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Afghanistan Clean Energy Program

BAKHSI KHEL MHP Mission Report (May, 2010)

Village elders guide an ACEP assessment team in Bakhsi Khel village in Panjshir province.

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BAKHSI KHEL (PANJSHIR)
May 2010
Afghanistan Clean Energy Program (ACEP)

A field assessment was undertaken in the village of Bakhshi Khel in Panjshir province to inspect the condition of an old, damaged micro hydropower plant (MHP) and to assess the possibility of either rehabilitating the existing MHP or building a new one for the electrification of approximately 400 households in the village.

1. FINDINGS AND RECOMMENDATION

(a) Upon arrival in Bakhsi Khel, the ACEP team was accompanied by a local villager (appointed by the Governor's office), to help in locating the old MHP. At the village, several locals joined the team to find the location of another MHP as well.

(b) There were apparently two separate MHPs in the area that were constructed several years ago; both have been damaged beyond repair. The width of the floodplain varies along the area of the intake of the upper plant (plant 1) down to the location of a possible new powerhouse (maximum width was 50 meters). Downstream from the proposed new powerhouse location, the floodplain at the right bank narrows significantly, leaving absolutely no space for a plant to be constructed.

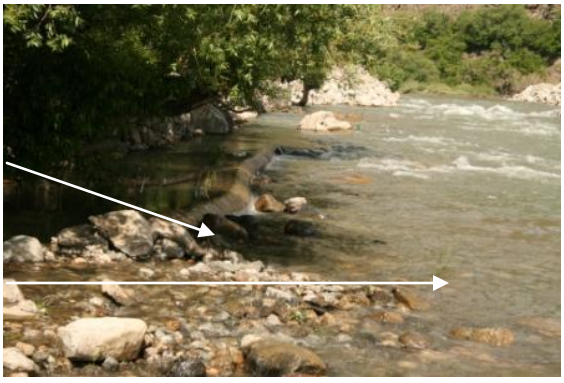
(c) Given the very short time available, it was not possible to scout out a longer length along the Panjsir River for a project site. However, this section of the Panjhsir River (between the first intake to the last/new powerhouse location) appeared to have relatively better river gradient. Moreover, the distribution area of the proposed plant is situated along sloping land on the right bank of the river, which is more or less within the stretch of the river under consideration. The distribution area continues up this sloping land and to the main highway and beyond (see the Google map and comments later in this report).

(d) **Plant 1:** Whereas the initial part of the headrace still exists, the powerhouse and most of the headrace are non-existent

- The location of the plant was shown to us by villagers in the area. A rudimentary intake and a short cement-lined canal of about 50 meters in length brings water from the Panjshir River to a area where a main sluice gate was installed, which was apparently used for diverting water into the main headrace or back into the Panjshir River.

Diversion canal of Powerhouse 1

Panjshir River

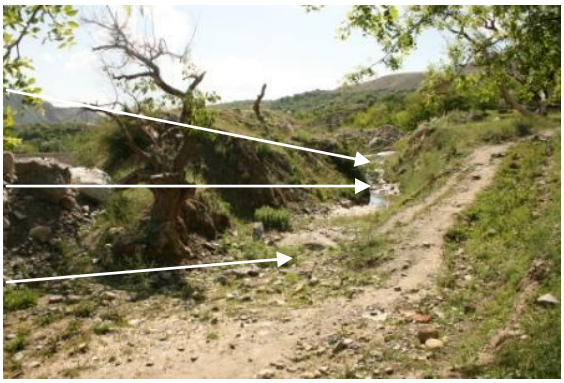


- Another 100 meters of headrace canal (now buried under debris) would bring water to a low head turbine (maybe about two meters). The location of the powerhouse indicated by villagers is right next to a small rivulet, which carried snowmelt water during spring months (about three to four months of the year). It should be noted that there was good quantity of water at the time of the visit, but the rivulet dries up for the remaining months of the year. It appears that a flood that occurred in the recent past had completely buried the headrace and the powerhouse; debris was transported through the small rivulet and flood water entering through the headrace from Panjshir River contributed to this situation.

Tributary rivulet to the Panjshir River

Approximate location of powerhouse 1, now covered by debris

Headrace canal approximately 50m downstream from the sluice gate location, now under debris



Conclusion: Rehabilitating this plant is not possible. The existing water level at the tributary rivulet is already higher than any powerhouse turbine level that could be proposed. Even if the debris located on the rivulet bed were to be cleared to bring the water level down, and a flood retaining wall were to be built to prevent the river water from entering the headrace, the powerhouse area would continue to be refilled with debris from the rivulet during times of high flow. Moreover, the head available is simply too low to produce any significant amount of power.

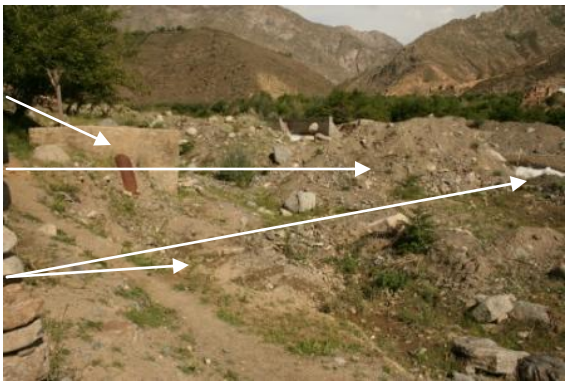
(e) **Plant 2**:

- After assessing the location of powerhouse 1, villagers took the assessment team to the location of the second powerhouse. A rudimentary diversion/intake is located approximately 150 meters downstream from the first powerhouse along with a short earth canal bringing water from the Panjshir River directly to the forebay.
- The off-take from the Panjshir River is located right next to the debris deposited by the flood. A pile of what seems to be freshly deposited debris serves as the only barrier protecting the intake from the earth canal. In was concluded that the current location of the off-take is not reliable.
- The top portion of the forebay and steel penstock is visible and the other section remains buried under debris. The forebay was also damaged by flood water entering the canal from the Panjshir River.

Top part of forebay and steel penstock can still be seen

Debris deposited by the Panjshir River during flooding

Powerhouse location is clearly not safe from the Panjshir River's high flood level



Conclusion: As with plant 1, rehabilitating this plant is not feasible. The existing water level of the Panjshir River is already higher than any powerhouse turbine level that can be proposed. If the debris accumulated at the penstock-powerhouse level were to be cleared, water would seep out due to the higher groundwater table. A flood retaining wall would need to be constructed right up to the intake of plant 1 and a flood control gate installed at intake of plant 2 to keep flood water from entering. If a new powerhouse would be built here, the powerhouse floor level would need to be sufficiently high and the available head would be too low to generate any appreciable amount of power.

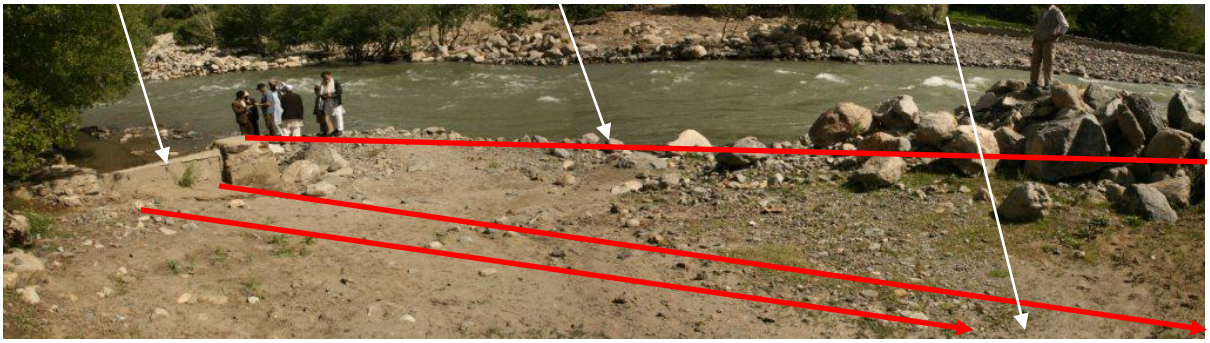
(f) **Possibility of a new plant** :

- There is a suitable powerhouse location further downstream from plant 2, but it is still within the Panjshir River floodplain and prone to damage by flood water. A flood protection wall would need to be constructed in order to protect the MHP construction from the high flow level of the Panjshir River.
- The gross head available at the location of plant 2 down to that of the plant 1 intake is about 12 meters (GPS reading was not very accurate). After factoring in a two meter safety buffer from the current water level, there should be about ten meters of gross head.
- According to information provided by accompanying village elders, the number of households within the distribution area varies widely throughout the year. During January and February most of the population migrates to Kabul or to lower elevations in the valley due to cold weather. It was estimated that a total of 400 households will be connected to the MHP.
- By allocating an average of 150 watts peak demand per household, the present demand would be about 60 kW.
- If 25 percent of present demand is further allocated to compensate for population growth in the near future and uncertainty, a 75 kW plant should be planned.
- At a gross head of about eight meters, the turbine design flow needed would be about 1.3 m3/sec.
- By allocating an additional ten percent, the quantity of water diverted from intake should be about 1.5m3/sec.

(g) **Configuration of the new plant**:

- The intake of plant 1 is ideally located, as it is slightly hidden and the headrace is diverting away from the main flow direction of the river. A flood protection wall should be built to protect the headrace from high flow (see photograph below).

Intake gate Flood protection wall Headrace canal



- The difference between the river water level and the canal level upstream of the gate appears to be insufficient to construct a gravel trap. Consequently, a gravel trap should be constructed after the gate. Its exact location will be known after a detailed level measurement is conducted along the headrace alignment in relation to the river's high water level.

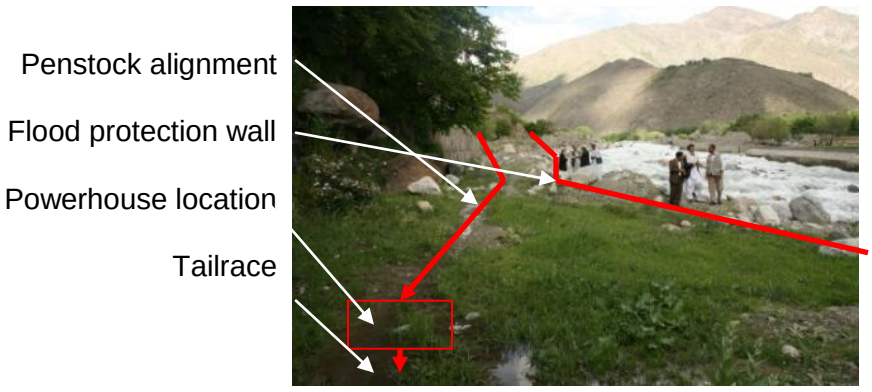
Tributary rivulet

Possible gravel trap locations

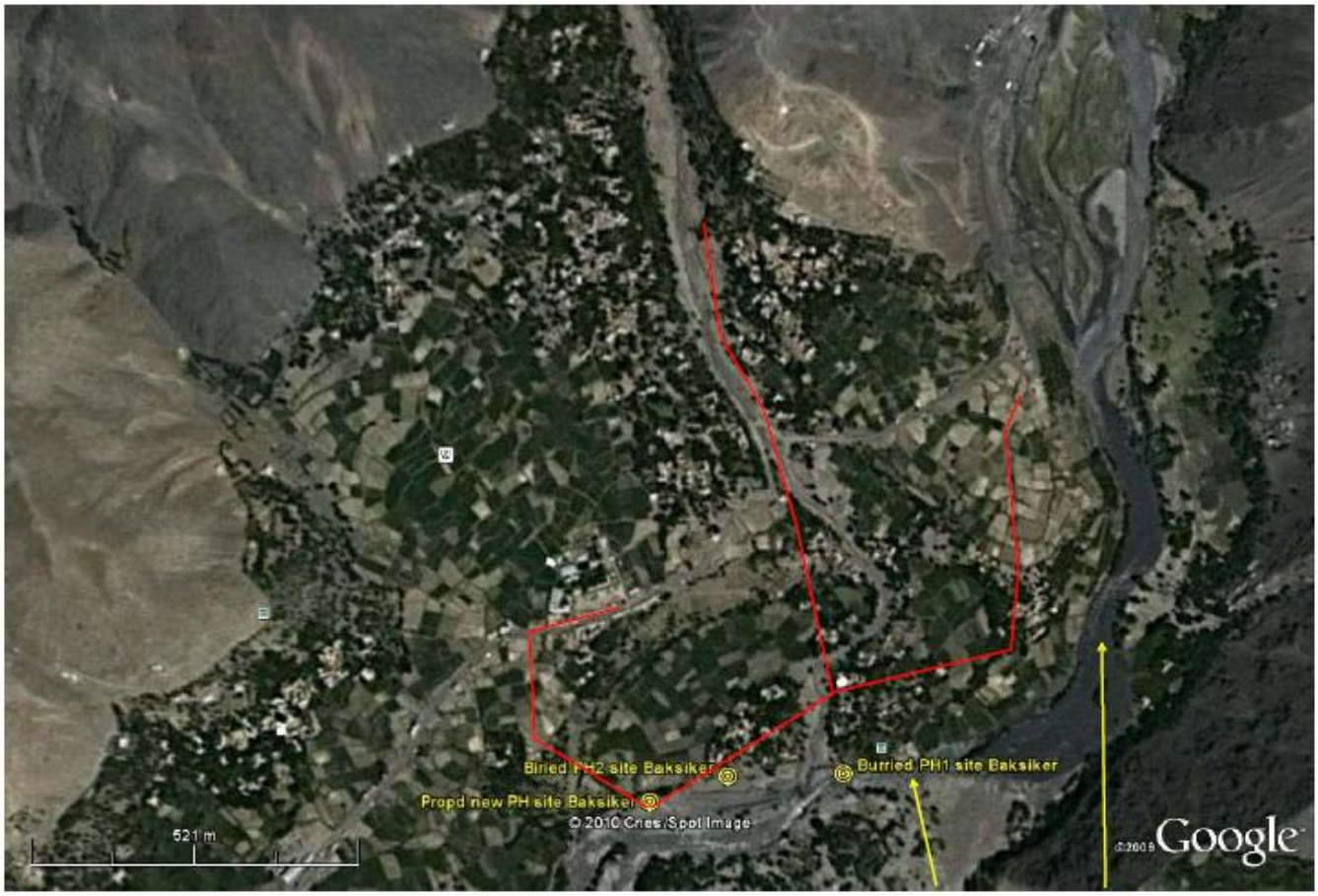
Old buried canal

New canal approx alignment

- The headrace through the rivulet should be an underground concrete conduit.
- There is limited space and flat width (sloping down to the powerhouse) along the right bank flood plain, steeply sloped cultivated land and an existing (small) irrigation canal along the slope to the right of the flood plain. Under such conditions, it might not be possible to extend the headrace canal much further after the tributary rivulet. To overcome this challenge, a forebay/settling basin will need to be constructed right after the rivulet and a long penstock, about 250 meters in length, will need to be extended down to the powerhouse.



- A long flood protection wall will need to be constructed along the right river bank to protect the plant and its equipment. This wall may need to be about 300 meters long, starting from the intake and extending down to the point where the tailrace level drops down to about one meter below the powerhouse floor level. There was found to be a low level flood protection wall, part of which could be seen along the right river bank between the forebay and powerhouse. Any new protection wall may be built on top of the existing one.
- A total of about 2.5 kilometers of low tension line might be required to connect consumers within the targeted distribution area of Bakhsi Khel. A tentative distribution layout is shown below in the Google map.



Existing Intake Pnjsir river

(a) Electrification required for : 400 house Holds
(b) Source river : Panjsir river
(c Flow sufficiency : Not a problem. But the wide river flood plain can occasionally cause river course to change, thus requiring maintenance to bring water to MHP intake
(d) First old powerhouse was built near the confluence of a small rivulet and Panjsir river. This is now completely buried under debris during a flood some years back.
(d Second old powerhouse was built further down stream using another offtake from Panjsir river. This is also completely buried. Only the top portion of penstock is visible above the debris.
(e) The proposed powerhouse location is also in the Panjsir river flood plain. safety measures for this site would be (a) flood retaining wall along the bank of Panjsir river right up to the intake which is ~ 400m (b) build powerhouse floor level at least 2 m above current water level to avoid equipment flooding
(f) Technically it is possible to build MHP as proposed above.
Available gross head ~ 10m
Plant rated capacity ~ 400 hh x 150 watt/hh = 60 kW + 20% future growth margin
Flow required ~ 1.3 m3/sec

2. NEXT STEPS

- Prepare a tentative layout, design and cost estimate of the plant based on the above pre-feasibility level assessment.
- If the project matches ACEP's criteria for further study and possible funding, the following works will need to be carried out:
    - Conduct a feasibility survey including (1) assessment of number/type of consumers, demand and growth (2) leveling/mapping of the construction alignment, including waterway and flood protection wall (3) measuring distribution lines to each load centers (4) collecting information on ability to pay and (5) collecting information on cost of construction materials
    - Design the scheme, including size of plant, configuration/size of various civil and hydro-mechanical works
    - Prepare drawings/maps of waterway, protection wall and distribution lines, including over all plans and longitudinal sections, and plan sections of each construction works
    - Estimate quantity of works required for overall civil, hydro-mechanical and electro-mechanical works
    - Estimate the cost of the project and analyze the cost/benefit ratio and internal rate of return.
- If meeting ACEP's criteria for further involvement, the following steps will be needed to implement the project:
    - Inform the community of ACEP's implementation process; prepare project document with project features, roles and responsibilities of ACEP and villagers and management of the plant following construction, and get the project document signed by ACEP, community representative, and local administration representative
    - Advertize separate request for proposals for (a) hydro-mechanical and electro-mechanical works and (b) civil construction works
    - Procure works and construct/install plant components under the supervision of ACEP (sub contractor)
- Hand over the project to the community.