

Cumulative Impact Assessment

Final Report

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Mira Power Limited

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Contents

1. Introduction.....	1-1
1.1 Project Overview	1-1
1.2 Project Setting	1-1
1.3 What are Cumulative Impacts.....	1-2
1.4 IFC Context	1-2
1.5 Objectives	1-4
1.6 Scope of the Assessment	1-4
1.7 Limitations	1-5
2. Hydropower Development Plans in AJK.....	2-1
2.1 Potential Hydropower Projects in AJK	2-1
2.2 SEA Perspective on Development of Hydropower Potential in the AJK2-4	
2.3 Existing and Planned Hydropower Projects on Poonch River Basin ...	2-6
3. Scoping	3-1
3.1 Background	3-1
3.2 Ecological Importance of Poonch River	3-3
3.3 Socio-economic uses of the Poonch River	3-6
3.4 Critical Habitat Assessment	3-9
3.5 Delineation of the Study Area.....	3-10
3.5.1 Geographical Boundary.....	3-10
3.5.2 Temporal Boundary.....	3-10
4. Valued Environmental and Social Components.....	4-1
4.1 Definition of VEC	4-2
4.2 Selection of VECs.....	4-2
4.2.1 Literature review.....	4-3
4.2.2 Stakeholder Consultations.....	4-3
4.3 VECs selected for Poonch River	4-5
5. Baseline Status of Selected VECs	5-6
5.1 Surface Water Quantity (Flow).....	5-6
5.2 Sediment Load of River.....	5-7
5.3 Fish Fauna	5-10

5.4	Landscape	5-15
6.	Cumulative Impact Assessment of Selected VECs.....	6-1
6.1	Approach for this Cumulative Assessment.....	6-1
6.2	Cumulative impact on selected VECs	6-3
6.2.1	Reduction in water quantity (flow).....	6-3
6.2.2	Sediment Load of River	6-6
6.2.3	Fish Fauna	6-8
6.2.4	Landscape Conversion.....	6-12
6.3	Overall Impact on Ecosystem Integrity.....	6-12
7.	Proposed Management Strategy	7-1
7.1	Position of AJK Government on Future Hydropower Projects on Poonch River	7-1
7.2	Strategy of MPL to Manage Cumulative Impacts	7-1
7.2.1	Biodiversity Action Plan	7-2
7.2.2	Sediment Mining Plan	7-3
7.3	Management of Risks Presented by Other Projects	7-4
7.4	Coordination with the Office of Pakistan Commissioner for Indus Waters	7-5
7.5	Policy Recommendations	7-6
8.	References	8-1

Exhibits

Exhibit 1.1:	Project Setting	1-3
Exhibit 2.1:	List of Hydropower Projects in AJK in Various Stages of Development under Different Agencies.....	2-1
Exhibit 2.2:	Locations, Capacities, Progress Status and Executing Agencies of Hydropower Projects in AJK.....	2-5
Exhibit 2.3:	Ecological Sensitivity Zones for Hydropower Development.....	2-7
Exhibit 2.4:	Proposed Hydropower Projects on Poonch River	2-8
Exhibit 3.1:	Similarity among Different Water Bodies Based on Principal Component Analysis	3-2
Exhibit 3.2:	Similarity among Different Water Bodies Based on Cluster Analysis	3-3
Exhibit 3.3:	Photographs of Sand and Gravel Extraction in Study Area	3-6
Exhibit 3.4:	Socio-Economic Uses of the Poonch River.....	3-8
Exhibit 3.5:	Study Area.....	3-12
Exhibit 4.1:	Expected Cumulative Impacts Resulting from Cascading Hydropower Development and other Present and Foreseen Activities.....	4-2
Exhibit 4.2:	Photographs of Consultations.....	4-4
Exhibit 5.1:	Monthly Flows and Runoff of Poonch River	5-7
Exhibit 5.2:	Mean Annual Flows of Poonch River	5-7
Exhibit 5.3:	Annual Suspended Sediment loads in the Poonch River (1960 to 2009).	5-9
Exhibit 5.4:	Large Volumes of Sandy Sediment Deposited where the Poonch River enters Mangla Reservoir.....	5-9
Exhibit 5.5:	Annual Suspended Sediment-Discharge Relationships in 1984 and 1985.....	5-10
Exhibit 5.6:	Fish Fauna Recorded from the Poonch River	5-11
Exhibit 5.7:	Species of Special Importance Found in the Poonch River.....	5-13
Exhibit 5.8:	Photographs of Fish Species observed in Poonch River.....	5-14
Exhibit 5.9:	Photographs of Poonch River and Basin (September 2013).....	5-15

Exhibit 6.1:	Length of River Habitat Severely Impacted by Flow Changes Associated with the Five Proposed HPPs	6-3
Exhibit 6.2:	Change in Flow in the Poonch River with Sequential Implementation of Planned HPPs	6-4
Exhibit 6.3:	Extent of River Length that will be Affected by Flow Changes as a Result of the Planned HPPs on Poonch River.....	6-5
Exhibit 6.4:	Relative Importance of the Poonch River Mainstem and Tributaries (Nullahs) for Breeding Areas for Endangered Fish	6-9
Exhibit 6.5:	Estimated Cumulative Impact of Planned HPPs on the Population of Mahaseer.....	6-11
Exhibit 6.6:	Definitions of the Present Ecological State (PES) Categories	6-13
Exhibit 6.7:	Estimated Cumulative Impact of Planned HPPs on the Overall Integrity of the Poonch River Ecosystem	6-16

1. Introduction

Mira Power Limited (the ‘MPL’ or the ‘Company’) is an Independent Power Producer (the ‘IPP’) which is planning to develop Gulpur Hydropower Project (Project) in the Azad Jammu & Kashmir (the ‘AJK’). The Project will utilize the flow of Poonch River, the full length of which within AJK has been notified as a national park by the AJK Wildlife and Fisheries Department. MPL engaged Hagler Bailly Pakistan to conduct an assessment of potential impacts on environment from the Project and to identify mitigation and management measures to address these potential impacts. A Cumulative Impact Assessment (CIA) was carried out as part of this Environment and Social Impact Assessment.¹ The focus of the CIA was to assess the combined impact of existing and planned hydropower projects on the ecological resources and ecosystem services of the Poonch River.

1.1 Project Overview

The Gulpur Hydropower Project with design capacity of 100 MW will use the water resources of the Poonch River for power generation. The Project site is located in Kotli District, Azad Jammu and Kashmir at latitude 33°27’ and longitude 73°51’, about 9 km South of Kotli Town.

The Project’s major components include weir, intake structure and power house. All the project structures will be located near Barali on the Poonch River at about 11 km downstream of Kotli Town and about 6 km downstream of the confluence of Ban Nullah with the river. The intake structure and intake portal of the power tunnel will be located on west bank of the Poonch River, 150 meter upstream of weir structure on the eastern face of a ridge. The power house and outlet will be located on right bank Poonch River about 800 m downstream of the weir structure. A low flow section of a length of about 700m will be created downstream of the weir to the outlet of the powerhouse. The Normal Operating Level (NOL) of the Project shall be at an elevation of 532 m from the sea level.

1.2 Project Setting

The map included in **Exhibit 1.1** illustrates the general setting of the area of interest for this Study. The Poonch River originates in the western foothills of Pir Panjal range, in the areas of Neel-Kanth Gali and Jamian Gali. The steep slopes of the Pir Panjal form the upper catchment of this river. It is a small gurgling water channel in this tract and descends along a very steep gradient until it reaches the foothill area. The river widens in the foothill area as more and more tributaries enter into the main river. The valley also opens up and Poonch River begins to flow in a leisurely manner in its middle and lower reaches. Dense forests cover the upper catchment while the vegetation of the middle and

¹ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.

lower region is under intense biotic pressure. Poonch River from the Line of Control² to Kotli town has slope of 6.9-8.3 meter per kilometer or m/km. Below Kotli, the river gradient is relatively mild (3.7 m/km). The river ultimately drains into the Mangla reservoir near Chomukh in Mirpur district of Azad Jammu and Kashmir (AJK).

1.3 What are Cumulative Impacts

Cumulative impacts are those impacts that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important based on scientific concerns and/or concerns of affected communities (local communities directly affected by the Project).³

Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development.

Ultimately, governments are responsible for preparing CIA frameworks to assist private sector actors in the identification and management of cumulative impacts. Because these frameworks barely exist in developing countries, it is clearly still in the private developer's interest to take into consideration not only its own contribution to cumulative impacts, but also other projects and external factors that may affect similar VECs (**Section 4**). Not doing so may place the developer's own efforts at risk and negatively affect its reputation. However, undertaking this process can be challenging and requires the cooperation of government, other developers, and other stakeholders.

1.4 IFC Context

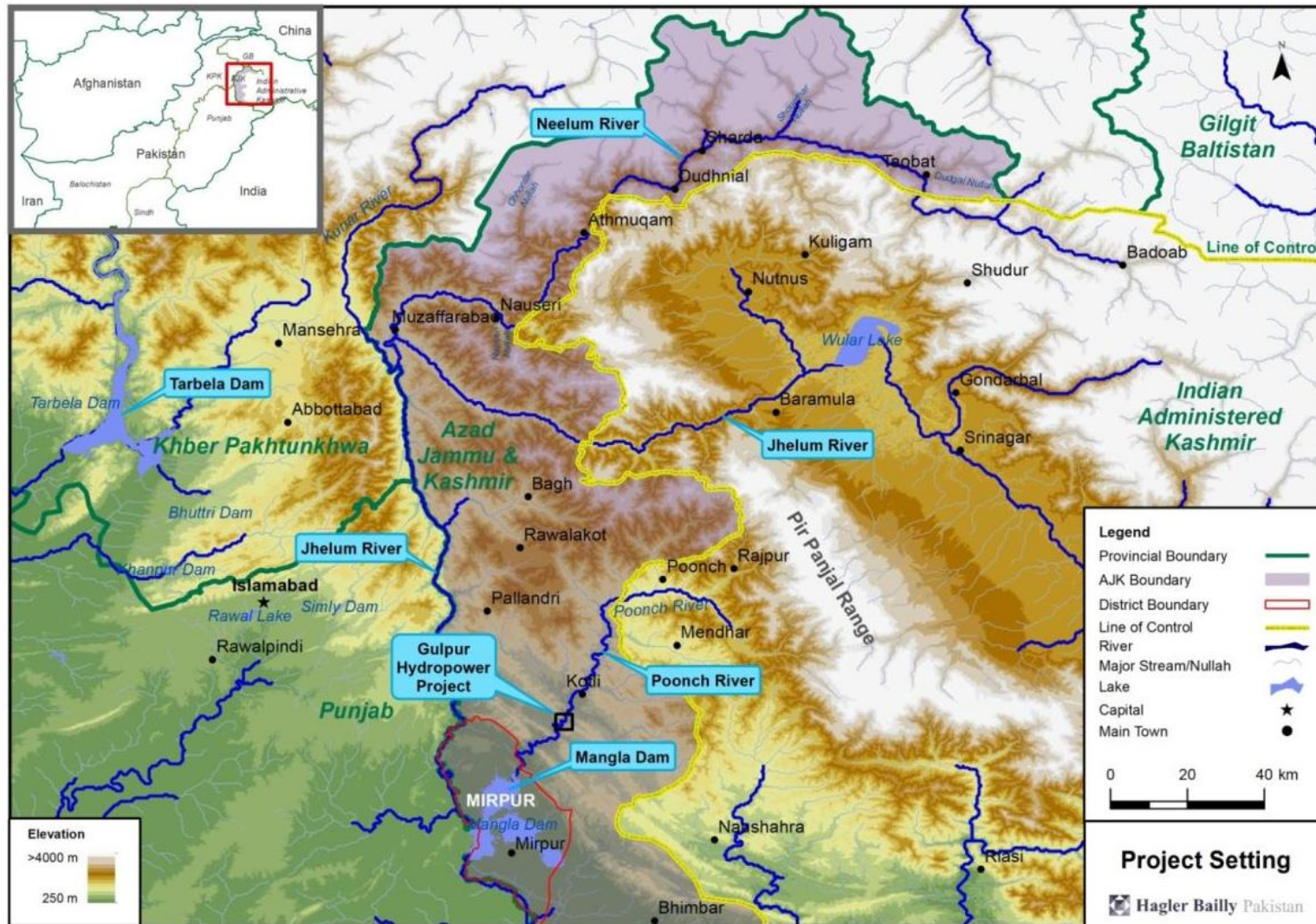
IFC Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts, recognizes that in some instances, private sector developers need to consider cumulative effects in their identification and management of environmental and social impacts and risks. IFC believes that when a private sector project sponsor faces cumulative environmental and social impacts, it should have mechanisms for identifying the magnitude and significance of its contribution to those impacts and risks, and should include appropriate mitigation measures as an integral component of the project's environmental and social management system (ESMS).⁴

² The de facto boundary between Indian Administrated Kashmir and AJK.

³ Cadinale, Pablo, and Lorne Greig. "Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets." In *Good Practice Handbook*: International Finance Corporation and ESSA Technologies Ltd, 2013.

⁴ Ibid.

Exhibit 1.1: Project Setting



For private sector management of cumulative impacts, IFC considers good practice to be two pronged:

- ▶ Effective application of and adherence to the mitigation hierarchy⁵ in environmental and social management of the specific contributions by the project to the expected cumulative impacts; and
- ▶ Best efforts to engage in, enhance, and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions that are beyond the capacity of an individual project proponent.

1.5 Objectives

The concept of Cumulative Impact Assessment (CIA) and Management is new to Pakistan and Azad Jammu and Kashmir. Both governments and their related Ministries and Departments (Pakistan and AJK Environment Protection Agency, Ministry of Science and Technology) do not require a CIA as part of the Environmental Impact Assessment (EIA) process under the applicable legislation.

However, Mira Power Ltd (MPL) has undertaken to assess potential cumulative impacts on the ecological resources of Poonch River from existing and planned hydropower projects. This Cumulative Impact Assessment (CIA) has an ultimate goal of identifying issues that the Project when placed in the context of existing, planned, and reasonable predictable developments in the future, may generate; or initiate cumulative effects that could jeopardize the overall ecological integrity of the Poonch River. MPL has committed to:

- ▶ include in its EMP the mitigation measures to appropriately manage its contribution to any potentially significant cumulative impacts, and
- ▶ work with the Government of AJK, and other stakeholders to design a governance mechanism that would allow for the appropriate development, implementation, enforcement, supervision and monitoring of an approach to minimize these cumulative impacts on the ecological resources of the Poonch River.

1.6 Scope of the Assessment

In view of the mountainous terrain and topography of the river valleys in AJK, the hydropower projects planned are the RoR projects, as opposed to projects that create storage for agriculture or power generation. The communities in the river valleys in AJK depend primarily on water from springs for drinking. There is very limited land available for agriculture, and it is either rain fed or depends on irrigation from water drawn from

⁵ Defined in Performance Standard 1, paragraph 3, as the strategy to first anticipate and avoid impacts on and risks to workers, the environment, and/or Affected Communities or, where avoidance is not possible, to minimize impacts and risks. Acceptable options for minimizing will vary and include abating, rectifying, repairing, and/or restoring. Finally, where residual impacts remain, these must be compensated for and/or offset. It is important to note that compensation and/or offsets are the mechanisms proposed for managing residual impacts, not cumulative impacts. This is an important clarification as it is impractical for a single sponsor to offset cumulative impacts. However, regional offset of cumulative impacts could still be possible as part of a collaborative CIA mitigation led by the government or a coalition of developers.

side streams and tributaries. The dependence of population on river water for drinking and irrigation purposes is therefore negligible.⁶

The forests and rangelands located at lower elevations in the river valleys in AJK in general and in Poonch River basin in particular suffer from a high level of disturbance and degradation due to anthropogenic impacts and grazing pressures. The powerhouse and associated structures and temporary construction facilities such as storage yards and camps are generally located closer to the river, and the proportion of land used for such facilities is small in relation to the overall landscape. Submergence areas also tend to be low in view of limited height of weirs of RoR projects and steeper slopes along the riverbanks. Thus, terrestrial flora and associated fauna such as mammals and reptiles are not likely to be impacted significantly by the construction and operation of hydropower projects. The impact of the planned RoR hydropower projects is expected to be primarily on the aquatic ecology caused by modification of flow regimes.

1.7 Limitations

Limitations of this CIA and aspects that are not included in this discussion are outlined below:

- ▶ *Secondary information:* With the exception of the project-related primary data collected as part of the ESIA, this CIA is based on secondary information.
- ▶ *Consultations with project proponents of other potential hydropower projects:* Consultations were not carried out with project proponents/owners of other potential hydropower projects on the Poonch River. However, stakeholder views on cumulative impacts of HHPs on the Poonch River were recorded during the consultations conducted for the ESIA of Gulpur HPP. Consultations were carried out with government departments including PPIB (Private Power Infrastructure Board), HEB (Hydroelectric Board) and AJK EPA (Environmental Protection Agency) as well as local communities (**Section 4.2.2**).
- ▶ *Impact on terrestrial ecological resources:* Impact on terrestrial ecological resources, including those caused by laying of transmission lines have not been discussed. This is because the proportion of land used for these facilities will be small in relation to the overall landscape and the transmission lines are likely to be laid on areas where land use is already intensive with settlements and agriculture.
- ▶ *Impact of construction of hydropower projects:* Cumulative impacts, resulting from simultaneous construction of hydropower projects have not been considered. This is because the ecological impacts resulting from overlapping project constructions are expected to have only short-term additive impacts, primarily on the terrestrial habitats in the vicinity of the project infrastructure.
- ▶ *Impact on traffic volumes:* The hydropower projects planned on the Poonch River will involve major construction activities in the basin over the next 10 to 15 years. Construction of individual projects is expected to happen in series with intervals of c.

⁶ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd

12 months between each, and the impacts of individual projects on traffic volumes are expected to be minor. Thus, provided peak travel times for individual projects do not coincide, the overall impact on traffic volumes is expected to be small and acceptable.

- ▶ *Impact on river water quality:* All the planned projects are so-called RoR, and as such are not expected to significantly alter the temperature regime or water chemistry of the river, other than within the reservoirs themselves. The cumulative impact could be of concerns, but relatively small in comparison to impacts of flow alteration and barriers due to hydropower projects.
- ▶ *Impact of migrant labor:* Construction of the hydropower projects planned on the Poonch River would provide employment for skilled and un-skilled laborers, and could attract an influx of migrant labor from outside the basin. However, if construction of individual projects is staggered (as suggested in traffic above) it should be possible to limit this influx. Once operational, each power project will employ c. 120 skilled and semi-skilled people. While this should provide some employment opportunities for locals in the basin, it is probably insufficient to represent a draw-card for unskilled labor from outside the basin.
- ▶ *Impacts due to land acquisition and resettlement:* The Cumulative Impact Assessment focuses on environmental concerns related to multiple HPPs on the Poonch River. The socio-economic impacts including those caused by land acquisition and resettlement have been discussed only at a high level as design details and resettlement plans for other hydropower projects proposed on the Poonch River are either not available or have not been approved by the AJK EPA as yet.
- ▶ *Increase in supply of electricity:* The availability of electricity in the Poonch basin is likely to improve if the proposed hydropower projects are implemented, despite the fact that the bulk of the power produced would be transmitted to the national grid. The hydropower generation potential of the Poonch River basin, however, is less than 5% of that of AJK and less than 1% of the potential in the country.⁷ As such, even if all the projects proposed for the Poonch River were implemented, they would not result in a significant increase in electricity supply for the country as a whole on a long-term basis.
- ▶ *Direct and induced economic development:* During the construction period, each proposed project will employ about 700 skilled and unskilled persons. In the near term, the demand for local goods such as construction materials and services such as supply of food and other services for the project and work force will temporarily increase. However, in the long term each project will provide direct employment for c. 120 people (see above) once the projects go into operation. While this level of employment will contribute to the local secondary economy, given the population of the area and size of the local economy the relative contribution of the hydropower projects is unlikely to be significant.

⁷ Potential for hydropower development for Pakistan and AJK is estimated at 60,000 MW by Pakistan Private Power and Infrastructure Board. Current hydropower capacity is 6,800 MW.

2. Hydropower Development Plans in AJK

Pakistan is facing massive shortfalls in energy that are estimated to rise to over 8,500 MW.⁸ Over the last decade, the development of hydropower resources in AJK and Pakistan has become a priority for the governments. This shortfall has resulted in prolonged power cuts of about 20 hours a day across both states and has adversely affected economic growth and development; thus becoming one of the top challenges facing the political leadership.

2.1 Potential Hydropower Projects in AJK

According to the latest information available from all the government agencies involved in hydropower development in AJK, there are currently 12 operational hydropower projects in the state; an additional 13 are under construction while 37 more sites have been identified for detailed feasibility studies, (which, for some sites may be under progress).⁹

Exhibit 2.1 shows a list of all the projects in different stages of completion with the government agency responsible for the project stated alongside it. In the late eighties, Water and Power Development Authority (WAPDA) conducted comprehensive hydel potential reports on the three main rivers of AJK, namely, the River Jhelum, River Poonch and River Neelum. Various sites with an estimated total capacity of about 4,635 MW have been identified in AJK and have been included in WAPDA's Vision 2025 program.

In order to exploit the hydel resources of AJK, the Government of AJK (GoAJK) established the AJK Hydro Electric Board (HEB) in 1989 to plan and undertake development of identified hydro potential there and implement public sector hydropower projects. Subsequently, the GoAJK created the AJK Private Power Cell (PPC) in 1995 to provide a 'one-window' facility and to encourage the development of hydel potential in the private sector.

Exhibit 2.1: List of Hydropower Projects in AJK in Various Stages of Development under Different Agencies

No	Project	Installed Capacity (MW)	Executing Agency	Project Status
1.	Patikka	0.05	HEB	Operational
2.	Changan	0.05	HEB	Operational
3.	Kel	0.4	HEB	Operational

⁸ Dawn. (2012, June 17). *Electricity Shortfall in the Country Reaches 8,500 MW*. Retrieved May 2013, 20, from Pakistan: <http://dawn.com/2012/06/17/residents-protest-prolonged-loadshedding-in-lahore>

⁹ IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report

<i>No</i>	<i>Project</i>	<i>Installed Capacity (MW)</i>	<i>Executing Agency</i>	<i>Project Status</i>
4.	Kathai	1.6	HEB	Operational
5.	Leepa	1.6	HEB	Operational
6.	Kundal Shahi	2	HEB	Operational
7.	Sharian	3.2	HEB	Operational
8.	Jagran - I	30.4	HEB	Operational
9.	New Bong Escape	84	PPC	Operational
10.	Jari	1	PPC	Operational
11.	Chinari	0.2	PPC	Operational
12.	Mangla (incl. Dam Raising)	1,000	WAPDA	Operational
13.	Halmat	0.32	HEB	Under Construction
14.	Hillan	0.6	HEB	Under Construction
15.	Dhanna	1.5	HEB	Under Construction
16.	Hajira	3	HEB	Under Construction
17.	Sharda	3	HEB	Under Construction
18.	Rerah	3.2	HEB	Under Construction
19.	Battar	4.8	HEB	Under Construction
20.	Chamfall	6.4	HEB	Under Construction
21.	Jhing - I	14.4	HEB	Under Construction
22.	Jagran- II	43.5	HEB	Under Construction
23.	Patrind	147	PPIB	Under Construction
24.	Kohala	1,100	WAPDA	Under Construction
25.	Neelum-Jhelum	969	WAPDA	Under Construction
26.	Naghdar	39	HEB	Planning or Feasibility Stage
27.	Doarian	46	HEB	Planning or Feasibility Stage
28.	Shontar	52	HEB	Planning or Feasibility Stage
29.	Luat	63	HEB	Planning or Feasibility Stage
30.	Jari II	2.5	PPC	Planning or Feasibility Stage
31.	Dakhari	2.2	PPC	Planning or Feasibility Stage
32.	Kathai - III	1	PPC	Planning or Feasibility Stage
33.	Hotreri	5.4	PPC	Planning or Feasibility Stage
34.	Jhing - II	4	PPC	Planning or Feasibility Stage
35.	Riali - III	3.7	PPC	Planning or Feasibility Stage
36.	Riali-II	4.9	PPC	Planning or Feasibility Stage

<i>No</i>	<i>Project</i>	<i>Installed Capacity (MW)</i>	<i>Executing Agency</i>	<i>Project Status</i>
37.	Riali-I	1.6	PPC	Planning or Feasibility Stage
38.	Ashkot	40	PPC	Planning or Feasibility Stage
39.	Jagran-III	35	PPC	Planning or Feasibility Stage
40.	Khoja Seri	2	PPC	Planning or Feasibility Stage
41.	Kundian	48	PPC	Planning or Feasibility Stage
42.	Madar Batdara	10.2	PPC	Planning or Feasibility Stage
43.	Samani	1.6	PPC	Planning or Feasibility Stage
44.	Sarhota	1	PPC	Planning or Feasibility Stage
45.	Sarswah	0.7	PPC	Planning or Feasibility Stage
46.	Pothi	1	PPC	Planning or Feasibility Stage
47.	Barar	1	PPC	Planning or Feasibility Stage
48.	Gumot Nar	40	PPC	Planning or Feasibility Stage
49.	Rajdhani	132	PPIB	Planning or Feasibility Stage
50.	Gulpur	100	PPIB	Planning or Feasibility Stage
51.	Kotli	100	PPIB	Planning or Feasibility Stage
52.	Karote	720	PPIB	Planning or Feasibility Stage
53.	Azad Pattan	222	PPIB	Planning or Feasibility Stage
54.	Kohala	1,100	PPIB	Planning or Feasibility Stage
55.	Changan-II	9	PPIB	Planning or Feasibility Stage
56.	Taobat	10	PPIB	Planning or Feasibility Stage
57.	Janawahi	12	PPIB	Planning or Feasibility Stage
58.	Mahl	511	PPIB	Planning or Feasibility Stage
59.	Harighel	53	PPIB	Planning or Feasibility Stage
60.	Abbasian	360	PPIB	Planning or Feasibility Stage
61.	Kundal Shahi - II	600	WAPDA	Planning or Feasibility Stage
62.	Dudhnial	960	WAPDA	Planning or Feasibility Stage

HEB and PPC are the two government agencies in AJK that are responsible for the implementation of hydropower projects in AJK with capacities up to 50 MW. This is in accordance with the Power Policy of 2002, which made provinces and the State of AJK responsible for managing the development and implementation of power projects with capacities up to 50 MW. Responsibility for projects greater than 50 MW lies with WAPDA for projects in the public sector, and with PPIB for projects in the private sector.

The exercise of mapping and identifying hydropower projects in different stages of development in AJK for this CIA made use of information from public and private

sources. Information on hydropower projects already in operation is available in detail; however, the latest information on projects under construction or in various stages of a feasibility study is limited to their locations, generating capacities and stages of development.

The various documents available from the four government agencies responsible for hydropower development in AJK: Water and Power Development Authority (WAPDA), Private Power and Infrastructure Board (PPIB), HEB and PPC, contain inconsistent information with varying levels of detail.

Among the different sources of information on hydropower development in the AJK provided by the four agencies, some provide detailed information covering location, capacity, progress status, energy generation, nature of project and other relevant information. Others, however, simply state names and power generating potential. The general trend revealed was that the federal agencies provided more information than their AJK counterparts and within the agencies there was more information on projects already in operation with only minimal information on projects under construction or in the feasibility stage.

Exhibit 2.2 shows the locations, capacities, progress status and executing agencies of existing and planned hydropower projects in AJK. The exact locations of the projects that are operational or under construction were easy to obtain, while locations of projects under different feasibility stages were limited to mentioning the river and closest town or village the hydropower project was to be located in. Therefore, the coordinates of the different projects being planned or in different stages of feasibility studies shown on maps in the sections above were the closest approximation according to the limited information available.¹⁰

2.2 SEA Perspective on Development of Hydropower Potential in the AJK

IUCN's 'Strategic Environmental Assessment of Hydropower Development Projects in Azad Jammu and Kashmir,'¹¹ recommended the preparation of strategic plans, policies and guidelines for hydropower development in AJK that recognize both the economic and environmental value of the regions rivers and guide their development in a sustainable manner. In the SEA:

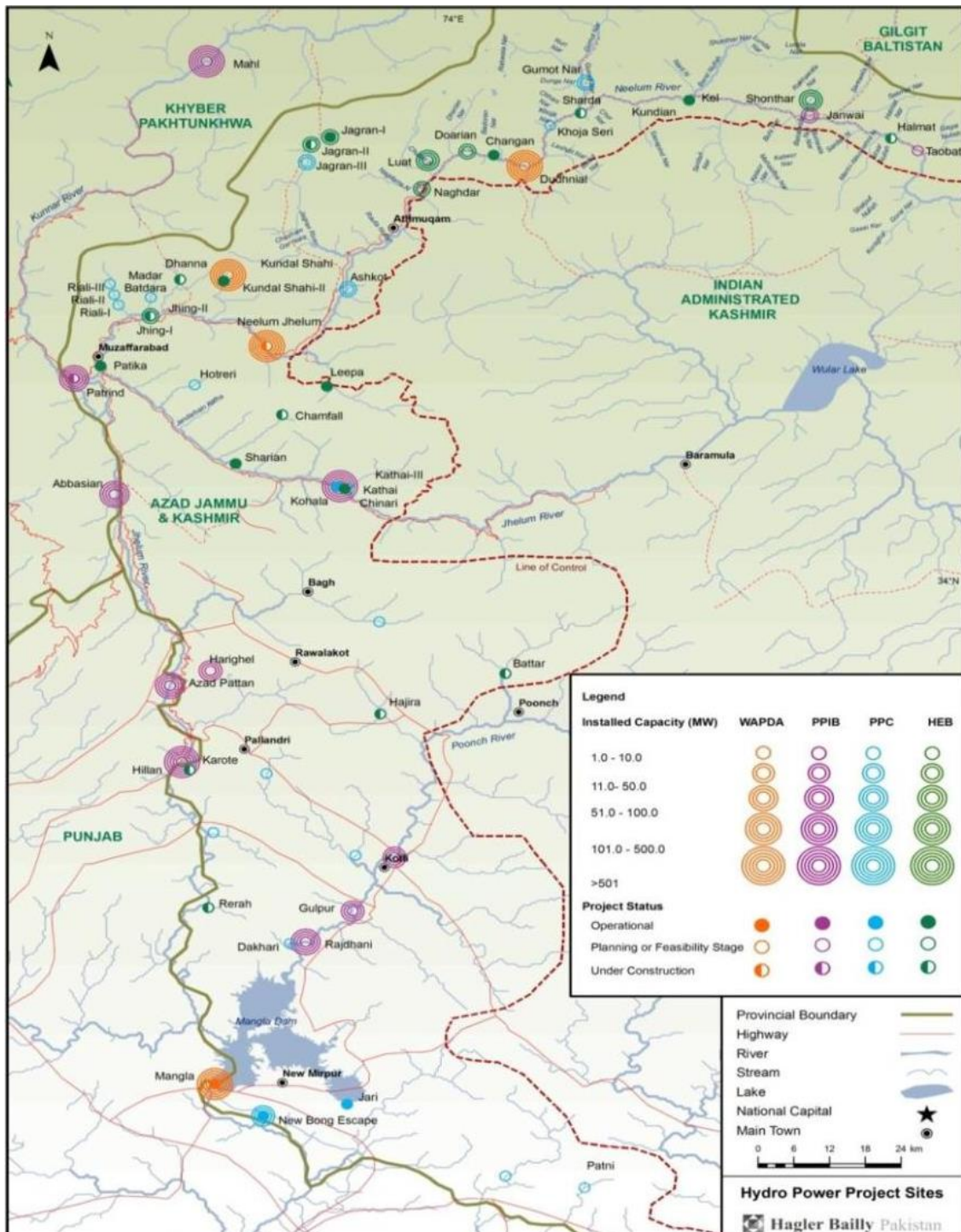
- ▶ The hydropower potential of Poonch River in AJK was estimated at c. 474 MW.¹²
- ▶ The hydropower potential of the Jhelum and Neelum Rivers in AJK was estimated at c. 7 000 MW.

¹⁰ Ibid

¹¹ Ibid

¹² This estimate is higher than the combined capacity of 462 MW for the projects in AJK listed in Section 2.2.1. It is likely that these are overestimates of hydropower potential as they were calculated at an earlier stage

Exhibit 2.2: Locations, Capacities, Progress Status and Executing Agencies of Hydropower Projects in AJK



Source: IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report.

- ▶ The entire Poonch River was classified as a ‘Highly Sensitive Zone’, mainly in recognition of the diversity of fish, the presence of endangered fish species, and status of the river as a National Park (**Exhibit 2.3**).
- ▶ Segments of the Jhelum and Neelum Rivers were classified as ‘Moderately Sensitive Zone’ and ‘Least Sensitive Zone’.

The SEA suggested that the hydropower potential of the Jhelum and Neelum rivers could be developed at a significantly lower cost to the environment than that of the Poonch River. Caution needed to be exercised in developing the potential of the Poonch River in view of its relatively high environmental value and relatively smaller contribution to the national economy.

Two hydropower plants on the Neelum/Jhelum are presently in advanced stages of construction, viz.: the 330 MW Kishenganga HPP, which is due for completion in 2016, and will supply power to the national grid in India; and the 969 MW Neelum-Jhelum HPP, which is due for completion by end 2015 and will supply power to the national grid in Pakistan.

2.3 Existing and Planned Hydropower Projects on Poonch River Basin

According to the latest information available, the following hydropower projects are planned on the Poonch River and its tributaries in Pakistan.

1. Gulpur Hydropower Project with an installed capacity of 100 MW
2. Sehra Hydropower Project with an installed capacity of 130 MW
3. Kotli Hydropower Project with an installed capacity of 100 MW
4. Rajdhani Hydropower Project with an installed capacity of 132 MW
5. Dakhari Hydropower Project with an installed capacity of 2.2 MW
6. Hajira Hydropower Project with an installed capacity of 3 MW
7. Battar Hydropower Project with an installed capacity of 4.8 MW
8. Sarhota Hydropower Project with an installed capacity of 1MW
9. Pothi Hydropower Project with an installed capacity of 1MW

Exhibit 2.4 shows the location of these projects. In the above list, the four large projects namely Sehra, Kotli, and Rajdhani appear in the sequence in which they are likely to be developed, if at all. The feasibility study for the Sehra project has been prepared and the developer has submitted an application to the electricity regulator for approval of tariff¹³. The EIA for this project has not been submitted as yet to the the AJK EPA. The PPIB has solicited and received proposals for the Kotli and rajdhani

¹³ Source: PPIB, http://www.ppib.gov.pk/N_upcoming_hydel.htm, visited on November 1, 2014

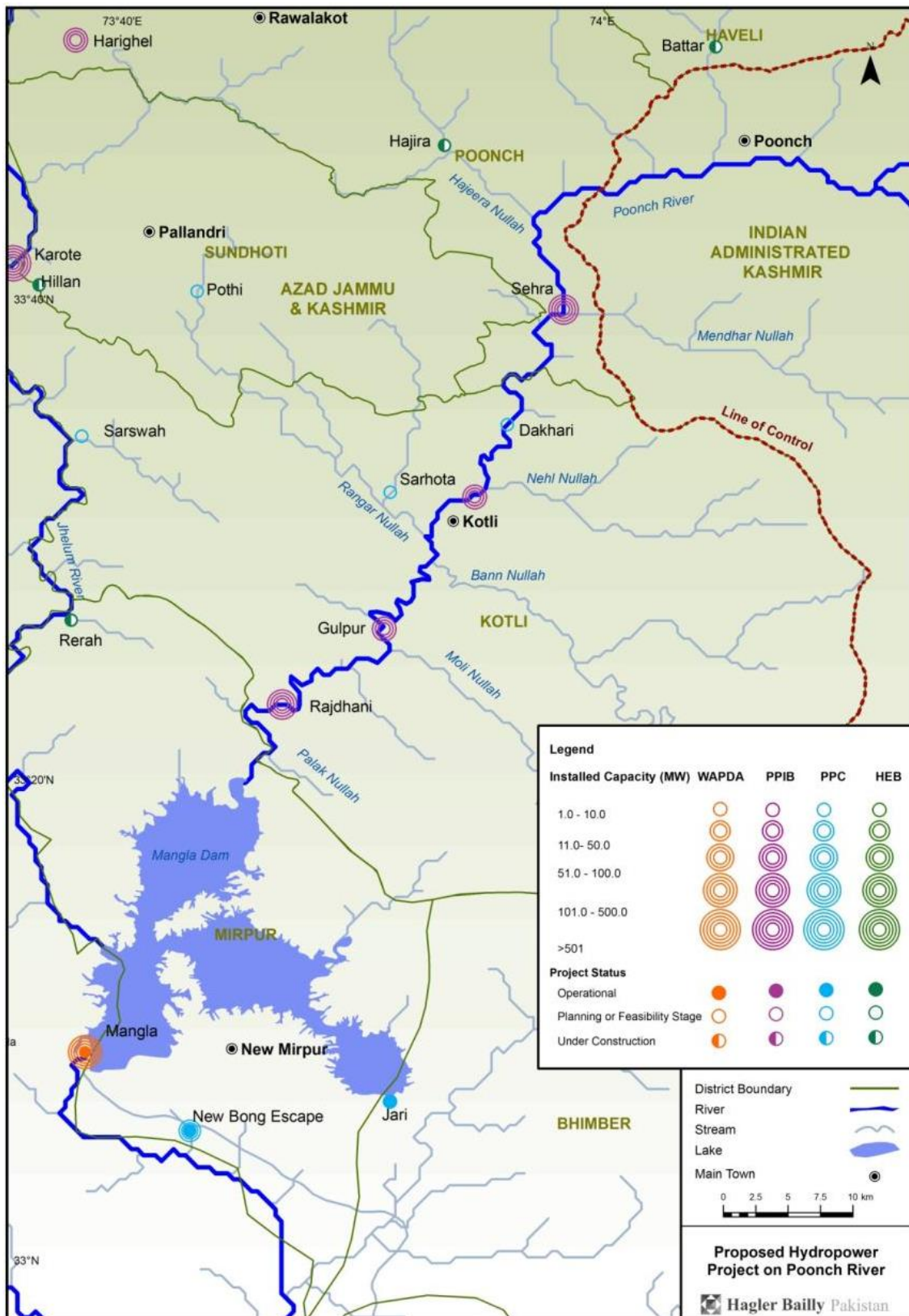
projects, and is evaluating them. The Parnai hydropower project not included in the list is already under construction in the Indian Administered Kahsmir.

Exhibit 2.3: Ecological Sensitivity Zones for Hydropower Development



Source: IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report.

Exhibit 2.4: Proposed Hydropower Projects on Poonch River



3. Scoping

The Project will be located on the Poonch River and utilize the flow of the river water for production of power. A scoping assessment was carried out to ascertain whether the area of influence of the cumulative impact of existing and planned hydropower projects may extend beyond the Poonch River. This assessment was instrumental in demarcating the Study Area (**Section 3.5**) based on ecological contiguity and connectivity of ecosystems. A literature review of research articles, previous EIA (Environmental Impact Assessment) reports, relevant books and websites was carried out to gather this information.

3.1 Background

The Area of Azad Jammu and Kashmir is drained by three main rivers viz., Neelum, Jhelum and Poonch, all draining into Mangla Reservoir. The Mangla Dam is the twelfth largest dam in the world. It was constructed in 1967 across the Jhelum River in Mirpur district of Azad Kashmir.

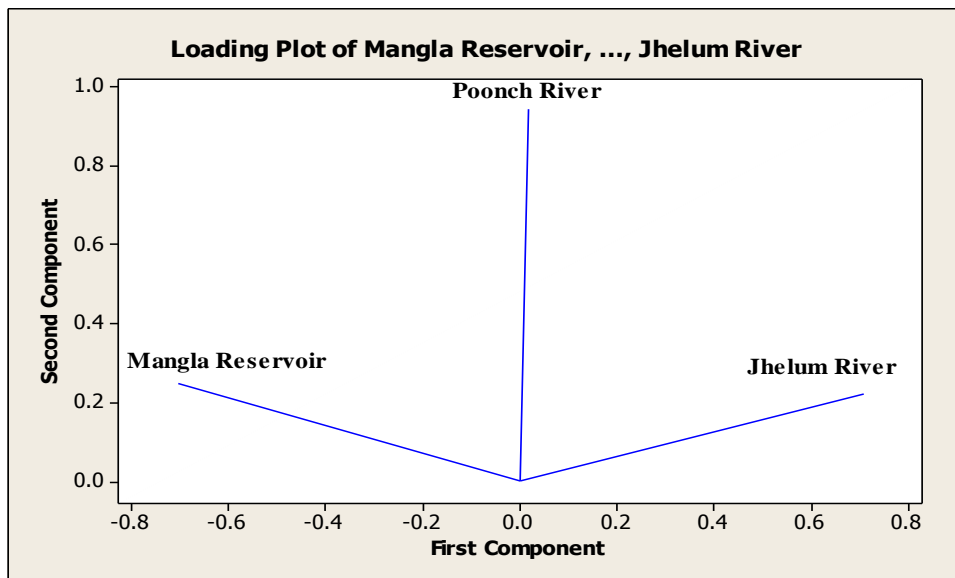
Mangla Dam, which became operational in 1967, was a major intervention that has altered the river ecology downstream as well as upstream of the reservoir. The rivers draining into Mangla Reservoir have different characteristics as they originate from areas having different geographical and physical features. The Poonch River originates in the western foothills of Pir Panjal Range. It is a warm water river and the water temperature approaches almost 30° C during the summer months. Water in the Jhelum River has the intermediate temperature reaching 25° C during the summer months. These variable temperature regimes give the Mangla reservoir a unique physic-chemical characteristic having different temperature regimes, both, on horizontal as well as on vertical scales. Different pockets in the Mangla reservoir have different temperature regimes, the variations are mainly attributable to stratification due to the depth of water. The Jhelum River is deep with fast water flows all along the river. It flows through a “V” shaped valley. On the other hand, the Poonch River is shallow, open, flat and the water flows with a moderate speed. The fish fauna in these water bodies is therefore distributed according to its optimal requirements of temperature and other physic-chemical factors. The vast lake environment of Mangla reservoir has facilitated large commercial fishes to be established in the dam area.¹⁴

The Principal Component Analysis indicates that the diversity of fish species can be grouped into Jhelum River, Poonch River and Mangla Reservoir. The Mangla Reservoir and Jhelum River differ from each other in diversity and the Poonch River falls in between these two water bodies (**Exhibit 3.1**). Poonch River is in between the Jhelum River and Mangla Reservoir in terms of water temperature, nature of habitat, physical conditions of the breeding grounds, water speed, water volume, relative length of the

¹⁴ Ecological Baseline Study of Poonch River AJ&K with Special Emphasis on Mahseer Fish, January 2012, Rafique, M., Pakistan Museum of Natural History, prepared for WWF Pakistan by Himalayan Wildlife Foundation

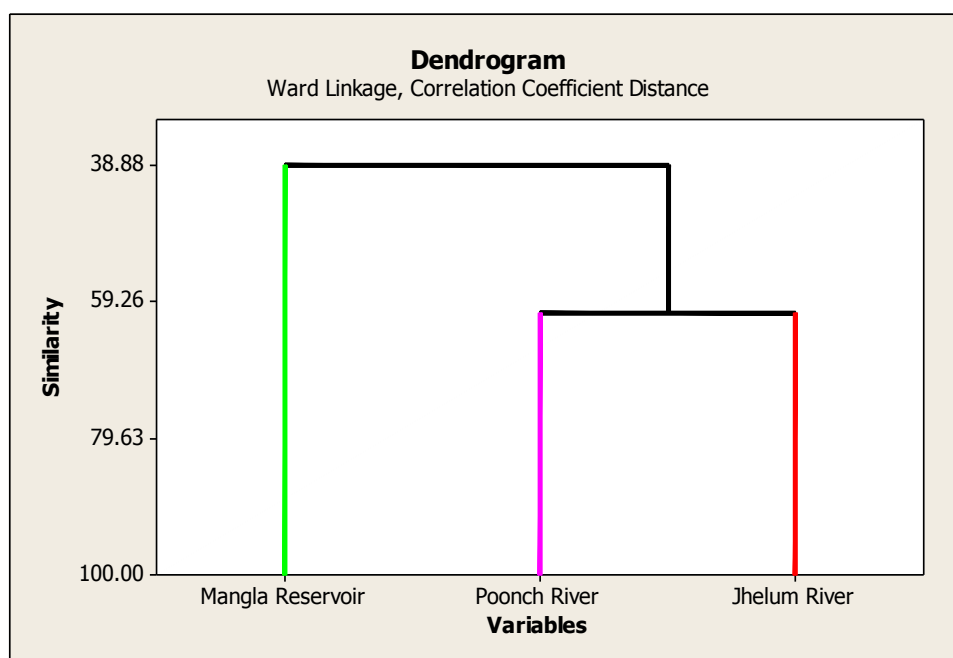
river and topography. Cluster Analysis also shows that the three water bodies can be divided into three distinct groups on the basis of their fish fauna at 65% similarity level as revealed by the **Exhibit 3.2**. The Poonch and Jhelum Rivers are however closer to each other due to the flowing water conditions in both of the water bodies and having similar impact of the Mangla Reservoir at least in their lower reaches. Moreover, most of the fish fauna found in the Mangla Reservoir, specially the commercially important fish fauna, is distributed in the downstream areas of the lake in the rivers of Punjab. Construction of the dam has changed the ecosystem from running to a large stagnant water body. The fish fauna of the Indus plain is distributed throughout the whole stretch of the Poonch in AJK while it is distributed in the River Jhelum to variable extent due to comparatively cold water of the river.¹⁵

Exhibit 3.1: Similarity among Different Water Bodies Based on Principal Component Analysis



¹⁵ Ibid

Exhibit 3.2: Similarity among Different Water Bodies Based on Cluster Analysis



The River Poonch also shares a number of fish fauna with the Jhelum River. All the cool water fish fauna found in the river Poonch is also represented in the river Jhelum. A total of 15 species are common between the two rivers. The River Poonch, therefore, shares its 52% fish fauna with the River Jhelum. The River Jhelum on the other hand shares 47% of its fish fauna with the Poonch River and both of these rivers have a similarity co-efficient of 0.49%. The fish fauna river Jhelum common with the Poonch River is distributed in the lower reaches of the river Jhelum which mainly migrates from Mangla Reservoir upstream in the river Jhelum during the summer season. Out of 62 species found in the Mangla Reservoir and 32 in the Jhelum River, only twenty species are common in both these water bodies. Poonch River is the main breeding area for the fish in the Mangla Reservoir, which is an important area for commercial fishery in the AJ&K, and is a source of revenue for the government.¹⁶

3.2 Ecological Importance of Poonch River

A total of 37 fish species have been recorded from the Poonch River (**Section 5.3**).^{17 18} The diversity¹⁹ is higher in the area where the River Poonch makes its confluence with

¹⁶ Rafique, M., Qureshi, M. Y. (1997). A contribution to the fish and fisheries of Azad Kashmir. In: S. A. Mufti, C. A. Woods and S. A. Hasan, (eds.), Biodiversity of Pakistan. Pak. Mus. Nat. Hist. Islamabad and Fl. Mus. Nat. Hist. USA, p 335-343.

¹⁷ Ecological Baseline Study of Poonch River AJ&K with Special Emphasis on Mahaseer Fish, January 2012, Rafique, M., Pakistan Museum of Natural History, prepared for WWF Pakistan by Himalayan Wildlife Foundation.

¹⁸ HBP, July 2014, Baseline Biodiversity Assessment Report for Gulpur Hydropower Project, Hagler Bailly Pakistan.

Mangla Reservoir. This diversity is quite high for a river of this size as compared to other rivers of AJK, the Neelum and Jhelum, which are bigger and longer. Of the fish species recorded from the Poonch River, 16 species are species of special importance because of their economic importance or conservation status (endemic or included in IUCN Red List).

The ecological importance of the Poonch River has been summarized in the Ecological Baseline Study of Poonch River AJ&K with Special Emphasis on Mahaseer Fish, January 2012²⁰ as outlined below.

- ▶ **Last refuge for Mahaseer Fish:** Mahaseer has been a widely distributed fish in Pakistan during sixties and seventies. It was flourishing in the five rivers of Punjab and breeding in the Himalayan foothill areas. Due to damming of the water bodies, ecological fragmentation of the water bodies, pollution, water diversion, habitat destruction and indiscriminate hunting, its population has been continuously declining in its natural habitat. Its distribution range in the country, therefore, continued squeezing and presently it is almost non-existent in the rivers of Punjab. IUCN has declared it as an “Endangered species”. The Poonch River, however, is still having a reasonably good population of Mahaseer. It is still successfully breeding in its upper and middle reaches. The main centers of Mahaseer breeding are the Ban Nullah, Rangar Nullah, Nehl Nullah, Hajeera Nullah, Meander Nullah and the Titri Note area where the river is wide.
- ▶ **Breeding ground for the fish fauna of Mangla Reservoir:** Poonch River serves as a huge breeding ground for most of the fish fauna of the Mangla reservoir which breeds in flowing water conditions. Most of the commercially important cyprinid and cat fish breed in backwaters of the reservoir in the Poonch River. The side nullahs meeting to Poonch river form the major breeding grounds for these fishes. These Nullahs also serve as nursery grounds for the fishes breeding in these side streams.
- ▶ **Natural reserve for Twin-banded Loach, *Botia rostrata*:** Twin banded loach is a beautiful aquarium fish. It has almost the same story as that of Mahaseer. The fish has been quite common in the Himalayan foothill areas but presently its population in the foothill areas is almost depleted or non-existent. The Poonch River has a very good population of this loach and is a hot spot area for this fish.
- ▶ **Supporting healthy population of *Labeo dyocheilus*:** Poonch River holds the largest population of *Labeo dyocheilus* as compared to any other river in the country. This fish has maximum size in this river and a fish weighing 3-4 kg is commonly caught in the nets.
- ▶ **Supporting healthy population of *Garra gotyla*:** The fish *Garra gotyla* is also a fish of submountainous areas but it is also found in plains. Its population in plain areas has decreased over the last 20 years and hardly one comes across any fish while sampling. Once upon a time it was very common in Potowar areas but it is no more

¹⁹ Relative diversity or richness observed.

²⁰ Ecological Baseline Study of Poonch River, AJ&K, with special emphasis on Mahaseer Fish. January 2012. Prepared for World Wide Fund for Nature (WWF-P) by Himalayan Wildlife Foundation.

seen in any of these areas except a few localized places. Poonch River has very healthy population of this fish throughout its length in AJK.

In addition to these factors, the Poonch River is ecologically important for the following reasons:²¹ :

- ▶ **Providing habitat to Kashmir Catfish *Glpthothorax kashmirensis*:** The Poonch River provides habitat for the Kashmir Catfish *Glpthothorax kashmirensis*. It was previously reported only from Jhelum River²², but has been captured from the Poonch River during the October 2013 and May 2014 survey conducted for the ESIA of Gulpur HPP.
- ▶ **Supporting high fish diversity as compared to its size:** The Poonch is the smallest river in AJK as compared to other two rivers, the Jhelum and the Neelum. It, however, has a very good fish diversity of 37 species as compared to 32 species in Jhelum and 12 species in Neelum. It is due to optimum water temperature, pristine breeding grounds, wide river valley, and network of side nullahs with suitable physico-chemical environment.
- ▶ **Conservation importance of fish species:** The species, *Barilius pakistanicus* and *Schistura punjabensis* are endemic to Pakistan. Five species have special IUCN status: *Tor putitora* (Endangered), *Schizothorax plagiostomus (richardsonii)* (Vulnerable), *Cyprinus carpio* (Vulnerable), *Botia rostrata* (Vulnerable), *Ompok bimaculatus* (Vulnerable) and *Ompok bimaculatus* (Near Threatened).
- ▶ **Economic importance of fish:** Of species bearing IUCN status, *Tor putitora*, *Schizothorax plagiostomus (richardsonii)*, *Cyprinus carpio*, and *Ompok bimaculatus* are commercially important. The other commercially important species are *Sperata seenghala*, *Clupisoma garua*, and *Mastacembelus armatus*, and *Cyprinus carpio*. Some of these species such as *Tor putitora*, *Sperata seenghala*, *Clupisoma garua* have very high commercial importance.
- ▶ **Protected area:** The entire stretch of the Poonch River along with its tributaries has been declared as Mahaseer National Park in a notification issued by the President of AJK in December 2010. The Poonch River was declared as a national park due to its high fish diversity and importance for supporting fish of both conservation and economic importance particularly the Endangered Mahaseer fish (IUCN Red List 2014).
- ▶ **Connectivity:** The Poonch River serves as a breeding ground for the commercially important fish species of the Mangla Reservoir and therefore plays a vital role in supporting fish populations in the downstream ecosystem.

²¹ IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report

²² IUCN 2014. IUCN Red List of Threatened Species. Version 2014.1. <www.iucnredlist.org>. Downloaded on 26 October 2014.

3.3 Socio-economic uses of the Poonch River

Sediment Mining in Poonch river

Sand and gravel extraction activities are extensively undertaken along the Poonch River and are widely practiced in the areas of Kotli, Hil Kalan up to confluence of Poonch River and Ban Nullah, in some parts of the river stretch near Kohali and Gulpur, as well near Rajdhani and upstream of Rajdhani (**Exhibit 3.4**).

Sand mining and gravel extraction is more common during the winter months (September to March) than in summers, since during low flows the sand is easier to mine along the exposed river-beds. The mining techniques are crude, and the sand, mined using shovels and spades, is loaded onto trolley-carts, horses and donkeys. Sand miners who own tractor trolleys transport the sand to Kotli, Nakyal, Gulpur, Rajdhani and other big settlements. The sand and gravel is then sold to residents of the nearby villages and construction contractors for use as construction material. Photographs of sand and gravel extraction in the Study Area are shown in **Exhibit 3.3**.

Baseline surveys conducted for the ESIA of the Gulpur Hydropower Project estimated the total quantity of sediment extracted in the stretch of the river downstream of the LoC to the Mangla Reservoir at 434,400 m³. The total financial value of the sediment excavated per year in entire stretch of Poonch River downstream of the LoC to the Mangla Reservoir is estimated at Rupees 400 million (USD 4 million).²³

Recreational and Subsistence Fishing

Recreational and subsistence fishing is limited to larger fish species such as the Mahaseer, Pakistan Labeo, and the Snow Trout. Mahaseer as a sport fish has a special value for the angling community. Areas along the Poonch river where fishing is practiced are shown in **Exhibit 3.4**.

Exhibit 3.3: Photographs of Sand and Gravel Extraction in Study Area



Sand and Gravel Extraction at Khuairatta



Sand Dumping Area near Bann Nullah

²³ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.



Gravel Extraction upstream Gulpur



Sand Dumping on Road Side near confluence of Poonch River and Bann Nullah

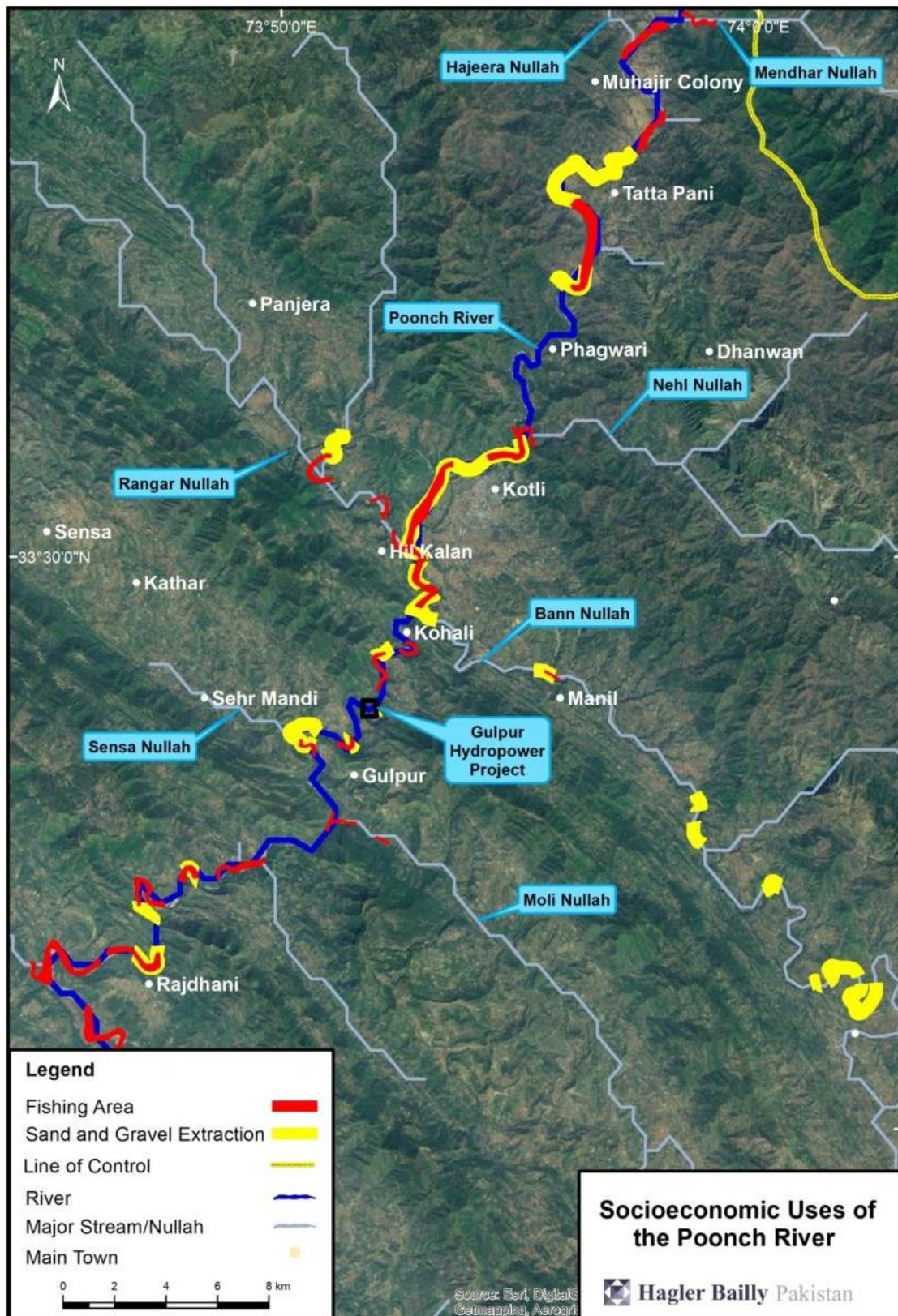


Gravel collected for Crushing near confluence of Poonch River and Bann Nullah



Gravel Extraction in Poonch River north-west of Kotli

Exhibit 3.4: Socio-Economic Uses of the Poonch River



3.4 Critical Habitat Assessment

The Critical Habitat Assessment of the Project was completed in January 2014²⁴ according to the principles defined by the IFC's PS6²⁵ and SR1, ADB SPS.²⁶ It was determined that the Poonch River and tributaries lie in a Critical Habitat on the basis of two criteria:

Criterion 1: Habitat of significant importance to Critically Endangered and/or Endangered species

The Poonch River provides habitat for two fish species: Kashmir Catfish *Glyptothorax kashmirensis* listed as Critically Endangered and Mahaseer *Tor putitora* listed as Endangered in IUCN Red List.

Criterion 2: Areas that meet the criteria of the IUCN's Protected Area Management Categories Ia, Ib and II, although areas that meet criteria for Management Categories III–VI may also qualify depending on the biodiversity values inherent to those sites²⁷

²⁴ HBP, January 2014, Critical Habitat Assessment of Gulpur Hydropower Project, Hagler Bailly Pakistan.

²⁵ Guidance Note 6, January 2012, Biodiversity Conservation and Sustainable Management of Living Natural Resources, International Finance Corporation. The World Bank Group

²⁶ ADB's 2009 Safeguard Policy Statement (SPS) – Safeguards Requirement (SR) 1 on Environment,

²⁷ IUCN Protected Areas Categories System

IUCN protected area management categories classify protected areas according to their management objectives. The categories are recognized by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

Ia Strict Nature Reserve

Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphical features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring

Ib Wilderness Area

Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

II National Park

Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.

III Natural Monument or Feature

Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.

IV Habitat/Species Management Area

Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.

V Protected Landscape/ Seascape

A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the

The Poonch River and tributaries was declared a national park in a letter from the AJK Secretariat Forest/AKLASC/Fisheries (ref no: SF/AV 11358-7/2010 dated 15 December 2010). Even though the official notification does not specify the basis for the designation, the objective for declaring the Poonch River as a national park was to protect the aquatic ecological resources of the Poonch River. It has not been designated any official protected area category by IUCN. However, it seems to fit the IUCN category II definition of National Park.²⁸

3.5 Delineation of the Study Area

The geographical and temporal boundary of the Study Area for Cumulative Impact Assessment was determined as follows:

3.5.1 Geographical Boundary

As explained in the previous section, the Poonch River shares a number of fish species common with the Mangla Reservoir. In addition, the Poonch River provides a breeding ground for the fish fauna of the reservoir. Thus, there is a connectivity between the Poonch and Mangla aquatic ecosystems and changes in the physical, chemical or biological characteristics of the Poonch River will impact the ecological resources of both the Poonch River and Mangla Reservoir. Based on ecological contiguity, the geographical boundary of the Study Area for CIA is defined to include the entire stretch of the Poonch River, its tributaries as well as the Mangla Reservoir (**Exhibit 3.5**).

3.5.2 Temporal Boundary

As explained in **Section 2.3**, there is a potential for development of nine hydropower projects on the Poonch River in Pakistan. However, given the uncertainty to predict if and when some or all of these developments will indeed materialize or be dropped, this CIA has focused on the following five potential projects that are in more advanced stages of planning and have a greater likelihood of being made. Four of these projects will be located in Pakistan while one is in India. The projects are (from upstream to downstream):

- ▶ Parnai HPP: a 37.5-MW diversion plant in Indian Administered Kashmir. Available design details indicate that the project will divert water through a tunnel into Mendhar

integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

VI Protected area with sustainable use of natural resources

Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

²⁸ Ibid

Nullah, which flows into the Poonch River in AJK about 15 km downstream of the Line of Control (LoC).²⁹

- ▶ Sehra HPP: a 130-MW RoR plant just downstream of the LoC.³⁰
- ▶ Kotli HPP: a 100-MW RoR plant just upstream of Kotli.³¹
- ▶ Gulpur HPP: a 100-MW RoR plant just downstream Kotli.³²
- ▶ Rajdhani HPP: a 132-MW RoR plant just upstream of Mangla reservoir.³³

Of these, design is complete for Parnai and Gulpur HPPs, and both of these projects are at an advanced stage of development, and award of engineering, procurement, and construction (EPC) contracts is expected in the near future. The feasibility study has been prepared for the Sehra HPP. Prefeasibility studies have been completed for the Kotli and Rajdhani HPPs, and a right to construct has also been granted for the Kotli HPP. If built, in all likelihood the five projects will be operational in a period of five to seven years. Therefore for the purpose of the CIA the temporal boundary has been limited to 10 years.

It is expected that the cumulative impacts associated with the other potential projects listed in **Section 2.3** will essentially be incremental to the five projects listed above, and will follow the same principles of cumulative impact assessment and mitigation as identified for these five projects.

Exhibit 3.5 includes a map of the Study Area. The map also indicates existing and planned hydropower projects.

²⁹ Parnai HPP: Project Design Document, 37.5-MW Parnai Hydroelectric Project, submitted to UNFCCC by Jammu and Kashmir State Power Development Corporation Limited and IT Power Consulting Private Limited, September 2013

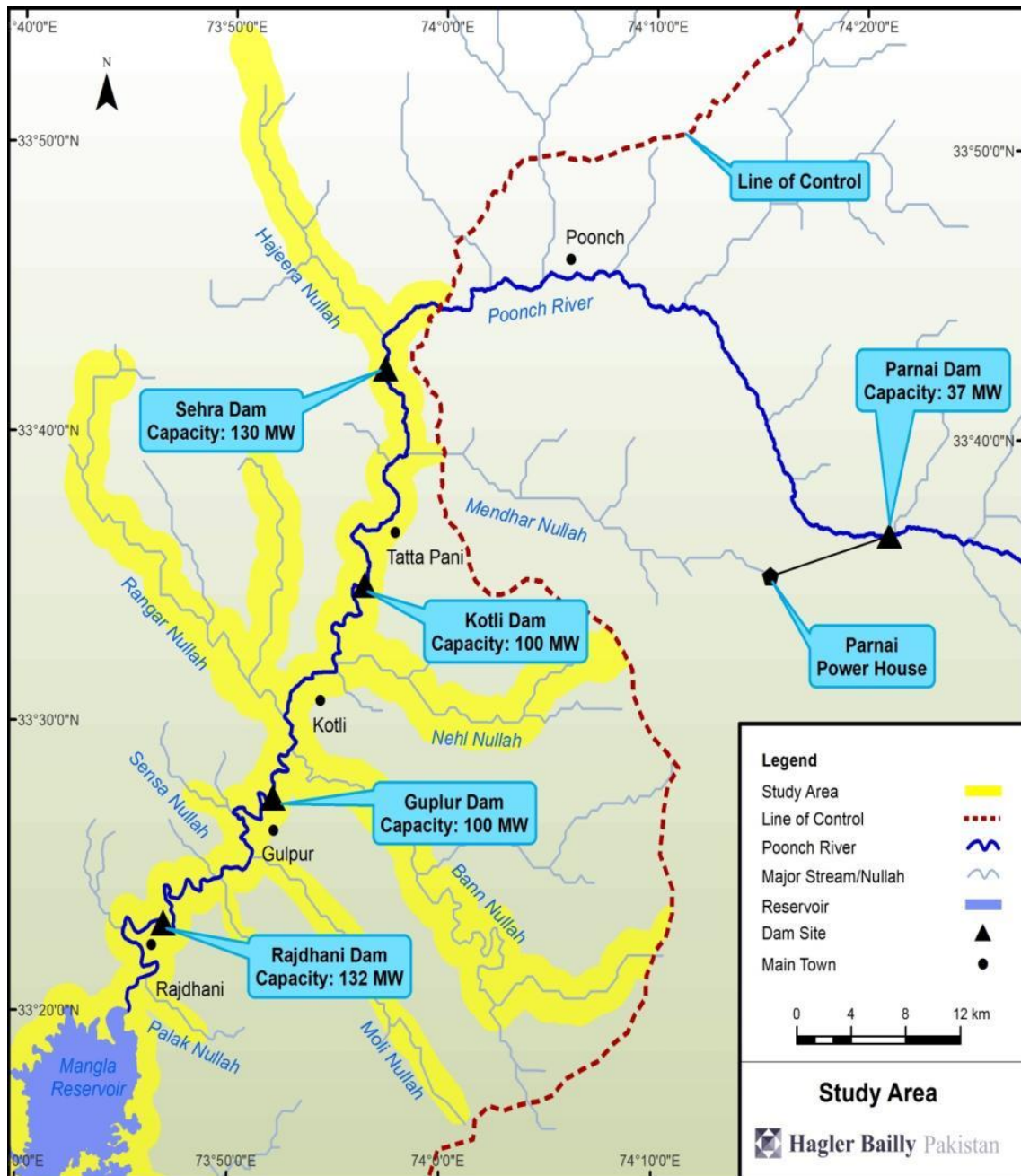
³⁰ Sehra HPP: Feasibility Study, Tamavan Company, Iran, November 2009.

³¹ Kotli HPP: Project Profile, 100-W Kotli Hydropower Project, Private Power and Infrastructure Board, Government of Pakistan, December 2013

³² Gulpur HPP: Basic Design Report and other design details for Gulpur Hydropower Project prepared by Mira Power Ltd.

³³ Rajdhani HPP: Feasibility Report, Rajdhani Hydropower Project, MWH, December 2003.

Exhibit 3.5: Study Area



4. Valued Environmental and Social Components

There is a constant interchange of materials, energy and nutrients between the water in the river, its banks, its bed and its floodplains. During the course of the water's passage from source to sea sediments are continuously transported, sorted by size, re-sorted, eroded and deposited by the daily, yearly and decadal variations in flow, giving rise to permanent and semi-permanent river-channel features, such as pools, rapids, ox-bow lakes, sandbars and floodplains. The floodplains are areas of fertile soils, replenished by the river during each flood and often highly valued as agricultural land. The dynamic, ever-changing environment creates the physical-chemical template upon which the river's organisms live their lives.^{34 35}

The changing conditions along a river result in an orderly and predictable transition of species. Different plants and animals live in the headwaters than in the lower reaches and different plant communities occur high on banks than lower down near the water. Some fish species need to move onto seasonally inundated floodplains to complete their life cycles whilst others need the conditions provided in-channel throughout their lives. Some animal species need to migrate up and downstream at different times of the year or into and out of tributaries, to find appropriate temperature and other conditions. Some plants and animals live in pools and others in fast-flowing rapids and riffles, some in colder water and some in warmer environments, and so on.

Similarly, species respond to temporal changes in changing flow conditions, with each river's mix of plant and animal species having evolved over millennia to live in synchrony with its unique short and long term cyclical flow patterns. Plant species have evolved to flower and fruit at specific times of the annual flow cycle, fish time their spawning to coincide with the optimal flow and temperature conditions for their young to survive, and insects emerge from the water to mate and release their eggs at specific times of the year when air temperatures, food and other conditions are optimal. Some species thrive in drier years and others in wetter years, and so the balance of species is maintained with none dominating but rather the mix of species changing from year to year. For all of these organisms the river provides breeding sites, a nursery for their young, a highway along which they migrate and a vehicle for dispersing the next generation.

Both the spatial and temporal responses of plants and animals to changing conditions are usually set within quite specific limits—limits that are usually not known or only barely understood by humans. In most cases, we manage river ecosystems without good knowledge of what species they support, even less the needs of those species for survival. In our ignorance, however, we do at least now better understand that any physical or

³⁴ King J, Tharme RE and de Villiers MS. 2000. *Environmental flow assessments for rivers: manual for the Building Block Method*. Water Research Commission Report TT 131/00, Pretoria South Africa

³⁵ Hagler Bailly Pakistan, Water Matters, Southern Waters, NESPAK, Environmental Assessment of Kishenganga /Neelum River Water Diversion. Report prepared for Pakistan Commission for Indus Waters. Lahore. Hagler Bailly Pakistan.

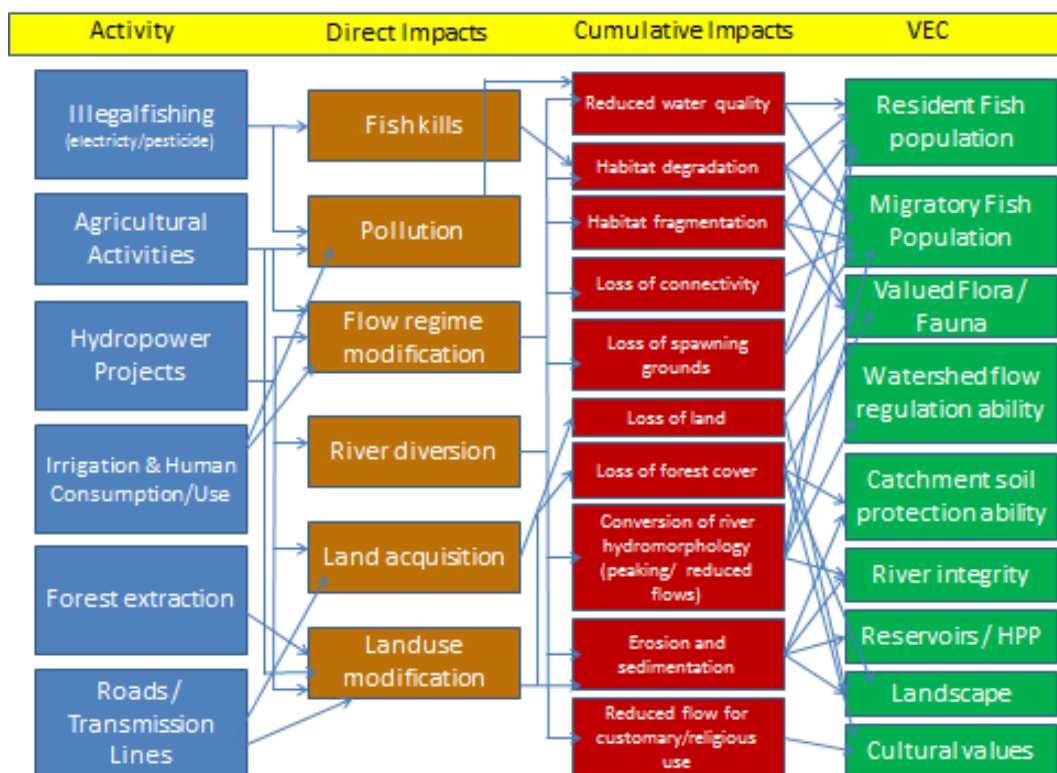
chemical change to an ecosystem outside of its natural range will disrupt relationships between species, probably reduce biological diversity and abundances, and potentially cause community shifts characterized by loss of sensitive, often rare, species and proliferation of robust, often common, species.

4.1 Definition of VEC

Valued Environmental Components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment, (including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use) that are likely to be the most sensitive receptors to the impacts of a proposed project or the cumulative impacts of several projects.

Exhibit 4.1 summarizes the possible cumulative impacts expected from multiple cascading hydropower developments when placed in the context of existing and foreseen future activities.

Exhibit 4.1: Expected Cumulative Impacts Resulting from Cascading Hydropower Development and other Present and Foreseen Activities



Source: World Bank. 2011. Environmental Impact Assessment Study of Kabeili 'A' Hydroelectric Project. Washington D.C. - The World Bank..

4.2 Selection of VECs

The selection of VECs for the Poonch River was made on the basis of a literature review of the of EIAs and conservation studies carried out on the AJK rivers particularly the

ESIA of the Gulpur Hydropower Project.³⁶ In addition, community and institutional stakeholder consultations carried out for the ESIA of the Gulpur Hydropower Project were instrumental in identification of the VECs.

4.2.1 Literature review

The ESIA of the Gulpur Hydropower Project³⁷ provides baseline information on the ecological resources of the Poonch River (**Section 5**), their conservation importance as well as the ecosystem services provided by the Poonch River (**Section 3**).

Two other studies conducted on the rivers of AJK were important in selection of the VECs. These included the following:

- ▶ Hagler Bailly Pakistan, Water Matters – South Africa, Southern Waters – South Africa, National Engineering Services Pakistan (NESPAK), 2011, Environmental Assessment of Kishenganga /Neelum River Water Diversion. Report prepared for Pakistan Commission for Indus Waters, Lahore.
- ▶ Hagler Bailly Pakistan, Water Matters – South Africa, Southern Waters – South Africa, National Engineering Services Pakistan (NESPAK), 2013. Environmental Assessment of Neelum Jhelum Hydroelectric Project River Diversion. Interim Report prepared for Ministry of Water and Power, Islamabad.

4.2.2 Stakeholder Consultations

Stakeholders are groups or individuals that can affect or take affect from a project's outcome. SPS 2009³⁸ and IFC Performance Standards³⁹ specifically identifies affected people, concerned nongovernment organizations (NGOs) and government as prospective stakeholders to a project. Public consultation is also mandated under Pakistan's environmental law (Pakistan Environmental Protection Act 1997) as part of the ESIA requirements.

Concerns relevant to biodiversity and ecology raised were raised during the following consultations carried out for the Gulpur Hydropower Project:

- ▶ community consultations carried out for the ESIA
- ▶ institutional consultations carried out for the ESIA
- ▶ ESIA public hearing
- ▶ consultations carried out specifically for developing the implementation strategy and monitoring framework of Biodiversity Action Plan.

These concerns of the local communities, scientists, relevant government departments and NGOs working in the Poonch River basin were compiled, analyzed and discussed with biodiversity experts to identify the VECs.

³⁶ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.

³⁷ Ibid

³⁸ Safeguard Policy Statement, Asian Development Bank, June 2009

³⁹ IFC Performance Standards, International Finance Corporation, January 2012

A summary of these consultations is provided in the Biodiversity Action Plan for the Gulpur Hydropower Project.⁴⁰ Some photographs of consultations are given in **Exhibit 4.2.**

Exhibit 4.2: Photographs of Consultations



Community Consultation with Men



Community Consultation with Women



Community Consultation with Men



Community Consultation with Women



Consultation with NGOs and Scientists



Consultation with Environmental Protection Agency, -AJK, Hydro-electric Board-AJK and Forest Department-AJK

⁴⁰ Hagler Bailly Pakistan (HBP), October 2014, Biodiversity Action Plan for Gulpur Hydropower Project.

4.3 VECs selected for Poonch River

Using results of the field surveys, data analysis, literature review, as well as stakeholder consultations outlined above, the following VECs were selected for the Cumulative Impact Assessment:

- ▶ Surface water quantity (flow)
- ▶ Sediment (sand and gravel)
- ▶ Resident and migratory fish species
- ▶ Landscape

These VECs encompass the two most important ecosystem services provided by the Poonch River to the local communities outlined in **Section 3.3**:

- ▶ sand and gravel extraction
- ▶ subsistence and recreational fishing.

5. Baseline Status of Selected VECs

This section summarizes the baseline status of the selected VECs. The impact of the construction and operation of hydropower projects on these VECs is discussed in the next section. This information is drawn from the ESIA of the Gulpur Hydropower Project⁴¹ that involved a basin wide assessment of impacts in view of the requirement to demonstrate net gain at the basin level, and to assess the impacts of the dam as a barrier, which extends in both upstream and downstream directions of the dam.

5.1 Surface Water Quantity (Flow)

An assessment of the hydrology of the Poonch River and tributaries was carried out for the ESIA of the Gulpur Hydropower Project.⁴² Surveys were conducted in August 2013. A summary of the baseline conditions of hydrology is given below.

Hydrology

Poonch River is a main tributary of Jhelum River. Besides the discharge of main trunk, the river receives discharge of many natural streams (Nullahs) including Bann Nullah and Rangar Nullah. Like other rivers of Pakistan and AJK, Poonch River exhibits seasonal variations in the discharges.

A stream gauging station on Poonch River is maintained at Rehman Bridge near Kotli by WAPDA since 1960. WAPDA has collected daily mean river flow data for a period of 43 years (from 1960 through 2002) for hydrological study. The analysis of data shows that monthly mean discharges varied from 41 cumecs⁴³ in November to 279 cumecs in August, while the annual mean had been 128 cumecs during this period. Overall, the river discharges varied from a minimum of 12 cumecs in January 1966 to a maximum of 830 cumecs in September 1992. However, the annual mean minimum and maximum flows had been 69 cumecs and 260 cumecs, respectively. The annual mean had been 128 cumecs that corresponds to a runoff of 4,044 (MCM)⁴⁴ or 3.28 (MAF)⁴⁵.

The configuration of the drainage area combined with the cloudbursts during monsoon results in instantaneous flood peaks in the Poonch River in a short period after the rains. The historical instantaneous flood peaks experienced at the site of the Gulpur Hydropower Project during the reference period from 1960 to 2002 had been in the range of 878 cumecs (on 2nd August, 1979) to 12,150 cumecs (on 10th September, 1992) with an average of 4,671 cumecs.

⁴¹ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.

⁴² Ibid

⁴³ cubic meters per second

⁴⁴ million cubic meters

⁴⁵ million acre feet

Exhibit 5.1 shows mean monthly flows and runoff in Poonch River whereas **Exhibit 5.2** gives the mean annual flows of Poonch River.

Exhibit 5.1: Monthly Flows and Runoff of Poonch River

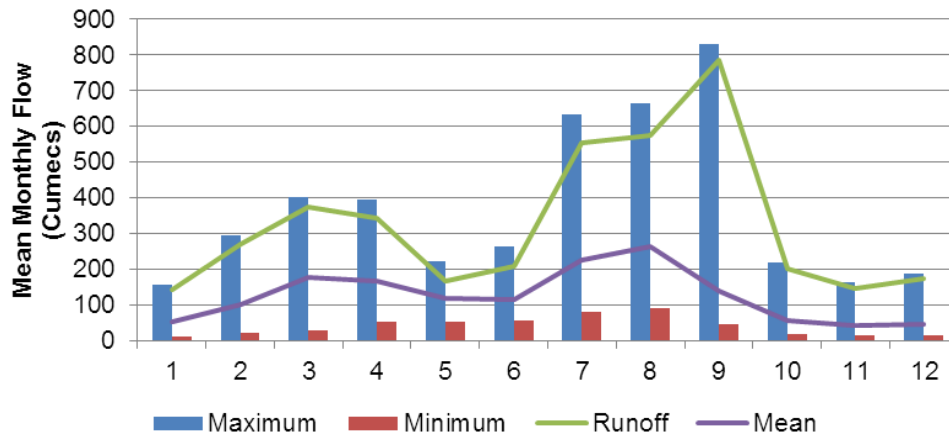
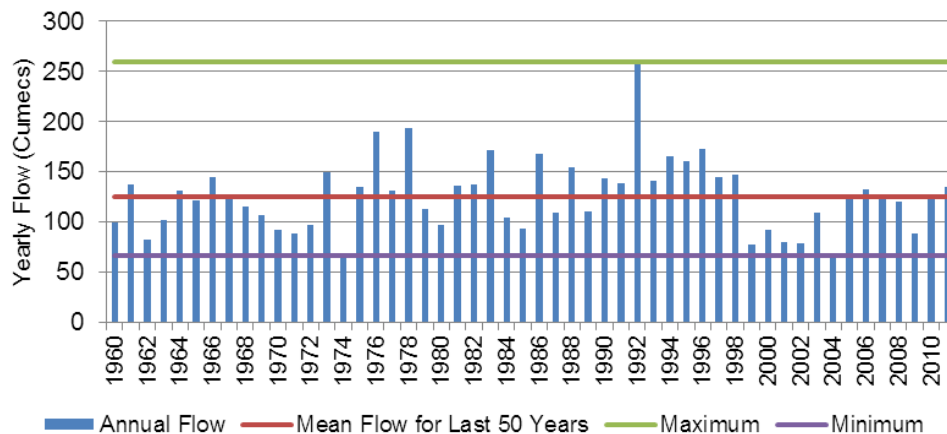


Exhibit 5.2: Mean Annual Flows of Poonch River



5.2 Sediment Load of River

River systems comprise not just the water flowing in the river channel itself, but also the sediment suspended in the water column or deposited along the river bed and banks. The erosion, transportation and deposition of these sediments by the river’s water during its passage to the sea is responsible for shaping the features commonly associated with river channels, such as meanders, sandbars, pools and deltas. Working and re-working the sediments, the river creates and maintains complex, shifting mosaics of features that provide the diversity of habitats upon which the river’s living organisms depend. Maintenance of these habitats is dependent on a continuing supply from upstream of the raw material—the silt, sand, gravel, cobbles and boulders supplied by the river bed and

the wider landscape. The same raw material maintains banks and shorelines and the bed in which the foundations of bridges are sunk.⁴⁶

Himalayan rivers are known for their high sediment loads resulting from high degree of catchment erosion. Typically the monsoon is a period of high sediment load in the river. Movement of fish for breeding, feeding, and wintering is typically triggered by changes in turbidity (in addition to changes in the temperature of water). The Poonch River is rich in sediment due to the high erodability of the rocks through which it passes.

Sediment Load

The form (morphology) of a river channel is dependent on the interaction between the supply of sediment from its catchment, and the ability, or capacity, of that section of the river to transport the sediment it is supplied with. The construction of hydropower project/s will affect both the sediment supply (through trapping in the reservoir) and transport potential (through the proposed reduced flows).

There are three components of sediment load:

- ▶ The dissolved load: the salts and nutrients which are dissolved in the water and moved downstream in solution.
- ▶ The suspended load: the sediment (usually very fine material) carried in suspension in the water column.
- ▶ The bedload: that component of the sediment load (the larger sediment fractions) transported along the bed of the river.

The dissolved load has no impact on the geomorphology and is not described below.

Suspended Load

The Surface Water Hydrology Project (SWHP) of the Water and Power Development Authority (WAPDA) provided data for the observed suspended sediment loads at the Rehman Bridge gauge station on the Poonch River (near Kotli) from 1960 to 2011. The mean suspended sediment load of the Poonch River is c. 10.87 million tonnes per annum (MTa^{-1}) (**Exhibit 5.3**).⁴⁷ Although cobble and boulder beds are extensive morphological features on the river bed and banks, the sand fraction represents a large portion of the river bed and banks. Data from the neighboring Jhelum River, indicate that sands are also the dominant bed load,⁴⁸ which suggests that the same may be true for the Poonch River.

The Poonch River flows into the large Mangla reservoir and a large volume of sediment has been deposited around this inflow (**Exhibit 5.4**). Observed measurements of sediment

⁴⁶ HBP (2011) Hagler Bailly Pakistan, Water Matters (South Africa), Southern Waters (South Africa), National Engineering Services Pakistan (NESPAK), *Environmental Assessment of Kishenganga /Neelum River Water Diversion*. Report prepared for Pakistan Commission for Indus Waters, Lahore.

⁴⁷ Mott MacDonald (2011). Gulpur Hydroelectric Power Project: Review of Requirement for Desanding Bay (Final Report), Sambu Construction Co. Ltd, November 2011.

⁴⁸ Qureshi, M.M., A.S. Shakir and E. Lesleighter (2013). Channel Forming Discharge in Rivers: A Case Study of Jhelum River in Pakistan. *Pakistan Journal of Engineering and Applied*

deposition indicated that 0.308 Billion Cubic Meters (BCM) of sediment was deposited in the Mangla Reservoir between 1967 and 2002.⁴⁹

Exhibit 5.3: Annual Suspended Sediment loads in the Poonch River (1960 to 2009)⁵⁰.

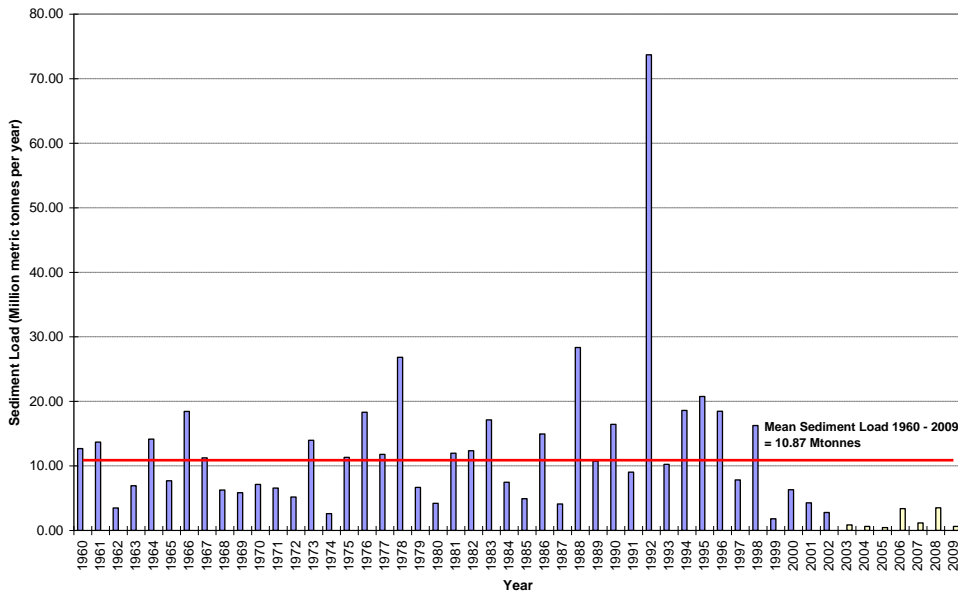


Exhibit 5.4: Large Volumes of Sandy Sediment Deposited where the Poonch River enters Mangla Reservoir

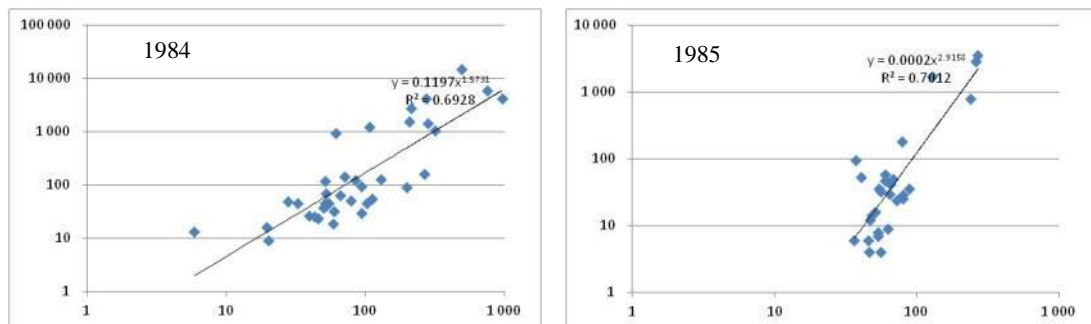


⁴⁹ Izhar-ul-Haq, Dr. and S. Tanveer Abbas, (2007) Sedimentation of Tarbela and Mangla Reservoirs. Pakistan Engineering Congress, 70th Annual Session Proceedings, Paper No. 659, pg 23-46.

⁵⁰ Mott MacDonald (2011). Gulpur Hydroelectric Power Project: Review of Requirement for Desanding Bay (Final Report), Sambu Construction Co. Ltd, November 2011.

Data provided by the Surface Water Hydrology Project (SWHP) of the Water and Power Development Authority (WAPDA) was used to generate annual suspended sediment discharge relationships in 1984 and 1985. Since applying sediment rating curves to discharge records often yields inconsistent correlations (Leopold et al.),⁵¹ annualized suspended sediment-discharge rating curves were generated to account for variable rainfall, changing catchment vegetation cover and the consequent inter-annual variability of sediment-discharge relationships (**Exhibit 5.5**).

Exhibit 5.5: Annual Suspended Sediment-Discharge Relationships in 1984 and 1985



Suspended sediment loads (vertical axis) are indicated in ppm, with discharge (m^3s^{-1}) on the horizontal axis

5.3 Fish Fauna

Fish are the most easily studied aquatic organisms (compared to algal flora and macro-invertebrates), sensitive to physical and chemical variations in the water as well as to changes in river flows and volumes. They are, therefore, vulnerable to changes caused by the construction and operation of hydropower projects and dams and useful indicators to ascertain the impact of hydropower projects on river ecological resources. Fishing not only provides food for local consumption but is also a source of livelihood for individuals involved in commercial fishing as well as for individuals working in the food industry (such as processing and packaging of edible fish species). Fish are also important for recreational and sport fishing and boost tourism.

The Poonch River is a warm water river and the water temperature approaches almost $30^{\circ}C$ during the summer months. A total of 37 fish species have been recorded from the Poonch River (**Exhibit 5.6**).^{52 53} The diversity⁵⁴ is higher in the area where the River Poonch makes its confluence with Mangla Reservoir. This diversity is quite high for a

⁵¹ Leopold, L. B., Wolman, M.G., and Miller, J.P. 1964. Fluvial Processes in Geomorphology, San Francisco, W.H. Freeman and Co., 522p.

⁵² Ecological Baseline Study of Poonch River AJ&K with Special Emphasis on Mahaseer Fish, January 2012, Rafique, M., Pakistan Museum of Natural History, prepared for WWF Pakistan by Himalayan Wildlife Foundation

⁵³ HBP, November 2013, Draft Baseline Biodiversity Assessment Report for Gulpur Hydropower Project, Hagler Bailly Pakistan.

⁵⁴ Relative diversity or richness observed.

river of this size as compared to other rivers of AJK, the Neelum and Jhelum, which are bigger and longer. The reason is the topography and water temperature of the River Poonch. The Poonch flows gently in a vast and flat valley, which provides numerous breeding grounds for the reproduction of fish. High temperature and gravely, rocky and the sandy river bed of the river Poonch not only helps for high river productivity but also enhance the breeding capacity of aquatic organisms and their subsequent survival. The completion of Mangla dam in 1967 created a barrier in the Jhelum River and isolated the Poonch River from the segment of Jhelum downstream of the dam. Mangla dam also created a barrier to movement of riffle dwelling smaller fishes such as the Kashmir Catfish *Glyptothorax kashmirensis* and the Twin-Banded Loach *Botia rostrata* between the Jhelum and Poonch rivers.

Of the fish species recorded from the Poonch River, 16 species are species of special importance because of their economic importance or conservation status (endemic or included in IUCN Red List). These include *Barilius pakistanicus*, *Schistura punjabensis*, *Cirrhinus reba*, *Labeo dero*, *Labeo dyocheilus*, *Tor putitora*, *Schizothorax plagiostomus (richardsonii)*, *Cyprinus carpio*, *Botia rostrata*, *Sperata seenghala*, *Clupisoma garua*, *Ompok bimaculatus*, *Glyptothorax naziri*, *Ompok pabda*, *Glyptothorax kashmirensis* and *Mastacembelus armatus*. The species *Glyptothorax kashmirensis*, previously only reported from Jhelum River, was captured from the Poonch River during the October 2013 survey and May 2014 survey and is discussed below. The species recorded in Poonch River and those that are of special importance are listed in **Exhibit 5.7**. Photographs of some fish species found in the Poonch River are given in **Exhibit 5.8**.

Exhibit 5.6: Fish Fauna Recorded from the Poonch River

No	Scientific Name	Common Name	Distributional Status	IUCN Status 2013*	Commercial Value
Cyprinidae					
1.	<i>Chela cachius</i>	Silver hatchet chela	Wide	LC	Low
2.	<i>Salmophasia bacaila</i>	Large razor belly minnow	Wide	LC	Low
3.	<i>Aspidoparia morar</i>	Aspidoparia	Wide	LC	Low
4.	<i>Barilius pakistanicus</i>	Pakistani baril	Endemic	ND	Low
5.	<i>Esomus danricus</i>	Flying barb	Wide	LC	Low
6.	<i>Cirrhinus reba</i>	Reba carp	Wide	LC	Fairly good
7.	<i>Cyprinion watsoni</i>	Cyprinion	Wide	ND	Low
8.	<i>Labeo dero</i>	Kalbans	Wide	LC	Fairly good
9.	<i>Labeo dyocheilus</i>	Pakistani Labeo	Wide	LC	High
10.	<i>Osteobrama cotio</i>	Cotio	Wide	LC	Low
11.	<i>Puntius chola</i>	Swamp Barb	Wide	LC	Low
12.	<i>Puntius sophore</i>	Spotfin Swamp Barb	Wide	LC	Low

No	Scientific Name	Common Name	Distributional Status	IUCN Status 2013*	Commercial Value
13.	<i>Puntius ticto</i>	Two spot Barb	Wide	LC	Low
14.	<i>Tor putitora</i>	Mahaseer	Wide	EN	Very high
15.	<i>Crossocheilus latius</i>	Gangetic latia	Wide	LC	Low
16.	<i>Garra gotyla</i>	Sucker head	Wide	LC	Low
17.	<i>Schizothorax plagiosomus (richardsonii)</i>	Snow carp	Wide	VU	High
18.	<i>Securicula gora</i>	Gora Chela		LC	Low
19.	<i>Cyprinus carpio</i>	Common carp	Exotic	VU	High
Noemacheilidae					
20.	<i>Acanthocobitis botia</i>	Mottled Loach	Wide	LC	Low
21.	<i>Schistura punjabensis</i>	Hillstream loach	Endemic	ND	Low
Cobitidae					
22.	<i>Botia rostrata</i>	Twin-banded Loach	Wide	VU	Low
Bagridae					
23.	<i>Sperata seenghala</i>	Giant river cat fish	Wide	LC	Very high
Schilbeidae					
24.	<i>Clupisoma garua</i>	Garua bachwaa	Wide	LC	Very high
Siluridae					
25.	<i>Ompok bimaculatus</i>	Butter catfish	Wide	NT	Low
Sisoridae					
26.	<i>Glyptothorax pectinopterus</i>	Flat head catfish	Wide	LC	Low
Channidae					
27.	<i>Chanda nama</i>	Elongate glass-perchlet	Wide	LC	Low
28.	<i>Parambassis baculis</i>	Himalayan glassy perchlet	Wide	LC	
29.	<i>Parambassis ranga</i>	Indian glassy fish	Wide	LC	
Botidae					
30.	<i>Botia almorhae</i>	Pakistani Loach		LC	Low
Chandidae					
31.	<i>Channa gachua</i>	Dwarf Snakehead		LC	Low
Sisoridae					
32.	<i>Glyptothorax cavia</i>	Heart Throat Catfish		LC	Low
33.	<i>Glyptothorax kashmirensis</i>	Kashmir Catfish		CR	Low
34.	<i>Glyptothorax naziri</i>	Nazirs' Catfish	Endemic	ND	Low

No	Scientific Name	Common Name	Distributional Status	IUCN Status 2013*	Commercial Value
35.	<i>Gagata cenia</i>	Clown Catfish		LC	Low
Siluridae					
36.	<i>Ompok pabda</i>	Pabdah Catfish		NT	Low
Mastacembelidae					
37.	<i>Mastacembelus armatus</i>	Tire-track spiny eel	Wide	LC	High

*Note: ND: Not Determined; LC: least Concern; NT: Near Threatened; VU: Vulnerable; EN: Endangered; CR: Critically Endangered; EW: Extinct in the wild; EX: Extinct.

Exhibit 5.7: Species of Special Importance Found in the Poonch River

No	Scientific Name	Common Name	Distributional Status	IUCN Status 2013	Commercial Value	Max. Length (cm)	Max. Weight (kg)
Cyprinidae							
1.	<i>Barilius pakistanicus</i>	Pakistani baril	Endemic	–	–	–	–
2.	<i>Cirrhinus reba</i>	Reba carp	–	–	Fairly good	30	0.3
3.	<i>Labeo dero</i>	Kalbans	–	–	Fairly good	75	0.2
4.	<i>Labeo dyocheilus</i>	Pakistani Labeo	–	–	High	90	5
5.	<i>Tor putitora</i>	Mahaseer	–	Endangered	Very high	275	54
6.	<i>Schizothorax plagiostomus (richardsonii)</i>	Snow carp	–	Vulnerable	High	60	2.5
7.	<i>Cyprinus carpio</i>	Common carp	–	Vulnerable	High	110	40.1
Cobitidae							
8.	<i>Botia rostrata</i>	Twin-banded Loach	–	Vulnerable	High	–	–
Bagridae							
9.	<i>Sperata seenghala</i>	Giant river cat fish	–	–	Very high	150	10
Schilbeidae							
10.	<i>Clupisoma garua</i>	Garua bachwaa	–	–	Very high	61	0.5
Siluridae							
11.	<i>Ompok bimaculatus</i>	Butter catfish	–	Near Threatened	Fairly good	45	0.2
Sisoridae							
12.	<i>Glyptothorax kashmirensis</i>	Kashmir Catfish	Endemic	Critically Endangered	Low	11.7	–

No	Scientific Name	Common Name	Distributional Status	IUCN Status 2013	Commercial Value	Max. Length (cm)	Max. Weight (kg)
13.	<i>Glyptothorax naziri</i>	Nazirs' Catfish	Endemic	Not Evaluated	Low		
Siluridae							
14.	<i>Ompok pabda</i>	Pabdah Catfish		Near Threatened	Low		
Noemacheilidae							
15.	<i>Schistura punjabensis</i>	Hillstream loach	Endemic	Not Evaluated	Low		
Mastacembelidae							
16.	<i>Mastacembelus armatus</i>	Tire-track spiny eel	–	–	High	90	0.5 g

Exhibit 5.8: Photographs of Fish Species observed in Poonch River



Golden Mahaseer *Tor Putitora*



Twin-banded Loach *Botia rostrata*



Kashmir Cat fish *Glyptothorax kashmirensis*



Pakistani Labeo *Labeo dyocheilus*



Garua Bachwa *Clupisoma garua*



Alwan Snow Trout *Schizothorax plagiostomus*

5.4 Landscape

The Poonch River basin is known for its spectacular natural landscapes (**Exhibit 5.9**). The rolling green hills, the winding rivers and the breath-taking views make it an area of significant tourism potential and can be developed for activities such as hiking, trekking, bird watching and recreational fishing.

Exhibit 5.9: Photographs of Poonch River and Basin (September 2013)



6. Cumulative Impact Assessment of Selected VECs

As outlined in **Section 2.3, Existing and Planned Hydropower Projects on Poonch River Basin**, there are a total of five potential hydropower projects (HPPs) on the Poonch River that are in more advanced stages of planning and have a greater likelihood of being made. Four of these projects will be located in Pakistan while one is in India. The projects are:

- ▶ Parnai HPP: a 37.5-MW diversion plant in Indian Administered Kashmir.
- ▶ Sehra HPP: a 130-MW RoR plant just downstream of the LoC.
- ▶ Kotli HPP: a 100-MW RoR plant just upstream of Kotli.
- ▶ Gulpur HPP: a 100-MW RoR plant just downstream Kotli.
- ▶ Rajdhani HPP: a 132-MW RoR plant just upstream of Mangla reservoir.

The sections that follow describe the cumulative impacts expected from the design and operation of cascading hydropower development over the selected VECs. This is followed by an assessment of the cumulative impact of these hydropower projects on the overall ecological integrity of the Poonch River.

6.1 Approach for this Cumulative Assessment

This cumulative assessment is based on the approach used and results obtained for the assessment of the environmental flows⁵⁵ (EFlows) for the Gulpur HPP.⁵⁶ The assessment is based on consideration of the impacts related to flow changes, including:

- ▶ the effects of habitat modification within the reservoir created by the HPP dam
- ▶ the effects of reduced flows between the HPP dam and the tailrace⁵⁷
- ▶ the effects of increased flows in the Mendhar Nullah as a result of releases from Parnai HPP. These include increased erosion, armouring, disruption of breeding cues, destruction of habitats and nests⁵⁸
- ▶ the effects of flow regime changes downstream of the tailrace, particularly where peaking-power releases are considered likely

⁵⁵ Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems

⁵⁶ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.

⁵⁷ For Parnai HPP, this river reach is from the Parnai dam to the confluence between the Poonch River and Mendhar Nullah.

⁵⁸ Gulpur Hydropower Project, Environmental Flow Assessment, Geomorphology Specialist Report, Fluvial Environmental Consultants and Southern Waters.

- ▶ the effects of changes in sediment supply and transport as a result of the HPP dams and changes in the flow regime
- ▶ The barrier effects of the HPP dams on fish

In the case of each, results obtained for Gulpur HPP were extrapolated to the other HPPs⁵⁹. While it is entirely possible that the impacts associated with the other HPPs may differ based on HPP design and localized river characteristics, it is unlikely that these differences will materially affect the outcome of this desktop cumulative impact assessment. Furthermore, it is assumed that the individual projects will conduct their own cumulative impacts assessments making appropriate assumptions on the status of the projects at the time of assessment.

The following assumptions were made in this cumulative impact assessment:

- ▶ The normal operating level (NOL) of Mangla reservoir will be 390 m.
- ▶ With respect to peaking power generation:
 - ▷ Sehra, Kotli and Gulpur HPPs will be limited to baseload power generation (i.e., no peaking power production).
 - ▷ Rajdhani HPP, which discharges into Mangla reservoir, may be operated in a peaking mode but this will not significantly increase its ecological impacts.
 - ▷ The design of Parnai HPP specifies a peaking operation in winter, and thus the potential impacts of Parnai with and without peaking are considered here.
- ▶ Management procedures for the mitigation of the existing impacts were assumed for the basin in AJK. These corresponded to Protection Level 2 (Pro 2) as described in **Section 7.2**.
- ▶ EFlow releases will be c. 40% of the natural 5-day minimum dry season flow, with the exception of the Rajdhani HPP where the tailrace will discharge directly into Mangla reservoir. Results from similar RoR projects suggest that this level of EFlow will probably translate into c. 10% less power generation than without an EF release. Higher level of EFlows could require higher level of supporting electricity tariffs, which may make the projects uneconomic.⁶⁰

The assessment took into account the potential beneficial effects of introducing management procedures for the mitigation of the impacts of over-fishing, sediment mining, harvesting of riparian vegetation and effluent disposal on condition of the riverine ecosystem.

⁵⁹ Modeling of the impacts of an additional four HPPs using DRIFT was outside the scope of this study.

⁶⁰ Where river flow is diverted into tunnels leading to a powerhouse, release of water at the dam to maintain an environmental flow in the river downstream of the dam normally results in reduced power generation. Where technically and economically feasible, this impact on power generation can be reduced or avoided by installing a small turbine at the dam to recover energy from the environmental flow release.

6.2 Cumulative impact on selected VECs

This section assesses the cumulative impact from the design and operation of the five hydropower projects listed above on selected VECs (**Section 4.3**).

6.2.1 Reduction in water quantity (flow)

Even though these cascading hydropower projects are not net consumers of water, the timing as well as the allocation of water flow will be modified. During dry months, the dewatered sections will likely achieve a steady state at the new reduced flows, typically of about 10% of the natural flow for that time of the year. On the other hand, during peaking generation, river sections downstream from the tailraces will be subjected to daily water pulses, that could sometimes be significantly higher than the natural base flow of the receiving river. These daily water flow pulsating shocks will not allow for the downstream stretches to reach an ecological steady state and thereby are expected to introduce a stressing river environment during the low flow season. These daily flow fluctuations might also be accompanied by the subsequent daily modification in water quality. Changes in downstream pulses of water could compromise any downstream water traditional uses (e.g. irrigation, recreation), due to modifications in the flow regime.

Assessment of Cumulative Impacts

This section provides an assessment of the cumulative impact from changes in river flow and resulting loss and degradation of aquatic habitat caused by the five proposed hydropower projects. An assessment of the impact of is outlined in **Exhibit 6.1**, **Exhibit 6.2** and **Exhibit 6.3**. The flow changes as a result of the proposed HPPs will severely impact c. 87% of the Poonch River (between Parnai HPP and Mangla reservoir) and 94% of the Mendhar Nullah. These impacts are:

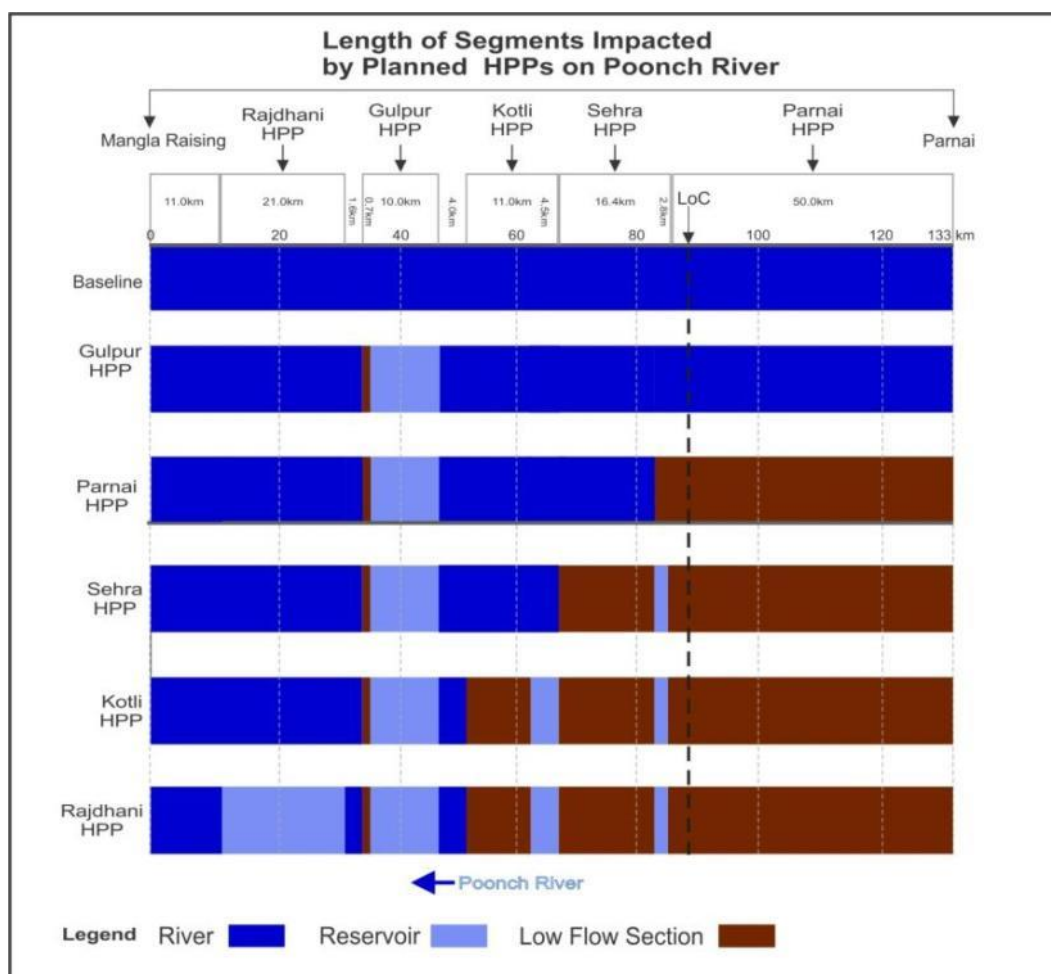
- ▶ 36.8 km of river lost as a result of inundation, 68.1 km impacted by reduced dry season flows; and
- ▶ 40.0 km of the Mendhar Nullah impacted by unnaturally high flows.

Exhibit 6.1: Length of River Habitat Severely Impacted by Flow Changes Associated with the Five Proposed HPPs

<i>HPP</i>	<i>River</i>	<i>Reach</i>	<i>Absolute Distance (km)</i>	<i>Cumulative Distance on Poonch</i>
Parnai	Poonch	Parnai reservoir	2	2
	Poonch	Parnai dam to Mendhar Nullah	50	52
	Mendhar Nullah	Parnai tailrace to Poonch River	40	52
Sehra	Poonch	Sehra reservoir	2.8	54.8
	Poonch	Sehra dam to tailrace	16.4	71.2
Kotli	Poonch	Kotli reservoir	4.5	75.7
	Poonch	Kotli dam to tailrace	11.0	86.7

HPP	River	Reach	Absolute Distance (km)	Cumulative Distance on Poonch
Gulpur	Poonch	Gulpur reservoir	10.0	96.7
	Poonch	Gulpur dam to tailrace	0.7	97.4
Radjhani	Poonch	Radjhani reservoir	21.0	118.4
	Poonch	Radjhani dam to tailrace	0	118.4
	Poonch	Radjhani tailrace to Mangla NOL	11.0	129.4
n/a	Poonch	Parnai reservoir to Mangla reservoir	148	
% of Poonch River affected				87.4%

Exhibit 6.2: Change in Flow in the Poonch River with Sequential Implementation of Planned HPPs



Note: The sequence for the projects in AJK is based on the discussion of the current status of development outlined in **Section 2.3**.

Exhibit 6.3: Extent of River Length that will be Affected by Flow Changes as a Result of the Planned HPPs on Poonch River



The distances exclude the river reaches between the tailrace outlets and the reservoir of the next HPP, as these are deemed to be negligible in terms of flow change unless peaking operations are employed. If peaking operations are employed at Parnai HPP and Radjhani HPPP, the extent of these impacts increases to 79.1 km.

It may also be noted that:

- ▶ the variations in the affected distances reflect the project designs as well the river gradient, which increases towards upstream; and
- ▶ the outlet of the power house of the Rajdhani project is close to the highest level reached by Mangla reservoir where the habitat already fluctuates between riverine and lake due to seasonal changed in the reservoir level.

It can be concluded that the cumulative impacts from the operation of all five HPPs will cause severe loss and degradation of aquatic habitat in approximately 87% of the Poonch River (between Parnai HPP and Mangla reservoir) and 94% of the Mendhar Nullah. Thus, the potential cumulative impact on quantity of river water and flow is likely to be significant.

6.2.2 Sediment Load of River

Dams form barriers to the transportation of much of this raw material, with sediments dropping from suspension as the river slows down upon entering the reservoir. The finer sediments may stay in suspension and pass through the dam outlets during floods and, sometimes, coarser material is scoured out through bottom gates to increase storage in a sediment-choked reservoir. Dams thus can change the total amount of sediment available to the river downstream, with a proportion of a river's sediment load possibly permanently trapped by the reservoir.^{61 62 63 64 65}

If sediments are trapped in this way, downstream reaches are starved of them and may become what is termed sediment hungry, eroding their bed and banks at higher than natural rates. Channel adjustments may manifest as changes in channel width, bed level and slope; down-cutting and entrenchment of the channel; and bed armouring or channel straightening. Land may be lost through bank slumping and bridges and roads threatened. The extent to which any of these is likely to occur will depend on how much the dam changes the river's ability to transport sediment through flow changes, the amount of sediment withheld by the reservoir and the erodibility of the bed and banks.

⁶¹ Ibanez C., Prat N. and Canicio A. 1996. Changes in the hydrology and sediment transport produced by large dams on the lower Ebro River and its estuary. *Regulated Rivers: Research and Management*, 12, 51–62.

⁶² Vorosmarty C.J., Meybeck, M., Fekete B., Sharma K., Green P. and Syvitski J.P.M. 2003. Anthropogenic sediment retention: major global impact from registered river impoundments. *Global and Planetary Change*, 39, 169–190.

⁶³ Wohl, E. 2004. *Disconnected Rivers: Linking Rivers to Landscapes*, Yale University Press, London, UK.

⁶⁴ Anselmetti F.S., Buhler R., Finger D., Girardclos S., Lancini A., Rellstab C. and Sturm M. 2007. Effects of alpine hydropower dams on particle transport and lacustrine sedimentation. *Aquatic Sciences*, 69, 179–198.

⁶⁵ Wang Z.-Y., Wu B. and Wang G. 2007. Fluvial processes and morphological response in the Yellow and Weihe Rivers to closure and operation of Sanmenxia Dam. *Geomorphology*, 91, 65–79.

As the flow and sediment regimes of the river are together altered by dams, the downstream physical environment will change in a way that reflects the interplay of these two forces. Under typical operations of hydropower projects, some reduction in the suspended and bedload sediment passing downstream is expected, as all but the finest particles should drop from suspension and settle in the reservoir. Periodic flushing and release of these sediments past the dam wall could result in slugs of anoxic sediments moving downstream, smothering habitats, increasing the embeddedness of riffles and detrimentally affecting water quality and the river's aquatic life. In addition, daily flow fluctuations and water pulses caused by operation of hydropower projects are also likely to modify the river geomorphology downstream from the tailraces.^{66 67 68 69}

In whatever way the channel adjustments play out, there will be impacts on the downstream riverine habitats, perhaps through sediments clogging important spawning grounds, habitats degrading through erosion, floodplains declining in extent and fertility, pools filling with sediments, or banks collapsing. All of these changes have implications for the riverine plants and animals, as well as for cultivated land adjacent to the channel.

Activities in the catchment, most notably the haphazard dumping of spoil from road construction directly into the rivers and introduction of garbage from emerging towns in the catchment; significantly alter the geo-morphological equation. Catchment erosion from an increase rate of changes in land use, added to indiscriminate development of roads and transmission lines, will likely increase access, leading to deforestation and consequent expansion of the frontier forest. Reduction of the catchment forest cover will have significant impacts on the soil retention capacity, increasing surface sediment runoff and vulnerability to landslides.⁷⁰

Assessment of Cumulative Impacts

The Geomorphology Specialist Report included in **Appendix E of the ESIA of Gulpur Hydropower Project** presents a discussion of patterns of deposition of sediments following the operation of Gulpur HPP. Cobbles will be trapped close to the upstream end of the reservoir or slightly upstream in the wet season backup zone because the lowered flow velocities in this backup area will be too slow to transport very large bed elements. Progressively smaller sediment classes, including sands, which travel as suspended load in high velocities, will be deposited where the river enters the reservoir and flow velocities drop. In the dewatered segment between the dam and the tailrace there will be very low total sediment loads because for most of the year the discharges will be very low, and the availability of cobbles and boulders in particular will be considerably reduced. However, during flushing or sluicing of the reservoir very large

⁶⁶ Petts, G. E., Long-term consequences of upstream impoundment, *Env. Cons.*, 7(4), 325-332, 1980.

⁶⁷ Williams, G. P., and M. G. Wolman, Downstream effects of dams on alluvial rivers, *Geol. Surv. Prof. Pap.* 1286, 83 pp., 1984.

⁶⁸ Ligon, F. K., W. E. Dietrich and W. J. Trush, Downstream ecological effects of dams: a geomorphic perspective, *Bioscience*, 45(3), 183-192, 1995.

⁶⁹ Brandt, S. A., Classification of geomorphological effects downstream of dams, *Catena*, 40, 375-401, 2000.

⁷⁰ World Bank. 2011. Environmental Impact Assessment Study of Kabeli 'A' Hydroelectric Project. Washington D.C

peak suspended sediments are likely to occur during high flows. Downstream of the tailrace, the suspended loads will be reduced relative to 2013 because of the sediment trapping effect of the reservoir. As in the upstream dewatered zone, annual flushing of the reservoir may however yield peak suspended sediment discharges higher than normal. The availability of cobbles and boulders is expected to be low immediately downstream of the tailrace but should improve with distance as a result of the replenishment by supply of these sediments from lateral bars, the channel bed and from tributary inputs.

Information about the schedule, drawdown level, and extent of sediment flushing from the proposed HPPs on the Poonch River basin is currently unavailable. Therefore, it is difficult to determine the exact magnitude and significance of the consequences from the cumulative effects of changes in river sediment loads. However, it can be safely deduced that if unmitigated, the cumulative impacts from the sediment barrier created by the proposed HPPs, poor watershed management, deforestation, and increased erosion will have a significant impact on the ecological and geomorphological integrity of the basin.

In addition, there will be a significant impact on the sand and gravel extraction by the local communities caused by changes in the sediment quantity, availability and distribution of sediment in the Study Area. As illustrated in **Section 3.3 Socioeconomic Uses of the Poonch River**, mining of sand, gravel, and boulders is spread over the entire stretch of the Poonch River in AJK, and mainly in downstream segments of three main tributaries, the Bann, Rangar, Hajeera, and Mendhar Nullahs closer to where they join Poonch River.

MPL has committed to develop a Sediment Mining Plan for the Gulpur HPP to minimize the impact of the Gulpur HPP Project on the river ecology while meeting the requirements of the community. Where multiple dams on a river are envisaged, it is important that a similar plan be made that encompasses all the proposed projects.

6.2.3 Fish Fauna

Because of the cascading hydropower plants in the same river system, fragmentation of aquatic habitat is expected from (i) reduced flow in the dewatered reaches and (ii) dams and weirs barrier effect.

Habitat fragmentation caused by both physical structures and mosaics of intermittent free-flowing and dewatered river sections, will negatively impact the aquatic ecology and overall river integrity, including aesthetics and morphology. Modifications in the river's eco-morphological character, fragmentation of the rivers into stretches of limited natural flows, long dewatered zones, and excessive sedimentation in the riverbed will likely cause significant conversion of the aquatic habitats of the Study Area. The natural flow disruption and reduced flow in the dewatered segments will likely reduce the quantity and quality of suitable foraging, spawning, cover and habitat for both migratory and resident species. The dewatered sections will receive water only from the designed minimum downstream ecological flows (e.g. typically 10% of an average minimum monthly flow) and any additional marginal recharge from seepage and minor tributaries.

In addition, the development of a cascade of hydropower projects will cause a closure of the ecological aquatic corridors due to the barrier provided by the dam. This closure will lead to reduction in species diversity, change of species dominance/natural assemblages

and impairment for migratory species to fulfill their lifecycle. The river system natural upstream-downstream connectivity will be significantly disrupted, especially during the dry season. The barrier effect will likely impair fish migration from downstream to the upstream reaches for spawning and feeding. Once breeding habitats and nursing areas are lost, a gradual decline in the fish population leading to extinction of the certain fish species in the watershed may be inevitable. One of the main reasons is that a robust fish population in the downstream reaches of the large river systems depends largely on the recruitment of fish fry and fingerlings from the upstream nursing areas. The economically important fish of the Mangla Reservoir that use the Poonch River as a breeding ground are likely to decline in numbers with consequent economic repercussions for the local communities involved in subsistence and commercial fishing.

Furthermore, the river fragmentation may cause a significant modification of organic detritus and nutrient flow downstream. If organic detritus and nutrients are retained in the upstream reaches by dams and weir structures, it may cause food scarcity and reduced productivity of fish populations in the downstream sections. This effect can cause reduced productivity and even an increased mortality in the downstream fish populations.

Assessment of Cumulative Impacts

The relative importance of the Poonch River mainstem and tributaries (nullahs) for breeding areas for endangered fish is given in **Exhibit 6.4**. Many of the fish that inhabit the Mangla reservoir breed in the rivers upstream, but once the HPPs are constructed fish will be unable to swim upstream of the first dam or will be trapped between dams. Thus, the proposed HPPs will affect not only the biodiversity of the river but also that of Mangla reservoir.

Exhibit 6.4: Relative Importance of the Poonch River Mainstem and Tributaries (Nullahs) for Breeding Areas for Endangered Fish

<i>River/River Reach</i>	<i>Relative Importance (%)</i>	<i>Access from Lower Poonch River Affected by</i>
Poonch River (upper mainstem)	30	All
Rangar Nullah	18	Radjhani
Bann Nullah	15	Radjhani and Gulpur
Mendhar Nullah	15	Radjhani , Gulpur, Kotli and Sehra. Nullah itself destroyed by Parnai
Nehl Nullah	11	
Hajeera Nullah	11	Radjhani, Gulpur, Kotli and Sehra.

The fish of a river system frequently represent fairly wide-ranging apex instream predators of that system and, as such, the fish communities tend to reflect an integration of the various prevailing conditions. The Poonch River fish community is comprised of 37 species, and is characterized by:

- ▶ a variety of species that feed on algae, macro-invertebrates and other fish, and thus any changes in these biota have a knock-on effect on the fish community

- ▶ 21 species that inhabit Mangla reservoir, and breed in the upper reaches of the basin in the summer, and overwinter in the warmer downstream reaches, including the endangered Mahaseer, the Pakistani Labeo and the Garua Bachwaa. 7 out of these 21 species though migrate in the upstream areas but do not reach to the dam site
- ▶ 15 species that do not migrate, but are reliant on river habitats for survival, including the Critically Endangered Kashmir Catfish and the Twin-banded Loach
- ▶ 1 species that over-summers in the upper Poonch River, upstream of the LoC and use the lower Poonch River as a refuge from freezing temperatures in the winter, such as the snow trout
- ▶ the difference in their basic biology influences the impact of the planned HPPs on the species making up the fish community.

For species such as the Mahaseer, the Pakistani Labeo and the Garua Bachwaa, the construction and raising of Mangla reservoir has already resulted in the division of populations upstream and downstream of the dam wall, plus the loss of c. 21 km of river habitat in the Poonch River that is now inundated by the reservoir. These fish can however survive in impounded waters provided they have access to their breeding areas. If the fish cannot reach their breeding grounds, breed successfully and return to their over-wintering areas they will become extinct in those areas, including in Mangla reservoir. While for the Labeo, the options for breeding areas out of Mangla reservoir include both the Poonch and the Jhelum Rivers, for the Mahaseer and Garua Bachwaa the Poonch River is the only option for breeding. For these kinds of fish, the HPPs planned in the Poonch River will threaten (*inter alia*):

- ▶ access to upstream breeding areas through the barrier effect
- ▶ availability of breeding and nursery habitat in the mainstem Poonch River and in the Mendhar Nullah through the flow and sediment changes
- ▶ the availability of food for adults and juveniles.

The estimated likely consequences of the accumulation of these impacts on Mahaseer is summarized in **Exhibit 6.5**. The consequences provided for Gulpur HPP are those that arose from the detailed investigations in the EIA. The cumulative consequences for the remaining HPPs are extrapolations based on the outcomes for Gulpur HPP and an evaluation of the overall effects on the Mahaseer of the extreme level of river fragmentation that will result.

As bad as the situation may appear for Mahaseer, it will be worse for Garua Bachwaa, which is unlikely to colonize the reservoirs, and has the bulk of its breeding areas downstream of Gulpur dam. As a result, Garua Bachwaa would be all but eliminated from the Poonch River if Radjhani HPP is constructed.

It is worth noting that these cumulative impacts exclude consideration of the vulnerability of the weakened native populations to threats from exotic species. Experiences from the Jhelum River have shown that, even in the absence of any additional barriers, a shift in habitat from riverine to lake and introduction of exotic commercial fishes (such as Grass Carp *Ctenopharyngodon idellus*, Silver Carp *Hypophthalmichthys molitrix*, Bighead Carp *Hypophthalmichthys nobilis*, Common Carp *Cyprinus carpi* and Tilapia

Oreochromis mossambicus) have permanently altered the ecology both upstream and downstream of the Mangla reservoir.

For species such as the Kashmir Catfish and the Twin-banded Loach, which require riverine habitat for survival, the loss of running water habitats through impoundment (36.8 km or 25% of the Poonch mainstem between LoC and Mangla) and a reduction in dry season habitat availability as a result of flow changes (68.1 km or 46%) are the main causes of concern. These species will not survive in the impounded sections, and survival rates in the low flow sections is expected to be 10 – 25% for a single project on the river will drop to 0–5% due to habitat partitioning. The remaining 8% of the river where the hydrology will be relatively intact will fare no better in terms of the population of this fish as this condition will occur in four short segments of the river ranging from 1.5 km to 11 km in length. Thus, if all five HPPs were built, these species are likely to become extinct in the Poonch. Indeed the possibility of their elimination even with two or three of the HPPs is extremely high.

Exhibit 6.5: Estimated Cumulative Impact of Planned HPPs on the Population of Mahaseer

Blue and green are major changes that represent a move towards natural: green = 40-70%; blue = >70%. Orange and red are major changes that represent a move away natural: orange = 40-70%; red = >70%. Baseline, by definition, equals 100%. Italicised scenarios are repeats

River reach		2013	Sequential implementation of:				
			Gulpur HPP	Parnai HPP	Sehra HPP	Kotli HPP	Rajdhani HPP
Poonch River Upstream of LoC	Parnai dam to LoC	–	40	-20	-40	-40	-40
Poonch River Downstream of LoC	LoC - 5 km	–	80	-20	-40	-40	-40
	10	–	80	60	-40	-40	-40
	15	–	80	60	-90	-90	-90
	20	–	80	60	-90	-90	-90
	25	–	80	60	-90	-90	-90
	30	–	80	60	60	-90	-90
	35	–	80	60	60	-90	-90
	40	–	80	60	60	-90	-90
	45	–	80	60	60	0	0
	50	–	80	60	60	0	0
	55	–	-90	-90	-90	-90	-90
	60	–	-8	-8	-8	-60	-90
	65	–	-8	-8	-8	-60	-90
	70	–	-8	-8	-8	-60	-90
75	–	-8	-8	-8	-60	-100	
80	–	-8	-8	-8	-60	-100	

River reach	2013	Sequential implementation of:				
		Gulpur HPP	Parnai HPP	Sehra HPP	Kotli HPP	Rajdhani HPP
85	–	-8	-8	-8	-60	-100
90	–	-8	-8	-8	-60	-100
Mendhar Nullah	–	–	-60	-60	-60	-60

Recreational and subsistence fishing focuses on larger species such as Mahaseer, Pakistan Labeo, and Snow Trout. Discussions with persons engaged in subsistence and recreational fishing suggest that both are likely to cease entirely once the fish populations drop below 40% of 2013 levels as the effort of trying to catch the fish would exceed the reward of fish caught. As illustrated in **Exhibit 6.5**, with all five HPPs in place, the populations of Mahaseer are expected to be below this threshold over at least 90% of the river (red and orange bars in **Exhibit 6.5**), particularly if Parnai HPP is operated as a peaking power plant. Thus, with all five HPPs in place, recreational fishing is expected to cease; and subsistence fishing will be confined to a few sections of the river where it is also likely to cease as well due to overfishing.

6.2.4 Landscape Conversion

Multiple cascading hydropower plants, together with the construction of ancillary facilities such as power houses, multiple transmission lines, towers, cables, roads, and the induced development, will modify the existing landscape and negatively impact the natural beauty of the Poonch River basin. Therefore, the visual impact and landscape fragmentation caused by the development of the proposed hydropower projects is likely to be significant. This could lead to a significant negative impact on the region's potential for tourism.

6.3 Overall Impact on Ecosystem Integrity

This section summarizes the cumulative impact of the proposed HPPs on the overall ecosystem condition and integrity of the Poonch River and draws from the impact on VECs outlined above.

The categories used to describe the Poonch River's Present Ecological Condition⁷¹ are based on modification from the natural, with the natural condition seen as the reference condition (**Exhibit 6.6**).

⁷¹ Hagler Bailly Pakistan (HBP), October 2014, Environmental and Social Impact Assessment (ESIA) of the Gulpur Hydropower Project, Mira Power Ltd.

Exhibit 6.6: Definitions of the Present Ecological State (PES) Categories

<i>Ecological Category</i>	<i>Description of the habitat</i>
A	Unmodified. Still in a natural condition.
B	Slightly modified. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged.
C	Moderately modified. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	Critically / Extremely modified. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.

The estimated cumulative impact on overall river and tributary condition associated with the proposed HPPs is summarized in **Exhibit 6.7** and discussed below.

The Poonch River is by no means an undisturbed system.⁷² Already the condition of the ecosystem has been affected by:

- ▶ inundation, and consequent destruction, of 21 km of river habitat as a result of the construction, and subsequent raising, of Mangla Dam.
- ▶ the barrier created by Mangla Dam, which reduced the populations of fish, such as Mahaseer, in the upstream river.
- ▶ over-harvesting of riverine resources, such as fish and woody vegetation.
- ▶ indiscriminate fishing methods, which compromise macro-invertebrate abundance and diversity.
- ▶ pollution for cities and towns in the basin.
- ▶ habitat destruction as a result of poorly regulated sediment mining.

In recognition of the impact of these pressures on overall ecosystem condition, the 2013 river condition downstream of LoC was rated as Category C.

For the Gulpur ESIA,⁷³ it was assumed that – as a best case scenario, if implemented, Gulpur HPP would provide funds that could be used to reduce some of the extant impacts on the Poonch River and its tributaries. These measures were referred to as Protection Level 2, and proposed to reduce the impact of the resource harvesting by 50%, thereby leading to an improvement in overall ecosystem condition. Excluding the impacts of

⁷² Ibid

⁷³ Ibid

Gulpur HPP itself, it was estimated that Pro 2 measures would result in an improvement to a Category B/C in the Poonch River downstream of the LoC.⁷⁴

Although there is very little data for the river upstream of the LoC, anecdotal accounts indicate that human pressures on the system are lower and the river reaches upstream of the LoC are better administered. Thus, it is plausible that the river is in a better condition in its upper reaches. For the purposes of this assessment, the Poonch River upstream of the LOC has been rated Category B.

In view of the cumulative impact on selected VECs discussed in the preceding section, it can be deduced that the construction of the five HPPs as planned, with no increase in protection (Business as Usual scenario) will irreversibly alter the entire Poonch River (last column in **Exhibit 6.7**). Downstream of the LoC, the river will comprise a series of lakes and low flow sections completely cutoff from one another by dams. The ecosystem of Poonch River will be permanently degraded and many, if not all, of the essential functions of the original ecosystem will be lost. Residual biota may survive in the tributaries (but probably not in Mendhar Nullah), but even there they will be at high risk from over-harvesting and other disturbances, such as sediment mining.

As discussed in **Section 5**, the barrier created by Mangla reservoir has resulted in significant drop in populations of fish such as Mahaseer that breed in rivers upstream such as Poonch. A shift in habitat from riverine to lake and introduction of exotic commercial fishes such as Grass Carp *Ctenopharyngodon idellus*, Silver Carp *Hypophthalmichthys molitrix*, Bighead Carp *Hypophthalmichthys nobilis*, Common Carp *Cyprinus carpio*, and Tilapia *Oreochromis mossambicus* have permanently altered the ecology of the Jhelum river both upstream and downstream of the Mangla reservoir. These impacts are likely to extend upstream in Jhelum River as far as Muzaffarabad where the fish diversity begins to change due to drop in the temperature of water. Raising of Mangla reservoir has resulted in loss of river habitat for about 5 km in the Poonch River where the conditions fluctuate between riverine and lake with the seasonal changes in the level of the reservoir.⁷⁵ Construction of dams sequentially upstream into the Poonch river will further extend the lake ecosystems into the Poonch River basin, with decreasing biodiversity. This is because the fish that inhabit the Mangla reservoir will not be able to swim upstream of the first dam, and the fish that breed mainly in the tributaries and river in comparatively warmer waters downstream of LoC such as Mahaseer, Garua and Pakistan Labeo will not be able to travel to upper reaches of Poonch River upstream of the LoC.

⁷⁴ Three protection levels were considered in the Gulpur ESIA:
Protection Level 1 (Pro 1) or Moderate Protection = maintain 2013 levels of non-flow-related pressures on the river; i.e., no increase in human-induced catchment pressures over time.
Protection Level 2 (Pro 2) or Enhanced Protection = reduce 2013 levels of non-flow-related pressures by 50%, i.e., decline in pressures (relative to 2013) over time.
Business as Usual (BAU) or Poor Protection = increase non-flow-related pressures in line with 2013 trends, i.e., 2013 pressures double in intensity over the next fifty years.

⁷⁵ Deposit of fine sediment or clay in the lake bed results in embedment of the cobblestones which eliminates the macroinvertebrate in the river bed. The river bed is essentially sterile even when the water recedes in the reservoir and flow channels are created. The morphology of the river is also permanently altered.

The baseline river condition downstream of LoC was rated as Category C and project to improve to High Category C after implementation of protection measures under Pro 2 Scenario. While data is not available for the ecological conditions in the river upstream of the LoC, anecdotal accounts indicate that the level of protection in the Indian Administered Kashmir is comparatively better than that in the Pakistan Administered Kashmir. The densities of human population are also comparatively lower, which would imply lower demand for ecosystem services such as fishing and sand and gravel extraction, and consequently lesser anthropogenic impacts on the river ecosystem. Cumulative impacts of specific HPPs in the anticipated sequence of construction are summarized in **Exhibit 6.7**.

Exhibit 6.7: Estimated Cumulative Impact of Planned HPPs on the Overall Integrity of the Poonch River Ecosystem

B = blue, B/C and C = green, C/D = white, D = orange, No river remaining = red

River Reach		2013	Sequential implementation of:				
			Gulpur HPP	Parnai HPP	Sehra HPP	Kotli HPP	Rajdhani HPP
Poonch River upstream of LoC	Parnai weir to LoC	B	B	C/D	C/D	C/D	C/D
Poonch River downstream of LoC	LoC - 5 km	B/C	B/C	C/D	D	D	D
	10	B/C	B/C	C	No river remaining	No river remaining	No river remaining
	15	B/C	B/C	C	D	D	D
	20	B/C	B/C	C	D	D	D
	25	B/C	B/C	C	D	D	D
	30	B/C	B/C	C	C	No river remaining	No river remaining
	35	B/C	B/C	C	C	D	D
	40	B/C	B/C	C	C	D	D
	45	B/C	No river remaining	No river remaining	No river remaining	No river remaining	No river remaining
	50	B/C	No river remaining	No river remaining	No river remaining	No river remaining	No river remaining
	55	B/C	D	D	D	D	No river remaining
	60	B/C	B/C	B/C	C	C/D	No river remaining
	65	B/C	B/C	B/C	C	C/D	No river remaining
	70	B/C	B/C	B/C	C	C/D	No river remaining
	75	B/C	B/C	B/C	C	C/D	D
	80	B/C	B/C	B/C	C	C/D	D
85	B/C	B/C	B/C	C	C/D	D	
90	B/C	B/C	B/C	C	C/D	D	
Mendhar Nullah		B	B	D	D	D	D

7. Proposed Management Strategy

As stated in SEA on Development of Hydropower Potential in AJK⁷⁶, “the hydropower potential of the Jhelum and Neelum rivers could be developed at a significantly lower cost to the environment than that of the Poonch River. Moreover, caution needs to be exercised in developing the potential of the Poonch River in view of its relatively high environmental value and relatively smaller contribution to the national economy.”

This section outlines the position of the AJK Government to future hydropower projects on the Poonch River, the strategy adopted by Mira Power Ltd (MPL) for environmental protection in the Poonch River basin, and recommendations for other project proponents. A summary of policy recommendations is also presented.

7.1 Position of AJK Government on Future Hydropower Projects on Poonch River

The AJK Department of Fisheries and Wildlife (Department) in a letter (ref no: 1944 – 48, dated 21 May 2014) granted permission for construction of the 100 MW Gulpur Hydropower Project in the Poonch River National Park on the condition that a Biodiversity Action Plan (BAP) be developed that will achieve betterment of the national park. In addition, the Department has taken a principled position in writing that hydropower projects on Poonch River will be allowed only if they can demonstrate betterment of the park or net gain, and for subsequent projects the implemented BAP for the Gulpur project will be considered as a baseline. The Department suggests that “AJK EPA consider the following while reviewing projects proposed in the national parks in the AJK in future:

- ▶ The projects should demonstrate achievement of the betterment of the national park over the life of the Project compared to the prevailing baseline conditions.
- ▶ Specifically for the Poonch River Mahaseer National Park, the baseline conditions for all future projects will be considered as those that will be achieved in the long term following the implementation of the Biodiversity Action Plan as specified in the EIA for the Gulpur Hydropower Project and as approved by the Department. Subsequent projects if any will therefore have to demonstrate improvement over and above that projected to be achieved by implementation of the Biodiversity Action Plan as part of the Gulpur Hydropower Project.”

7.2 Strategy of MPL to Manage Cumulative Impacts

The ESIA of the Gulpur Hydropower Project has proposed good practices in project design and operation and recommended appropriate mitigation measures and specific management actions to minimize potential negative impacts of Project activities on the

⁷⁶ Source: IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report.

environment. The ESIA adopted a basin wide approach to conservation of biodiversity in the Poonch River.

MPL intends to co-ordinate with PPIB and Government of AJK for issuance of licenses for development of future HPPs on the Poonch River. MPL will inform PPIB about the environmental sensitivity of the Poonch River and the need for PPIB to inform prospective project developers on the caution they need to exercise when developing hydropower projects on the Poonch River. Of particular importance would be informing the prospective developers on the environmental safeguard policies and guidelines of lending agencies such as ADB and IFC when a project is located in a national park that has endangered species in it. Further details on information that PPIB could share with prospective developers is included in **Section 7.3** below, ‘Management of Risks Presented by Other Projects’.

7.2.1 Biodiversity Action Plan

Keeping in view the environmental sensitivity of the Poonch River and the fact that it is located in a Critical Habitat (**Section 3.3**), Mira Power Ltd. has developed a Biodiversity Action Plan (BAP)⁷⁷ to address regional biodiversity concerns and achieve net gain for the biological resources of the Poonch River basin according to the requirements of IFC’s Performance Standard 6.⁷⁸ The BAP also meets the requirements of the permission letter from the Directorate of Wildlife and Fisheries, AJK that states that the Project should “demonstrate achievement of betterment of the national park over the life of the Project compared to the prevailing baseline conditions” (**Section 7.1**).

The BAP for the Poonch River Basin will address the implementation of the Protection Level 2 i.e. reduce 2013 levels of non-flow-related pressures on the environment by 50%. The implementation of the BAP will focus on protecting the aquatic and semi-aquatic resources, primarily the fish, marginal and flood plain vegetation as well as the mammals and herpeto-fauna dependent on the river, by putting in place a protection system. This protection will not be limited to the river and tributaries alone but will also extend to the adjacent terrestrial habitats and terrestrial species of conservation importance in the Poonch River valley.

The objectives of the BAP are outlined below:

- ▶ High level baseline of the defined Study Area
- ▶ Identification of conservation issues, protected areas, critical habitats and species of conservation importance
- ▶ Establishment of priorities for conservation action
- ▶ Outline of actions and activities that should be undertaken to protect the biodiversity in the Study Area

⁷⁷ Hagler Bailly Pakistan (HBP) October 2014, Biodiversity Action Plan for Gulpur Hydropower Project, Mira Power Ltd.

⁷⁸ Performance Standard 6, January 2012, Biodiversity Conservation and Sustainable Management of Living Natural Resources, International Finance Corporation. The World Bank Group

- ▶ Budget and timelines for implementation
- ▶ Institutional partnerships and arrangements for implementing the BAP
- ▶ An awareness raising and capacity building program of the relevant stakeholders including Mira Power Ltd, staff of AJK Fisheries and Wildlife Department, relevant communities, and NGOs
- ▶ A monitoring and evaluation plan to ensure that the measures outlined in the BAP are implemented

The strategy suggested for implementation of the BAP includes:

- ▶ A framework Agreement between government of AJK and MPL defining the roles and responsibilities of the two parties in implementation of the BAP and the specific responsibilities to be assigned to AJKFWD for implementation.
- ▶ Putting in place a protection system, consisting of an effective watch and ward for the national park and adjacent areas, to fill the gaps in the existing system
- ▶ Establishment of two wildlife management offices along the Poonch River to provide a base for the watch and ward staff to operate
- ▶ Advice and support for Mahaseer hatchery to be developed by the AJKFWD near Moli Nullah for stocking of fish downstream of the Project powerhouse
- ▶ Implementation by an independent Implementation Organization selected by MPL in consultation with the AJKFWD
- ▶ Active supervision and support from the AJKFWD by making available existing staff for protection, assistance in coordination with other government line departments such as police and district administration
- ▶ Commitment by AJKFWD to provide legal authority to the staff of the Independent Organization for exercising powers under wildlife legislation
- ▶ Regular oversight and monitoring by a Management Committee set up for implementation of the BAP Monitoring on a long term basis by an independent Monitoring and Evaluation Consultant

MPL shared the draft BAP with the relevant stakeholders particularly the AJK Fisheries and Wildlife Department (AJKFWD), the NGOs working in the area, and relevant communities for their comments and suggestions. MPL then finalized the BAP after addressing their concerns and comments and has now been accepted and agreed upon by all the stakeholders.

7.2.2 Sediment Mining Plan

Given that it is entirely plausible that the demand for sediment will continue to increase during the operation of the Project, achieving the Protection Level 2 will necessitate management and control that will limit the impact of mining on the river in the face of increased demand/volumes being abstracted (**Section 6.2.2**). This could be achieved using one or more of the following strategies:

- ▶ Focus mining activities in non-sensitive areas

- ▶ Ban mining in sensitive areas
- ▶ Implement on-site control and management of mining activities
- ▶ Rehabilitate/restore habitats already destroyed by mining
- ▶ Use of alternatives sources of aggregate for the Project including the following:
 - ▷ reuse spoil
 - ▷ quarries for aggregate

MPL has committed to prepare a Sediment Management and Mining Plan to identify appropriate strategies and develop mechanisms for achieving the objectives of the BAP. Rationale and requirements for this plan as well as the suggested Terms of Reference are included in **Appendix F, ESIA of Gulpur Hydropower Project**.

7.3 Management of Risks Presented by Other Projects

According to the letter from the Directorate of Fisheries and Wildlife AJK giving permission to MPL to construct the Project (**Section 7.1**), the baseline conditions for all future projects will be those that will be achieved in the long term following the implementation of the Biodiversity Action Plan for the Project. Subsequent projects if any will therefore have to demonstrate improvement over and above that projected to be achieved by implementation of this BAP (**Section 7.1**).

The environmental sensitivity that was addressed in the ESIA for the Project was previously not in the knowledge of nor was it investigated by the development agencies such as PPIB and the prospective project developers. The Government of AJK notified Poonch River as a national park in 2010. The ecological baseline study prepared by HWF in 2012⁷⁹ identified Poonch River as an important habitat for diverse fish fauna, including the Endangered Mahaseer fish. The Baseline studies conducted as a part of the ESIA of the Project further identified the presence of the Critically Endangered Kashmir Catfish in the river. The feasibility studies for the multiple projects in Poonch River sponsored by the government to assist the developers and promote investment completed prior to 2010 ignored the ecological sensitivity of the river and relied on baseline information that was of very limited value.

In view of this background and the directive of the Directorate of Fisheries and Wildlife AJK requiring future projects to achieve net gain or an improvement in biodiversity, it is quite unlikely that the project developers will be able to obtain environmental permits for construction of projects on the Poonch River in AJK. Additional constraints in development of specific projects on Poonch River are:

- ▶ Both Rajdhani and Kotli projects involve significant resettlement. The reservoir created by the Kotli project will inundated parts of Kotli town where land is expensive and management of resettlement will present special challenges.

⁷⁹ Ecological Baseline Study of Poonch River AJ&K with Special Emphasis on Mahaseer Fish, January 2012, Rafique, M., Pakistan Museum of Natural History, prepared for WWF Pakistan by Himalayan Wildlife Foundation

- ▶ The Sehra project proposed to be located downstream of the Line of Control will be impacted by lower flows resulting from Parnai hydropower project being constructed by India in the upper reaches of Poonch River.
- ▶ The economics of all the subsequent projects will be negatively impacted by changes in design to minimize low flow segments, and avoidance of peaking in operation the precedent for which has been set by the Gulpur Project.

Efforts of the Gulpur Project to maintain the ecological and socio-economic integrity of the Poonch River and tributaries need to be combined with a wider recognition of the need for instituting sustainable development practices in the Poonch basin. The institutional stakeholders such as AJK Fisheries and Wildlife Department and the PPIB, local communities of the Poonch River basin, as well as developers of the various hydropower projects in the Poonch River need to take responsibility for avoiding damage to the environmental resources of the basin. Management and mitigation measures recommended for other developers who may want to invest in hydropower projects on the Poonch River are:

- ▶ Consistent with the direction of the AJK Fisheries and Wildlife Department, develop a Biodiversity Action Plan that demonstrates an improvement of ecological resources above and beyond that achieved by implementation of the BAP for Gulpur HPP.
- ▶ Design downstream flow regimes that will adequately meet ecological and social requirements, especially during the dry season. This minimum environmental flow should be calculated using holistic methods as opposed to outdated rule-of-thumb or single species based approaches.
- ▶ Native fish hatcheries should be supported by all developers in the basin, and open water fish-restocking should take place on an annual basis and in a coordinated fashion.
- ▶ Infrastructure should be shared where possible to avoid unnecessary land acquisition and additional habitat and landscape fragmentation caused by overlapping access roads and transmission lines.
- ▶ Develop joint operation and maintenance activities for hydropower projects (e.g. agreeing on common operation and maintenance manuals and guidelines). Coordinated downstream environmental flow and extraordinary flow release, flushing, and other operational, maintenance and emergency prevention and response activities are crucial for the increased efficiencies and reduction in maintenance costs.

7.4 Coordination with the Office of Pakistan Commissioner for Indus Waters

Given the developments in Kishenganga project where environment has been recognized as an issue under the Indus Water Treaty, environmental impacts related to hydropower developments on either sides of LoC can be discussed by the offices of the Pakistan Commission for Indus Waters (PCIW) and India Commission for Indus Waters (ICIW) established under the Indus Waters Treaty. The Biodiversity Action Plan prepared for the Gulpur HPP includes a provision for the project owner to share the Poonch River environmental monitoring data and reports with the PCIW, on the basis of which the

PCIW could coordinate with the ICIW on management of environmental issues across the LoC. Such cross border co-ordination is recommended for all other potential HPPs.

7.5 Policy Recommendations

Given below are policy recommendations for minimizing the negative environmental impacts of hydropower projects.

- ▶ There is a lack of basin development planning in the Poonch River at all levels by the regulating government agencies. Development practices also indicate absence of the guiding policies while approving or issuing licenses for development of HPPs. Though an EIA is legally mandatory for the projects identified as environmentally sensitive, it is limited to the project specific area and disregards cumulative aspects of the environmental degradation from the sectoral and cross-sectoral development projects in the same area or at the basin level. It is recommended that a more systematic government-lead approach to basin level Cumulative Impact Assessment and Management (CIA) be adopted.
- ▶ The recommendations of this SEA prepared by IUCN⁸⁰ should be shared with all stakeholders and incorporated into planning, management and operations of all hydropower projects in AJK. Different river segments in AJK vary in their ecological importance and thus sensitivity to hydropower development. The approach to management and protection needs to take into consideration these varying sensitivities during the design and operation of hydropower projects. Policies and legislations need to be introduced and/or amended to address these issues. Moreover, capacity building of Government organizations particularly the AJK Fisheries and Wildlife Department and regulatory agencies is important to apply this principle.

In addition, it is recommended that the following practices be put in place:

- ▶ allow for the overall integration of the development plans of the local, district, and central governments at least at the basin levels (by developing an integrated Basin Development Plan).
- ▶ screen projects and their locations taking into account potential project specifics and cumulative impacts for guiding the sectoral and cross-sectoral development planning of the basin.
- ▶ develop specific standards and regulations for:
 - ▷ environmental and social baseline determination, (e.g. standard sampling methods and parameters),
 - ▷ methodologies for assessment of downstream environmental flows. The use of holistic approaches, such as DRIFT, should be mandatory for projects in the high sensitivity zones (such as Poonch) as identified in the SEA of AJK hydropower projects,

⁸⁰ IUCN (March 2014), Strategic Environmental Assessment of Hydropower Development in Azad Jammu and Kashmir, Final Report

- ▷ design parameters for the fish friendly infrastructure: fish ladders / intakes/ spillways,
 - ▷ consultation and stakeholder engagement,
 - ▷ land acquisition, involuntary resettlement and livelihood restoration,
 - ▷ free, prior and informed consent of indigenous people, and
 - ▷ benefit sharing
- ▶ capacity building of Government organizations particularly the AJK Fisheries and Wildlife Department and regulatory agencies to understand the principles of Cumulative Impact Assessment and varying sensitivity of different river segments.

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