 | 37  | 19                                | 150.00                |
| 5      | Total<br>Suspend<br>ed Solids | APHA-2540 D                | mg/L | 5.0                                 | 366                                       | 241                               | 200.00                |
| 6      | Total<br>Dissolv<br>ed        | APHA-2540 C                | mg/L | 5.0                                 | 114                                       | 109                               | 3500.00               |
| 7      | Chloride (Cl)                 | APHA-4500Cl <sup>-</sup> B | mg/L | 0.5                                 | 10  | 10.6                              | 1000.00               |
| 8      | Fluoride ( F)                 | APHA - F <sup>-</sup> C    | mg/L | 0.01                                | 0.4                                       | 0.6                               | 10.00                 |
| 9      | Cyanide<br>(CN)               | APHA-4500CN F              | mg/L | 0.01                                | <0.01                                     | <0.01                             | 01.00                 |

|    |                             |                             |      |       |        |        |        |
|----|-----------------------------|-----------------------------|------|-------|--------|--------|--------|
| 10 | Sulphate (SO <sub>4</sub> ) | APHA-4500 SO <sub>4</sub> C | mg/L | 5.0   | 45     | 40     | 600.00 |
| 11 | Sulphide (S)                | APHA-4500S <sup>2-</sup> D  | mg/L | 0.1   | <0.1   | <0.1   | 01.00  |
| 12 | Magnesium                   | APHA-3500Mg B               | mg/L | 0.5   | 11.9   | 10.9   | -      |
| 13 | Ammonia (NH <sub>3</sub> )  | APHA-4500NH <sub>3</sub> B  | mg/L | 0.1   | <0.1   | <0.1   | 40.00  |
| 14 | Cadmium (Cd)                | APHA-3500Cd B               | mg/L | 0.05  | <0.05  | <0.05  | 00.10  |
| 15 | Chromium (Cr)               | APHA-3500Cr B               | mg/L | 0.01  | <0.01  | <0.01  | 01.00  |
| 16 | Copper (Cu)                 | APHA-3500Cu B               | mg/L | 0.01  | 0.02   | 0.02   | 01.00  |
| 17 | Lead (Pb)                   | APHA-3500Pb B               | mg/L | 0.01  | 0.02   | 0.02   | 00.50  |
| 18 | Mercury (Hg)                | APHA-3500Hg B               | mg/L | 0.001 | <0.001 | <0.001 | 00.01  |
| 19 | Selenium (Se)               | APHA-3500Se C               | mg/L | 0.01  | <0.01  | <0.01  | 00.50  |
| 20 | Nickel (Ni)                 | APHA 3500 Ni B              | mg/L | 0.01  | 0.04   | 0.04   | 01.00  |
| 21 | Silver (Ag)                 | APHA-3500Ag B               | mg/L | 0.1   | <0.1   | <0.1   | 01.00  |
| 22 | Zinc (Zn)                   | APHA-3500Zn B               | mg/L | 0.05  | 0.14   | 0.12   | 05.00  |
| 23 | Arsenic (As)                | APHA-3500As B               | mg/L | 0.005 | <0.005 | <0.005 | 01.00  |
| 24 | Barium (Ba)                 | APHA-3500Ba B               | mg/L | 0.5   | <0.5   | <0.5   | 01.50  |
| 25 | Iron (Fe)                   | APHA-3500Fe B               | mg/L | 0.01  | 12.5   | 7.5    | 8.00   |
| 26 | Boron (B)                   | APHA-4500B C                | mg/L | 0.02  | <0.02  | <0.02  | 6.00   |

#### 13.4.2.14 Ambient Air Quality

There are no major sources of air pollution in the vicinity. Vehicular traffic on local roads mobilizes dust, although its effect is fairly localized. Study was done to have proper Ambient Air Quality and Noise levels by SGS.

The data presented in Table 13.4.5 and Table 13.4.6 indicate that the carbon monoxide, nitrogen oxides and sulphur dioxide levels at dam site and powerhouse site respectively are quite lower than the National Environmental Quality Standards for these gases. Presently the Ambient Air Quality is good in the project area.

**Table 13.4.5: Ambient Air Quality at Dam Site**

| Parameter                           | Unit              | Duration | LDL  | Average Obtained Concentration |
|-------------------------------------|-------------------|----------|------|--------------------------------|
| Nitrogen Dioxide (NO <sub>x</sub> ) | ppb               | 24Hours  | 1    | 11.62                          |
| Sulfur Dioxide (SO <sub>2</sub> )   | ppb               | 24 Hours | 1    | 1.96                           |
| Carbon Monoxide (CO)                | ppm               | 24 Hours | 0.01 | 2.12                           |
| PM <sub>10</sub>                    | ug/m <sup>3</sup> | 24 Hours | 2    | 109.02                         |

µg/m<sup>3</sup>: micrograms per cubic meter  
LDL: Lowest Detection Limit

**Table 13.4.6: Ambient Air Quality at Powerhouse Site**

| Parameter                           | Unit              | Duration | LDL  | Average Obtained Concentration |
|-------------------------------------|-------------------|----------|------|--------------------------------|
| Nitrogen Dioxide (NO <sub>x</sub> ) | ppb               | 24Hours  | 1    | 14.22                          |
| Sulfur Dioxide (SO <sub>2</sub> )   | ppb               | 24 Hours | 1    | 2.00                           |
| Carbon Monoxide (CO)                | ppm               | 24 Hours | 0.01 | 2.61                           |
| PM <sub>10</sub>                    | ug/m <sup>3</sup> | 24 Hours | 2    | 136.10                         |

µg/m<sup>3</sup>: micrograms per cubic meter  
LDL: Lowest Detection Limit

#### 13.4.2.15 Noise Levels

The noise levels were measured for 24 hours at dam site and powerhouse site and are presented in Table 13.4.7 and 13.4.8 respectively. Overall the noise levels are within safe limits except at one or two occasions as recorded during the monitoring period.

**Table 13.4.7: Noise Level at Dam Site**

| S. No. | Time  | Leq(dB) | Lmax(dB) | Lmin(dB) |
|--------|-------|---------|----------|----------|
| 1      | 11:00 | 59.9    | 77.0     | 53.8     |
| 2      | 12:00 | 57.6    | 76.2     | 52.2     |
| 3      | 13:00 | 56.7    | 76.6     | 53.4     |
| 4      | 14:00 | 58.2    | 79.3     | 55.3     |
| 5      | 15:00 | 59.6    | 78.0     | 55.9     |
| 6      | 16:00 | 59.8    | 79.7     | 54.8     |
| 7      | 17:00 | 60.2    | 80.2     | 55.2     |
| 8      | 18:00 | 61.0    | 82.1     | 55.8     |
| 9      | 19:00 | 59.4    | 78.6     | 54.2     |

| <b>S. No.</b> | <b>Time</b> | <b>Leq(dB)</b> | <b>Lmax(dB)</b> | <b>Lmin(dB)</b> |
|---------------|-------------|----------------|-----------------|-----------------|
| 10            | 20:00       | 60.6           | 80.4            | 52.4            |
| 11            | 21:00       | 58.2           | 76.9            | 55.6            |
| 12            | 22:00       | 59.0           | 75.6            | 51.9            |
| 13            | 23:00       | 55.9           | 72.7            | 50.8            |
| 14            | 24:00       | 54.8           | 70.9            | 48.2            |
| 15            | 01:00       | 53.4           | 66.6            | 47.6            |
| 16            | 02:00       | 51.2           | 62.7            | 48.4            |
| 17            | 03:00       | 51.6           | 63.6            | 47.5            |
| 18            | 04:00       | 53.2           | 64.3            | 45.4            |
| 19            | 05:00       | 51.9           | 66.6            | 46.3            |
| 20            | 06:00       | 52.8           | 64.6            | 46.9            |
| 21            | 07:00       | 53.4           | 65.4            | 47.8            |
| 22            | 08:00       | 51.8           | 62.6            | 46.5            |
| 23            | 09:00       | 55.4           | 78.2            | 49.6            |
| 24            | 10:00       | 58.6           | 77.4            | 51.0            |

**Table 13.4.8: Noise Level at Powerhouse Site**

| <b>S. No.</b> | <b>Time</b> | <b>Leq(dB)</b> | <b>Lmax(dB)</b> | <b>Lmin(dB)</b> |
|---------------|-------------|----------------|-----------------|-----------------|
| 1             | 11:00       | 64.7           | 82.6            | 47.3            |
| 2             | 12:00       | 67.4           | 84.0            | 49.7            |
| 3             | 13:00       | 67.0           | 83.2            | 50.0            |
| 4             | 14:00       | 68.1           | 92.1            | 50.9            |
| 5             | 15:00       | 68.3           | 90.3            | 51.2            |
| 6             | 16:00       | 67.4           | 91.0            | 49.1            |
| 7             | 17:00       | 66.2           | 80.1            | 45.0            |
| 8             | 18:00       | 65.7           | 84.2            | 46.1            |
| 9             | 19:00       | 70.1           | 92.7            | 51.9            |
| 10            | 20:00       | 63.0           | 83.0            | 47.4            |
| 11            | 21:00       | 65.7           | 84.3            | 45.5            |
| 12            | 22:00       | 63.9           | 80.4            | 43.6            |
| 13            | 23:00       | 67.6           | 86.2            | 46.0            |
| 14            | 24:00       | 67.1           | 88.1            | 44.7            |
| 15            | 01:00       | 63.0           | 83.1            | 42.2            |
| 16            | 02:00       | 62.4           | 80.0            | 43.1            |
| 17            | 03:00       | 60.1           | 79.2            | 41.1            |
| 18            | 04:00       | 61.0           | 80.4            | 45.2            |

| <b>S. No.</b> | <b>Time</b> | <b>Leq(dB)</b> | <b>Lmax(dB)</b> | <b>Lmin(dB)</b> |
|---------------|-------------|----------------|-----------------|-----------------|
| 19            | 05:00       | 62.1           | 80.1            | 43.4            |
| 20            | 06:00       | 59.3           | 79.2            | 42.3            |
| 21            | 07:00       | 64.4           | 81.5            | 44.0            |
| 22            | 08:00       | 66.6           | 85.0            | 46.9            |
| 23            | 09:00       | 66.0           | 87.6            | 43.4            |
| 24            | 10:00       | 69.1           | 90.9            | 47.2            |

### **13.4.3 Biological Environment**

#### **13.4.3.1 Terrestrial Ecology**

##### **13.4.3.1.1 Overview**

The baseline data, presented mainly consist of the data collected from various government records / publications as secondary, as well as primary data was collected through the site visits. Information given below provides a description of flora, fauna and other ecologically significant features of the area in general and project site in particular. Number of trees, other vegetation to be affected due to clearance of land for construction of dam, powerhouse associated activities is also estimated.

These estimates are based on satellite imagery and through consultation with local residents and with on the spot observations made during field visits.

##### **13.4.3.1.2 Flora in the Project Area**

Natural flora in the Project Area comprises of forests (mainly conifers), shrubs, herbs, forbs, grasses, ferns, mosses, lichens, medicinal plants, and cultivated fruit trees. The information below is about the Project Area as a whole supplemented by information on areas to fall under the proposed dam / reservoir, powerhouse, access road(s), residential colonies, labour camps, material dumping sites, batching plant etc.

##### **13.4.3.1.3 Forests**

The distribution of forest vegetation in Pakistan is primarily governed by climatic and edaphic factors and which is reflected in the diversity of forests types. While large areas are-under natural coniferous and broad-leaved forests, some of the forests are entirely man-made. From the alpine forest in the northern Himalayas, to the mangrove forests in-the Indus delta swamps-there is a variety of forest types.

#### **13.4.3.1.4 Forests in the Project Area**

The whole forest tract is bounded by the State of Azad Kashmir on the eastern side as well as on the northern side and by Rawalpindi District to the northeast. The damages to forest is due to natural causes and human activities. Natural causes include wind, lightening, hailstorms, frost, wild animals, birds, insects and fungi. Human activities such as fire, looping, grazing, browsing, and extraction of wood and illegal felling is the main reason for forest depletion. Local population living near the forests mostly depends on the forests for fuel, timber, and to some extent grazing. The population living away from the forests also depend on the shrubs for heating as well as cooking. Within the Project Area, the forests belong to the sub-tropical pine forests.

#### **13.4.3.1.5 Sub-tropical Pine Forests**

The Project Area falls under the sub-tropical pine forests. Those areas are mainly covered by "chir pine" and include the lower sub-mountainous terrain of the Project Area within the lower reaches of the Jhelum River. Within those reaches, Pinus Rorhurgii is the only conifer forest plant and is dominant within the area. In association with the pine community are patches or pockets of broad leaved species such as; olive olea ferruginea, timber zanthoxylum armatum, fig ficus palmate, sanatha doclonea viscosa, and simblu berberis lyceum main species of trees, shrubs, herbs, forbs, grasses, ferns, mosses, lichens, medicinal plants, and cultivated fruit trees species in the Project Area and are presented in Tables 13.4.9, 13.4.10, 13.4.11, 13.4.12 and 13.4.13.

**Table 13.4.9: Inventory of Trees in the Project Area**

| <b>Scientific / Biological Name</b> | <b>Common Name/Local Name</b> |
|-------------------------------------|-------------------------------|
| Morus nigra                         | Kala toot                     |
| Ficus carica                        | Paghwari                      |
| Populus nigra                       | Sufaida                       |
| Ailenthus excelsa                   | Darwia                        |
| Melia azederach                     | Drek                          |
| Grewia spp.                         | Dhaman                        |
| Cedrella toona                      | Tun                           |

| <b>Scientific / Biological Name</b> | <b>Common Name/Local Name</b> |
|-------------------------------------|-------------------------------|
| Salmalia melabarica                 | Sembel                        |
| Bauhinia variegata                  | Kaliar/Kachnar                |
| Olea cuspidate                      | Kaho                          |
| Celtis australis                    | Khirk                         |
| Accacia modesta                     | Phulahi                       |
| Coetonestor species                 | Lohn                          |
| Robinia pseudocassia                | Apil Apil/ kikar              |
| Ficus bengalensis                   | Bohr                          |
| Daibergia sissoo                    | Tahli / Shisham               |

**Table 13.4.10: Inventory of Medicinal Plants of the Project Area**

| <b>Scientific / Biological Name</b> | <b>Common Name/Local Name</b> |
|-------------------------------------|-------------------------------|
| Phyllanthus emblica                 | Amla                          |
| Berberis lycium                     | Komal                         |
| Berberis vulgaris                   | Komal                         |
| Solanum nigrum                      | Makoo                         |
| Artimisea vulgaris                  | Chahoo                        |
| Agave Americana                     | Kewra                         |
| Aloe vera                           | Kanwar gandal                 |
| Adhatoda vasica                     | Behakar                       |
| Anethum graveolens                  | Sowa                          |
| Calotropis procera                  | Ak                            |
| Cannabis sativa                     | Bhang                         |
| Datura alba                         | Datura                        |
| Cichorium intybus                   | Kasni                         |
| Lepidium sativum                    | Water cress                   |
| Linum usitatissimum                 | Alsi                          |
| Melia azederach                     | Drek                          |
| Mentha arvensis                     | Pudina                        |
| Nerium odorum                       | Kaner gandra                  |
| Ocimum basilicum                    | Bhabori                       |

| Scientific / Biological Name | Common Name/Local Name |
|------------------------------|------------------------|
| Viola odorata                | Banafsha               |
| Zanthoxylum armatum          | Timar                  |
| Cordia myxa                  | Lasoorra               |
| Zizyphus vulgare             | Anab/Sanjli            |
| Ricinus Communis             | Arnolu                 |
| Woodfordia floribunda        | Dhavi                  |
| Adiantum                     | Fern                   |
| Aspidium                     | Fern                   |
| Narcisus                     | Rinjal                 |
| Tulipa                       | Mamoona                |
| Fumaria indica               | Papra                  |
| Equisetum                    | Tamtaror               |
| Ajuga bracteosa              | jan-e-azam             |
| Ipomea spp                   | Ishaq pecha            |

**Table 13.4.11: Inventory of Shrubs in Project Area**

| Scientific Name       | Common Name/Local Name |
|-----------------------|------------------------|
| Adhatoda vasica       | Bahekar                |
| Zizyphus jujuba       | Beri                   |
| Dodanea viscosa       | Sanatha                |
| Nerium indicum        | Kaner                  |
| Berberis aristata     | Sumble                 |
| Punica spp.           | Julngli anar           |
| Rhuscotinus           | Hiponter               |
| Mollotus phillipensis | Kamela                 |
| Berberis lyceum       | Komal                  |
| Artimisea vulgaris    | Chahoo                 |
| Calotropis procera    | Ak                     |
| Cannabis sativa       | Bhang                  |
| Mentha arvensis       | Pudina                 |
| Zanthoxylum armatum   | Timar                  |
| Zizyphus vulgare      | Anab/Sanjli            |

| <b>Scientific Name</b> | <b>Common Name/Local Name</b> |
|------------------------|-------------------------------|
| Tulipa                 | Mamoonna                      |
| Fumaria indica         | Papra                         |
| Equisetum              | Tamtaror                      |

**Table 13.4.12: Inventory of Grasses of Project Area**

| <b>Scientific Name</b> | <b>Common Name/Local Name</b> |
|------------------------|-------------------------------|
| Cynodon dactylon       | Khabal                        |
| Saccharum munja        | Munge                         |
| Panicum antidotale     | Naru                          |
| Cyprus rotandus        | Deela                         |
| Jhonson grass          | Baru                          |
| Dub grass              | Dib                           |
| Arundo donax           | Neri                          |

**Table 13.4.13: Inventory of Plants for Honey Bee Keeping**

| <b>Scientific Name</b> | <b>Common Name/Local Name</b> |
|------------------------|-------------------------------|
| Brassica compestris    | Sarsoon                       |
| Adhatoda vasica        | Bahekar                       |
| Acassia arabica        | Kikar                         |
| Zizyphus jujuba        | Beri                          |
| Dodanea viscose        | Sanatha                       |
| Cirsus procera         | Saree                         |
| Olea cuspidate         | Kaho                          |
| Prunus species         | Hari Arwari                   |
| Vitis Vinifera         | Dakh                          |
| Robina pseudocassia    | Kikar                         |

### 13.4.3.1.6 Fruit Trees

In the Project Area limited number of fruit trees is grown in the surrounding villages. Some important fruits plant species in the Project Area are presented in Table 13.4.14.

**Table 13.4.14: Inventory of Fruit Trees in Project area**

| <b>Scientific Name</b> | <b>Common Name/Local Name</b> |
|------------------------|-------------------------------|
| Ficus Carica           | Phagwara                      |
| Morus alba             | Caroon / Toot                 |
| Punica granatum        | Daroonna                      |
| Prunus arminiaca       | Hari                          |
| Prunus arminicca       | Khobani                       |
| Prunus persica         | Arwari                        |
| Prunus persica         | Peach                         |
| Prunus domestica       | Aloochoa                      |
| Pyrus pashia           | Dandli                        |
| Pyrus communis         | Batang                        |
| Zizyphus vulgaris      | Barhoi                        |
| Fragaria nubicola      | Mevwa                         |
| Rubus specie           | Raspberry                     |
| Vitis vinifera         | Dakh/Ansoor                   |
| Musa sapientum         | Kela                          |
| Berberis lyceum        | Simbloo                       |
| Phoenix dactyliferx    | Khajoor                       |
| Citrus medica          | Galgal                        |
| Citrus Limon           | Nimbu                         |
| Eriootria Japonica     | Loquat                        |
| Psidium guvajava       | Amrood                        |
| Mangifera indica       | Tukhmi aam                    |

### 13.4.3.2 Natural Fauna

#### 13.4.3.2.1 Mammals

Pakistan is considered to have; 166 mammals, 476 birds species, 143 reptiles, out of which 12,25 and 17 species respectively are considered to be threatened. Similarly there are 5500 plants out of which 14 are threatened. (Source; UNEP Environmental Data Report, Pakistan; 1993-94).

Wildlife suffers from human dependence on forests and rangelands with many habitats being progressively degraded by human activity and livestock. Apparently

there is little awareness or interest in wildlife by local population and officials. Laws are difficult to enforce. Some mammal species in the Project Area are shown in the Table 13.4.15.

**Table 13.4.15: Inventory of Wild Mammals in Project Area**

| <b>Zoological name</b>   | <b>Common name</b> |
|--------------------------|--------------------|
| Oryctotagus cuniculus    | Rabbit             |
| Vulpes vulpes            | Fox                |
| Canis aureus             | Jackales           |
| Hystrix indica           | Porcupines         |
| Myotis specie            | Bats               |
| Sus serofa               | Wild boar          |
| Felis chaus              | Jungle Cat         |
| Rattus rattus            | Rats               |
| Millardia meltoda        | Field rat          |
| Funambuius pennanti      | Squirrel           |
| Lepus nigricolis dayanus | Wild hare          |
| Herpestes auropunctatus  | Indian mongoose    |
| Herpestes edwardsi       | Mongoose           |

The entire Project Area is located on the bottom of the valley with steep rocky slopes, which are mostly devoid of forest plants. Small terraced area exists on which agricultural crops are being grown. No rare and endangered species of forest/ plants are found within the Project Area.

#### **13.4.3.2.2 Birds in the Area**

The Project Area has only one wetland nearby in the Mangla Reservoir and several water pools on the Jhelum River exists, that are available for the birds. There will be no danger to the birds habitats in the project area but will create suitable place for the birds. The birds in the Project Area are shown in Table 13.4.16.

**Table 13.4.16: Inventory of Birds in Project Area**

| <b>Zoological name</b>    | <b>Common name</b> |
|---------------------------|--------------------|
| Gallus domestica          | Common fowl        |
| Passer domesticus         | House Sparrow      |
| Corvus splendens          | House Crow         |
| Streptopelia senegalensis | Little Brown Doves |

| <b>Zoological name</b>       | <b>Common name</b> |
|------------------------------|--------------------|
| Columba rupeteris            | Pigeons            |
| Francolinus francolinus      | Black patridge     |
| Francolinus pandiceranus     | Grey patridge      |
| Coturnix coturnix            | Common Quil        |
| Otus brucel                  | Owl                |
| Culculus varius              | Cuckoo             |
| Accipiter badius cenchroides | Shikra             |
| Alauda gulgula               | Lesser skylark     |
| Acridother estristis         | Common manna       |
| Pycnonotus cafer             | White bubul        |
| Turdoides striatus           | Jungle Babbler     |

#### **13.4.3.2.3 Insects in the Project Area**

There are many varieties of butterflies in the Project Area, particularly during the humid months of July and August, in addition to praying mantis, bugs, cicadas, beetles, centipedes, millipedes, spiders, scorpions, snails, slugs, and arrow worms.

Insect populations in Project Area include Caterpillar, Pieris brassicae (Linn) and leafminer, Chromatomyia horticola goureau (Agromyzidae: Diptera), painted bug, Bagrada cruciferarum kirk. (Pentatomidae: Hemiptera) and cabbage semilooper, Plusia orichalcea fab. (Noctuidae: Lepidoptera).

The project area is in a gorge and it will have minimum effect on the insect's vector population. Since the project is designed on the run of the river water hence there are lesser chances of any effect on insects and related water borne diseases. Ecologically it is the same fauna available in the adjacent area; hence fauna will have alternate and plenty of adjacent area to inhabitate.

#### **13.4.3.2.4 Amphibians and Reptiles**

Rana tigrana (Rain Frog), Trachydosaurus rugosus (Stripped Lizard) and Uromastix hard (Jungli Kirla) and a variety of snakes (poisonous and non-poisonous) have been reported both from the dam/reservoir and powerhouse complex area. Obviously, this is caused by the climatic conditions particularly the summer heat, which clearly is favouring reptiles. Resting and breeding places are located beneath stones. The existing nullahs in the Project Area are the habitat of these creatures which will remain least disturbed.

### **13.4.3.3 Fish in the Project Area**

Fish and other aquatic organisms require snags, logs and rocks where they can get shelter from predators and the water current and can reproduce, to help them establish territories and to provide markers that help them navigate. Aquatic plants are also very important for fish and other creatures in the stream; apart from providing food, their presence has a direct effect on the available oxygen in the water, which in turn can affect the type of fish and other living creatures in the stream. Protruding snags provide roosting and preening sites for birds.

The majority of species belong to the carp family, followed by loaches and catfish. The most commonly found species is *Schizothorax plagiostomus* which belongs to the carp family and is common in the river throughout the whole area. The only other fish that was common upstream and downstream of Project Area was *Schistura naihanti*.

The river is only occasionally being used for fishing, that too by a few fishermen. Apart from opportunistic fishing, the fish does not form an important part of diet of the local communities. Within the Project Area there is no formal fish market.

The blue green algae and green algae were the main algal foods recorded within the river. Other food sources included planarians, insects and their larvae and nymphs, crustaceans, molluscs and amphibians.

#### **13.4.3.3.1 Important Fish Species in the Jhelum River**

Some Important fish species in the Jhelum River upstream and downstream of the Project area include *Schizopyge esocinus*, *Schizothorax plagiostomus*, *Tor putitora*, *Botia birdi* Chaudhari, *Schistura alepidota*, *Schistura nalbanti*, *Glyptothorax kashmirensis*, *Glyptothorax pectinopterus*, *Glyptothorax stocki*, *Clupisoma naziri*, *Triplohysa kashmirensis*, *Barilius pakistanicus*, *Barilius vagra*, *Crossocheilus diplocheilus*, *Cyprinus carra gotyla*, *Labeo dero*, *Puntius conchoniis*, *Puntius sarana*, *Racoma labiata* and *Notopterus notopterus*

#### **13.4.3.3.2 Genera of Algae in the Jhelum River**

Some genera of Algae recorded Upstream and Downstream of the Jhelum River in the Project Area included the following:

*Gloeocapsa*, *Nostoc*, *Spirulina*, *scillatoria*, *Cladophora*, *Ulothrix*, *Scenedesmus*, *Pediastrum*, *zvpama*, *Spirogyra*, *Cylindrocystis*, *Closterium*, *Cosmarium*, *Diatoma*, *Cymbella*, *Gophonema*, *Pinnularia*, *Nitzchia*, *Phacus*, *Chroococcus*.

#### **13.4.3.4 Protected Areas**

There is no protected area like National Park, Wild life Park, and Wildlife sanctuary, Private Game Reserves in the Project Area. However these are defined as below:

- **National Parks**

A National Park is an area owned by the Government and set aside for protection and preservation of its natural beauty/scenery, flora and fauna in a natural state. It is accessible to the public for recreation, education and research activities, subject to such restrictions, as the Government may like to impose. The construction of access roads, tourist facilities and other buildings in the National Park must not impair the park objectives. Forestry activities must also be controlled in the same way.

- **Wildlife Parks**

Wildlife Park is an area owned by the Government and set aside for the rehabilitation of endangered wildlife species under semi natural conditions as well as for the education and recreation of the public. The following acts are prohibited in a wildlife park:

- Hunting, killing or capturing of any wild species or firing from any gun or any other fire arms,
- Polluting the water
- Damaging or destruction of vegetation.

- **Wildlife Sanctuaries**

A Wildlife Sanctuary is an area owned by the Government (set aside by notification in the official gazette) as an undisturbed breeding ground for the protection of wildlife. Public access to the sanctuary is prohibited. Exploitation of forest resources in a wildlife sanctuary is not permitted except for reducing fire-hazards, epidemics, insect attacks or other natural calamities.

- **Private Game Reserves**

Private game reserves are areas dedicated by landowners for the purpose of exclusively hunting wild animals within the reserve. Persons other than the owner of the reserve are not permitted within private game reserves without the owner's permission. The owner of a private game reserve is empowered to exercise, within the limits of his private game reserve, the same powers as a wildlife officer.

#### **13.4.3.5 Methodology for Socio-economic Baseline**

Following methodology was adopted for field survey in Project Area after review of the published project documents/literature.

- i. A reconnaissance survey was conducted to have an overview about the project area and gauge the needs, issues, problems and impacts of the project on local population and other stakeholders. This initial assessment was utilized to develop detailed methodology for conducting the study. The reconnaissance survey provided the base to go ahead for the future planning of the study.
- ii. A stratified random sampling technique was adopted after preliminary visit. This technique was very helpful to select adequate and representative sample so as to generalize survey findings at the Project level with the highest level of statistical confidence and meaningful fact-findings on the subject under review.
- iii. The geographical boundaries of the reservoir area by identifying the existing villages and settlements were defined in the project area.
- iv. To collect valid, authentic and reliable data, the study tools were designed in such a way that all indicators required in the scope of work of the proposed project on the basis of field reality, will be included for study. The questionnaires, interviewing guide/schedule were prepared in English and discussed in local language during the course of the study. The nature of study tools/questionnaires were comprised on socio-economic household survey, village profile survey and Women survey. These questionnaires were pre-tested in the non-sampled area for clarity and to obtain the required results. These questionnaires were altered and modified as per the ground reality. The detail of the study tools is discussed as under,

##### **a) Household Sample Survey**

Household of total sample size from each sample village of the Project Area were interviewed by using structured questionnaire. Detailed information about socio economic status of household and family was obtained from the respondent(s).

##### **b) Village Profile**

To document the socio economic and demographic characteristics of the villages, fall in the project area, a comprehensive village profile was prepared with the help of Un/structured questionnaires and public consultation process which was conducted through applying Participatory Rural Appraisal (PRA) tool.

**c) Women Survey**

A separate questionnaire covering various aspects / issues of women, including gender profile and project impact on the women population of the area were developed (Annexed 01). The services of a gender specialist were hired for gender and development study in the Project Area.

**13.4.3.5.1 Sampling Design**

A 10% random sampling technique was applied. In this way a sample of 48 was chosen by random sampling technique from the list of 480 households. Village wise households and sample size are shown in Table 13.4.17.

**Table 13.4.17: Village Wise Households and Sample Size**

| Sr. No | Village     | Household (No.) | Sample Size(No.) |
|--------|-------------|-----------------|------------------|
| 1      | Karot       | 48              | 5                |
| 2      | Gorah       | 42              | 4                |
| 3      | Brohi       | 50              | 5                |
| 4      | Tandal      | 40              | 4                |
| 5      | Azad Pattan | 50              | 5                |
| 6      | Muslim Abad | 250             | 25               |
|        | Total       | 480             | 48               |

**Source:** MAES 2008

**13.4.3.6 Human and Economic Development Baseline**

The Karot Hydropower Project (KHPP) will be located along River Jhelum at the boundary of Pakistan and Azad Jammu and Kashmir. A weir will be constructed near Gorah village, which will divert the river water through a 0.725 km long tunnel to Karot village where a powerhouse is to be built. As it is a tunnel based project, there will not be, relatively speaking, much activity above the ground with the exception of two sites i.e., at Gorah village where a head pond and secondly at Karot village where some intermediate facilities and power house will be constructed.

Most of the project related activities will be carried out along the right bank of River Jhelum located in Rawalpindi District, however the proposed reservoir area will lie on the left Bank of River Jhelum in the Kotli and Sudhnuti area under the jurisdiction of Govt. of Azad Jammu and Kashmir (AJK).

### 13.4.3.6.1 Administrative Areas and Population

District Rawalpindi is a part of Punjab Province under the executive charge of District Coordination Officer (D.C.O.) with overall supervision of the Commissioner Rawalpindi Division. DCO's office also performs the functions of District Magistrate and Collector Revenue. District Rawalpindi is divided into following six tehsils:

- i) Rawalpindi
- ii) Kahuta
- iii) Murree
- iv) Kotli Sattian
- v) Taxila and
- vi) Gujjar Khan

### 13.4.3.6.2 Population

The total area of the district is 5286 square kilometers which gives population density of 636.5 per square kilometer as against 401 persons as reported in the last census (1981), indicating a fast growth rate of the district". The urban population was 1,788,233, which is 53.2 percent of the total population (1998). The average household size of the district is 6.4. The total population of AJK was 2.973 million in 1998. The Urban – Rural ratio was 12:88.

District-wise Area, population, Growth Rate, Family Size and Projected population is presented in the Table 13.4.18.

**Table 13.4.18: Detailed Census Population and Projected Population of the Project Area,**

| Distt      | Area Sq. km | Population 1998 | Growth Rate | Family size | Projected Population |         |
|------------|-------------|-----------------|-------------|-------------|----------------------|---------|
|            |             |                 |             |             | 2008                 | 2018    |
| Kotli      | 1862        | 563000          | 2.59        | 7.3         | 708817               | 892401  |
| Sndhuti    | 569         | 224000          | 1.99        | 7.3         | 268576               | 322023  |
| Rawalpindi | 5286        | 3364000         | 2.7         | 6.4         | 4272280              | 5425796 |

**Source:** Population census organization, Islamabad.

The table indicates that the Rawalpindi district is more populated than the other districts of the project area. The proposed project is located in District Rawalpindi. Reservoir and power house is located in Gorah & Karot villages in Tehsil Kahuta of Rawalpindi District. The sample survey of house holds was carried out in the six villages of the project influence area. Table 13.4.19 shows estimated household, population and average family size in sample villages ranged from 6.2 to 8.8 with an average of 7.2 per family.

**Table 13.4.19: Population of the Sample Villages in Karot Hydropower Project Area**

| <b>Village</b>                | <b>Population 1998</b> | <b>Estimated House Hold 2008</b> | <b>Projected Population 2008</b> | <b>*Projected Population 2018 *</b> | <b>Estimated Family Size</b> |
|-------------------------------|------------------------|----------------------------------|----------------------------------|-------------------------------------|------------------------------|
| Karot                         | 275                    | 48                               | 350                              | 450                                 | 7.3                          |
| Gorah                         | 281                    | 42                               | 360                              | 465                                 | 8.6                          |
| Brohi                         | 321                    | 50                               | 425                              | 540                                 | 8.5                          |
| Tandal                        | 280                    | 40                               | 355                              | 448                                 | 8.8                          |
| Batian Azad Pattan)           | 350                    | 50                               | 430                              | 542                                 | 8.6                          |
| Muslimabad (Pattan sher Khan) | 1200                   | 250                              | 1550                             | 1950                                | 6.2                          |
| <b>Total</b>                  | <b>2707</b>            | <b>480</b>                       | <b>3470</b>                      | <b>4395</b>                         | <b>7.2</b>                   |

\* Population estimated at the growth rate of 2.75 & 2.59 respectively.

As indicated in Table 13.4.19 Muslimabad is a big village with about 250 houses but with less family size, compared to other villages. The household size may also affect the economic situation of the household. A bigger household may mean more hands to do farm and non-farm work but it also means more mouth to feed. The average household size in the study area is found to be 7.2 individuals. The family size clearly reveals the existence of extended family system which is still dominating the rural set up of the project area.

Muslimabad village is located on the left bank of river Jhelum up Stream of Azad Pattan Bridge. This village is located almost near the end of proposed reservoir. Proposed powerhouse of KHPP will be located in Karot village. Gorah village located upstream of dam site and its small agriculture land area located at lower portion of the village may be submerged in the proposed reservoir.

#### **13.4.3.6.3 Vulnerable Groups**

##### **i) Disabled Persons**

The disabled residents in the Rawalpindi district constitute 1.50 % Of the total population. The disability group is classified as blind, deaf and mute, crippled, insane, mentally retarded persons. The disabled residents in AJK constitute about 1.95% of the total population. The percentage of male and female disabled persons is 2.37 and 1.55 percent respectively.

##### **ii) Widows**

There were five and seven widows living in Gorah and Karot villages respectively which are likely to be affected due to the reservoir area and construction activities of the project. They are most vulnerable and need to be appropriately compensated.

##### **iii) Landless Persons**

All landless population are non-locals. Among the local residents, Rajputs, Sudhans, Gujjars, janjuas and Sattis are the biggest land owners. They claim to be the original owners of all the land in the area. Most of them have their land in upper elevations. In some villages, they do not cultivate their land by themselves. The tenants from other areas cultivate their land on one third share basis. The poorest groups are therefore those non-local population, who are working as tenants. The ownership of land by the non-local races is insignificant and so are the social conflicts.

#### **13.4.3.6.4 Religion**

The population of Azad Jammu & Kashmir is mostly Muslim and constitutes 99.24% of the total population. As per population census 1998, the population of District Rawalpindi is about 97.71 percent Muslim, followed by Christian 2.11 %, Ahmadi 0.15 % where as other minorities like Hindus and Scheduled Castes are in a very small number.

#### **13.4.3.7 Social Conditions**

##### **13.4.3.7.1 Culture and Local Traditions**

The concept of culture can provide ways of explaining and understanding human behavior, belief system, value and ideologies, as well as particular culturally specific personality types. Following traditions /practices are existed in the project area,

- The combination of new and old culture is found in the Project Area, although the young generation is fond of modern culture. The majority of the population follows the Islamic tradition, which is well practiced in rural area and has high moral values in the society. Moreover, the influence of Pir (spiritual leader) is quite strong. The shrines located in the vicinity are regularly visited by the devotees.
- Food of the inhabitants is very simple. Wheat, maize and rice are the staple food grains while Bajra (millet) is also used to some extent. Meat and vegetables are also consumed by well to do families. Tea is popular all over the Study Area. Bread is generally baked in Tandoor. The use of Desi ghee, milk and lassi is very popular in the rural area, which is available in a sufficient quantity. However, the residents near city have started using different packed cereals in breakfast.
- “Shalwar Qamiz” is the most commonly worn dress both among men and women of the Project Area. However, Government officials and students use western dress, i.e., pent coat during the day time and indigenous dress is worn at home in the evening. Female dress is also very simple and consists of Shalwar, kameez and Dopatta.
- The use of ornaments among the females is also common. The females decorate themselves with ear-ring, necklaces, and Churies (bangle), especially on festive occasion or marriages.
- Marriage is a special happy occasion in the family, which is performed with all its charms by singing and dancing. The persons of the family and adjacent locality are invited by the bridegroom’s family and are entertained with delicious meals. The bride’s parents donate the dowry to the girl for equipping her new house.
- The joint family system is predominant in the Project Area. The field investigation shows that significant majority (85 percent) of the respondent are still living under the joint family system. However, new life style and cultural impacts from the outside world have directly influenced the joint family system, and gradually shifting it to the nuclear family system.

#### **13.4.3.7.2 Community Structure**

Rajput, Janjua, Satti, Qureshi and Sudhan tribes are a community of relatives with same origin, the same language and close family ties. In the entire six sample villages, majority of the population belongs to those tribes. Joint efforts on community based projects in irrigation, tracks / roads, education and conservation of nature in general is continuing. Important issues and disputes are solved by the

head of families and village elders. However, there is no significant role of women in decision making process.

The oldest member of the family is the head of family. Male members of the family hold the decision making power in most of family matters, The total members in family include parents, their children and grand children. The average family size is about seven (7) members per family.

### 13.4.3.7.3 Language

Main spoken language is Punjabi followed by Hindko, Kashmiri and Saraiki. However, the Urdu is also spoken but only with the visitors. Table 13.4.20 below shows major castes, religious affiliation and spoken languages in the sample villages of the Project Area.

**Table 13.4.20: Major Castes, Religion and Spoken Language in Sample Villages of Project Area (District Rawalpindi)**

| Village                      | Ethnic Groups           | Religion | Spoken Language by Majority |
|------------------------------|-------------------------|----------|-----------------------------|
| Karot                        | Janjua, Gujjar, Qureshi | Islam    | Punjabi                     |
| Gorah                        | Janjua                  | Islam    | Punjabi                     |
| Brohi                        | Satti, Malik            | Islam    | Punjabi, Saraiki            |
| Tandal                       | Sudhan Zai              | Islam    | Kashmiri, Punjabi           |
| Batian(Azad Pattan)          | Satti, Sudhan, Rajput   | Islam    | Kashmiri, Punjabi           |
| Muslimabad(Pattan sher khan) | Sudhan, Malik           | Islam    | Kashmiri, Punjabi, Hindko   |

### 13.4.3.7.4 Shrines

Like all the places of the country the project area has been frequented by a number of saints who came here to spread Islam. The shrines of these holy men were built after their death by their followers. The most important of these shrines are:

- Zinda Pir
- Syed Masoom Shah
- Syed Ghulam Hassan shah
- Baba Gul Hussain

### 13.4.3.7.5 Education and Available Amenities

Education has significant impact on the life of an individual, which enhances the quality of life and productivity. It also serves as a key indicator of any socio-economic development. A study of educational status not only provides guidelines to policy makers but also help in understanding the demographic behaviour of the population.

#### i) Education

In terms of educational facilities, Azad Pattan area is comparatively in a better position and facilities exist for boys and girls. There is a private secondary school and three primary schools which are providing educational facilities to boys and girls. Karot, Gorah and Tandal have only one primary school. Table 13.4.21 shows the number of schools in sample villages.

**Table 13.4.21: Education Facilities in Project Area**

| Village                      | Government Schools |   |        |    |         |    | Non-Formal / Private Co-education |         | Dini Madrassa |
|------------------------------|--------------------|---|--------|----|---------|----|-----------------------------------|---------|---------------|
|                              | High               |   | Middle |    | Primary |    | High                              | Primary |               |
|                              | B                  | G | B      | G  | B       | G  |                                   |         |               |
| Karot                        | -                  | - | -      | -  | 01      | 01 | -                                 | -       | 01            |
| Gorah                        | -                  | - | -      | -  | -       | 01 | -                                 | -       | -             |
| Brohi (Azad Pattan)          | 01                 | - | -      | 01 | 01      | -  | -                                 | 01      | -             |
| Tandal                       | -                  | - | -      | -  | 01      | -  | -                                 | -       | 01            |
| Batian (Azad Pattan)         | -                  | - | 01     | -  | -       | 01 | -                                 | 01      | 01            |
| Muslimabad (Pattan sherkhan) | -                  | - | 01     | -  | -       | 01 | -                                 | 01      | 01            |

A review of Table 13.4.21 indicates that high school for boys exist only at Brohi village in Azad Pattan area. Students from surrounding areas go to Brohi village for high school education. Girl's middle school at Brohi village is providing education to the students of the area. It is difficult for girls to go to school from other villages located at a distance of 4 to 5 km away from Brohi village. There is also a lack of trained teachers and Lab facilities in the schools of the Project Area.

It is concluded that the educational facilities available from the government are not adequate, and persons have the option to send their children in the nearest town(s) for education, which is a financial burden for the poor parents as they cannot afford these educational expenses. However, residents are more interested in imparting religious education to their children at mosque which is normally free of cost.

**ii) Literacy Rate**

The literacy is measured as the ratio in percentage of literate population to the corresponding population aged 10 and above, who can read and write simple language scripts. The overall literacy rate among the respondents is about 43.6 %. The literacy rate is minimum at Karot i.e 37.2 % and maximum in Azad Pattan i.e 49.4%. Higher literacy rate in Azad Pattan shows the availability of better facilities for education in that area.

**iii) Health Facilities**

Health condition is one of the major determinants of a society's social development and quality of life. Healthy manpower is imperative for derive to advancement and economic growth.

Although Rawalpindi is a divisional headquarter and has good hospitals but adequate health facilities are not available in the Project Area. For Gorah and Karot villages the nearest dispensary is at a distance of 9 km at union council Brohi. Nearest civil hospital is located at Kahuta, at a distance of 32 kilometers. From Tandal village located at the left bank of River Jhelum, Local residents have to go Holar and Sensa for medical treatment. Better health facilities exist to some extent in the Azad Pattan Area. There is a dispensary at Muslimabad and a basic health unit (B.H.U.) is under construction. Although a qualified dispenser is posted here, but shortage of medicine and proper medical equipments are the serious constraints to provide quality health services. The residents of Muslimabad have to travel to Muzaffarabad and Pallandri for medical treatment of serious patients.

It is concluded that the health facilities provided by the government in the Project Area are very limited. Therefore, residents are compelled to consult with private practitioner and Hakeem etc. for their medical treatment. The licensed lady health visitors are also few in numbers, so major reliance on traditional childbirth attendant for assisting the delivery, which is the only service available in the Project Area.

Overall the project area has not got adequate medical facilities, which is a cause of prolonged illness and mortality. The prevailing diseases in the Project Area were reported to be diarrhea, dysentery, pneumonia, typhoid and tuberculosis (TB) of

lungs. The main reasons for those diseases are unclean drinking water, poor diet and unhygienic living conditions.

#### **iv) Communication Infrastructures**

Communication network is a fundamental prerequisite for boosting economic activities. The topography of the Project Area is mountainous in nature. District Rawalpindi is well connected with other parts of the country by road, rail and air. The communication system in District Rawalpindi is very satisfactory. According to 1998 Census, the District has a total metalled road length of 1146 kilometers. The main railway line and grand trunk road (G.T. Road) runs parallel to the railway line and connects the district to various parts of the country. However, there is no rail link with Project Area and Azad Kashmir. The nearest railway station is Sehala Town which is located on the main railway line/G.T. Road. Air service is also available at Rawalpindi with an International Airport which connects the Capital city to the other destinations in the country. This airport is also connected through air services provided for two small Airports at Muzaffarabad and Rawalakot cities in AJK for travelling.

Roads are the only mode of transportation in Kotli and Sudhnuti districts. Those districts have total metalled road length of 851 and 447 kilometers.

The villages of the Project Area are normally connected with main road(s) and district headquarters through metalled roads, although those roads required extensive repair and maintenance. The telephonic facilities by Pakistan Telecommunication Company Limited (PTCL) landline are also available but at limited scale. However, a growing trend of utilization of cell phones, for which connections are easily available, are also facilitating the local population with communication network. Karot, Gorah and Tandal residents have access to postal services through temporary arrangements.

#### **v) Power Supply**

Electricity is available in all the villages of the Project Area, but the residents are complaining for the load shedding, which adversely affect their routine daily business. Electricity has been supplied to all the sample villages by the Government of Pakistan and Azad Jammu and Kashmir except Brohi village.

Firewood and kerosene oil are the major source of energy in case of non-availability of electricity. Fire wood is used for cooking and heating purpose, which is collected by the villagers by lopping dried branches of bushes and trees around their area. However, few residents also use the gas cylinder for cooking.

**vi) Banking**

Banking services are available in Holar for the population of Karot, Gorah and Tandal, which is a nearby small town. This is a branch of Habib Bank Limited. The residents of remaining Project Area go to nearby town / cities for banking services.

**vii) Water Supplies**

The availability of water is the major concerns for the inhabitants of the Project Area. The water resources are available at limited scale. The surface water is available in the river and Nullah but that is not used for drinking purpose. The groundwater resource is available at limited scale, which is only used for drinking purpose through wells/water pumps, which are either operated manually or by electricity. Ground water is available at a depth of 36.3 meters to 45.4 meters. Tap water facility through government water supply schemes for meeting their domestic/drinking water requirement is demanded by the local population. In addition, the local population want the installation of open surface wells from the government/NGO at subsidized rate for meeting their irrigation water requirement.

**viii) Other Social Amenities**

Karot, Gorah and Brohi villages are located in Rawalpindi District at the right bank of River Jhelum while Tandal, Azad Pattan (Batia) and Muslimabad are located in Azad Kashmir on the left bank. Rawalpindi District is divided into three parts according to general configuration. The higher part consists of Murree and Kotli Sattian Tehsils and northern part of Kahuta Tehsil. The second part consists of Rawalpindi Tehsil and extending through Kahuta upto the west bank of Jhelum river and down into Gujjar Khan Tehsil. The third part in the Pothar region includes Tehsil Gujjar Khan. The Karot Project is located in Tehsil Kahuta. A road leads to Karot and Azad Pattan villages from Rawalpindi via Kahuta. Karot Bridge is also an entry point for AJK. A road from Karot leads to Kotli and Mirpur Districts. A road from Azad Pattan leads to Rawala Kot and Sudhnuti districts. The existing infrastructure facilities in the Project Area are presented in Table 13.4.22.

**Table 13.4.22: Basic Infrastructure in Project Area**

| Villages                      | Distance (Km) from |          | Access Road |             | Electricity | Tapped Water | Health Facilities |     |          |
|-------------------------------|--------------------|----------|-------------|-------------|-------------|--------------|-------------------|-----|----------|
|                               | Rawal-Pindi        | Dam Site | Metalled    | Un Metalled |             |              | Dispensary        | BHU | Hospital |
| Karot                         | 52                 | 2        | Yes         | -           | Yes         | -            | -                 | -   | -        |
| Gorah                         | 48                 | 6        | No          | Track       | Yes         | -            | -                 | -   | -        |
| Brohi                         | 55                 | 30       | Yes         | -           | No          | -            | Yes               | -   | -        |
| Tandal                        | 58                 | 8        | -           | Yes         | Yes         | -            | -                 | -   | -        |
| Batia(Azad Pattan)            | 57                 | 32       | Yes         | -           | Yes         | -            | Yes               | -   | -        |
| Muslimabad (Pattan sher khan) | 75                 | 40       | Yes         | -           | Yes         | -            | Yes               | -   | -        |

**Source:** Socio-economic Survey 2008, MAES

#### ix) Industry

Some block factories are working within the Project Area. Due to poor infrastructure heavy industries have not been established in the Project Area. However, a flour mill is under construction near Azad Pattan Bridge.

#### x) Minerals

District Rawalpindi is rich in mineral wealth including limestone, marble, fire clay, ordinary sand and stones. Lime and marble are found at Margallah range. AJK has variety of minerals and precious stones including marble, coal, gypsum, graphite, silver, copper, bauxite and ruby, tourmaline and garnets. However, none of the respondents reported any mineral exploration in the Project Area.

#### xi) Suspension and RCC Bridges

There are two RCC bridges on River Jhelum in Project Area. One is located near Karot village and other at Azad Pattan as the entry points to AJK. Similarly two suspension bridges are located in Project Area. One is located seven (7) kilometers downstream of Azad Pattan near Pona Village. These bridges are used to cross Jhelum River to go to Kahuta, Rawalpindi and Azad Pattan Area on the right bank. An unmetalled road leads to the bridge from Kahuta - Azad Pattan Road. Another suspension bridge is located near Muslimabad, eighteen kilometers upstream of Azad Pattan Bridge. A katcha road leads to the bridge from Azad Pattan - Muzaffarabad Road. Presently, that road is badly damaged due to heavy rains. Only pedestrians use that bridge to cross the Jhelum River.

## xii) Housing Characteristics

The housing characteristics of respondents are given in Table – 13.4.23, which shows the following characteristics.

**Table 13.4.23: Housing Status of Sample Villages in Karot Hydro Power Projects**

| Villages                      | Av. Area (Marlas*) |             |             | Type of Houses % |            |       | Period since construction (years) | Approx. Value (Thousand Rs.) |
|-------------------------------|--------------------|-------------|-------------|------------------|------------|-------|-----------------------------------|------------------------------|
|                               | Total              | Covered     | Uncovered   | Pacca            | Semi Pacca | Kacha |                                   |                              |
| Karot                         | 8.3                | 4.0         | 4.3         | 87               | -          | 13    | 17                                | 760                          |
| Gorah                         | 12.3               | 5.0         | 7.3         | 66               | 2          | 32    | 15                                | 750                          |
| Brohi                         | 6.8                | 3.5         | 3.3         | 71               | 3          | 26    | 18                                | 500                          |
| Tandal                        | 7.6                | 3.5         | 4.1         | 78               | 1          | 21    | 16                                | 650                          |
| Batian(Azad Pattan)           | 10.2               | 5.5         | 4.7         | 85               | -          | 15    | 16                                | 700                          |
| Muslimabad (Pattan sher khan) | 15.0               | 6.0         | 9.0         | 88               | 4          | 8     | 12                                | 550                          |
| <b>Total</b>                  |                    | <b>27.5</b> | <b>32.7</b> |                  |            |       |                                   |                              |

**Note:** One Marla = 25 m<sup>2</sup>, Kacha House = Made of mud, Pacca House = made of bricks, blocks and Cement, Semi-pacca = made of blocks/stones and mud mortar. Kacha is made of mud plaster, unbaked bricks blocks with tin roofing.

## xiii) Salient Features of Houses in the Project Area

### a) Nature of Construction

About 79 % of the total houses were reported to have pacca construction whereas about 2 % and 19 % of the houses were semi pacca and kacha respectively.

### b) Housing Area

The total area of housing units varied from 6.8 marlas to 15 marlas. This included both covered and uncovered area. It is pertinent to note that information on housing area may not be exact as the revenue records were not available to verify the input from the respondents. These houses were constructed in the last 20 years. Exact measurements of each affected house is required to be made and valued by the Public Work Department at the time of relocation and compensation payment by the Revenue Department.

**c) Estimated Value of Housing Units**

All the respondents were living in self owned houses. The total cost including the cost of land and construction of housing units in the Project Area as reported by the residents has been shown in Table 13.4.23 and varied between from Rs. 500,000/- to Rs. 760,000/- per house. The approximate value of a house as per respondents were higher in Karot village (Rs. 760,000/-) and lowest at Brohi village (Rs.500, 000/- ).

**d) Self Occupation of the Houses**

The residents have constructed the houses for their own residing purpose and all the respondents are living in their own houses and none of them was found to be residing in the rented house.

**13.4.3.7.8 Economic Feature**

**(i) Agriculture**

Agriculture in District Rawalpindi and Azad Jammu and Kashmir is both rainfed and at some locations is irrigated through streams. There is a general scarcity of Irrigation water; hence a lot of cultivable land cannot be brought under cultivation. The residents in the Project Area generally have small land holdings and grow two crops in a year, Rabi and Kharif. This system is locally known as Do- Sala. Wheat and Maize are main crops. Some areas where water from hills is available vegetables like lady finger, turnip, brinjal, tinda, radish, onion, cabbage, tomato, beans and spinach are also grown but it is only for home consumption. Patato cultivation has also made considerable progress. There are tremendous possibilities of fruit and vegetable cultivation in the area.

Ploughing is done usually by bullocks. The use of latest agricultural equipment and chemical fertilizer is not common except for growing the cash crops.

Wheat is largely grown on major part of their land, however some farmers have started to cultivate potato in the last two to three years. Maize is the second major crop after wheat, mostly grown in Kharif season. It is mainly cultivated for domestic use as fodder for animals and grain for human use. Table – 13.4.24 shows major crops with area and production in Rawalpindi District and Azad Kashmir.

**Table 13.4.24: Area and Production under Rabi / Kharif Crops**

| Crops | Rawalpindi                  |                         | AJK                 |                        |
|-------|-----------------------------|-------------------------|---------------------|------------------------|
|       | Area(ooo hec)<br>Distt. RWP | Production<br>(000 ton) | Area(000hec)<br>AJK | Production<br>(000ton) |
| Wheat | 121.80                      | 138.20                  | 31.77               | 31.33                  |

|        |         |         |       |       |
|--------|---------|---------|-------|-------|
| Gram   | 0.80    | 0.30    |       |       |
| Mung   | 3055.00 | 634.00  |       |       |
| Mash   | 8906.00 | 2469.00 |       |       |
| Masoor | 8163.00 | 3024.00 |       |       |
| Maize  | 46.50   | 44.40   | 32.24 | 31.94 |
| Bajra  | 7.80    | 2.20    |       |       |
| Jowar  | 34.70   | 15.80   |       |       |
| Barley | 0.70    | 0.40    |       |       |

**Source:** Agriculture census data 2006

Area under fruit trees / orchards is increasing every year in Rawalpindi District and AJK. The important fruit trees are apple, mango, citrus, guava, apricot, walnuts, peach and pears. Significant fruit trees, area and production in Rawalpindi District is prevented in Table – 13.4.25.

**Table 13.4.25: Fruit Production and Area in Rawalpindi District.**

| <b>Fruit</b> | <b>Area(000hec)</b> | <b>Production (000 tones)</b> | <b>Yields (kg/hect)</b> |
|--------------|---------------------|-------------------------------|-------------------------|
| Citrus       | 32.00               | 241.00                        | 7531.00                 |
| Mango        | 4.00                | 32.00                         | 8000.00                 |
| Banana       | 3.00                | 18.00                         | 6000.00                 |
| Apple        | 243.00              | 2239.00                       | 9213.00                 |
| Guava        | 26.00               | 193.00                        | 7423.00                 |
| Apricot      | 5.00                | 25.00                         | 5000.00                 |
| Peach        | 3.00                | 18.00                         | 6000.00                 |
| Pears        | 5.00                | 36.00                         | 7200.00                 |

**Source:** Agriculture census data 2006

**(ii) Tenancy Status**

Tenancy is not very common in the Project Area, because the agricultural land is limited; therefore local population prefer to cultivate the land by themselves.

Majority of the respondents in Project Area were owner-cum-operator. Only two (2%) percent were owner-cum-tenant.

**(iii) Land Holding Size**

The average land holding in the Project Area was 15.00 kanals. The maximum land holding size was in Muslimabad i.e., 28.4 kanal and minimum size was 10.0 kanals at Barohi.

**(iv) Approximate Cost of Agricultural Land**

According to the respondents, the average price of land in the Project Area was Rs. 100,000/- per kanal ranging from lowest of Rs.75000/- at Gorah to the highest of Rs. 150,000/- at Azad Pattan Area.

**(v) Main Crops in the Project Area**

Main crops in the Project Area are Wheat, Maize, Potatoes, Spinach, Peas, Tomatoes, Turnip Cabbage, Onion, Barley, Gram, Mash, Masoor and other Pulses. The source of irrigation is rains and streams originating from springs. The current status of agriculture in the Project Area is presented in Table 13.4.26.

**Table 13.4.26: Status of Agriculture in the Project Area**

| Village Name                  | Avg. Land Holding (Kanal) | Land Value / Kanal (Rs.) | Average Area / Production of Important Crops kgs/ Kanal |        |        |        |        |
|-------------------------------|---------------------------|--------------------------|---|--------|--------|--------|--------|
|                               |                           |                          | Wheat   | Maize  | Mash   | mung   | Masoor |
| Karot                         | 18.5                      | 170000                   | 3.0   | 5.0    | 3.5    | 2.6    | 3.9    |
|                               |                           |                          | (60.0)  | (80.0) | (15.0) | (14.0) | (19.5) |
| Gorah                         | 12.4                      | 150000                   | 2.5   | 4.6    | 3.3    | 3.0    | -      |
|                               |                           |                          | (65.0)  | (68.0) | (14.0) | (14.0) | -      |
| Brohi                         | 10.0                      | 250000                   | 3.0   | 5.0    | -      | -      | 2      |
|                               |                           |                          | (60.0)  | (75.0) | -      | -      | (20.0) |
| Tandal                        | 22.0                      | 200000                   | 5.0   | 7.0    | 4.0    | 2.0    | 4.0    |
|                               |                           |                          | (55.0)  | (70.0) | (13.5) | (15.0) | (20.0) |
| Batian (Azad Pattan)          | 16.0                      | 300000                   | 4.0   | 6.0    | 2.0    | 1.5    | 2.5    |
|                               |                           |                          | (60.0)  | (75.0) | (16.0) | (15.0) | (18.0) |
| Muslimabad (Pattan Sher Khan) | 28.2                      | 200000                   | 5.5   | 10.0   | 4.4    | 5.0    | 3.3    |
|                               |                           |                          | (65.0)  | (80.0) | (18.0) | (15.0) | (20.0) |

**Source:** Field survey,

**Note:** Figures in parentheses show production.

**(vi) Live Stock**

Live Stock is the back bone of rural economy. Livestock comprises native cattle, goats and sheep along with poultry and donkeys for transportation of loading/unloading of materials.

The livestock is an important aspect of livelihood of the population in the Project Area. Its products are used for consumption and also for income generation, however, higher quality livestock could help to raise output and become a viable

cash source for residents. Similarly poultry is a source of added income and a healthy protein food source. The livestock holding in the Project Area are presented in Table 13.4.27.

**Table 13.4.27: Livestock / Poultry Heads and Sale Amount of Livestock in Sample Villages**

| Name of Village     | Ownership of Livestock (Nos) |             |         |      | Sale of Livestock (Nos.) |             |      | Sale Amount (Rs.) |
|---------------------|------------------------------|-------------|---------|------|--------------------------|-------------|------|-------------------|
|                     | Buffaloes / Cows             | Goat/ Sheep | Poultry | Ox   | Buffaloes / Cows         | Goat/ Sheep | Ox   |                   |
| Karot               | 6.50                         | 20.00       | 10.00   | 1.50 | 0.60                     | 8.00.       | 1.00 | 60500             |
| Gorah               | 8.30                         | 8.00        | 8.00    | 1.33 | 1.00                     | 5.00        | -    | 28000             |
| Brohi               | 5.50                         | 20.25       | 12.00   | 0.90 | 0.75                     | 10.00       | 0.40 | 49600             |
| Tandal              | 8.50                         | 22.00       | 6.25    | 1.40 | 0.48                     | 9.00        | 0.50 | 25690             |
| Azad Pattan (Batia) | 7.5                          | 15.00       | 6.60    | 1.60 | 0.55                     | 10.0        | 0.30 | 30000             |
| Muslimabad          | 10.2                         | 18.80       | 8.00    | 1.25 | 0.80                     | 12.00       | 0.50 | 27350             |

**(vii) Grazing Rights**

There is no hard and fast rule for grazing purpose; simply the shepherd prefers to go, where ever the water and grazing land is available. However, in the Project Area, the agricultural fields are mainly used for grazing after crop harvesting which adds manure to the fields improving the soil fertility. Moreover, the vegetation along the Nullah/forest is also usually used for grazing purpose.

**(viii) Occupations**

It is useful to have information about occupational distribution of the households. Such information will facilitate better planning and execution of the project. The main occupations of the households in the Project Area are presented in the Table 13.4.28.

**Table 13.4.28: Profession/Occupation in Project Area**

| Sr.No. | Profession     | Number | Percentage |
|--------|----------------|--------|------------|
| 1      | Farmers        | 28     | 58.3       |
| 2      | Shops/ Hotel   | 08     | 16.7       |
| 3      | Govt. Employee | 06     | 12.5       |

|              |          |           |            |
|--------------|----------|-----------|------------|
| 4            | Business | 04        | 8.3        |
| 5            | Private  | 02        | 4.2        |
| <b>Total</b> |          | <b>48</b> | <b>100</b> |

**Source:** Socio-economic Survey 2008, Mirza Associates Engineering Services (Pvt.) Limited (MAES).

The table reveals the professional status of the respondents and indicates that 58.3 percent are farmers and the remaining are composed of, shopkeeper/hotel owner 16.7 percent, government employee 12.5 percent, Businessmen 8.3 and the private employees are 4.2 percent.

**a) Monthly Family Income**

The household income related to various professions like farming, shop-keeping, service, businessmen and remittance from abroad is reflected in Table 13.4.29.

**Table 13.4.29: Household Income**

| Sr. No       | Income Level(Rs./Month) | Number of Households | Percentage (%) of household |
|--------------|-------------------------|----------------------|-----------------------------|
| 1            | Up to 5000              | 10                   | 21                          |
| 2            | 5001-10000              | 12                   | 25                          |
| 3            | 10001-15000             | 9                    | 19                          |
| 4            | 15001-25000             | 15                   | 31                          |
| 5            | 25001 and above         | 2                    | 4                           |
| <b>Total</b> |                         | <b>150</b>           | <b>100</b>                  |

**Source:** Field survey

The survey findings show that majority (31 percent) of the households are falling in the income level 4. This income category is shopkeepers and government employees. Contrary to this, there is less population falling in the higher income category. The population of high income category is big farmers, businessmen and persons receiving remittance from their relatives/sons living abroad (mostly in Middle East or Europe). The person's falls in the lowest income category are 21 percent, which are almost the one-fifth of the total respondents. These are mostly the small farmers and tenant who hardly get the crop produce for even their household use, with an overall meager monthly income. In addition, the person of this particular income level are either engaged in labor work or employees in the private sectors.

The persons fall in the income level 2 and 3 are usually medium level farmers, hotel owner and government employees who can make that much income on monthly

basis. Moreover, the persons involved, in the livestock management activities are also falling in this particular income categories.

**b) Family Expenditure**

**i) Households Total Monthly Expenditure**

The expenditures of the household on monthly basis include expenditure on food, non-food items (washing, bathing, clothing and shoes expenses), educational, utility bills and health care. The detail of the household expenditures is given in the Table 13.4.30.

**Table: 13.4.30: Household Expenditures**

| <b>Sr. No.</b> | <b>Expenditures Level (Rs./Month)</b> | <b>Number of Household</b> | <b>Percentage (%) of household</b> |
|----------------|---------------------------------------|----------------------------|------------------------------------|
| 1              | 5000 and below                        | 10                         | 20.83                              |
| 2              | 5001-10000                            | 12                         | 25.00                              |
| 3              | 10001-15000                           | 09                         | 18.75                              |
| 4              | 15001-20000                           | 06                         | 12.50                              |
| 5              | 20001-25000                           | 02                         | 04.17                              |
| 6              | 25001-30000                           | 05                         | 10.42                              |
| 7              | 30001-35000                           | 03                         | 06.25                              |
| 8              | 35001-40000                           | 01                         | 02.08                              |
| <b>Total</b>   |                                       | <b>150</b>                 | <b>100</b>                         |

**Source:** Field survey

The table indicates that about 43.75 % of the respondents in the Project Area were spending from Rs. 5001 to Rs 15000 per month, whereas monthly expenditure ranged between Rs. 15001 to Rs. 25000 for 16.67 % and between Rs. 25001 to Rs 30000 for 10.42 % of the respondents. The families spending Rs. 5,000 and below per month are almost one fifth of the total families. Contrary to this, families who spend more than Rs. 30, 000 per month are merely eight (8) percent of the total interviewed families. . Interestingly, the income of these families' is almost same as per their expenses. This scenario indicates that the residents of the Project Area do not possess any saving capacity; rather they are surviving on day-to-day basis. The average monthly expenditure was about Rs 12678/m in the Project Area.

**ii) Kitchen Expenditures**

About 46 % of the respondents in the Project Area were spending upto Rs 4450 on food items, where as kitchen expenditure of 19.00 % and 12.00 % of the households were between Rs. 6001 to Rs 9000 and Rs 9001 to Rs 12000 per month. While 15% of respondents were spending Rs 12001 to Rs 15000 on food items. Remaining 8% were spending more than Rs 15000 per month as kitchen expenses. The average monthly expenditure on food items was computed as Rs 6678/m in the Project Area. It may be noted that expenditures included the expenses incurred on family members living in Rawalpindi and Muzaffarabad for education. The proportion of expenditures on food items is about 44 % of total monthly expenditure of a family.

• **Poverty**

A person is considered poor if his or her consumption or income level falls below some minimum level necessary to meet basic needs. This minimum level is usually called the "poverty line". What is necessary to satisfy basic needs varies across time and societies. Therefore, poverty lines vary in time and place, and each country uses lines which are appropriate to its level of development, social norms and values.

• **Distribution of Poor and Non-Poor**

The Pakistan Economic Survey 2006-07 revealed that on the average population living below absolute poverty line was 23.94 percent distributed into 28.13% in rural area and 14.94% in Urban areas giving a ratio of 1:1.88.

The per capita income during the same period works out to be US\$ 847 per annum or US\$ 2.32 per day. By applying a national poverty rural / urban ratio to the per capita income, the income for rural areas emerges as US\$ 1.23 per day. An appreciable decline in poverty rates has occurred between 2000-01 and 2004-05. At the national level head count decreased from 34.46 to 23.94 percent in 2004-05, depicting a substantial reduction of 10.52 percentage points over that period (Table 13.4.31).

**Table 13.4.31: Comparison of Poverty**

| <b>Count Head</b> |           |           |
|-------------------|-----------|-----------|
| Poverty           | 2000-2001 | 2004-2005 |
| Urban             | 22.69     | 14.94     |
| Rural             | 39.26     | 28.13     |
| Overall           | 34.46     | 23.94     |

**Source:** Economic Survey of Pakistan 2006-07

Per capita income per annum and poverty level for Azad Jammu and Kashmir is assumed equal to Pakistan. Quality of life index of year 2006 are presented in Table 13.4.32.

**Table 13.4.32: Quality Indices 2006**

| ITEMS  | AJK                   | PAKISTAN             |
|--|-----------------------|----------------------|
| Literacy   | 60 %                  | 53 %                 |
| Per capita power availability (kwh)                      | 335                   | NA                   |
| Infant mortality rate( per 1000 live births )            | 56                    | 77                   |
| Maternal mortality rate                                  | 350 per 100000 births | 98 per 100000 births |
| Life expectancy ( years )                                | 64                    | 65                   |
| Population per hospital bed                              | 2092                  | 1530                 |
| Population per doctor                                    | 5650                  | 1310                 |
| Full immunization of children under The age 0- 11 months | 87 %                  | 87 %                 |
| Primary health care coverage                             | 58 %                  | 45%                  |
| Per capita income per annum                              | 847 \$                | 847 \$               |
| Un employment rate (per annum)                           | 65 %                  | 61 %                 |

**Source:** Federal Bureau of Statistics, Islamabad Department of Health, Education & Public Works, Muzaffarabad.

- **Major Poverty Issues.**

Discussion with affected population in the Project Area and literature on the poverty reduction suggested the following poverty issues in the Project Area.

- i. Poor quality of life and inadequate access to basic health and educational opportunities.
- ii. Lack of improved physical infrastructure i.e. roads, communication, irrigation/drainage and delivery of utility services.
- iii. Absence of any social security system for an effective coverage of the vulnerable population and the poor.
- iv. Lack of horizontal and vertical social mobility among ethnic groups.
- v. Un-equal employment and access to economic resources for rural women folk.
- vi. Gender un-equality in access to formal educational opportunities and health facilities.

#### **13.4.3.7.9 Socio-economic Impacts of the Project**

The study examines both the positive and negative socio-economic impacts of Karot hydropower project in the area and outlines some key measures for improving sustainability in the sector. The details of the impact is discussed as under,

During the socio-economic survey, it was inquired from the local population whether they have any concern/views regarding the project on their social and economic life. They have multiple views regarding the Project. The respondents views / concerns are, i) unfair compensation package, ii) loss of livelihood due to acquiring of agricultural land, iii) social disturbance due to resettlement, iv) dismantling of the existing track/route, v) lack of job opportunities to local population vi) disturbance of privacy, especially the female of the area during the construction stage of the Project. The majority of the population especially highlighted this issue of blockage of women movement during the construction stage of the project. They suggested establishing the residential colony away from the population centers.

The vulnerable populations have also showed their apprehensions regarding the loss of their livelihood due to land acquisition. They responded that their income is made while working on other farm and if there is no land, then where they will work, even the landlord will suffer with the earning problem due to loss of their land. The Table 13.4.33 illustrates the impact of the Project on the communities and infrastructures.

**Table 13.4.33: Impacts of Project on Communities and Infrastructures**

| <b>Sr. No</b> | <b>Respondents views / concerns</b>   | <b>Number</b> | <b>Percentage</b> |
|---------------|---|---------------|-------------------|
| 1             | Unfair compensation package which is not at par with the current market value of their assets | 30            | 35                |
| 2             | Adverse affect on the livelihood due to acquiring of agricultural land                        | 22            | 30                |
| 3             | Privacy will be disturbed during the construction stage of the project                        | 18            | 21                |
| 4             | Homeless due to acquiring residential structures  | 10            | 11                |
| 5             | Reduction in livestock rearing area due to acquiring of agriculture/grazing land              | 5             | 6                 |
| Total         |   | 85            | 100               |

**Source:** Field Survey carried out by the consultant

**a) Social Benefits of the Project**

**i. Change in the Nearby Land Value**

The proposed project is expected to increase the land values due to project execution. Land owners will have an opportunity to sell their lands on increased prices and may start new businesses.

**ii. Lifestyle and Culture**

Change in local lifestyle and culture may occur when the local and migrant workers/population will come in contact related to the project activities. This will enhance their understanding about culture of migrant from other provinces and develop a harmony among migrants/settled population with different background and experience.

**iii. Temporary Employment Opportunities**

The construction of the project will require large number of skilled and unskilled workers during its implementation. During the construction stage preference will be given to hire local labour and affected population. So, construction of the proposed project will provide steady labour market for the residents of the project area.

**iv. Community Development/Commercial Activities**

The project execution in the project area will promote community development schemes and provision of better business opportunities for the local population.

**v. Provision of Basic Facilities**

The local population will get the basic health and educational facilities at their door steps due to the advancement of the area in the context with the project execution.

**b) Project Impact and Poverty Reduction**

Karot will be hydropower project with a power generation capacity of 720 Mega Watt (MW). The project work will be carried out at two different locations i.e. Dam site and the powerhouse site. The civil works particularly manual jobs for unskilled workers / labour are likely to generate significant employment opportunities and income to the potential beneficiaries particularly the poor in the area. Project would not only provide regular job opportunity for significant number of poor beneficiaries but also will have economic multiplier effect on the rural economy of the Project Area.

**c) Social Organizations and NGO Involvement**

• **Social Organization**

Social organizations refer to group dynamics, role playing and conflict resolution mechanism in a given social situation aiming at functional network and linkage prevailing in a given community. The nature of social relationship and International process provide meaningful understanding within structure and functioning of social organizations with respect to any development activity. The consultant carried out participatory rapid appraisal (PRA) studies to understand the phenomena with respect to the proposed Karot Hydropower Project's planning, implementation and its completion. Essentially, the tribal system is the guiding force in social interactional processes, group dynamics, Institutional arrangements and economic activities at village level. Tribal / village elders command respect and holds higher status as compared to an ordinary village inhabitant. Their opinion should get due weightage regarding development activities in the area.

• **NGO Involvement**

The basic philosophy and instrument of any development project is to work "with residents" and not "working for them" in order to achieve long term sustainable development goals. It is the local population, who identify their "felt needs" as they perceive it, interpret it and relate it to themselves, to their families and

communities and get tips for development behavior performance to achieve project objectives with an active co-operation of project officials. The NGOs could play an efficient and effective mediation role between the project authorities and the affectees / beneficiaries. The involvement of following NGOs would facilitate the process of participatory development and act as an agent of social change for development activities. The NGOs working in the AJK and Rawalpindi District, particularly in the Project Area are mentioned in Table 13.4.34.

**Table 13.4.34: NGO’s Working in Rawalpindi and AJK**

|   |       |                                    |
|---|-------|------------------------------------|
| 1 | AKHSP | Aga Khan Health Services Pakistan. |
| 2 | WWF   | World Wild Fund                    |
| 3 | KIRF  | Kashmir International Relief Fund  |
| 4 | MH    | Muslim Hands                       |
| 5 | SDF   | Sungi Development Foundation       |
| 6 | AKF   | Al Khidmat Foundation              |
| 7 | NRSP  | National Rural Support Programme   |
| 8 | TVO   | Trust for Voluntary Organization   |
| 9 | CBO   | Community Based Organization       |

Interviews and social survey findings in the project area revealed that there was a complete consensus regarding the construction of Karot Hydropower Project. There was no overt intra and inter group rivalries, hostilities, disputes or tension on the subject of proposed Karot Hydropower Project. However, residents of Gorah and Karot Villages have some reservation on the project functionaries and compensation procedure.

#### **13.4.3.7.10 Status of Women**

Generally the attitude toward women is not very positive in the rural areas. There is a male dominating society and they dominate in all occupations. In many villages away from cities, women are facing difficulties to get school education and excluded from most of decision-making processes. The gender situation is further complicated by:

- Early marriage of girls
- Restriction on women’s mobility
- Poor domestic sanitation conditions

- Long working hours (both for girls and women)
- Too much miscellaneous chores
- Preference to sons over daughters

In the daily life within their villages women contribute vitally to the economic survival of the poor households. This includes working in the house for cooking, laundry, child care, cultivation of agricultural crops on their land and livestock breeding including poultry. Thus, despite overall deprivation, women are major contributors to the household life.

Karot consultants hired the services of qualified gender specialist to collect data on gender issues. All the contacted women supplied detailed information about many social activities including:

- Daily work of a female in house keeping, laundry, cooking and taking care of animals
- Obligations of females for agricultural activities of major crops (wheat, maize), vegetables, etc.
- Educational constraints including desire of female for more facilities
- Occupational preferences including desire for jobs
- Family income including contribution by the women
- Skill development
- Health situation, particularly: child deliveries; vaccinations; water-borne diseases.
- Information about the Project and its benefit.

The Intensive Case Study Method gained many new views about the social structure in the Project Area as a whole, villages affected and tribes.

Gender situation is not very well in the Project Area. Women belonging to well off families generally do not work with men or out side their houses. However, women from economically weak families not only work at home but also go out side for grazing of their animals and to collect fuel wood besides their contribution in farm activities.

Most of the agricultural works are done by girls and women. Women have to carry the biggest workload also in the daily schedule. They are waking up first in the morning every day and after prayer they feed the domestic animals and then prepare the breakfast for the entire family.

It can be concluded that girls and women contribute well to the economic survival of the poor households. Despite the overall discrimination, women are responsible for management of daily family relations and economic performance. They are taking over a huge work load of the family.

#### **13.4.3.7.11 Archaeology / Historical Heritage**

District Rawalpindi and Azad Jammu and Kashmir have a number of cultural heritage and archeological sites (List of archaeological sites published in the District Census Report Rawalpindi in 1998 and District Census Reports of Kotli and Sudhnuti of AJK were also reviewed for ready reference). All the artifacts, petrography, monuments and buildings of historical importance are part of archeological heritage. It is obligatory to preserve this cultural heritage under Pakistan Antiquities Act. 1975.

The guideline for sensitive and critical areas issued by the Government of Pakistan in October 1997 identifies a list of notified protected archaeological sites and monuments in Pakistan. A review of nationally important sites and world heritage sites indicate that none of these are located within the Project Area, except some ruins of Owen qila at the left bank of River Jhelum near the proposed dam site. However those ruins are located above the crest level of reservoir and are safe and will remain protected as such. Similarly, foundation stone of old Karot wall is present along the side of Kahuta-Karot road about 3 km away from the dam site. It is very important that during widening of road it should be preserved and protected properly.

## **SECTION 13.5**

### **13.5 ENVIRONMENTAL IMPACT ASSESSMENT**

#### **13.5.1 Impact Area**

This project will have some impacts, on physical, biological and socio economic features of the project area. These impacts are covered in this section of the report.

##### **13.5.1.1 Impacts during Construction**

###### **13.5.1.1.1 Impacts on Environment**

Direct impacts as a result of construction of various engineering infrastructure such as dam construction, widening of road, establishment of batching plant area, and spoil excavated material would affect a few number of houses and residential properties in the Project Area.

For the dam construction, equipment, storage yards and accommodation facilities for labour and contractor offices, an area of about 25 acres will be required. There is plenty of wasteland on the banks of the Jhelum River close to the powerhouse and dam site. Therefore, the fertile and agriculturally productive land should not be acquired specially as there is already shortage of productive land. All the required area for various project related installations/ housing, camping must be established away from the residential area to avoid any social problem.

###### **13.5.1.1.2 Dam, Quarries and Excavated Material Disposal**

The construction works at dam site would not directly affect settlements and houses because there are no houses in the vicinity. However, there is an estimation of spoil material of about 365,000 m<sup>3</sup>. This material has to be dumped at switch yard and construction areas or at some suitable site. However, it is estimated that about 80% of the excavated material for construction will be used from quarry at Karot Village. Blasting and transport will cause noise and dust affecting lower part of adjacent villages. No trees will be affected. However, some bushy plants may be affected. There will be increase in traffic flow so alternative road or better traffic management is to be ensured to avoid inconvenience to the local population. During these activities water quality downstream may also be affected.

###### **13.5.1.1.3 Batching Plant**

In Karot Village (potential dam site), there is plan to establish temporary construction works (for 4 years) for batching plant, crushing plant and stockpiling.

These plants should be constructed away from the residential area to avoid any problem to the local population. If, some residents are going to be affected these

would need to be relocated. Efforts should be done to establish batching plant on barren / waste land away from the residential area.

#### **13.5.1.1.4 Powerhouse, Water System, Adits and Spoil Material**

Powerhouse and surge tunnel are located close to the Jhelum River. Due to the underground works and at the specific location (almost at the upper slopes), no human settlements or population will be affected. The spoil material from underground excavation would need to be dumped at appropriate location. The topography around the powerhouse portal and switchyard, comprising the upper terraces of the Jhelum River banks, offers a large area for disposal of excavated material. Indeed, if the material is properly placed, compacted having drainage and topped with fertile soil, then the resulting land could be turned into housing or commercial properties or even agricultural fields. There will be no impact on forests, bushes and animals. However, some local birds may sear away temporarily during construction period due to machinery noise and other activities.

#### **13.5.1.1.5 Switchyard and Transmission Line**

The switchyard will be constructed (Fig 5.1) on unused public land, therefore loss of, or damage to, property and/or productive land would not be a significant issue. The route of the transmission line should be so selected that private or public properties are not intersected and it is to be avoided. Towers should only be constructed on unused land or only occupy small areas. Thus, the construction of the steel towers should not be a significant issue. However compensation cost to the private land owners need to be paid before the initiation of work on transmission line. A separate EIA need to be prepared for transmission line.

**Figure 13.5.1: Construction Areas**

#### **13.5.1.2 Impact on Agriculture**



There will be some insignificant impact on culturable land of Karot Village during project construction. This minor impact may be due to dumping of the huge amount

of rock and other surface/earth material by the road widening and dam construction (including diversion facilities) at some specific site (Table 13.5.1).

### 13.5.1.3 Impact on Forestry

Some impacts on forestry would occur on the area proposed for construction works of the water conveyance system. It is located on the slopes of the right bank foothills. All other construction works will be carried out where there is no forest trees/bushes etc (Table 13.5.1). The compensation need to be paid to the owner of such areas.

**Table 13.5.1: Environmental Impact of Project on Different Parameters**

| S. No | Impact on                              | Significant Impact | Potentially Adverse Impact – Design Solution can be developed | Potentially Adverse Impact but requires further studies | Minor or Insignificant adverse impact | Significant Environmental Enhancement | Remarks   |
|-------|--|--------------------|---|---|---------------------------------------|---------------------------------------|---|
| 1     | Agriculture                            |                    |   |   | √                                     |                                       |   |
| 2     | Forestry                               |                    |   |   | √                                     |                                       |   |
| 3     | Fishery                                |                    |   |   | √                                     | √                                     |   |
| 4     | Drinking Water                         |                    |   |   | √                                     |                                       |   |
| 5     | Transportation                         | √                  |   |   |                                       |                                       |   |
| 6     | Business                               |                    |   |   |                                       | √                                     |   |
| 7     | Impact on workers and local population |                    |   |   |                                       | √                                     |   |
| 8     | Land                                   | √                  |   |   |                                       |                                       | If properly leveled can be used for crop production |

|    |                            |   |  |  |   |  |  |
|----|----------------------------|---|--|--|---|--|--|
| 10 | River Hydropower           |   |  |  | √ |  |  |
| 11 | Water Quality              | √ |  |  |   |  | Impact can be minimized by efficient management and planning |
| 12 | Biological Environment     |   |  |  | √ |  | Avoid degradation of broad leaves forest                     |
| 13 | Endangered Animals Species |   |  |  | √ |  |  |
| 14 | Fish Stock                 |   |  |  | √ |  |  |

#### 13.5.1.4 Impact on Fishing Activities

There are no fishing activities in the Karot Village. Some fish is caught only for self-consumption from the Jhelum River. There is possibility that fish production may increase in the reservoir area upon completion of the project (Table 13.5.1). It is proposed that fish seed spawning should be done in the reservoir and fish protection arrangements need to be made in front of intake tunnel structure etc.

#### 13.5.1.5 Impacts on Irrigation Water

During the construction, the river water will go through diversion tunnels back into the River Jhelum below the dam site. The water supply for irrigation and animals, in the 700 meters length lower part of the river will not be influenced. Consequently, there is no impact on downstream water supply for irrigation or other purposes as presented in Table 13.5.1. River water is not used for drinking purposes by human beings directly.

#### **13.5.1.6 Impact on Transportation**

All construction works require heavy duty equipment/machinery for earth removal such as large and heavy machinery, turbines, transformers, pipes, steel, and timber, cement and earth material to be brought to various locations. This would affect significantly the Kahuta-Kotli Road, which is a major road for linking AJK and Punjab from this side. A significant increase in traffic will occur due to the movement of heavy machinery etc. and there would be a severe impact on humans and animals due to noise and dust of this enhanced traffic (Table 13.5.1).

#### **13.5.1.7 Impact on Business**

There is not much business activity in the Karot. Thus, the road would have some, but positive impact on those small business activities. However, the improved road conditions and the increased income could enhance business activities in the project and surrounding areas (Table 13.5.1).

#### **13.5.1.8 Impact on Workers and Local Population**

For workers and local population there is high risk of falling down due to the existing steep mountainous conditions. The other group of potential risks for the workers is due to blasting works at the quarry or for road widening (Table 13.5.1). So proper precautionary measures should be adopted during blasting and other similar type construction activities.

#### **13.5.1.9 Impacts on Physical Environment (Land/ Soil)**

The demand for land during construction will be significant as it will be acquired for dumping of waste material from the dam's construction works, from road widening and underground works. In particular in the narrow Karot valley, where the soils are very fertile in comparison to the Jhelum River slopes, the impact on soil and natural land properties will be significant (Table 13.5.1). However, it is emphasized that disposal of the excavated materials should be done on a barren / waste land as the agriculturally productive lands in the project are already short. After dumping the excavated material these areas will need to be leveled and these areas can be developed and utilized for crop production and other commercial purposes.

#### **13.5.1.9.1 Impacts on Local Climate, Air and Noise**

There will be no major impact on the local climate from the constructions works. During construction impacts will appear on humans, caused by noise and dust emissions from machinery at the batching plant and heavy traffic along the dam site and road widening construction works (Table 13.5.1). The impacts of the noise should be minimized by using new and well maintained machinery. The dust level should be controlled by sprinkling the water on construction site and dusty roads 2-3 times a day or as required.

#### **13.5.1.9.2 Impact on River Hydrograph**

During the construction phase the water diversion will go through a diversion tunnel and spillway in the river bed as usual area. There is no impact on downstream hydrograph and it is also presented in Table 13.5.1.

#### **13.5.1.9.3 Impact on Water Quality**

Impacts on water quality may occur from the labourers camp and its sewage disposal. The sewage may pollute the River immediately. Other potential impacts on the water quality of the river water might be caused by various chemicals used for processing. These risks include pollution of water by cement, gravel, rock, sand, fuel, lubricants and oil residues/spills from vehicles and machines (Table 13.5.1). The water quality deterioration can be minimized by managing labour camps and machinery and ensuring its treatment to safer limits prior to its disposal.

#### **13.5.1.10 Impacts on Biological Environment**

Most of the construction works/activities will be confined to the relatively leveled area around Karot village and this area is also being used to grow crops as well. It is perceived that around adits some dumping of excavated material will be required which will have some affects on broad leave forest plants. Efforts should be made to avoid any damage to the biological environment. This can be achieved by selecting most appropriate material dumping sites.

##### **a) Impacts on Endangered Animals Species**

There is hardly any presence of endangered animal species in the project area. In general, the inventory did not reveal any rare and endangered species in the Project Area.

**b) Impact on Reptiles/ Birds Habitat**

The habitats around the dam site are prone for reptiles. However, agamas are also not widespread, which is likely due to permanent appearance of human beings using different footpaths crossing this area. During widening of road there might be minor impact (Table 13.5.1) on reptiles due to destroying of vegetation along the road side. Birds may fly away from the construction sites but will return gradually after completion of the project.

**c) Impacts on Fish Stocks**

The inventory of fish stocks revealed some common fish species existing in the area. In addition, there are some species which are migrating from the upper area of Jhelum River. On a limited scale impact may occur on fish around the excavation during construction at the dam site (Table 13.5.1). Migrating of the fish through the diversion tunnels upstream and downstream would occur possibly.

**13.5.2 Impacts on Social Environment during Operation**

**13.5.2.1 Impact on Settlements, Houses and Population**

During operation of the Karot Hydro Power Plant no impact on settlements, houses, other land based assets, and local population would occur. Even the proposed reach up to 27 km upstream of the Azad Patten Bridge would not have any adverse affect on the population (Table 13.5.2) as it is deep gorge area.

There will be some benefits for the local population after completion of the Project. The new and improved road will be available for public transport. This will improve the accessibility of the right bank villages. Women of Gorah Village are using the Karot stream for washing the laundry. The raised water level would facilitate an easy access to water source.

**13.5.2.2 Impacts on Agriculture**

During operation of the Karot Hydro Power Plant, there will be no impact on agricultural activities (Table 13.5.2). Due to the small reservoir and the high natural discharge during summer months, there will be an additional spill-out from the dam, which will increase the availability of water in Summer. However, protective measures need to be adopted to avoid any mishap downstream during high flow season.

### 13.5.2.3 Impact on Forestry

Due to rising of the water level in the reservoir, some bushes / trees may be affected to some extent (Table 13.5.2). In general there are no forest trees along the river bank which are going to be affected.

**Table 13.5.2: Impact on Environment During Operational Phase**

| Sr. No | Impact on                         | Significant Impact | Potentially Adverse Impact – Design Solution can be developed | Potentially Adverse Impact but requires further studies | Minor or Insignificant adverse impact | Significant Environmental Enhancement | Remarks   |
|--------|-----------------------------------|--------------------|---|---|---------------------------------------|---------------------------------------|---|
| 1      | Settlements Houses and Population |                    |   |   | √                                     | √                                     |   |
| 2      | Impact on Agriculture             |                    |   |   | √                                     |                                       | Easy access to water for the local population               |
| 3      | Impact on Forestry                |                    |   |   | √                                     |                                       |   |
| 4      | Impact on Fishery                 |                    |   |   | √                                     |                                       | If seeding is done it may help in fish production in summer |
| 5      | Impact on Water Quality           |                    |   |   | √                                     |                                       | 5 cumecs will be released continuously                      |
| 6      | Impact on Transportati            |                    |   |   |                                       | √                                     | Due to improvem-  |

|           |                                     |   |  |  |   |   |  |
|-----------|-------------------------------------|---|--|--|---|---|--|
|           | on                                  |   |  |  |   |   | ent in roads etc.  |
| <b>7</b>  | Impact on Business                  |   |  |  |   | √ |  |
| <b>8</b>  | Impact on Land / Soil               |   |  |  | √ |   |  |
| <b>9</b>  | Impact on Climate and Air           |   |  |  | √ | √ |  |
| <b>10</b> | Impact on River hydrograph          | √ |  |  |   |   | During winter more impacts                                     |
| <b>11</b> | Impacts on Sediments Downstream     | √ |  |  | √ |   |  |
| <b>12</b> | Impact on Water quality D/S and U/S |   |  |  | √ |   |  |
| <b>13</b> | Impacts on Plant                    |   |  |  | √ |   |  |
| <b>14</b> | Impacts on Endangered Animals       |   |  |  | √ |   |  |
| <b>15</b> | Impact on Fish                      |   |  |  | √ | √ | Possibly enhancement of fish migrating and spawning conditions |

#### **13.5.2.4 Impact on Fishing Activities**

Due to the lack of fishing activities in the River it is anticipated to be no adverse impact on economic activities (Table 13.5.2). The exploitation of the reservoir for fishery purposes (even with introduction of fingerlings) would not be suitable to sustain fish reserves for fishery. This is due to relative cold water oligotrophic water, which does not offer much plankton, detritus and other fish food. And frequently (during winter months even in a daily mode) release of most storage water for sediment flushing through the gates in high flood season, no suitable shallow areas for spawning, would be available for congenial conditions for fish culture and its production.

Introduced fish could only grow up during summer. The fish growth rate due to the low nutrition water body would be very small. Due to daily high water fluctuations and emptying of the reservoir, fish production business would not become economically feasible.

#### **13.5.2.5 Impact on Irrigation and Drinking Water**

Water diversion from Karot would have a minor adverse impact on the downstream water flow pattern for use in irrigation and drinking water supply (Table 13.5.2) in the downstream. Correspondingly drinking water requirement is low as population is low and even agricultural land is negligible hence having no irrigation water requirement.

The minimum release of water from the dam will ensure a flow of 5 m<sup>3</sup> / second, which has been assessed based on a 10% limit of the ever measured lowest daily discharge. The stream itself, its habitats, flora and fauna and the socio-economic demand are adapted to maintain the various functions. Under this condition, all functions (socio-economic, hydrological and biological) totally would remain well preserved. During high water periods, surplus water would improve the conditions and re-fresh various locations.

#### **13.5.2.6 Impact on Transportation**

Due to widening of the road, the overall transportation infrastructure in the Karot would be improved significantly. The future use of the improved road will significantly improve the accessibility of upper right bank villages/settlements. Further enhancement is focused on improved river crossing conditions and accessibility of the left bank of River Jhelum. The stream crossing procedures due to the lower and more stable water level would be improved. Presently there is limited number of existing bridges in the area to cross River Jhelum. There will be positive impact on the local population as presented in Table 13.5.2.

### **13.5.2.7 Impact on Business Activities**

The operation itself would not have any impact on business activities. However, the improved road in the Karot would support the business in general. Also, the inter-Karot business relations would be improved by the road. In particular, the transport business would benefit. Moreover, the access to the markets in Karot, Kahuta and Islamabad for the Karot population would be enhanced. This will improve their economic and social life and would enable the Karot residents to work in those urban centers, to transport agricultural commodities and trade goods speedily to the markets (Table 13.5.2).

### **13.5.2.8 Impacts on Land / Soil**

The reservoir would cover the bottom of the canyon downstream of the Azad Pattan Bridge. There is only very little land and almost no soil due to the existing geomorphological and geological situation due to rocky steep slopes. All other construction elements would not cause any change. The adverse impact is insignificant (Table 13.5.2).

There are even some positive effects on soils: Flooding and water logging processes, which are normal phenomena of alluvial areas, would be reduced or even wiped out. From the cultivation point of view it may stabilize or even enhance the crop yield, due to higher moisture levels in the area. There is the presumption that some small pieces of land due to the lowered water level and the lack of periodical floods of alluvial land would be available for cultivation on residual moisture temporarily.

### **13.5.2.9 Impact on Local Climate and Air**

The reservoir with huge storage would only have minor impact on local climate due to the physical conditions: The energy from daily radiation in particular during summer season would be transformed and collected at the small reservoir surface area only. It would result slightly higher water temperature of the upper water layer. This would induce evaporation from the water surface and increase of air humidity above the reservoir. The air temperature will be decreased to a very small extent around reservoir. In winter, the reverse situation would generate a slightly warmer water body.

However, the overall impact on the local climate due to temperature regime changes of the reservoir will be minor. The total effect on air would be negligible as presented in Table 13.5.2.

Emission of greenhouse gases CO<sub>2</sub> and CH<sub>4</sub> would be irrelevant for the Karot HPP due to dominant reservoir conditions and hydrological effects. It may be estimated that the CO<sub>2</sub> dissolved in the reservoir water will be released at the gates and spillways in high range due to water turbulence will be balanced because of inundation of present very turbulent 300 meters of canyon (which is normally a source for CO<sub>2</sub>). Moreover, CH<sub>4</sub>, which in shallow water bodies in tropical regions having a warm water regime, will be generated due to the dissimilation of high biomasses in the water will not be produced in that magnitude. Conclusively, the greenhouse gas emission of the Karot HPP will be insignificant.

A very positive effect is that the hydropower generation of 3436 GWh would avoid emission of greenhouse gases, based upon gas turbines.

#### **13.5.2.10 Impact on River Hydrograph**

The River hydrograph currently is determined by high seasonal fluctuations and in particular spring and summer season peaking and low water in winter season. The River is very turbulent and torrential. Diversion of most of the water through the power plant and then to the Jhelum River will make significant changes (Table 13.5.2). During winter months only releasing the discharge of 5 m<sup>3</sup>/s to the down stream would change the turbulent and torrential character of the stream significantly. Many smaller water pools in the course of the River Jhelum with shallow water and much less turbulent sections would be developed. In summer due to higher flows some excess water would run down to the Jhelum River through the dam downstream outlets.

#### **13.5.2.11 Impact on Sediment Flushing on Downstream**

The total suspended sediment yield of the Karot Power Plant has been estimated at 1176 tons/km<sup>2</sup>/year, which means that on the average during five summer months each year 15.54 Million Cubic Meters (MCM)/month sediment would be trapped and will cause significant impact as presented in Table 13.5.2. In order to prolong the reservoir's life, regular sediment flushing needs to be done during flood flows, and in general, through low-level gates in the dam.

During conventional flushing, a chamber that is full is taken out of operation and emptied. When the water flows sediments will be flushed out of the chamber through a low-level sluice as into the river downstream of the dam. Given that the river flows downstream of the dam are much reduced by the hydropower project (even during the high flow summer season), the sediments flushed may not be immediately transported down the River Jhelum and finer sediments will accumulate close to their discharge point. Only during the higher floods, when the low-level gates in the dam are in operation and the reservoir is being flushed, the accumulated finer sediments

will be washed down stream to River. The overall sediment balance of the River Jhelum would not be much disturbed.

Arrangements will need to be made to supply sediment free water for local population, animals, and plants, which are dependent on the water from River Jhelum.

#### **13.5.2.12 Impact on Water Quality Upstream and Downstream**

There will be no adverse impact on upstream water quality. The daily emptying would not enable biological development in the upper reservoir water layer. The cold water conditions would not favour biomass (plankton, fish, and benthos) growth in oligotrophic water body. Furthermore, potential nutrients from sewage, if any, (other pollution sources do not exist) would be moved downstream. Generally the physical (temperature) and bio-chemical (nitrogen, phosphorous, alga) parameters of reservoir water would not favor eutrophication.

Considering water quality changes in the downstream section caused by extremely lesser amount of water, could have an adverse impact (Table 13.5.2). Direct disposal of sewage into the river water may further increase this adverse impact on water quality. However, this seems to be unlikely due to the following conditions, which would prevent such a phenomenon.

- Very small number of sewage water intakes (from toilets) exist (mostly dry toilets are used)
- Turbulence of stream water would oxidize the organic waste components, and
- Rapid downstream transport of waste to the Jhelum River.

#### **13.5.2.13 Impacts on Biological Environment (Plants etc)**

As presented in Table 13.5.2, during operation of Karot HPP only minor impacts on plants, plant associations or ecosystems may appear due to the proposed reservoir. The area in general has very few places of natural vegetation cover on slopes and cliffs in the adjacent area.

#### **13.5.2.14 Impact on Endangered Animals**

With the submergence of the reservoir and commencing operation, there would be only minor impacts on natural animals (Table 13.5.2). Due to the human pressure and presence at and near the dam site and the inhospitable character of the canyon, there are only a few numbers of animal species present in the proposed reservoir area.

Two reptile species potentially available in the reservoir area could be expected. If the first filling would not happen during hibernation period (until March/April), which is quite unrealistic due to the low water flow, the reptiles (the rock agama presumably) would escape to higher locations in the canyon.

Only for birds, there are quite valuable nesting and feeding habitats available. However, in the vicinity of these potentially submerged habitats many locations are available offering all types of identical habitats for the birds recorded or considered to be in the area. Even after submergence there would be plenty of habitats available for the bird species of the area, summer breeding, migrating or passage migrants. These birds would shift to alternate habitats available in plenty in this area. None of the species recorded is endangered and listed in the Red Data Books of Pakistan.

#### **13.5.2.15 Impact on Fish**

The operation of Karot Hydro Power Plant as a whole would not harm natural fish stocks (Table 13.5.2). In river some common fish species had been recorded. The species in accordance with the List on Fish of the Red Data Book Pakistan neither are indigenous nor rare and endangered species.

## **SECTION 13.6**

### **13.6. MITIGATION AND REMEDIAL MEASURES FOR SOCIAL AND ENVIRONMENTAL IMPACTS**

The Hydropower Projects generally have impacts on physical (water, soil, climate, atmosphere etc), biological (flora, fauna, wet lands, endangered species) and social (social, economic, cultural, human health etc) environment. These impacts and its related mitigation measures are covered in this section of the report.

#### **13.6.1 Mitigation of Social Environment**

##### **13.6.1.1 Settlements, Houses and Population**

Most important mitigation action is to minimize any damage of houses, cultivated land, business and public properties. Most relevant causes of damage to social Environment are as follows:-

- Dam site construction works and dumping of spoil materials with consequent damage to adjacent land and properties (houses).
- Establishment of batching plant

All feasible solutions have to be applied in order to mitigate adverse impacts on the social environment. Different options have to be investigated for an improved design, which takes into account the environment. This would require developing suitable alignment and siting of construction works in close co-ordination among the road/construction engineers, the environmentalist, the local population to minimize damages to land and property.

Where damages to houses cannot be avoided, relocation of affected persons has to be carried out in the most Judicious and careful manner. The other land based assets, if any should be compensated on market rate or replacement should be provided before the start of the project. Brief Resettlement Plan (RP) has been prepared in an other section of this report (section 13.8) addressing the impacts on properties, development of compensation procedures and land acquisition.

Due to the scarcity of agriculturally productive land, such land should not be taken. And only barren / waste land should be used for the project. However, the acquired land should be:

- close to the project site.
- close to the excavation site in order to avoid transport and additional land needs

- accessible from the main Kahuta-Karot Road
- preferably near a source of water (stream water, spring water, piped water).

#### **13.6.1.2. Impacts on Cultivated Land and Trees**

The need for land for the road widening, establishment of batching plant, dumping of earth materials, laborer camp and other construction works has to be limited as much as possible.

It is proposed that terraced agricultural land, located on higher ground on the right Karot flank upstream and above the dam site, be permanently acquired from the villagers for the construction installations and future residential areas. This arrangement will require the relocation of about 10 families for the construction period. The potentially affected families should be relocated. The affected families need not be compensated through “land for land” arrangement. This would in any case be difficult as there is only limited land available on the higher ground. A better solution would be to offer cash compensation and gainful employment on the Project to family members. In that way, a new skill can be imparted to one or more of the family members.

During the public consultations it was also indicated by the residents of this village that they would be willing to relocate in case there is no alternative to move out. Already most of the families have their earning family members working in Kahuta or Rawalpindi as employees of different organizations or working in the services sectors / businesses enterprises. Hence the shifting or their relocation specially when the livelihood or main earning source is already away from their current residences will not be difficult. As such remaining family members can also shift to the population centers where better health and education facilities are available for them and their children.

Trees provided multipurpose benefits to mankind including bearing of fruit, providing fodder and shadow in a hot climate where the summer continues for as long as 7-8 months. Therefore the trees have to be protected, wherever possible and allowed to stay intact. However if it is not at all possible and the removal of valuable trees has to be done then it has to be compensated and also mitigated by re-plantation (forestation) of 3-4 times of the uprooted trees.

#### **13.6.1.3 Impacts on Forestry Activities**

Dumping of spoiled rock and earth from dam, adits, and road should be done on the designated areas along the river banks, nullahs with gabion protection. Forest areas

need to be protected. In case of damage to any one forest tree it will be mitigated by planting 3-4 times new trees.

#### **13.6.1.4 Impacts on Irrigation and Drinking Water Supply**

The overall target is to supply water to all downstream users. This should ensure not only their water needs for drinking and irrigation, but also improve the living conditions of the affected population. A side affect would be the reduction of water and losses, from ground due to tunnels execution. Such losses may be compensated and supplied through piped water to Karot Village.

#### **13.6.1.5 Impacts on Houses and Cultivated land by Sediment Flushing**

The sediment flushing procedure has to be carefully planned and carried out in order to avoid damages to houses, trees, stream embankments, irrigation intakes structures and other water related facilities. Degradation of cultivated land by inundation of fields and damage to crops has to be avoided.

#### **13.6.1.6 Impacts on Transportation**

The construction works, especially the widening of the road, might have an adverse impact on the local transport on the Karot Road. All works have to be carried out with the aim to avoid any disturbance to the regular traffic along the Kahuta-Kotli Road. Unnecessary and prolonged blockages due to blasting or other physical works have to be avoided.

It may not be possible to avoid some blockages but public inconvenience should be minimized through careful planning of operations and advance warning to road users. Adequate steps to mitigate dust and noise along the road need also to be taken by spraying / sprinkling of water near the construction area. Noisy works in areas where population would be significantly affected have to be done preferably during day time. Vehicles and heavy machines have to meet international standards on noise, vibrations and dust emission levels and remain within the Natural Environmental Quality Standards (NEQS).

### **13.6.2 Mitigation of Impacts on Physical Environment**

#### **13.6.2.1 Impacts on Land and Soil**

Any construction work should be guided to minimize the use of land as far as possible. Available land in the Karot Village is very limited and is used for cultivation, grazing of livestock, and production of fuel wood and timber. The excavated material must be disposed off in a manner that neither endangers the lives and livelihoods of

the local population nor diminishes to an unacceptable extent of the quality of the natural environment or quality of life of the local residents.

The potential significant adverse impact on the existing land in the Karot Village will be the huge amount of rock and earth material to be excavated which has to be reduced as much as possible essentially by developing technical solutions.

The transport of rock and excavated soil towards lower areas of Karot Village has to be assessed carefully from the point of view of acceptance by the Karot community. Acceptance and seeking co-operation from the local community / village elders has to be taken into account. If there would be serious concerns, this option might have to be abandoned. The guiding principle must be to not transfer the problem of one area onto another area without amicable settlement with the concerned community.

#### **13.6.2.2 Impacts on River Hydrograph**

One of the main environmental consequences of the construction of Karot Hydro Power Project will be the change of the hydrograph downstream of the dam. The present torrential stream would become much more balanced. Only in summer / monsoon period, when the flow into the reservoir exceeds the live storage than the additional water than the guaranteed 5 m<sup>3</sup>/s would be discharged into the downstream of dam axis.

Therefore, the mandatory water release for maintaining the hydrographical character of River should be increased accordingly.

#### **13.6.2.3 Impacts on Downstream by Sediment Flushing**

Damages due to sediment flushing procedure, which are required in order to prolong the reservoir's life, have to be mitigated as far as possible. Flushing procedures seem to be acceptable for the downstream livelihood due to their low magnitude. In addition, the downstream habitations are quite distant from the dam. However, it is required to develop plans addressing impacts and measures to be taken (including advance information to the potentially affected population) to guard against the sediments flushing procedures and timings carefully.

#### **13.6.2.4 Impact on Downstream Water Quality**

All such construction or operation measures or procedures have to be avoided, which may harm the water quality of the downstream reaches of the River. In order to mitigate the potential pollution of soils and water, appropriate methods for usage of vehicles, machinery and vehicle repair services have to be applied. High standards and permanent continuous monitoring during construction phase for vehicles and machinery have to be established with the objective that no waste

lubricants, oil, petrol or other liquids should pollute the water. Potential contamination of the River has to be avoided by treatment of waste material. Proper sewage treatment at the labour camp or other construction sites has to be ensured through septic tanks or otherwise.

During operational phase water quality monitoring has to be carried out on a continuous basis. Special attention is needed to check biological pollution by sewage from the six villages, which so far discharge their human excreta into the river stream directly. If there is evidence that nitrogen and bacteriological pollution would appear the proponent has to prepare and fund actions for treatment of the sewage in the relevant locations. This is very crucial since the dilution in River Jhelum which is quite abundant presently, may be reduced in future, especially during dry season flows.

### **13.6.3 Mitigation of Impacts on Biological Environment**

#### **13.6.3.1 Impacts on Plants**

Although no rare and endangered natural vegetation is growing in the Project Area, the construction procedures/practices have to be so planned to minimize and mitigate any damage to the natural vegetation as far as possible. Necessary help and guidance from local NGOs and concerned departments should be sought for protection and preservation of natural vegetation. However, if there is any damage to a plant occurs it has to be replaced with 3-4 plants for better environment.

#### **13.6.3.2 Impacts on Endangered Animal Species**

Although wildlife is scarce in the Project Area, construction activities should be aimed to avoid any further disturbance to wildlife in the Area if any. Most important mitigation actions are linked to excavation and leveling works during construction as follows:

- Mitigation of the impoundment of the reservoir during hibernation of reptiles (winter up to April)
- Mitigation of excavation and leveling works during breeding period of birds (April-June)
- Avoiding dumping of huge amount of material on natural terrain, which is habitat of various creatures.

### **13.6.3.3 Impacts on Fish**

Although the fish stocks are very poor (number of species and specimens with growing distance towards upper reaches) and any disturbance of aquatic life during construction and operation have to be mitigated. During construction, the diversion of water through the diversion tunnel has to preserve the regular flow conditions. Pollution of water should be avoided. During operation the river release of 5 m<sup>3</sup>/s downstream to dam axis should be able to maintain the limited fish stocks. This would further increase due to inflows of water from the nullahs downstream of dam axis, which will contribute to enhanced water and consequently provision of congenial fish survival conditions.

## **SECTION 13.7**

### **13.7. ENVIRONMENTAL MANAGEMENT AND PROTECTION**

#### **13.7.1. Environmental Management and Protection Program**

There will be some physical, biological and social impacts during the construction, execution and operational phase of this hydropower project. Any adverse impact need to be addressed effectively. For this purpose a well planned environmental management and protection program is imperative in order to avoid any environmental and social problems/issues.

This program also includes environmental monitoring which will be quite useful for identifying the negative and positive impacts of the project activities during execution and operation and mitigation of such negative impacts effectively. A detailed implementation strategy is formulated to involve different stakeholders in an effective manner, to make them aware of the environmental/ social issues/risks, their identification and its mitigation measures accordingly.

#### **13.7.2 Environment Management and Protection Plan**

The EMPP will identify different environmental issues/ problems and mitigation measures to settle these issues with the participation of different stakeholders well in time and efficiently. The EMPP includes the following broad areas:

- i. Comprehensive strategy with time frame and schedule of activities.
- ii. Responsibilities of different actors and cost estimate.

##### **13.7.2.1 Monitoring Program**

The monitoring program has been chalked out for construction, operation and maintenance phases. The monitoring program and activities are briefly summarized as under:

###### **13.7.2.1.1 Water Quality Monitoring**

The water samples of river Jhelum and ground water from the project site and surrounding area will be collected and got analyzed for various parameters to evaluate the effects of the project with the passage of time.

###### **13.7.2.1.2 Water Quality Baseline Conditions Monitoring**

In order to have the baseline data the water samples were collected from different sites/ areas and analyzed for various quality parameters. Two water samples were collected from just above the dam axis and downstream the powerhouse. These

samples were analyzed for 26 parameters for human and aquatic purposes including BOD and COD requirements. This baseline data will serve as bench mark for future evaluation of the impact of the project on water quality. The strict monitoring will minimize the negative effects on water quality.

#### **13.7.2.1.3 Impact on Aquatic Life and Monitoring**

The aquatic life grows and multiplies rapidly under certain environmental conditions. However, when these environmental conditions are changed there might be negative or positive impacts. Reservoir area of the project may cause some change in river ecology, fisheries and other aquatic life. The construction of reservoir will provide the possibility of enhanced aquatic habitat. However, there is possibility of increase in water born diseases which may affect the aquatic life. Similarly contamination of reservoir water by different pollutants/ sediment load may also have potential negative impacts on fish and other aquatic life. So it is important to adopt proper mitigation measures to conserve and protect the aquatic life and continuously monitor on regular intervals to ensure sustainability.

#### **13.7.3 Resettlement and Compensation Monitoring**

With the construction of the Karot Hydropower Project there is likelihood of some displacement and resettlement issues. Accordingly resettlement rehabilitation measures are required to settle the affectees, if any, during the execution of the project. For this purpose the resettlement plan for the acquisition of land, development of other facilities and payment of compensation to the affectees has been prepared and given as per section 13.8. The resettlement, rehabilitation and livelihood restoration and payment of compensation speedily and in a transparent manner need to be ensured by the relevant authority. A representative from the Government/ WAPDA or a committee should be constituted for monitoring of the resettlement and compensation/ payment issues.

#### **13.7.4 Community Awareness Program**

Enhanced community awareness will be an important component of the project. For effective implementation of the project activities in a friendly environment the awareness of the concerned population about the social and environmental issues is very essential. There is crucial need to raise awareness amongst the affectees about the positive and negative impacts, if any, so that they are ready to cooperate to face the situation. The local residents were informed that how the project activities will affect them and this will assist them to rearrange their activities accordingly in the light of the issues/problems.

The estimated cost of the community awareness program will be Rs. 1.0 million.

### **13.7.5 Site Protection and Rehabilitation Program**

During the execution of the project the area will be disturbed to some extent. The main affected/ disturbed area will be:-

- i. Excavated affected quarrying areas
- ii. Spoil deposition areas

A program will be formulated for the rehabilitation of such areas in order to make these areas more useful and productive.

#### **13.7.5.1 Disturbed Quarrying Areas**

The disturbed areas will include the main dam site, powerhouse site, slopes and other excavated areas like operator's hut and roadside batters etc. At the execution stage of the project the top soil of about 50 cm should be stripped and collected in a separate place. This top soil collected can be spread over the base soil areas which will improve and restore the fertility and productivity of the area rapidly.

#### **13.7.5.2 Spoil Disposal Areas**

During the construction of different components of the project there will be spoil material to be properly disposed off at suitable site to avoid any environmental problems/issues. It is even more important and necessary in such areas where land is already scarce. So reshaping and rehabilitation / reclamation of the spoil heaps will provide a suitable alternative of replacing the land taken by the project. This leveled land will provide the source of livelihood through land utilization by the residents of these areas.

The total cost involved for the rehabilitation of the spoil areas will be Rs. 6.0 million.

#### **13.7.5.3 Cost of Environmental Management Program**

The estimated/indicative cost of the environmental management program will be Rs. 995 million. The details of this cost are given in Table 13.9.1.

### **13.7.6 Environmental Monitoring Plan**

Effective and regular monitoring of the project activities with respect to identified environment and social issues/risks, proposed mitigations and effectiveness of the mitigation measures to sustain the environmental values is a pre-requisite of the monitoring plan. The project authorities should maintain a track record of the

activities that have potential impacts on corresponding environmental conditions to evaluate the effectiveness of the measures adopted for mitigation of the envisaged adverse impacts.

The negative impacts like the displacement of the community, loss of arable land, unemployment, social cohesion, disturbance in utility services and destruction of flora and fauna can appear during project activities. Under such conditions only a planned monitoring can be effective in the redressal of such issues.

### **13.7.7 Environmental Monitoring During Construction**

Implementation of the project involves wide range of activities such as land acquisition, land clearance/levelling, excavation of material and its disposal, construction of building, roads, labour camps etc. and all these activities may cause some positive or negative impacts on physical, biological and social environment. As such it is essential to monitor regularly (Figure 13.7.1) and adopt mitigation measures for the negative impacts, if any, for these parameters during construction phase. During the construction phase the WAPDA /ATL Environmental Cell, will ensure that mitigation measures, identified in EIA of the project, are implemented and EPA regulations are complied with for sustainable and environment friendly development. The possible issues which may appear will need attention are as under:-

#### **13.7.7.1 Air Quality**

During construction, the air quality of the adjoining areas becomes deteriorated during excavation, disposal of the excavated material, fugitive dust and emission gases from the construction machinery and haulage of automobiles on unpaved roads along the construction sites. Care should be taken that these may not exceed allowable limit (PM 10). Similarly exhaust gaseous emission should also be within EPA standards (NEQS).



#### **13.7.7.2 Noise and Vibration**

Noise and vibration will be produced through the movement of construction machinery and other activities. This should be mitigated by avoiding night time activities, using noise control techniques such as silencers and sound insulation materials. In no case the noise level should be upto 85 dB (A). No worker should be exposed to more than 8 hours to a noise level of 85 dB (A).

#### **13.7.7.3 Drinking Water**

Drinking water should be supplied to the workers and other staff members after proper treatment according to the World Health Organization (WHO) standards of drinking water.

#### **13.7.7.4 Sewage Effluent**

Arrangement should be made for the proper disposal of the sewage effluent from labour camps and other resources according to EPA surface discharge standards.

#### **13.7.7.5. Solid Waste**

Proper arrangements should be made for the collection of solid waste and disposal to a landfill site.

#### **13.7.7.6. Explosive Material**

Explosive material, if any, should be stored in a safe place away from the work and residential area and its storage, handling and use should comply with explosive Act of Ministry of Mines.

#### **13.7.7.7 Hazardous and Toxic Material**

In transportation, storage, handling and use of hazardous and toxic materials proper care need to be taken to avoid soil and water contamination. The persons handling such materials must be provided with protection devices/gadgets. The containers of the toxic materials should be disposed off properly so that it may not be re-used by any body.

#### **13.7.7.8 Flora and Fauna**

The project activities may affect the flora and fauna of the area. Accordingly care should be taken to avoid damage to flora and fauna of the area due to operation of machines, equipment, transport, and human interventions.

#### **13.7.7.9 Excavated Material**

During construction substantial quantity of excavated material will be produced and it should be properly disposed off outside the reservoir area at appropriate and designated site. This will reduce the contribution of sediment to surface water resulting in better water quality and prolonged life of reservoir.

#### **13.7.7.10 Weather Recording Instrument**

In the project area there is a possibility of weather hazardous conditions during the execution. It should be ensured that weather recording instruments are working properly and alert the contractors/workers of any expected weather hazard like excessive rain or wind storm.

#### **13.7.7.11 Blasting and Quarrying Operation**

The blasting and quarrying operation may cause some damage to the men working in the project. It is important that during blasting and quarrying operation comply with regulations and adopt safety precautions.

#### **13.7.7.12 Traffic Problem**

During construction and transportation of the heavy machinery it should be ensured that traffic is controlled properly to avoid any bad effect on the movement of local traffic and inconvenience to the local population of the area. A well maintained diversion road, if possible, should be provided to minimize the effects and inconvenience to the local residents.

### **13.7.8 Environmental Monitoring During Operation**

#### **13.7.8.1 Water Quality Monitoring**

It is an important component of the post project monitoring. The environmental monitoring cell should collect and analyze the water samples from the streams entering into the reservoir to assess the water quality. Water quality entering the reservoir should be monitored at regular intervals to pre-empt any pollution of reservoir water and adopt necessary remedial measures.

#### **13.7.8.2 Replacement of Plants**

Plants are very important for healthy environment. During project construction some plants will be cut / damaged. In order to maintain the friendly environment it is proposed that these cut/damaged plants will be replaced/replanted with 3-4 times the numbers of these affected plants/trees.

### **13.7.8.3 Fish Spawning**

Fish is an important part of flowing river water but with the construction of reservoir, there may be some ill effects on the fish growth and survival. It is proposed that fish spawning should be introduced in the reservoir/lake in order to enhance the fish production.

### **13.7.9 External Monitoring**

In addition to regular internal monitoring, it is essential to undertake external monitoring after regular intervals by some consultants/institutions/university to evaluate the environmental impacts on various parameters. The external monitoring will play an important role and ensure that the emerging issues are being properly tackled during project execution, implementation and maintenance. This external monitoring will be done periodically by independent consultants and reports will be submitted to WAPDA/ATL.

## **SECTION 13.8**

### **13.8. RESETTLEMENT PLAN (RP)**

#### **13.8.1 General**

Karot Hydropower project is planned on River Jhelum at Karot, Tehsil Kahuta, District Rawalpindi. With the construction, execution, of the project there will be some significant impacts on physical, biological and socio-economic parameters including resettlement issues of this project. These impacts need to be assessed before the start of the project. To achieve long term social benefits in development projects, the residents must be consulted, compensated for their losses and assisted in rebuilding their lost assets and livelihoods to enjoy at least the same standard of living which they have before the project. Very often affected population are poor and vulnerable and therefore, unable to absorb the adverse impacts on their lives. They need significant help to restart their normal life and re-establish their livelihoods. Mere payment of cash compensation under the LAA is not enough to restore livelihood and living standards.

#### **13.8.2 Objective**

A study was carried out with the broad objective to evaluate the impact of the project on the local population through public consultation process. The specific impact assessment aims were:-

- Level of acceptance of the Project by the local community;
- Identification of project potential adverse effects, i.e., resettlement issues and spelling out remedial measures as per national laws/policy, local culture and tradition,
- Conduct the public consultation session to assess the locals' need, demands and possible options for the sustainability of the proposed Project.

#### **13.8.3 Data Collection**

The data were obtained from primary and secondary sources through applying various techniques and methodologies. Secondary information was collected from available documents i.e. Population Census 1998, National Guidelines for Involuntarily Resettlement, Land Acquisition Act 1894 (LAA), Agriculture Extension Survey Reports, Satellite Images and Maps etc. related to Project Areas prepared by the various organizations. After the review of published information, primary data were collected through following data collection tools like focus census, socio-economic household survey, village profiles and women profile survey.

### **13.8.3.1 Census Components**

The parameters documented as part of the census were:-

- Number of PAPs in the project area.
- Nature of business/ occupations
- Type and value of structures and assets owned
- Replacement cost of structures/assets
- Vulnerable groups
- Alternate arrangements for resettlement

### **13.8.4 Policy Framework**

#### **13.8.4.1 National Resettlement Policy (March 2002)**

In Pakistan, a number of laws give and protect the proprietary rights. Also, laws have been promulgated at different occasions for purposes like urban and rural development, and for establishment of the authorities to implement their programs that include acquisition of private properties for development. The Land Acquisition Act, 1894 (LAA) has been the most commonly used law for acquisition of land and other properties for development projects. Although it lays down detailed procedures for the acquisition of private properties for public purposes and their compensation, the LAA or any other law of the land, does not cover resettlement and rehabilitation of persons in a manner perceived today.

National Resettlement Policy has, therefore, been formulated (which is still in draft shape) to not only cover the Affected Persons (APs) in existing systems but also to ensure an equitable and uniform treatment of resettlement issues all over Pakistan. This Policy will apply to all development projects involving adverse social impacts, including land acquisition, loss of assets, income, business etc. It has addressed to those areas, which are not looked after in LAA and will be applicable wherever the residents, families or communities are affected by any public sector or private development project, even when there is no displacement. The Policy also aims to compensate for the loss of income to those who suffer due to loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools, graveyards etc.

#### **13.8.4.3 Policy Objectives**

The Policy objectives are relevant to other policies and laws of the Government of Pakistan, including the following:

- Avoid or minimize adverse social impacts in a project wherever possible and where adverse impacts cannot be avoided, the mitigation measures and resettlement activities should be conceived and executed as development programs and the affected persons be provided opportunity to share the project benefits.
- Project Affected Persons (APs) be provided with sufficient compensation and assistance for lost assets that will assist them to improve or at least restore their living standards, income earning or production capacity to the pre-project levels.
- Provide a development opportunity to all vulnerable groups (including poverty groups, women headed households, refugees and those without security of tenure /usufruct rights, etc.). The vulnerable population should receive special assistance to bring them at least to a minimum living standard at par with the pre-project level.
- All population adversely affected by the project, should be eligible for sharing the social and economic benefits, envisaged after completion of the project.

#### **13.8.4.4 Principals of Policy**

The Policy is based on the following principles, whereas the Guidelines will explain all resettlement issues at operational and procedural levels.

- To minimise involuntary resettlement, the proponents should consider alternate planning and design standards, and finalize an option with minimum adverse impacts.
- Involuntary resettlement should be conceived and executed as a part of the project and full cost of resettlement and compensation be included in the project costs and benefits.
- Key stakeholders (including affected communities and APs) are fully consulted regarding the project's design, implementation and operation and all activities are carried out through a participatory process.
- All APs residing in, working, doing business, or cultivating land, or having rights over resources within the project area as on the date of the census surveys are entitled to compensation for their lost assets, incomes, jobs and businesses at replacement cost, at the cut-off-date notified in the Official Gazette.

- APs losing their incomes, jobs and employment, should get additional development assistance that enables them to improve their incomes to maintain their standard of living to pre-project level.
- APs losing all of their productive assets (farm land, house or business), or in case of partial loss when the remaining assets are not viable for continued use, will be entitled for full compensation for the entire affected assets at replacement cost.
- APs affected by partial impact on their assets i.e. suffering partial loss of land or structures while the remaining assets remain viable for continued use, and where the livelihood is not land-based, the compensation for affected assets would be paid in cash.
- Affected population should be informed fully and consulted in a timely manner, in order to enable them to make the informed decisions on resettlement and compensation options.
- Existing social and cultural institutions of affected communities and their host communities should be supported and integrated.
- Absence of a formal legal title to land by some affected person should not be a bar to qualify for compensation of his/her lost assets (structure, houses, trees, etc.), business and incomes, including rehabilitation assistance measures.
- Special provisions should be made for the vulnerable groups in a project, over and above their entitlements for compensation and other assistance to improve their living standards to minimum socially acceptable level.
- Where in a project the cultural minorities or indigenous population (tribal communities) are affected, the social and economic benefits they receive be in harmony with their cultural preferences and be decided in consultation with affected communities.
- Any acquisition of, or restriction on access to resources owned or managed by the APs as a common property will be mitigated by arrangements ensuring access of those APs to equivalent resources on a continuing basis.
- The affected persons losing land of all types, shall be given first choice to opt for “land-for-land” compensation, wherever possible, and preferably in the same region. All such APs will be provided land with secured tenure status and without any additional cost, taxes and surcharges, at the time of transfer, alongwith previous level of community services and access to resources.
- Project proponents shall resolve maximum possible claims and unresolved issues related to the tenure status and ownership of land and other assets, prior to initiating any land acquisition activity. However, just for this reason, the scheduled commencement of project work should not be delayed.

- The usufruct rights of affected persons shall be protected.
- Resettlement programs will have adequate institutional set-ups to ensure effective design, planning, consultation and implementation of compensation, resettlement and rehabilitation measures, supervision and monitoring of the resettlement and rehabilitation measures.
- A clear mechanism of grievance redress should form part of resettlement and rehabilitation process.
- Resettlement transition period be minimized and the acquisition of assets, compensation, resettlement and rehabilitation activities (except where long-term rehabilitation measures such as vocational training are recommended) be completed prior to the initiation of construction work.
- In resettlement and compensation, the gender biases should not deny to the women their due entitlements. Affected women will have equal access to all income restoration programs. In addition to receiving the compensation, the women be eligible for financial credit for starting own businesses, etc. and to restore their income and livelihoods.

#### **13.8.4.5 Impacts Covered**

This policy covers direct social and economic impacts that are caused by;

**(a)** The involuntary taking of land resulting in

- (i) Relocation or loss of shelter;
- (ii) Loss of assets or access to assets; or
- (iii) Loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or

**(b)** The involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

**(c)** Where necessary to achieve the objectives of the policy, the resettlement plan or resettlement policy framework also includes measures to ensure that displaced persons are;

- (i) offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living; and
- (ii) Provided with development assistance in addition to compensation measures such as land preparation, credit facilities, training, or job opportunities.

#### **13.8.4.6 Criteria for Eligibility**

Displaced persons may be classified in one of the following three groups:

- (a) Those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
- (b) Those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan;
- (c) Those who have no recognizable legal right or claim to the land but they are occupying the land.

Persons who encroach the project area after the cut-off date established by the borrower are not entitled to compensation or any other form of resettlement assistance.

#### **13.8.4.7 Projects' Resettlement Principles and Objectives**

The development projects that displace population involuntarily can generally give rise to economic, social and environmental problems. Involuntary resettlement may cause severe long term hardship, impoverishment, and environmental damage without the application of appropriate measures to mitigate these impacts. The RAP provides details regarding the likely impacts resulting from this intervention and the mitigatory measures that will be adopted to address these adverse impacts.

The main objectives of the RAP are to:

- a. Present a strategy for achieving the objectives of the resettlement policy;
- b. Provide a framework for implementation of the stated strategies to ensure timely acquisition of assets, payment of compensation and delivery of other benefits to Project affected persons (PAP);
- c. Provide details on the policies governing land expropriation, the range of adverse impacts and entitlements, and implementation of the project facilitating the PAPs' efforts to improve their living standards, income earning capacity and production levels or, at least restore them to pre-project levels;
- d. Provide details on the public information, consultation and participation, and grievance redress mechanism in project planning, design and implementation;

- e. Identify and provide an estimate of required resources for implementation of recommended strategies; and
- f. Provide a framework for supervision, monitoring and evaluation of resettlement implementation.
- g. Given the growing requirements and complexity of resettlement in development projects, the government agencies and departments should upgrade the institutional capacity to design and implement RAPs.

#### **13.8.4.8 Entitlement and Compensation Matrix**

In the light of review of above Act (LAA, 1894) and Policy Framework (World Bank OP 4.12), and consultations with the affected population, the Entitlement and Compensation Matrix (Table 13.8.1) is prepared keeping in view the nature of losses, entitlements and implementation issues. The answers to some of the frequently asked questions related to compensation are given below in accordance with the guiding principles laid out for such purposes;

- a)** What will be the entitlements for different categories of affectees (based on the severity of impacts)?

This has been precisely identified and given in the Entitlement and Compensation Matrix (Table 13.8.1), which covers all types of affectees and their entitlements. This Entitlement and Compensation Matrix is based on the National Policy.

- b)** What will be the status of title and non title holders? Who are eligible for what?

In case of title holders

- i. One-time cash compensation grant for facilitating alternative housing/ land
- ii. Shifting charges to resettle some where else
- iii. Transition period allowance
- iv. Trainings of the affectees for their capacity building to restore their livelihoods

In case of non-title holder

**Table 13.8.1: Entitlement and Compensation Matrix**

| Sr. No. | Nature of Loss  | Definition of Entitled Person   | Entitlements  | Implementation Issues   |
|---------|---|---|---|---|
| 1       | Loss of agricultural land   | Legal owner of the land, as identified by the revenue record in the Land Acquisition Assessment report. | i. Replacement land if available or<br><br>ii. Cash Compensation under LAA-1894 & National Policy on Involuntary Resettlement (replacement value assessed by DOR plus 15% compulsory land acquisition cost)   | a. Assessment of quantity and quality of land<br><br>b. Assessment of market value<br><br>c. Assessment of replacement value land<br><br>d. Title updating<br><br>e. Payment of cash compensation<br><br>f. APs will be fully informed of the entitlements and procedures regarding payment |
| 2       | Loss of crops to cultivable land by farmers, (tenants/share croppers) | Farmers, tenants and share croppers of the land under contract  | i. Cash compensation for crop loss to farmer, tenant/share cropper, based on market value of crops as per LAA-1894 & National Policy on Involuntary Resettlement.<br><br>ii. Preference in employment during construction activities as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement. | a. Individuals identified by the Land Acquisition Assessment Report (LAAR) as tenant or share cropper of land<br><br>b. Cash grant as determined by assessment will be paid after taking possession of the land<br><br>c. The legal owner certifies the tenancy                             |

| Sr. No. | Nature of Loss                                     | Definition of Entitled Person  | Entitlements  | Implementation Issues   |
|---------|--|--|---|---|
| 3       | Loss of trees/perennials                           | Persons with legal ownership of the land where the trees are located and crops are grown | i. Compensation at the market value, based on productivity and age of trees assessed as per LAA-1894 & National Policy on Involuntary Resettlement.   | a. Assessment of loss and market value of the loss<br><br>b. Payment of cash compensation for the losses<br><br>c. Additional cash grant to cover the replacement value of the lost trees / perennials (if necessary)   |
| 4       | Loss of residences/ commercial structures by owner | (a) Legal owner of the structures  | i. Cash compensation for the structure at the market/replacement value as per LAA-1894 & National Policy on Involuntary Resettlement.<br><br>ii. One time cash grant to transfer the structure to new location as per National Policy on Involuntary Resettlement.<br><br>iii. Transitional period allowance to affected households and businesses as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement.<br><br>iv. Trainings of the affectees for their capacity building as income restoration | a. Payment of compensation for the losses<br><br>b. APs will be fully informed about their entitlement and assisted in obtaining it<br><br>c. A transfer grant to each household will be paid during or after vacating the project sites<br><br>d. Removal cost for commercial structure at the same rate to the owners of structures |

| Sr. No. | Nature of Loss   | Definition of Entitled Person                                   | Entitlements   | Implementation Issues   |
|---------|--|---|--|---|
|         |  |   | <p>and rehabilitation measure as per National Policy on Involuntary Resettlement.</p> <p>v. Preference in employment during construction activities as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement.</p>   |   |
| 5       | Loss of business by shops/business owners due to dislocation | Owner/operator of the business as recorded by the census survey | <p>i. Business restoration grant to owners, renters and lease holders as per National Policy on Involuntary Resettlement.</p> <p>ii. Illegal landlords occupying the government land/public parks will not be eligible for business restoration grant but illegal shop owners will be eligible for business restoration grant as per National Policy on Involuntary Resettlement.</p> <p>iii. Trainings of the affectees for their capacity building as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement.</p> <p>iv. Preference in employment during</p> | <p>a. All persons recorded by the census survey</p> <p>b. Cash grant to be paid after taking possession of land</p> |

| Sr. No. | Nature of Loss   | Definition of Entitled Person  | Entitlements   | Implementation Issues   |
|---------|--|--|--|---|
|         |  |  | construction activities as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement.   |   |
| 6       | Loss of income, employment/work opportunity of full-time/ part time workers      | Workers of affected business as recorded in the census survey  | i. One time cash compensation for six month salary as per National Policy on Involuntary Resettlement.<br><br>ii. Trainings of the affectees for their capacity building as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement.<br><br>iii. Preference in employment during construction activities as income restoration and rehabilitation measure as per National Policy on Involuntary Resettlement. | a. All persons recorded by the census survey<br><br>b. Cash grant to be paid after taking possession of land<br><br>c. Involvement of the incumbents in project civil works |
| 7       | Impacts on public utilities like piped water supply, electricity, telephone etc. | Legal owner of the structure(s) with utility services or only the legal owner of the utility services as identified by Land Acquisition Assessment Report (LAAR) | i. Cash compensation for the utility facilities at reconstruction cost as per LAA-1894 & National Policy on Involuntary Resettlement.<br><br>ii. One time cash grant to transfer/re-installment the utility services to new location as per National Policy on   | a. Payment of cash compensation for the losses<br><br>b. Verification of the ownership records<br><br>c. APs will be fully informed about their entitlement and             |

| <b>Sr. No.</b> | <b>Nature of Loss</b>  | <b>Definition of Entitled Person</b>                      | <b>Entitlements</b>  | <b>Implementation Issues</b>  |
|----------------|--|---|--|---|
|                |  |   | Involuntary Resettlement.  | <p>assisted in obtaining it</p> <p>d. A transfer/re-installment grant for identified utilities to each household/structure owner (renter) will be paid during or after vacating the project sites</p>   |
| 8              | Adverse impact on the host communities due to relocation of APs during and after the implementation of the project | Affected or host area/village where the APs will relocate | i. Provision for additional civic amenities (roads, tube well for drinking water, community slab latrines, addition to community facilities) as per National Policy on Involuntary Resettlement. | <p>a. Assessment of community needs</p> <p>b. Consult the host population and provision for common property resources</p> <p>c. Implement the mitigation programs</p> <p>d. All affectees are settled on agriculture land and they will shift to their adjacent ownership area, hence no major host population is involved.</p> |

- i. Compensation for the lost structure (if owner) as per assessed values/price by District Officer Revenue (DOR), provided it is certified by the land owner.
  - ii. The owner's income is below the poverty line.
  - iii. Cash compensation for shifting of the house from proposed project.
  - iv. Trainings of the affectees for their capacity building to restore their livelihoods.
- c)** How will the prices for different affected assets / infrastructures / livelihood / community property etc, be determined?
- d)** What prices will be used? (Mere mention of market prices is not sufficient); how will those prices be collected?

Compensation framework (**Section – 13.8.1**) covers all these parameters in detail for each type of affected land, private and commercial building structures and other immovable land based assets. These prices are based on the current market prices ascertained through the field investigations and consultation with the affectees, relevant government departments, local real estate dealers and transactions made in the project area within the last one year.

- e)** The affected community will be paid cash compensation for structure through the Management Committee along with the shifting assistance.

Community facilities/common property resources will be reconstructed/improved/rehabilitated at project cost.

- f)** What else will be provided besides, the cash compensation?

Beside cash compensation for the lost assets, the seriously affected and vulnerable affectees will be provided with the preference to employment opportunity during project construction and vocational training as a measure of capacity building in various trades according to the interest and capability of the affectees or their family members. Funds have been allocated for capacity building/ training and the training institutions will be identified.

- g)** What will be the status of salvage value and depreciation?

All the salvage materials will remain the property of the affectees and assets will be compensated at the current market rate with no depreciation.

h) At what time in the process will all compensations be paid?

The compensation will be paid one month prior to the formal issuance of the construction contract.

i) There are many other variables that need to be addressed, along with those mentioned here.

The Entitlement and Compensation Matrix framework fully covers all the elements related with the affectees and their affected land and land based assets, livelihoods restoration measures to mitigate the adverse impacts.

### **13.8.5 Consultations / Scoping Sessions**

A series of scoping sessions and focus group discussions were carried out with the affectees, local communities, representatives from non-governmental organization, so that their support may be obtained during resettlement and expropriation process. Generally, residents are found to be aware about the need of the proposed hydropower project. The concerns of the PAPs were discussed through individual interviews and scoping sessions from the sample villages.

#### **13.8.5.1 Points Discussed**

Following points were discussed during the public consultations:

- Project components, its activities and impacts
- Needs, priorities and reactions of the affected population regarding the proposed Project
- Ensuring the participation of the PAPs in the resettlement planning
- Grievances redress procedures
- Entitlement Matrix development for the affectees of the Project
- Evaluation criteria of the buildings
- Basis for determining the rates of the land, houses, and other infrastructures
- Compensation framework for the Project affectees
- Compensation criteria to be followed for the payment to the affectees and
- Role of the affectees in implementation of the project

### **13.8.5.2 Consultations and Participation During Implementation Stage of RAP**

The representative of implementing agency together with social and Resettlement Experts will publish brochures, posters, leaflets etc. explaining the impacts of the proposed Project, compensation policies for APs, resettlement options/ strategies for households, and tentative implementation schedule of the project. Furthermore, steps will be taken to keep the affected population informed about land acquisition plan, compensation policies and payments, resettlement plans and strategies and to ensure that the APs will be involved in making decisions concerning their relocation and implementation of the RAP. During the implementation stage, various stakeholders from the Project Area will be involved to seek input in the decision making and implementation of the RAP.

### **13.8.6 Institutional Framework**

WAPDA / ATL (Associated Technologies (PVT) Ltd) will be responsible for the implementation of the RAP through its Project Director and field offices, with the collaboration of district government departments. Project Director will make necessary arrangements for the implementation of tasks about Environment, Afforestation, Land and Social Aspects and to coordinate and monitor the resettlement activities. The concerned government departments will assess the prices; undertake the process of land acquisition, compensation and livelihood rehabilitation. Grievances redress mechanism, internal and external monitoring mechanism will be established to ensure the proper implementation of the RAP in an accountable and transparent manner.

#### **13.8.6.1 Implementation Arrangements**

WAPDA / ATL have overall responsibility for the Program implementation and financing of all RAP development tasks and cross-agency coordination by following arrangements.

- i. Program Management Unit. There shall be a Program Management Unit (PMU) comprising WAPDA / ATL at Lahore, headed by the General Manager (Hydropower Program). The PMU shall be adequately staffed with competent professionals. The staff will include an Environment Specialist, a Resettlement Specialist, a Contract Administration Specialist and a Financial Management Specialist. The PMU will be responsible for the overall planning, management and monitoring of the resettlement program.
- ii. Environmental, Afforestation, Land and Social. Development specialists at PMU will provide technical guidance and support to the PMU and field offices

on environmental and social issues during implementation. They will supervise the implementation of the RAP. Specific responsibilities will be as under:-

- Coordination for all land management related issues with the Project Director and ensure economic utilization of funds earmarked for land acquisition.
  - Liaison with field office on land management and project matters on permanent basis.
  - Maintain complete record/data of land management and social issues including follow-up of land acquisition disputes and response to petitions/complaints received from general public regarding payment of compensation and other related issues.
  - Assist in court cases concerning land acquisition disputes.
  - Monitoring and reporting of social and environmental issues compliance during the implementation of the project.
  - Coordination for all relevant foreign missions visiting various components of project for social / environmental impact review and analysis.
- iii. Field Implementation Unit. One 'Field Implementation Unit' (FIU) shall be set up headed by a Project Director (PD). The PD will be overall responsible for the implementation of all RAP development tasks and cross-agency coordination, and shall be tasked with day-to-day RAP related activities. The PD shall be assisted by a 'Social Safeguards / Resettlement / Environment Specialist' at PMU. A Land Acquisition Collector (LAC) – one assigned to project area– shall acquire land.
- iv. RAP Steering Committee (RSC): To be established soon after project approval at project level to provide overall guidance and oversight for the RAP implementation. The RSC will meet periodically to ensure that PMU, the consultants, the LACs, other district agencies and the office of the relevant department work together to implement the RAP. Its membership is as follows
- a. WAPDA
  - b. ATL
  - c. The Board of Revenue;
  - d. Relevant District Departments and

- e. The Environmental Protection Agency (EPA).
- f. Local Government Representative(s)
- g. Contractor Representative (if other than ATL)

### **13.8.7 Grievances Redressal Mechanism**

A Grievance Redressal Committee (GRC) will be constituted and established at District level in Rawalpindi, which will look into all the grievance cases. This GRC will be composed of the representatives of (i) District Revenue Officer; (ii) WAPDA (iii) ATL and (iv) the Affectees Representatives. The main objective of the grievance redressal mechanism shall be to investigate charges of irregularities and complaints received from the affectees and provide an early, transparent and fair resolution. The Deputy Project Director (DPD) will be assigned to maintain a community complaints-management register to record grievances brought forward by affected persons/communities, and ensure that these are appropriately addressed. Main objective of the grievance redress procedure will be to provide a mechanism to mediate conflict and cut down on lengthy litigation, which are often observed to be source of delays of such projects. It will also provide a forum of persons who might have objections or concerns about their assistance and address these issues adequately.

WAPDA / ATL Project Director Site Office will nominate one Deputy Director (DD). He will review the case on merit and address the problem in accordance with the standing rules/procedures applicable to such grievances as per provisions in the RAP. In the event that Deputy Director is unable to reach an agreement, the cases will be referred to GRC. GRC will meet at least once every fortnight to review and consider the cases on merit and take a decision as per compensation package and entitlement matrix developed and approved in RAP. This decision of GRC will be the final. The GRC will deliver its decision within two weeks of registration of the case. If no understanding or amicable solution can be reached or if the affected person does not receive a response from the GRC within two weeks of the registry of the complaint, he/she can appeal to the Project Director WAPDA / ATL, through site office, who should act on the complaint/grievance within two weeks of the day of its filing. If the affected person (s) is not satisfied with the decision of the Project Director, then it can be referred to higher authorities/relevant Government departments for its resolution. As a last resort he/she may submit the complaint to a court of law. Affected persons will be exempted from all administrative and legal fees incurred due to the grievance redress procedures. All complaints received in writing (or written when received verbally) will be documented. The flow chart of the proposed grievance redressal mechanism is presented in Fig. 13.8.1.

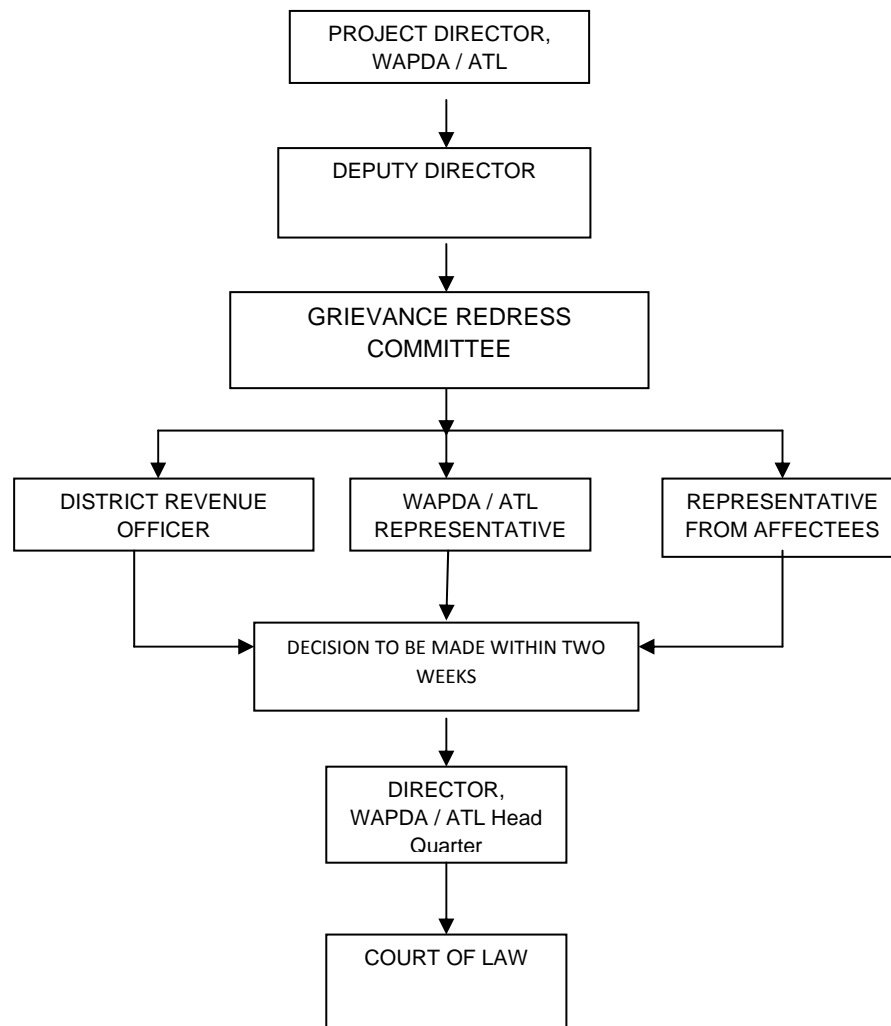


Figure 13.8.1: Flow Chart of the Proposed Grievance Redressal Mechanism

### 13.8.7.1 Procedure for Redress of Grievances

Suggested procedures to be adopted for the redressal of the grievances are given below:

- Project affectee will submit his/her application to the Field Implementation Unit for consideration. Within 15 days of the receipt of the complaint, action will be taken up for redressal of the grievance. Wherever policy matters are involved, the case will be referred to the appropriate authority or committee appointed by the Project to decide the matter.
- In case some response on the complaint is not received within 15 days of the receipt of the complaint, the complainant may also send a reminder to the PMU within 15 days notice to take legal remedial measures.

- In case the matter has been decided but the complainant is not satisfied, he/she may go to the court of law.
- In case of such eventualities, all affected persons should be exempted from legal and administrative fees made/paid/incurred pursuant to the grievance redressal procedures.
- All complaints received in writing or written when received verbally will be properly recorded and documented.

#### **13.8.7.2 Complaints and Grievances**

A grievance mechanism will be available to allow an AP appealing any disagreeable decision, practice or activity arising from land or other assets assessment, acquisition and compensation. APs will be fully informed of their rights and of the procedures for addressing complaints whether verbally or in writing during consultation, assessment survey, and at the time of compensation. Care will always be taken to prevent grievances rather than going through a redress process. This can be obtained through careful Land Acquisition Resettlement (LAR) design and implementation, by ensuring full participation and consultation with the Affected Persons (APs), and by establishing extensive communication and coordination between the community, the Project Management, the Land Acquisition Collector (LAC) and local governments in general.

#### **13.8.7.3 Disbursement of Funds**

As finances will move from WAPDA / ATL through the District Coordination Officer/Collector Office to the APs. Consequently disbursement of funds for Land Acquisition and land based assets in assistance with the relevant line departments and approval of WAPDA/ATL will be taken up.

#### **13.8.8 Monitoring and Evaluation**

Monitoring and evaluation is an important tool for the managers to determine the status of the Project. Only through a well planned and organized system of monitoring and evaluation, the progress against the given targets for various components of a development project can be achieved. The purpose of RAP monitoring is to verify that:

- Actions and commitments described in the RAP are implemented fully and on time,
- Eligible affected residents receive their full compensation entitlements within agreed timeframe,

- RAP actions and compensation measures are effective in sustainable enhancing (or at least restoring) affected population living standards and income levels,
- Complaints and grievances lodged by Project affected persons are followed up and where necessary, appropriate corrective actions are taken up and implemented.

In the project two types of monitoring and evaluation processes are involved i.e. internal and external monitoring. Internal monitoring includes performance monitoring, whereas external monitoring includes impact monitoring and completion report (Figure 13.8.2).

#### **13.8.8.1 Internal Monitoring**

The indicators and benchmarks for achievement of the objectives under RAP are categorized as follows:

- (i) Process indicators, which include project inputs, expenditures, staff deployments etc;
- (ii) Output indicators are results in terms of numbers of affected persons compensated and mitigated, incomes restored, additional assistance provided etc; and
- (iii) Impact indicators related to the long-term effects/benefits of the project on residents lives in the project-affected area.

The first two types of indicators, related to process monitoring and immediate outputs and results will be monitored internally by WAPDA / ATL. This information will be collected from the project site and assimilated in the form of a monthly progress reports to assess the progress and results of RAP implementation and adjust the work program, where necessary, in case of any delay or problem. Specific activities under RAP implementation that will be monitored are:-

- (i) Consultation with the AP's and information dissemination campaign to create awareness,
- (ii) Compensation payments for affected structures, houses, shops, businesses etc,
- (iii) Status of compensation disbursement for houses / shops / rentals (if any),
- (iv) Progress of community development activities / community structures restoration/relocation,

- (v) Progress of liaison with construction contractor for employment opportunities for AP's,
- (vi) Payments for loss of income; and
- (vii) Income restoration activities.

The PMU will be responsible for monitoring / supervising the day-to-day rehabilitation, resettlement/activities of the Project. A performance data sheet will be developed to monitor the project at the field level. Monthly progress reports (Figure 13.8.2) will be prepared by the WAPDA / ATL field office.

#### **13.8.8.2 External Monitoring**

Resettlement consultants will be engaged to carry out the evaluation of the RAP implementation. The Resettlement Consultants will review the status of the RAP implementation in the light of the targets, budget and duration that had been laid down in the RAP. The key tasks during external monitoring include:

- a) Review and verify internal monitoring reports prepared by WAPDA / ATL Site / Field office
- b) Identification and selection of impact indicators;
- c) Impact assessment through formal and informal surveys with the APs;
- d) Consultation with APs and Officials of WAPDA / ATL for preparing review report; and
- e) Assess the resettlement efficiency, effectiveness, impact and sustainability, drawing lessons for future resettlement policy formulation and planning in the private investment programs/ projects.

Figure 13.8.2: Resettlement Action Plan Monitoring Schedule

| S. No | Types of Monitoring                       | Year 1   |   |   |   | Year 2 |   |   |   | Year 3 |   |   |   | Year 4 |   |  |   |
|-------|---|--|---|---|---|--------|---|---|---|--------|---|---|---|--------|---|--|---|
|       |   | 1  | 2 | 3 | 4 | 1      | 2 | 3 | 4 | 1      | 2 | 3 | 4 | 1      | 2 | 3  | 4 |
| 2     | Internal Monitoring (Monthly)             | [Continuous monitoring indicated by a thick black line across all quarters of all years] |   |   |   |        |   |   |   |        |   |   |   |        |   |  |   |
| 3     | RAP Implementation Monitoring (Quarterly) | -  | - | - | - | -      | - | - | - | -      | - | - | - | -      | - | -  | - |
| 4     | External Monitoring                       |  | - |   | - |        | - |   | - |        | - |   | - |        |   | [Monitoring indicated by a thick black line across quarters 3 and 4 of Year 4] |   |

Monitoring will also pay close attention to the status of project affected vulnerable groups such as female-headed households and economically backwards families (i.e. below poverty line). The following will be the basis for indicators in monitoring and evaluation of the project:

- a) Socio-economic conditions of the APs in the post-resettlement/ rehabilitation period;
- b) Communications and reactions from APs on entitlements, compensation;
- c) Changes in housing/ business restoration and income levels;
- d) Grievance procedures; its recording, reporting and processing time and its redressal;
- e) Progress of community development schemes;
- f) Disbursement of compensation; and
- g) Level of satisfaction of APs in the post resettlement period.

External consultants will also carry out a final evaluation / closures report at the end of the project as per implementation schedule given in Figure 13.8.2.

### **13.8.8.3 Reporting Requirements**

The WAPDA / ATL will be responsible for supervision and implementation of RAP and will prepare monthly progress reports on resettlement/rehabilitation activities and the external consultant will also monitor RAP implementation and prepare reports. The external consultants/ Resettlement Consultants will prepare and submit a brief mid-term Report to WAPDA / ATL and determine whether or not resettlement/rehabilitation/business restoration goals have been achieved. A completion report will be prepared at the end of the project covering the progress of work and achievements against the planned targets and lessons learnt.

### **13.8.9 Implementation Schedule**

The implementation of the RAP is briefly described as under:-

#### **13.8.9.1 Acquisition of Land and Land Based Assets**

In the project area, land and land based assets are existing. These need to be acquired for which necessary legal procedures are involved which will be completed.

Land and land based immovable assets will be compensated by the Land Acquisition Collector (LAC). The total amount so assessed will be deposited by WAPDA / ATL to the LAC(s) for subsequent payment of compensation to the entitled affected persons. After its taking over by WAPDA / ATL, the construction contractor will be able to start construction work. Payment of compensation to the entitled persons will be made about one month prior to the possession of acquired land. No land will be possessed without full payment of the entitled compensation to the affected land owners and tenants. In case of dispute the assessed/allocated amount of compensation will be pledged with the DOR in favour of the affected person, till a decision is made on disputed issue. Various steps are involved in the land acquisition process, for which responsibilities are lying with a number of other line departments as indicated in Table 13.8.2.

### **13.8.9.2 Implementation Process**

The AP's of affected structures/assets (houses, shops, etc.) will be paid their due compensations at least one month (30 days) prior to demolition of the structures from the project area. This time will allow them to dismantle and remove all salvageable material for rebuilding of houses and re-establishment of businesses. However, WAPDA / ATL reserves the right of directly demolishing of such structures if this has not been done by the AP's by the agreed deadline.

**Table: 13.8.2:RAP Implementation Processing**

| <b>Sr. No</b> | <b>Description</b>   | <b>Responsibility</b>                        |
|---------------|--|--|
| 1             | Board of Revenue approval  | WAPDA/Consultants                            |
| 2             | Reconfirmation of impact inventory data                                | WAPDA / ATL                                  |
| 3             | Compensation assessment /award issuance                                | Revenue Department                           |
| 4             | Payment of compensation to APs   | Revenue Department                           |
| 5             | Grievance Redress  | Aggrieved Affectees /WAPDA/Revenue Dept. ATL |
| 6             | Possession of Land/ and other assets                                   | Revenue /WAPDA / ATL                         |
| 7             | Finalization and implementation of household skill development options | WAPDA / ATL                                  |
| 8             | Monitoring and evaluation Internal                                     | WAPDA / ATL                                  |
| 9             | Monitoring and evaluation External                                     | Consultant/ Institution                      |

Some of these activities like assessment, compensation payment, grievances redress, monitoring and evaluation will continue simultaneously by revenue department.

### **13.8.10 Resettlement and Compensation Cost**

The environmental and resettlement cost is an important component of EIA. The cost of this component is calculated keeping in view the guidelines, objectives and policies made by Pakistan Environmental Protection Agency and World Bank/Asian Development Bank. The compensation has to be fair, judicious and transparent in order to satisfy the project affected population and avoid any litigation.

Efforts were made to work out realistic cost estimates/values that are applicable for a fair compensation to the affectees. For this reason, concerned Government departments like building, revenue, forest, agriculture were consulted and subsequently market surveys were carried out in order to evaluate and apply unit rates based on the ground realities. However, these costs are indicative and presently applicable and will be reviewed by the committees constituted for such purposes as the Land Price Evaluation Committees or Revenue Department.

The costs include the cost of land, building structures/houses and commercial structures, forest and fruit trees, crops, transitional period assistance and shifting charges for the affectees falling in the project area. The estimated costing details are presented in Table 13.8.3.

#### **13.8.10.1 Land Acquisition**

The land acquired for various activities consists of two types i.e. (i) the agricultural/residential land and (ii) uncultivable/range land. The agricultural/residential land is the private land and will be fully compensated while the uncultivable/range land mostly consists of river banks area and ownership of the land is both public (state land) and private ownership. The reservoir area has been estimated from the satellite imageries, the total area comes to 1053 ha (2602 acres). Out of this 1053 ha, 181 ha (447.3 acres) area is under river bed and remaining 872 ha (2154 acres) area is of state+ private area. Assuming that 60 % of the 872 ha (2154 acres) area is of state land and remaining 40 % (861.6 acres) area belongs to private ownership which will be compensated @ 700000/ acre + 10 % compulsory acquisition charges. These rates for land acquisition will be however fixed by the Revenue Department of District Rawalpindi. These costs will need to be adjusted accordingly based on the evaluation of the Land valuation Committee. The total cost of land comes to Rs. 663.35 Millions and is presented in Table 13.8.3.

#### **13.8.10.2 Houses Compensation**

The number of houses (10 Nos) affected due to project construction and their cost (Rs. 45 millions) is given in Table 13.8.3. House assessment was made in the field. It

is estimated that the average constructed/covered area of a house is about 3000 square feet, and cost of per square foot for pacca is estimated as Rs. 1500.

#### **13.8.10.3 Trees**

There is no regular specific forest or fruit plantation in the project area. Mostly some fast growing forest species are grown. However, the compensation, if any, will be paid to the affectees on the basis of volume of timber. The removed forest plantation has to be replanted in a 1:4 ratio through the project. The estimated cost of trees comes to Rs. 6 million and is given in Table 13.8.3.

#### **13.8.10.4 Infrastructures**

Privately owned community structures generally include mosques and ground/overhead tanks and the Government infrastructures include suspension bridge, electric poles relocation, telecommunication poles, compensation of schools and relocation of transmission line etc. These are valued at current replacement costs including installation charges. With addition of 15% involuntary acquisition charges, the cost of compensation of the affected infrastructures i.e. (4 bridges and underground/ over head water tanks etc) in the project is worked out as Rs. 188.0 millions and is presented in Table 13.8.3.

#### **13.8.10.5 Crop Compensation**

Main crops being grown in the areas are wheat, rice, maize. Vegetables are cultivated on a very limited scale. More than 50 percent of the cultivable land remains fallow. Based on this cultivation pattern and intensity, these farm owners will be entitled for crop produce compensation on gross income. The estimated cost for this purpose is Rs.2.8 millions (Table 13.8.3).

#### **13.8.10.6 Access Road**

The diversion / access road(s) will need to be constructed by the WAPDA / ATL. The cost for diversion / access road(s) needs to be provided in main project cost.

#### **13.8.10.7 Construction Material and Spoil Disposed Areas Rehabilitation**

The proposed dam of Karot Hydropower Project is concrete gravity dam and during construction a huge amount of crushed aggregate will be required for fabrication of different types of structures. These aggregates will be collected from different nearby suitable sites. After getting the aggregates/material these sites will need to be rehabilitated properly. In addition to above during construction period there will be lot of waste material/ muck due to the cutting and excavation; which has to be disposed off properly. These areas will also need to be rehabilitated after disposing off the

waste material/ muck for having better environment. By this rehabilitation and land filling some additional areas will be available for growing crops/trees etc and provide land for livelihood restoration to some families. The cost for the restoration of such areas is estimated as Rs. 10 millions (Table 13.8.3).

#### **13.8.10.8 Transition, Shifting and Livelihood Restoration Allowance**

Each family is entitled for transition period allowance. Transition period allowance consists of six months rent @ Rs. 12,000 per month for hiring a house by each family during their house construction and house hold shifting charges of Rs. 16,000. Livelihood restoration charges for six months @ Rs 12000 per month will also be paid with overall total amount of Rs. 1.6 million (Table 13.8.3) to the affected families.

#### **13.8.10.9 Restoration and Rehabilitation of Commercial and Business Enterprise**

There is fifteen (15) timber saw commercial enterprise the owners of the timber saw will be entitled to receive cash allowance for six months @ 50,000/ month in addition to the compensation for loss of structures. The total cost approximately comes to Rs. 7.9 millions and is presented in Table 13.8.3.

#### **13.8.10.10 Livelihood Restoration for Employees of Commercial and Business Enterprises**

One time cash allowance for six months @ Rs. 9000/month lumpsum will be paid to the employees. The estimated cost comes to Rs. 1.35 millions and is presented in (Table 13.8.3).

#### **13.8.10.11 Community Awareness Program**

To increase awareness about the project structure and its subsections and their role in sustainability of the project an awareness drive is to be taken up. The estimated cost for this purpose comes to Rs. 1.0 million (Table 13.8.3).

#### **13.8.10.12 Monitoring and Evaluation and Environment Management Program**

For proper analysis and assessment to determine the extent to which the targets planned are being achieved. Monitoring and evaluation of the project program are made and is considered necessary. This is also necessary to identify the short falls of the program and suggest remedial measures. A lump sum provision of Rs. 5 million for 5 years (Table 13.8.3) is earmarked for this purpose.

#### **13.8.10.13 Capacity Building / Training**

Project affectees will need to be given opportunity of improving their skills through capacity building / training program. This capacity building / training of the APs will play important role in the resettlement/ rehabilitation of these residents. After this training they will have better opportunities for employment or running their own business. The estimated cost for this purpose comes to Rs. 2.5 millions and is presented in Table 13.8.3.

#### **13.8.10.14 Contingencies**

To meet the cost of some unforeseen items a contingency allowance will be required @ 6% of cost of all resettlement related items and is given in Table 13.8.3.

**Table 13.8.3: Environment Management and Resettlement Cost**

| Sr. No | Description                        | Unit  | Quantity | Cost / unit (Rs) | Total Cost (Rs million) | % of cost | Remarks  |
|--------|------------------------------------|-------|----------|------------------|-------------------------|-----------|--|
| 1      | Land Acquisition                   | kanal | 6892     | 96250            | 663.35                  | 67.2      | 15 % involuntary land acquisition charges included                   |
| 2      | House Compensation                 | Sq.ft | 30000    | 1500             | 45.0                    | 4.5       | 10 Nos of houses are going to be affected.                           |
| 3      | Trees Compensation                 | No    | LS       |                  | 6.0                     | 0.06      | Damaged trees will be replaced by 3-4 times.                         |
| 4      | Infrastructures                    | -     |          |                  | 188                     | 18.93     | Include 4 Pedestrian bridges and underground/ over head water tanks. |
| 5      | Crop Compensation                  | -     | LS       |                  | 2.8                     | 0.28      | Compensation will be based on existing crop in the field.            |
| 6      | Spoil Disposal Area Rehabilitation | -     | LS       |                  | 10                      | 1         |  |
| 7      | Transition Allowances              | No    | 10       | 12000            | 0.73                    | 0.07      | 12000/month /family for 6 months.                                    |

| Sr. No | Description  | Unit | Quantity | Cost / unit (Rs) | Total Cost (Rs million) | % of cost | Remarks                                   |
|--------|--|------|----------|------------------|-------------------------|-----------|---|
| 8      | Livelihood Allowance for Affectees by House  | No   | 10       | 12000            | 0.72                    | 0.07      | 12000/month /family for 6 months.         |
| 9      | Shifting Charges   | No   | 10       | 12000            | 0.16                    | 0.016     | 16000/ family. One time.                  |
| 10     | Commercial Enterprises   | No   | 15       | 50000            | 7.5                     | 0.75      | 50000/month/enterprise for 6 months       |
| 11     | Shifting Charges   | No.  | 15       | 40000            | 0.6                     | 0.06      | 40000/enterprise one time                 |
| 12     | Rent for Six Months  | No   | 15       | 10000            | 0.9                     | 0.09      | 10000/month/enterprise for six months     |
| 13     | Livelihood for Commercial Enterprise   | No   | 15       | 10000            | 0.9                     | 0.09      | 10000/month/enterprise for six months     |
| 14     | Livelihood Allowance for Affected Employees of Commercial Enterprises for six months | No   | 25       | 9000             | 1.35                    | 0.13      | 9000/month/employee for six months        |
| 15     | Community Awareness  | -    | LS       |                  | 1.0                     | 0.1       | For awareness of the affected population. |

| <b>Sr. No</b> | <b>Description</b>         | <b>Unit</b> | <b>Quantity</b> | <b>Cost / unit (Rs)</b> | <b>Total Cost (Rs million)</b>  | <b>% of cost</b> | <b>Remarks</b>                         |
|---------------|----------------------------|-------------|-----------------|-------------------------|---------------------------------|------------------|--|
| 16            | Monitoring and Evaluation  | -           | LS              |                         | 5.0                             | 0.5              | Monitoring and evaluation for 5 years. |
| 17            | Capacity Building/Training | No          | 10              |                         | 2.5                             | 0.25             | For affected families.                 |
|               | <b>Sub total</b>           | -           | -               |                         | <b>936.5</b>                    |                  |  |
| 18            | Contingencies @ 6 %        | -           | -               |                         | 56.19                           | 3.6%             |  |
|               | <b>Grand Total</b>         | -           | -               |                         | <b>992.69</b><br><b>Say 993</b> | <b>100</b>       |  |

### 13.8.10.15 Summary of Resettlement Cost

A summary of resettlement cost of all the components is provided in Table 13.8.4. The total indicative resettlement cost amounts to Rs. 993 million.

**Table 13.8.4: Summary of Indicative Costs for Resettlement Action Plan**

| Sr. No | Description   | Unit  | Quantity | Total Cost<br>(Rs million) | % of cost  |
|--------|---|-------|----------|----------------------------|------------|
| 1      | Land Acquisition  | kanal | 6892     | 663.15                     | 67.2       |
| 2      | House Compensation  | Sq.ft | 30000    | 45                         | 4.5        |
| 3      | Trees Compensation  | No    | LS       | 6.0                        | 0.06       |
| 4      | Infrastructures   | -     | -        | 188                        | 18.93      |
| 5      | Crop Compensation   | -     | LS       | 2.8                        | 0.28       |
| 6      | Spoil Disposal Area Rehabilitation                                    | -     | LS       | 10                         | 1          |
| 7      | Transition Allowances   | No    | 10       | 0.73                       | 0.07       |
| 8      | Livelihood Allowance for Affectees by House                           | No    | 10       | 0.72                       | 0.07       |
| 9      | Shifting Charges  | No    | 10       | 0.16                       | 0.06       |
| 10     | Commercial Enterprises  | No    | 15       | 0.9                        | 0.09       |
| 11     | Shifting Charges  | No.   | 15       | 0.6                        | 0.06       |
| 12     | Rent for Six Months   | No    | 15       | 0.9                        | 0.09       |
| 13     | Livelihood for Commercial Enterprise                                  | No    | 15       | 0.9                        | 0.09       |
| 14     | Livelihood Allowance for Affected Employees of Commercial Enterprises | No    | 25       | 1.35                       | 0.13       |
| 15     | Community Awareness   | -     | LS       | 1.0                        | 0.30       |
| 16     | Monitoring and Evaluation   | -     | LS       | 5.0                        | 1.52       |
| 17     | Capacity Building/Training  | No    | 10       | 2.5                        | 0.76       |
|        | <b>Sub total</b>  | -     | -        | <b>936.5</b>               |            |
| 18     | Contingencies @ 6 %   | -     | -        | 56.19                      | 3.6        |
|        | <b>Grand Total</b>  | -     | -        | <b>992.69</b>              | <b>100</b> |
|        |   |       |          | <b>Say 993</b>             |            |

**Note: These resettlement costs have already been included in main EIA report.**

## **SECTION 13.9**

### **13.9 CONCLUSIONS AND RECOMMENDATIONS**

#### **13.9.1 Conclusions**

##### **13.9.1.1 Project Beneficial Impacts**

The Karot Hydropower Project has been proposed on River Jhelum upstream of Mangla Dam at Karot Village. After completion the project, in general, will have the following benefits:-

- The direct benefits of the project will be 720 MW of electrical power and on average 3436 GWh of electrical energy on average per year .In the wet summer months of May, June, July and August, the plant will generate up to full installed capacity almost around the clock. From October to February, the plant will generate up to full capacity for at least 4 hours per day. During the intervening months of September and March the hours of power generation at maximum capacity will fall/rise according to the river flows.
- The proposed hydropower project exploits a renewable energy source. It will not deplete Pakistan's reserves of natural resources, it will not increase the nation's dependence on imported fossil fuels and its operation will not produce harmful gases. Indeed the hydropower scheme will be credited with displacing the emission of just over 203,000 tones of CO<sub>2</sub> per year that would otherwise be released into the environment by a thermal power plant. For Co<sub>2</sub> reduction, carbon credits can be claimed as compensation.
- Construction of the project will take about 4 years and provide employment and career opportunities for several hundred persons of local population.
- The upgraded Karot access road will substantially improve the transport link between the Upper Karot village and the Kahuta. This in turn will stimulate local trade and correspondingly improve the quality of life of the local communities in the Karot village.
- Encourage international investment in the country.
- Help in the setting up of the industry.
- Ensure regular power supply especially in the project and surrounding areas.

##### **13.9.1.2 Project Adverse Impacts**

The project will be constructed in the sparsely populated area with only 10 households having 70 affected persons only and 15 acres of affected agricultural

land. There is also not much flora and fauna. However, some of the expected adverse impacts are:-

- Deterioration of river water quality, to some extent, between dam site and powerhouse site (About 0.7 km only)
- Increase in flood levels and frequency due to head pond flushing.
- Insignificant impact on fish production downstream.
- Some productive area may come under reservoir resulting in loss of livelihood.
- Minor impacts on flora in the reservoir area along the river banks.

### **13.9.2 Recommendations**

- Compensation to the affected persons should be made on market rates promptly, and in a transparent way.
- Contractor should hire the labour and skilled / technical staff, if available from the project area on preferential basis.
- During head pond flushing or flood downstream local population should be informed timely to avoid any mishap.
- Water supply for downstream should be ensured to meet the environmental and irrigated agricultural requirements.
- Contractors /labour camps should be located away from the local residential areas.
- Hired labour should be properly housed and all facilities be provided.
- Explosive and toxic material should be stored at proper place and used carefully.

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## **ANNEXURE 13.1**

### **SOCIO-ECONOMIC SURVEY OF KAROT HYDROPOWER PROJECT**

**Socio-Economic Survey of Karot Hydropower Project**

Name of Interviewer: -----

Date: -----

(a) Location -----

(b) Union Council: -----

(c) Tehsil -----

(d) District: -----

1 Name of Respondent -----

2 What is your father's name -----

3 What is your age

|           |          |       |
|-----------|----------|-------|
| Age years | 15 – 25  | ----- |
|           | 25 – 35  | ----- |
|           | 35 – 45  | ----- |
|           | Above 45 | ----- |

4 Marital Status.

1. Married      2. Unmarried

5 What is your caste /ethnic group -----

6 What is your educational qualification?

1. Illiterate      2. Primary      3. Middle  
4. Matric      5. Intermediate      6. Above

7 What is your profession -----

If business, nature of business -----

8 How much is your average monthly expenditure

Expenditure Rs. Less than 5000 -----

5,001 – 15,000 -----

15,001 – 30,000-----

Above 30,000 -----

9 What is your average monthly income?

Income Rs. Less than 5,000-----

5,001 – 15,000 -----

15001 – 25000 -----

25,001 – 40,000-----

Above 40,000 -----

10 Do you get any loan during last year

If yes reasons\_\_\_\_\_ ,

Sources

1. Bank                      2. Relatives                      3. Money Lender

Loan Interest (%)\_\_\_\_\_ ,

11 What is type of your family system?

1. Joint                      2. Nuclear

12 What is employment status of your family members

1. Govt. Employee                      2. Private Employee  
3. Self Employed                      4. Unemployed  
5. Others

13 What are your major sources of income

- |                    |                  |
|--------------------|------------------|
| 1. Agriculture     | 2. General Labor |
| 3. Trade /Business | 4. Service       |
| 5. Any other       |                  |

14 What is type of ownership of your house

- |               |           |
|---------------|-----------|
| 1. Self Owned | 2. Rented |
| 3. Others     |           |

15 What is nature of construction of your house

- |          |               |
|----------|---------------|
| 1. Pacca | 2. Semi-pacca |
|----------|---------------|

16 Which of the following facilities are available in your house

- |                |                 |
|----------------|-----------------|
| 1. Electricity | 2. Water Supply |
| 3. Gas         | 4. Telephone    |
| 5. Sewerage    |                 |

17 What is your landholding size\_\_\_\_\_ (acres)

- |                                    |
|------------------------------------|
| 1. Cultivated land_____ (acres)    |
| 2. Un-cultivated land_____ (acres) |
| 3. Forest Land_____ (acres)        |
| 4. Others_____ (acres)             |

18 What is your cultivation status

- |                     |           |                     |
|---------------------|-----------|---------------------|
| 1. Owner cultivator | 2. Tenant | 3. Owner cum Tenant |
|---------------------|-----------|---------------------|



-----  
-----

24 What kinds of your assets will be affected due to proposed project

i) Land / \_\_\_\_\_ ii) House \_\_\_\_\_ iii) Business / Shop \_\_\_\_\_

iv) Water Resources \_\_\_\_\_ v) Public Assets \_\_\_\_\_

vi) Trees \_\_\_\_\_ vii) Others \_\_\_\_\_

25 Do you have any alternative land/ plot for shifting of your house \_\_\_\_\_

26 What kind of compensation do you want

i) Cash \_\_\_\_\_ ii) Land \_\_\_\_\_ iii) Other \_\_\_\_\_

27 In case of relocation / rehabilitation, what will be your optional

i) Self Arrangement \_\_\_\_\_

ii) Relocation / rehabilitation by the Department \_\_\_\_\_

28 What protective measures do you suggest to safeguard your interests

-----  
-----  
-----  
-----

**Women Survey**

1. Name: -----W/O:-----
2. Age:-----
3. Occupation:-----
4. Married / Unmarried / Widow:-----
5. Children:----- -Male:-----Female:-----
6. Skills You Know:-----
7. Needs Additional Skills:-----
8. Do You Work in Farm:-----
9. Health Status / illness / type:-----
10. Role in Family Decisions: -----
11. Development Needs:-----
12. Priority Needs:-----
  - 
  - 
  -
13. Project Awareness:-----  
-----

## **ANNEXURE 13.2**

### **PHOTOLOG**



**Consultation and Discussion with Project Area Residents**



**Agriculturally Productive Land**



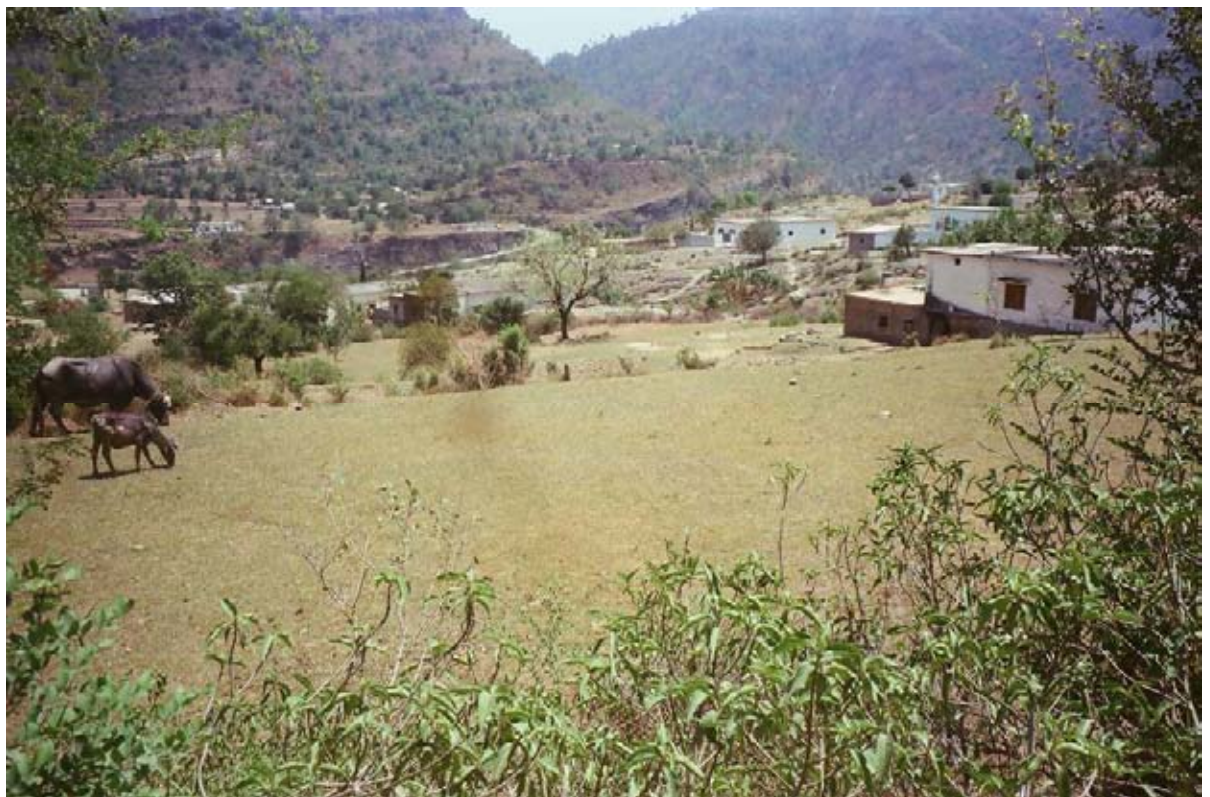
**Houses in Project Area**



**Gorah settlement above submergence level**



**Reservoir Area upstream of Dam Axis**



**Flora and Fauna of the Project**



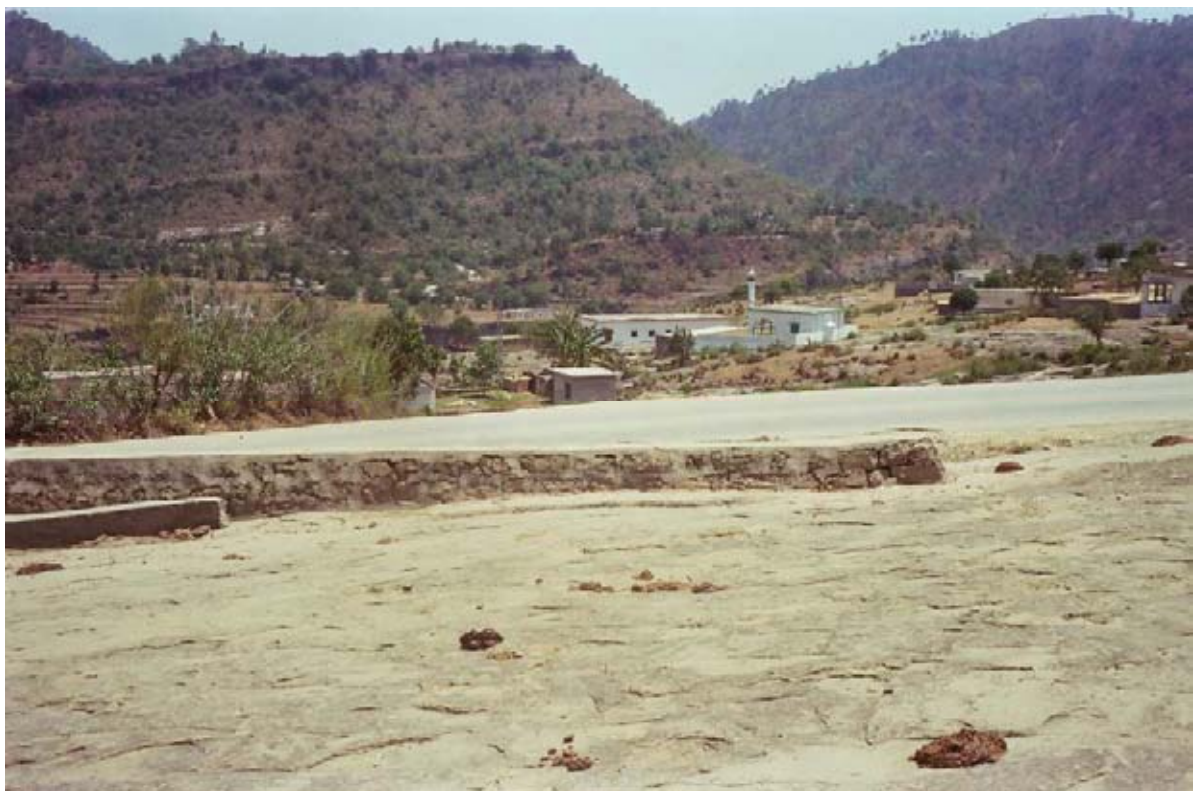
**Dam Axis Site**



**Kahuta-Karot-Kotli Road (With graveyard and Test Borehole area)**



**Block factory and Historical Karot Wall Plaque**



**Mosque and Shrine in the Project Area**

## **ANNEXURE 13.3**

### **FINAL REPORT**

#### **AMBIENT AIR QUALITY, NOISE LEVELS AND RIVER WATER QUALITY**

Consisting of following Annexure

- |                 |   |
|-----------------|---|
| 1- Annexure - 1 | Meteorological Data                           |
| 2- Annexure - 2 | Ambient air quality monitoring Data           |
| 3- Annexure - 3 | Noise Level Monitoring Data                   |
| 4- Annexure - 4 | Surface Water Analysis Report                 |
| 5- Annexure - 5 | Photographs                                   |
| 6- Annexure - 6 | USEPA and Pak- NEQS Standards for Ambient Air |



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**Annexure:**

|              |   |
|--------------|---|
| Annexure - 1 | Meteorological Data                           |
| Annexure - 2 | Ambient air quality monitoring Data           |
| Annexure - 3 | Noise Level Monitoring Data                   |
| Annexure - 4 | Surface Water Analysis Report                 |
| Annexure - 5 | Photographs                                   |
| Annexure - 6 | USEPA and Pak- NEQS Standards for Ambient Air |



## **1. Introduction**

Associated Technologies (Pvt) Ltd. hired the services of SGS Pakistan (Pvt) Limited for environmental assessment. This report is prepared on the basis of environmental monitoring conducted at Karot Hydro Power Project according to the instructions provided by client. Field survey was carried out on July 24 to July 26, 2009 for ambient air quality monitoring, weather conditions, noise level monitoring, sampling and analysis of surface water samples from advised sampling points.

### **1.1. Scope**

Scope of services was finalized after discussion with Associated Technologies (Pvt) Ltd. project team, a brief description of services is as follows:

#### **1.1.1. Ambient Air Quality Monitoring**

Following points were selected for ambient air quality monitoring. The duration of monitoring was 24 hours at individual point.

- Karot Hydro Power Project (Dam Site)
- Karot Hydro Power Project (Power House Site)

#### **1.1.2. Noise Level Monitoring**

Noise level using portable digital sound meter was monitored at same locations where the ambient air quality was monitored.

#### **1.1.3. Sampling and analysis of surface water samples**

Two surface water samples were collected from advised sampling points and submitted to SGS lab for analysis according to parameters as per contract.



## 1.2. Schedule

A site visit was made for selection of sampling points. Sampling schedule was finalized after discussion with Associated Technologies (Pvt) Ltd. project team. The agreed schedule for environmental baseline studies is as follows:

**Table 1: Sampling Schedule**

| Date of Intervention | Scope of Services                             | Location                       | Duration      |
|----------------------|---|--------------------------------|---------------|
| 24-07-09             | Site visit for selection of monitoring points | Karot Hydro Power Project Site | -             |
| 24-07-09 to 26-07-09 | Metrological conditions                       | Dam Site<br>Power House Site   | 24 hours      |
| 24-07-09 to 26-07-09 | Ambient air quality monitoring                | Dam Site<br>Power House Site   | 24 hours      |
| 24-07-09 to 26-07-09 | Noise level monitoring                        | Dam Site<br>Power House Site   | 24 hours      |
| 26-07-09             | Surface Water Sampling                        | Dam Site<br>Power House Site   | Grab Sampling |



## 2. Methodology

Following is the brief description of methodology adapted for this environmental assessment:

### 2.1. Ambient air Quality

Ambient air quality was monitored with the help of Mobile Air Quality Station equipped with the state of the art ambient air analyzers. Selection of sampling points was made considering the wind direction at the advised sampling sites. Following pollutants were measured during monitoring:

- Particulate Matter (PM<sub>10</sub>)
- Sulphur Dioxide (SO<sub>2</sub>)
- Combine Oxides of Nitrogen (NO<sub>x</sub>)
- Carbon Monoxide (CO)

Monitoring for the above mentioned parameters was conducted for 24 hours at advised sampling points. The methodology adopted for ambient air quality monitoring is as follows:

**Table 2: Methodology of ambient air quality monitoring**

| Air Pollutant                          | Monitoring Technique               | Method                                | Measurement Range         | Lowest Detection Limit |
|--|------------------------------------|---------------------------------------|---------------------------|------------------------|
| Carbon Monoxide (CO)                   | Gas Filter Correlation CO Analyzer | USEPA Designated Method RFCA-0981-054 | 0-100                     | 0.01 ppm               |
| Sulfur Dioxide (SO <sub>2</sub> )      | Pulsed Fluorescent Analyzer        | USEPA Designated Method EQSA-0486-060 | 0-50 ppb 0-100 ppm        | 1 ppb                  |
| Nitrogen Dioxide (NO <sub>2</sub> )    | Chemiluminescent Analyzer          | USEPA Designated Method RFNA-1289-074 | 0-50 ppb 0-100 ppm        | 1 ppb                  |
| Particulate Matter (PM <sub>10</sub> ) | High Volume Sampler                | 40CFR50, App. B (US-EPA)              | 2 - 750 µg/m <sup>3</sup> | 2 µg/m <sup>3</sup>    |



## 2.2. Meteorological Conditions

In addition to the advised parameters for ambient air quality, weather conditions were also monitored continuously for 24 hours with the help of mobile weather station. Selection of sampling points was made considering the wind direction at the advised sampling sites. The parameters monitored are as follows:

- Wind Direction
- Wind Speed
- Humidity
- Barometric Pressure

## 2.3. Sampling and Analysis of Particulate Matter

Particulate matter samples for ambient air quality monitoring were collected on fiberglass filters. The collected samples were properly stored and placed in the vacuum desiccators transported to SGS Lab for analysis.

## 2.4. Noise Level Monitoring

Noise level using portable digital sound meter was monitored at same locations where the ambient air quality was monitored.

## 2.5. Water Sampling and Analysis

Two surface water samples were collected from advised sampling points. The collected samples were preserved and submitted to lab for analysis of following parameters:

### 2.5.1. Surface Water Samples 2.5.1.1.

#### Chemical Analysis

- Temperature
- BOD<sub>5</sub>
- COD
- Magnesium
- Fluoride
- Sulphate
- Sulphide
- Ammonia
- Ph
- TDS
- TSS
- Iron
- Chloride
- Barium



Cyanide  
Cadmium  
Chromium  
Copper  
Lead  
Mercury  
Selenium  
Nickel  
Silver  
Zinc  
Arsenic  
Boron



## **Annexure -1**

### **Meteorological Data**



## Meteorological Data

**Client** : Associated Technologies (Pvt) Ltd  
**Sampling Point** : Karot Hydro Power Project (Dam Site)  
**Date of Intervention** : July 24 - 25, 2009

| Time  | Temp | Wind Dir | Wind Speed | Hum | Pressure |
|-------|------|----------|------------|-----|----------|
|       | °C   |          | m/s        | %   |          |
| 11:00 | 33   | E        | 2.7        | 45  | 738.7    |
| 12:00 | 35   | N        | 3.6        | 43  | 738.4    |
| 13:00 | 35   | N        | 3.1        | 42  | 738.2    |
| 14:00 | 36   | E        | 4.5        | 41  | 738.0    |
| 15:00 | 35   | E        | 6.2        | 41  | 737.2    |
| 16:00 | 36   | E        | 7.2        | 43  | 736.7    |
| 17:00 | 33   | E        | 5.8        | 50  | 736.9    |
| 18:00 | 33   | E        | 3.6        | 53  | 736.8    |
| 19:00 | 32   | E        | 4.1        | 56  | 735.8    |
| 20:00 | 31   | NE       | 3.6        | 60  | 736.0    |
| 21:00 | 31   | SE       | 2.2        | 66  | 737.0    |
| 22:00 | 29   | SE       | 1.8        | 74  | 736.8    |
| 23:00 | 28   | SE       | 1.4        | 79  | 736.9    |
| 24:00 | 27   | SE       | 0.9        | 80  | 737.0    |
| 01:00 | 27   | SE       | 0.9        | 82  | 737.1    |
| 02:00 | 26   | SE       | 0.9        | 82  | 736.8    |
| 03:00 | 26   | S        | 0.9        | 80  | 736.0    |
| 04:00 | 26   | SE       | 1.8        | 79  | 736.4    |
| 05:00 | 26   | SW       | 1.3        | 72  | 736.7    |
| 06:00 | 26   | SW       | 0.9        | 72  | 736.9    |
| 07:00 | 26   | S        | 0.4        | 70  | 736.4    |
| 08:00 | 29   | S        | 1.8        | 61  | 736.5    |
| 09:00 | 29   | S        | 2.3        | 58  | 737.0    |
| 10:00 | 30   | W        | 3.6        | 47  | 737.2    |



## Meteorological Data

Client : Associated Technologies (Pvt) Ltd.  
 Sampling Point : Karot Hydro Power Project (Power House Site)  
 Date of Intervention : July 25 - 26, 2009

| Time  | Temp | Wind Dir | Wind Speed | Hum | Pressure |
|-------|------|----------|------------|-----|----------|
|       | OC   |          | m/s        | %   |          |
| 11:00 | 36   | W        | 3.6        | 44  | 744.9    |
| 12:00 | 37   | NW       | 2.2        | 43  | 744.8    |
| 13:00 | 38   | E        | 2.2        | 41  | 744.4    |
| 14:00 | 36   | SE       | 4.9        | 40  | 744.0    |
| 15:00 | 37   | N        | 4.0        | 41  | 743.6    |
| 16:00 | 38   | N        | 3.6        | 38  | 743.3    |
| 17:00 | 38   | N        | 3.2        | 40  | 743.2    |
| 18:00 | 36   | N        | 2.2        | 45  | 743.1    |
| 19:00 | 34   | E        | 2.1        | 46  | 742.9    |
| 20:00 | 33   | NW       | 3.6        | 50  | 742.7    |
| 21:00 | 32   | NW       | 3.0        | 55  | 742.6    |
| 22:00 | 32   | W        | 2.7        | 59  | 742.5    |
| 23:00 | 30   | SW       | 2.4        | 65  | 742.2    |
| 24:00 | 29   | S        | 3.0        | 74  | 742.1    |
| 01:00 | 28   | S        | 1.9        | 80  | 742.7    |
| 02:00 | 28   | N        | 2.0        | 82  | 742.6    |
| 03:00 | 27   | N        | 0.9        | 82  | 742.9    |
| 04:00 | 27   | N        | 3.2        | 81  | 743.1    |
| 05:00 | 27   | N        | 2.1        | 79  | 743.4    |
| 06:00 | 29   | E        | 2.2        | 77  | 743.6    |
| 07:00 | 30   | NE       | 2.7        | 65  | 743.8    |
| 08:00 | 31   | NE       | 3.6        | 60  | 744.4    |
| 09:00 | 30   | N        | 3.0        | 53  | 744.6    |
| 10:00 | 32   | N        | 4.7        | 47  | 744.7    |



## **Annexure - 2**

### **Ambient Air Quality Data**



## Ambient Air Quality

Client : Associated Technologies (Pvt) Ltd.  
Sampling Point : Karot Hydro Power Project (Dam Site)  
Date of Intervention : July 24 - 25, 2009

| Sr. # | Time  | CO (ppm) | NO <sub>x</sub> (ppb) | (SO <sub>2</sub> ) (ppb) |
|-------|-------|----------|-----------------------|--------------------------|
| 1     | 11:00 | 2.13     | 11.2                  | 1.9                      |
| 2     | 12:00 | 2.08     | 11.9                  | 1.6                      |
| 3     | 13:00 | 2.28     | 13.4                  | 2.0                      |
| 4     | 14:00 | 1.98     | 10.8                  | 1.9                      |
| 5     | 15:00 | 1.94     | 11.6                  | 1.8                      |
| 6     | 16:00 | 2.16     | 10.4                  | 1.9                      |
| 7     | 17:00 | 2.05     | 12.2                  | 2.1                      |
| 8     | 18:00 | 2.14     | 11.9                  | 2.0                      |
| 9     | 19:00 | 2.16     | 13.6                  | 1.9                      |
| 10    | 20:00 | 2.29     | 14.2                  | 2.1                      |
| 11    | 21:00 | 2.10     | 11.1                  | 2.0                      |
| 12    | 22:00 | 2.43     | 10.9                  | 2.2                      |
| 13    | 23:00 | 2.16     | 9.6                   | 2.1                      |
| 14    | 24:00 | 2.23     | 9.2                   | 1.8                      |
| 15    | 01:00 | 1.90     | 10.4                  | 1.9                      |
| 16    | 02:00 | 1.94     | 10.6                  | 1.6                      |
| 17    | 03:00 | 1.82     | 8.9                   | 1.7                      |
| 18    | 04:00 | 1.92     | 9.4                   | 2.0                      |
| 19    | 05:00 | 2.02     | 10.6                  | 1.9                      |
| 20    | 06:00 | 2.43     | 12.8                  | 2.0                      |
| 21    | 07:00 | 2.13     | 11.9                  | 2.1                      |
| 22    | 08:00 | 2.09     | 14.6                  | 2.3                      |
| 23    | 09:00 | 2.16     | 13.7                  | 2.0                      |
| 24    | 10:00 | 2.24     | 14.0                  | 2.2                      |



## Ambient Air Quality

Client : Associated Technologies (Pvt) Ltd.  
Sampling Point : Karot Hydro Power Project (Dam Site)  
Date of Intervention : July 24 - 25, 2009

| Parameter                           | Unit              | Duration | LDL  | Average Obtained Concentration |
|-------------------------------------|-------------------|----------|------|--------------------------------|
| Nitrogen Dioxide (NO <sub>x</sub> ) | ppb               | 24Hours  | 1    | 11.62                          |
| Sulfur Dioxide (SO <sub>2</sub> )   | ppb               | 24 Hours | 1    | 1.96                           |
| Carbon Monoxide (CO)                | ppm               | 24 Hours | 0.01 | 2.12                           |
| PM <sub>10</sub>                    | µg/m <sup>3</sup> | 24 Hours | 2    | 109.02                         |

µg/m<sup>3</sup>: micrograms per cubic meter

LDL: Lowest Detection Limit

## **Ambient Air Quality**

Client : Associated Technologies (Pvt) Ltd.

Sampling Point : Karot Hydro Power Project (Power House Site)

Date of Intervention : July 25 - 26, 2009

| <b>Sr. #</b> | <b>Time</b> | <b>CO (ppm)</b> | <b>NOx(ppb)</b> | <b>(SO2) (ppb)</b> |
|--------------|-------------|-----------------|-----------------|--------------------|
| 1            | 11:00       | 2.56            | 16.1            | 2.1                |
| 2            | 12:00       | 2.73            | 15.2            | 2.5                |
| 3            | 13:00       | 2.12            | 16.4            | 2.0                |
| 4            | 14:00       | 3.09            | 14.3            | 2.7                |
| 5            | 15:00       | 3.27            | 14.7            | 2.4                |
| 6            | 16:00       | 2.18            | 11.2            | 1.9                |
| 7            | 17:00       | 3.11            | 13.4            | 1.7                |
| 8            | 18:00       | 3.01            | 10.7            | 2.5                |
| 9            | 19:00       | 2.92            | 12.8            | 1.4                |
| 10           | 20:00       | 3.01            | 17.6            | 2.9                |
| 11           | 21:00       | 2.12            | 14.1            | 2.0                |
| 12           | 22:00       | 2.79            | 13.2            | 1.7                |
| 13           | 23:00       | 2.17            | 12.3            | 1.4                |
| 14           | 24:00       | 2.09            | 11.0            | 1.2                |
| 15           | 01:00       | 1.99            | 11.9            | 1.0                |
| 16           | 02:00       | 2.04            | 12.6            | 1.4                |
| 17           | 03:00       | 1.27            | 14.7            | 1.1                |
| 18           | 04:00       | 1.14            | 17.0            | 1.3                |
| 19           | 05:00       | 2.74            | 11.1            | 2.2                |
| 20           | 06:00       | 3.06            | 16.3            | 2.7                |
| 21           | 07:00       | 3.43            | 14.6            | 2.4                |
| 22           | 08:00       | 3.22            | 18.7            | 2.2                |
| 23           | 09:00       | 3.21            | 15.4            | 2.8                |
| 24           | 10:00       | 3.36            | 16.0            | 2.6                |



## Ambient Air Quality

Client : Associated Technologies (Pvt) Ltd.  
Sampling Point : Karot Hydro Power Project (Power House Site)  
Date of Intervention : July 25 - 26, 2009

| Parameter                           | Unit              | Duration | LDL  | Average Obtained Concentration |
|-------------------------------------|-------------------|----------|------|--------------------------------|
| Nitrogen Dioxide (NO <sub>x</sub> ) | ppb               | 24Hours  | 1    | 14.22                          |
| Sulfur Dioxide (SO <sub>2</sub> )   | ppb               | 24 Hours | 1    | 2.00                           |
| Carbon Monoxide (CO)                | ppm               | 24 Hours | 0.01 | 2.61                           |
| PM <sub>10</sub>                    | µg/m <sup>3</sup> | 24 Hours | 2    | 136.10                         |

µg/m<sup>3</sup>: micrograms per cubic meter

LDL: Lowest Detection Limit



## **Annexure - 3**

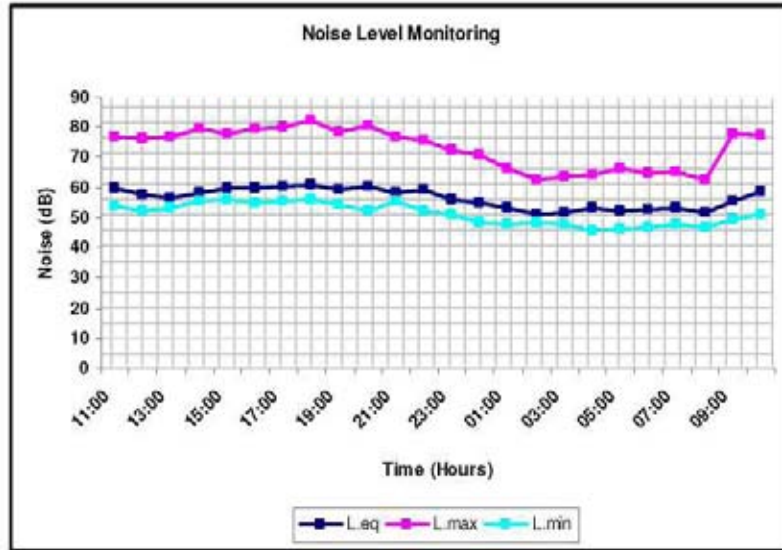
# **Noise Level Monitoring**



## Noise Level Monitoring

Client : Associated Technologies (Pvt) Ltd.  
Sampling Point : Karot Hydro Power Project (Dam Site)  
Date of Intervention : July 24 - 25, 2009

| S. No. | Time  | Leq(dB) | Lmax(dB) | Lmin(dB) |
|--------|-------|---------|----------|----------|
| 1      | 11:00 | 59.9    | 77.0     | 53.8     |
| 2      | 12:00 | 57.6    | 76.2     | 52.2     |
| 3      | 13:00 | 56.7    | 76.6     | 53.4     |
| 4      | 14:00 | 58.2    | 79.3     | 55.3     |
| 5      | 15:00 | 59.6    | 78.0     | 55.9     |
| 6      | 16:00 | 59.8    | 79.7     | 54.8     |
| 7      | 17:00 | 60.2    | 80.2     | 55.2     |
| 8      | 18:00 | 61.0    | 82.1     | 55.8     |
| 9      | 19:00 | 59.4    | 78.6     | 54.2     |
| 10     | 20:00 | 60.6    | 80.4     | 52.4     |
| 11     | 21:00 | 58.2    | 76.9     | 55.6     |
| 12     | 22:00 | 59.0    | 75.6     | 51.9     |
| 13     | 23:00 | 55.9    | 72.7     | 50.8     |
| 14     | 24:00 | 54.8    | 70.9     | 48.2     |
| 15     | 01:00 | 53.4    | 66.6     | 47.6     |
| 16     | 02:00 | 51.2    | 62.7     | 48.4     |
| 17     | 03:00 | 51.6    | 63.6     | 47.5     |
| 18     | 04:00 | 53.2    | 64.3     | 45.4     |
| 19     | 05:00 | 51.9    | 66.6     | 46.3     |
| 20     | 06:00 | 52.8    | 64.6     | 46.9     |
| 21     | 07:00 | 53.4    | 65.4     | 47.8     |
| 22     | 08:00 | 51.8    | 62.6     | 46.5     |
| 23     | 09:00 | 55.4    | 78.2     | 49.6     |
| 24     | 10:00 | 58.6    | 77.4     | 51.0     |



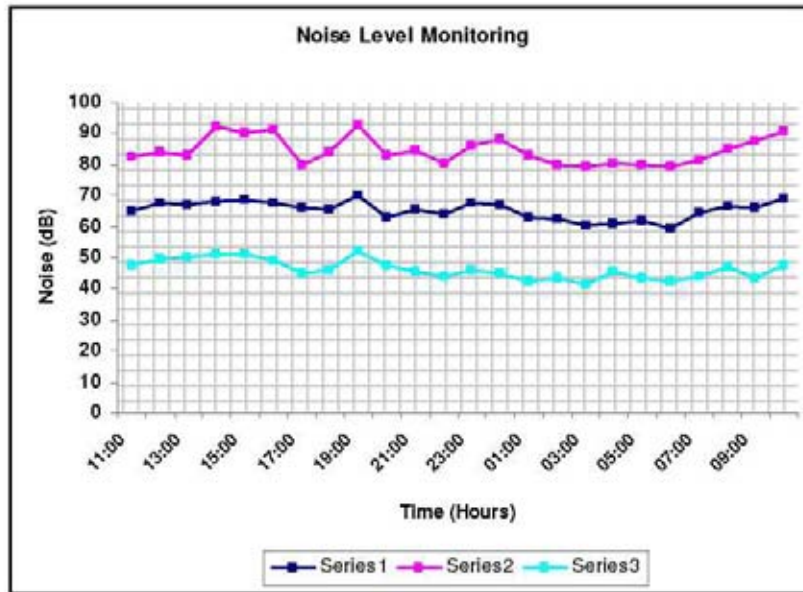
Graph 1: Variation of Noise with Time



## Noise Level Monitoring

Client : Associated Technologies (Pvt) Ltd.  
Sampling Point : Karot Hydro Power Project (Power House Site)  
Date of Intervention : July 25 - 26, 2009

| S. No. | Time  | Leq(dB) | Lmax(dB) | Lmin(dB) |
|--------|-------|---------|----------|----------|
| 1      | 11:00 | 64.7    | 82.6     | 47.3     |
| 2      | 12:00 | 67.4    | 84.0     | 49.7     |
| 3      | 13:00 | 67.0    | 83.2     | 50.0     |
| 4      | 14:00 | 68.1    | 92.1     | 50.9     |
| 5      | 15:00 | 68.3    | 90.3     | 51.2     |
| 6      | 16:00 | 67.4    | 91.0     | 49.1     |
| 7      | 17:00 | 66.2    | 80.1     | 45.0     |
| 8      | 18:00 | 65.7    | 84.2     | 46.1     |
| 9      | 19:00 | 70.1    | 92.7     | 51.9     |
| 10     | 20:00 | 63.0    | 83.0     | 47.4     |
| 11     | 21:00 | 65.7    | 84.3     | 45.5     |
| 12     | 22:00 | 63.9    | 80.4     | 43.6     |
| 13     | 23:00 | 67.6    | 86.2     | 46.0     |
| 14     | 24:00 | 67.1    | 88.1     | 44.7     |
| 15     | 01:00 | 63.0    | 83.1     | 42.2     |
| 16     | 02:00 | 62.4    | 80.0     | 43.1     |
| 17     | 03:00 | 60.1    | 79.2     | 41.1     |
| 18     | 04:00 | 61.0    | 80.4     | 45.2     |
| 19     | 05:00 | 62.1    | 80.1     | 43.4     |
| 20     | 06:00 | 59.3    | 79.2     | 42.3     |
| 21     | 07:00 | 64.4    | 81.5     | 44.0     |
| 22     | 08:00 | 66.6    | 85.0     | 46.9     |
| 23     | 09:00 | 66.0    | 87.6     | 43.4     |
| 24     | 10:00 | 69.1    | 90.9     | 47.2     |



Graph 2: Variation of Noise with Time



# **Annexure - 4**

## **Analysis Report**



## CHEMICAL LABORATORY TEST REPORT

**Job No :** Env - Lhr - 267 / 2009  
**Client Name :** Associated Technologies (Pvt) Ltd.  
**Description Of Sample :** Surface Water (River Jhelum)  
**Marking (If Any):** Dam Site                      No. of sample :                      01  
**Sample Condition Upon Receipt:** Satisfactory                      Sample Collection Date : 26-07-09  
**Environmental Conditions:** Temperature: NA    Humidity:                      NA

| Sr.# | Parameters                   | Method                      | Unit | LDL  | Results | Limits as per NEQS |
|------|------------------------------|-----------------------------|------|------|---------|--------------------|
| 01   | Temperature                  |                             | °C   | -    | 12      | ≤40                |
| 02   | PH                           | APHA-4500H <sup>+</sup> B   |      | -    | 7.92    | 06-09              |
| 03   | Biochemical Oxygen Demand    | ASTM5210                    | mg/L | 5.0  | 10      | 80.00              |
| 04   | Chemical Oxygen Demand (COD) | APHA-5220 D                 | mg/L | 5.0  | 19      | 150.00             |
| 05   | Total Suspended Solids (TSS) | APHA-2540 D                 | mg/L | 5.0  | 241     | 200.00             |
| 06   | Total Dissolved Solids (TDS) | APHA-2540 C                 | mg/L | 5.0  | 109     | 3500.00            |
| 07   | Chloride (Cl)                | APHA-4500Cl <sup>-</sup> B  | mg/L | 0.5  | 10.6    | 1000.00            |
| 08   | Fluoride ( F)                | APHA - F <sup>-</sup> C     | mg/L | 0.01 | 0.6     | 10.00              |
| 09   | Cyanide (CN)                 | APHA-4500CN F               | mg/L | 0.01 | <0.01   | 01.00              |
| 10   | Sulphate (SO <sub>4</sub> )  | APHA-4500 SO <sub>4</sub> C | mg/L | 5.0  | 40      | 600.00             |
| 11   | Sulphide (S)                 | APHA-4500S <sup>2-</sup> D  | mg/L | 0.1  | <0.1    | 01.00              |
| 12   | Magnesium                    | APHA-3500Mg B               | mg/L | 0.5  | 10.9    | -                  |
| 13   | Ammonia (NH <sub>3</sub> )   | APHA-4500NH <sub>3</sub> B  | mg/L | 0.1  | <0.1    | 40.00              |





| Sr.# | Parameters    | Method         | Unit | LDL   | Results | Limits as per NEQS |
|------|---------------|----------------|------|-------|---------|--------------------|
| 14   | Cadmium (Cd)  | APHA-3500Cd B  | mg/L | 0.05  | <0.05   | 00.10              |
| 15   | Chromium (Cr) | APHA-3500Cr B  | mg/L | 0.01  | <0.01   | 01.00              |
| 16   | Copper (Cu)   | APHA-3500Cu B  | mg/L | 0.01  | 0.02    | 01.00              |
| 17   | Lead (Pb)     | APHA-3500Pb B  | mg/L | 0.01  | 0.02    | 00.50              |
| 18   | Mercury (Hg)  | APHA-3500Hg B  | mg/L | 0.001 | <0.001  | 00.01              |
| 19   | Selenium (Se) | APHA-3500Se C  | mg/L | 0.01  | <0.01   | 00.50              |
| 20   | Nickel (Ni)   | APHA 3500 Ni B | mg/L | 0.01  | 0.04    | 01.00              |
| 21   | Silver (Ag)   | APHA-3500Ag B  | mg/L | 0.1   | <0.1    | 01.00              |
| 22   | Zinc (Zn)     | APHA-3500Zn B  | mg/L | 0.05  | 0.12    | 05.00              |
| 23   | Arsenic (As)  | APHA-3500As B  | mg/L | 0.005 | <0.005  | 01.00              |
| 24   | Barium (Ba)   | APHA-3500Ba B  | mg/L | 0.5   | <0.5    | 01.50              |
| 25   | Iron (Fe)     | APHA-3500Fe B  | mg/L | 0.01  | 7.5     | 8.00               |
| 26   | Boron (B)     | APHA-4500B C   | mg/L | 0.02  | <0.02   | 6.00               |

∴ Not Defined  
 < Less Than.  
 LDL: Lowest Detection Limit



## CHEMICAL LABORATORY TEST REPORT

**Job No :** Env - Lhr - 267 / 2009  
**Client Name :** Associated Technologies (Pvt) Ltd.  
**Description Of Sample :** Surface Water (River Jhelum)  
**Marking (If Any):** Power House Site      No. of sample :      01  
**Sample Condition Upon Receipt:** Satisfactory      Sample Collection Date :      26-07-09  
**Environmental Conditions:** Temperature:      NA      Humidity:      NA

| Sr.# | Parameters                   | Method                      | Unit | LDL  | Results | Limits as per NEQS |
|------|------------------------------|-----------------------------|------|------|---------|--------------------|
| 01   | Temperature                  |                             | °C   | -    | 13      | ≤40                |
| 02   | PH                           | APHA-4500H <sup>+</sup> B   |      | -    | 7.78    | 06-09              |
| 03   | Biochemical Oxygen Demand    | ASTM5210                    | mg/L | 5.0  | 21      | 80.00              |
| 04   | Chemical Oxygen Demand (COD) | APHA-5220 D                 | mg/L | 5.0  | 37      | 150.00             |
| 05   | Total Suspended Solids (TSS) | APHA-2540 D                 | mg/L | 5.0  | 366     | 200.00             |
| 06   | Total Dissolved Solids (TDS) | APHA-2540 C                 | mg/L | 5.0  | 114     | 3500.00            |
| 07   | Chloride (Cl)                | APHA-4500Cl <sup>-</sup> B  | mg/L | 0.5  | 10      | 1000.00            |
| 08   | Fluoride ( F)                | APHA - F <sup>-</sup> C     | mg/L | 0.01 | 0.4     | 10.00              |
| 09   | Cyanide (CN)                 | APHA-4500CN F               | mg/L | 0.01 | <0.01   | 01.00              |
| 10   | Sulphate (SO <sub>4</sub> )  | APHA-4500 SO <sub>4</sub> C | mg/L | 5.0  | 45      | 600.00             |
| 11   | Sulphide (S)                 | APHA-4500S <sup>2-</sup> D  | mg/L | 0.1  | <0.1    | 01.00              |
| 12   | Magnesium                    | APHA-3500Mg B               | mg/L | 0.5  | 11.9    | -                  |
| 13   | Ammonia (NH <sub>3</sub> )   | APHA-4500NH <sub>3</sub> B  | mg/L | 0.1  | <0.1    | 40.00              |



| Sr.# | Parameters    | Method         | Unit | LDL   | Results | Limits as per NEQS |
|------|---------------|----------------|------|-------|---------|--------------------|
| 14   | Cadmium (Cd)  | APHA-3500Cd B  | mg/L | 0.05  | <0.05   | 00.10              |
| 15   | Chromium (Cr) | APHA-3500Cr B  | mg/L | 0.01  | <0.01   | 01.00              |
| 16   | Copper (Cu)   | APHA-3500Cu B  | mg/L | 0.01  | 0.02    | 01.00              |
| 17   | Lead (Pb)     | APHA-3500Pb B  | mg/L | 0.01  | 0.02    | 00.50              |
| 18   | Mercury (Hg)  | APHA-3500Hg B  | mg/L | 0.001 | <0.001  | 00.01              |
| 19   | Selenium (Se) | APHA-3500Se C  | mg/L | 0.01  | <0.01   | 00.50              |
| 20   | Nickel (Ni)   | APHA 3500 Ni B | mg/L | 0.01  | 0.04    | 01.00              |
| 21   | Silver (Ag)   | APHA-3500Ag B  | mg/L | 0.1   | <0.1    | 01.00              |
| 22   | Zinc (Zn)     | APHA-3500Zn B  | mg/L | 0.05  | 0.12    | 05.00              |
| 23   | Arsenic (As)  | APHA-3500As B  | mg/L | 0.005 | <0.005  | 01.00              |
| 24   | Barium (Ba)   | APHA-3500Ba B  | mg/L | 0.5   | <0.5    | 01.50              |
| 25   | Iron (Fe)     | APHA-3500Fe B  | mg/L | 0.01  | 12.5    | 8.00               |
| 26   | Boron (B)     | APHA-4500B C   | mg/L | 0.02  | <0.02   | 6.00               |

-: Not Defined  
 <: Less Than.  
 LDL: Lowest Detection Limit



## **Annexure - 5**

## **Photographs**



Fig 1: Ambient Air Quality Monitoring at Dam Site



Fig 2: Ambient Air Quality Monitoring at Dam Site



Fig 3: Ambient Air Quality Monitoring at Power House Site



Fig 4: Noise Level Monitoring at Dam Site



Fig 5: Noise Level Monitoring at Power House Site



## **Annexure - 6**

# **USEPA and Pak-NEQS Standards for Ambient Air**



### USEPA NATIONAL AMBIENT AIR QUALITY STANDARD

Following are the limits specified in NAAQS for primary as well as secondary pollutants.

| POLLUTANT  | STANDARD VALUE *      |                           | STANDARD TYPE       |
|--|-----------------------|---------------------------|---------------------|
| <b>Carbon Monoxide (CO)</b><br>8-hour Average<br>1-hour Average                        | 9 ppm                 | (10mg/m <sup>3</sup> )    | Primary             |
|  | 35 ppm                | (40 mg/m <sup>3</sup> )   | Primary             |
| <b>Nitrogen Dioxide (NO<sub>2</sub>)</b><br>Annual Arithmetic Mean                     | 0.053 ppm             | (100 µg/m <sup>3</sup> )  | Primary & Secondary |
| <b>Ozone (O<sub>3</sub>)</b><br>1-hour Average<br>8-hour Average                       | 0.12 ppm              | (235 µg/m <sup>3</sup> )  | Primary & Secondary |
|  | 0.08 ppm              | (157 µg/m <sup>3</sup> )  | Primary & Secondary |
| <b>Lead (Pb)</b><br>Quarterly Average  | 1.5 µg/m <sup>3</sup> |                           | Primary & Secondary |
| <b>Particulate (PM 10)</b> <i>Particles with diameters of 10 micrometers or less</i>   |                       |                           |                     |
| Annual Arithmetic Mean   | 50 µg/m <sup>3</sup>  |                           | Primary & Secondary |
| 24-hour Average  | 150 µg/m <sup>3</sup> |                           | Primary & Secondary |
| <b>Particulate (PM 2.5)</b> <i>Particles with diameters of 2.5 micrometers or less</i> |                       |                           |                     |
| Annual Arithmetic Mean   | 15 µg/m <sup>3</sup>  |                           | Primary & Secondary |
| 24-hour Average  | 65 µg/m <sup>3</sup>  |                           | Primary & Secondary |
| <b>Sulfur Dioxide (SO<sub>2</sub>)</b>   |                       |                           |                     |
| Annual Arithmetic Mean   | 0.030 ppm             | (80 µg/m <sup>3</sup> )   | Primary             |
| 24-hour Average  | 0.14 ppm              | (365 µg/m <sup>3</sup> )  | Primary             |
| 3-hour Average   | 0.50 ppm              | (1300 µg/m <sup>3</sup> ) | Secondary           |



Draft National Environmental Quality Standards (NEQS) for Ambient Air

| Pollutants   | Time-weighted average | Concentration in Ambient Air    |                                 | Method of measurement                             |
|--|-----------------------|---------------------------------|---------------------------------|---|
|  |                       | Effective from 1st January 2009 | Effective from 1st January 2012 |   |
| Sulphur Dioxide (SO <sub>2</sub> )   | Annual Average*       | 80 µg/m <sup>3</sup>            | 80 ug/m <sup>3</sup>            | Ultraviolet Fluorescence method                   |
|  | 24 hours**            | 120 µg/m <sup>3</sup>           | 120 Ijg/m <sup>3</sup>          |   |
| Oxides of Nitrogen as  | Annual Average*       | 40 µg/m <sup>3</sup>            | 40 ug/m <sup>3</sup>            | Gas Phase Chemiluminescence                       |
|  | 24 hours**            | 40 µg/m <sup>3</sup>            | 40 ug/m <sup>3</sup>            |   |
| Oxides of Nitrogen as  | Annual Average*       | 40 µg/m <sup>3</sup>            | 40 ug/m <sup>3</sup>            | Gas Phase Chmiluminescence                        |
|  | 24 hours**            | 80 µg/m <sup>3</sup>            | 80 ug/m <sup>3</sup>            |   |
| O <sub>3</sub>   | 1 hour                | 180 µg/m <sup>3</sup>           | 130 ug/m <sup>3</sup>           | Non Dispersive UV absorption method               |
| Suspended Particulate  | Annual Average*       | 400 µg/m <sup>3</sup>           | 360 Ijg/m <sup>3</sup>          | High Volume Sampling, (Average flow rate not less |
|  | 24 hours**            | 550 µg/m <sup>3</sup>           | 500 Mg/m <sup>3</sup>           |   |
| Respirable Particulate   | Annual Average*       | 200 µg/m <sup>3</sup>           | 120 Mg/m <sup>3</sup>           | β Ray absorption method                           |
|  | 24 hours**            | 250 µg/m <sup>3</sup>           | 150 Mg/m <sup>3</sup>           |   |
| Respirable Particulate   | Annual Average*       | 25 µg/m <sup>3</sup>            | 15 Mg/m <sup>3</sup>            | β Ray absorption method                           |
|  | 24 hours**            | 40 µg/m <sup>3</sup>            | 35 Mg/m <sup>3</sup>            |   |
|  | 1 hour                | 25 µg/m <sup>3</sup>            | 15 Mg/m <sup>3</sup>            |   |
| Lead (Pb)  | Annual Average*       | 1.5 µg/m <sup>3</sup>           | 1 Mg/m <sup>3</sup>             | ASS Method after sampling using EPM 2000 or       |
|  | 24 hours**            | 2 µg/m <sup>3</sup>             | 1.5 Mg/m <sup>3</sup>           |   |
| Carbon Monoxide (CO)   | 8 hours **            | 5 mg/m <sup>3</sup>             | 5 mg/m <sup>3</sup>             | Non Dispersive Infra Red (NDIR) method            |
|  | 1 hour                | 10 mg/m <sup>3</sup>            | 10 mg/m <sup>3</sup>            |   |
| * Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.                 |                       |                                 |                                 |   |
| ** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days. |                       |                                 |                                 |   |