APPENDIX A: KEY STAKEHOLDER CONSULTATIONS

Preinception Visit

Ministry of Population and Environment (MoPE)

Basic details	
Location: Kathmandu, MoPE Office	Village: Kathmandu
District: Kathmandu	Date: December 4, 2017

Purpose of the visit: To introduce the Cumulative Impact Assessment (CIA) for Trishuli River Basin and request for information from MoPE on upcoming policy initiatives and suggestions on VECs and key stakeholders (national level) to be included in the assessment.

Key points discussed

- MoPE is presently involved in finalizing the General Environmental Impact Assessment (EIA) Guidelines for approval by the Council of Ministers (update of 1993, likely to be in place in January 2018).
- Aware of the EIA Guidelines for Hydropower: This will be taken up once the general guidelines are approved.
    - While cumulative impacts have not been specifically considered under the guidelines, there is a generic mention of climate change impacts as well as glacial lake outburst floods (GLOF).
    - EFlows: 10% minimum lean season flow requirements are driven by the Ministry of Energy. This requirement has a strong push by the Independent Power Producers (IPP) lobby. MoPE is aware that the hydropower guidelines recommend that the EFlows must be linked to the basin's hydrology and downstream users.
    - Fish Pass: Not mandatory as per the existing and revised guidelines—this is a lender's requirement.
- MoPE is likely to merge with the Forests, Soil and Conservation Ministry and the population component will be merged into the Ministry of Health.
- Initial Environment Examinations (IEE) and EIA requirements:
    - No approvals required for hydro projects less than 1 megawatt (MW).
    - Projects of 1 to 50 MW must undertake an IEE, which is reviewed and approved by the Department of Electricity Development (DoED).
    - Projects greater than 50 MW as well as projects in conservation areas require EIA approval from the MoPE.
    - Projects less than 50 MW, but which have at least 5 hectares of land affected and/or forest clearance and/or conservation area impact will also require EIA approval from the MoPE.
- Data for the CIA is a challenge. The team may need to make a formal request to the MoPE secretary to access EIA reports available for the basin.
- **General discussion on stakeholder groups:**
    1. Roads and irrigation departments will need to be involved in the CIA to understand other projects that are proposed for consideration as stressors.
    2. There is an ongoing initiative led by the Department of National Parks and Wildlife Reserves to not consider new hydropower projects (HPPs) within protected areas, such as Langtang National Park. Implications on existing projects as well as projects that are under various stages of approval will need to be developed.
    3. No specific initiative of the Government of Nepal (GoN) to integrate/consolidate multiple transmission lines other than the MCC project (Lapsiphedi to Ratmate corridor).
    4. Other national level stakeholders:
        - Environment department of each relevant ministry (irrigation, roads, industries, and so forth)
        - Federal Affairs and Local Development Department—especially for quarries

- **General discussion on valued environmental and social components (VECs):**
  1. Consider health and sanitation: there have been instances of cholera outbreak during hydropower construction phases (linked to indiscriminate solid and liquid waste disposal). In general, the water quality in Trishuli River is considered of poor quality.
  2. Transmission lines and migratory birds can also be considered within the study. However, there is a constraint that some of the developers have already commenced construction of their transmission lines.
- **Spatial boundary:** Cut-off for the boundary of the Trishuli River Basin is important. There is a need to consider the landscape linked to Chitwan National Park as well as the river basin after confluence with the Budhi Gandaki River Basin.

Meeting attended by

1. Ms. Jwala Shrestha, Under Secretary, MoPE
2. Dr. Arun Venkataraman, ERM
3. Dr. Salil Devakota, NESS
4. Ms. Rutuja Tendolkar, ERM

Nepal Water and Energy Development Company (NWEDC)

Basic details	
Location: NWEDC Office, Kathmandu	Village: Kathmandu
District: Kathmandu	Date: December 4, 2017

Purpose of the visit: To introduce the CIA for Trishuli River Basin and obtain buy-in from NWEDC to be the key facilitator from the hydropower developer perspective.

Key points discussed

- **General data challenges:** Other developers will have limited environmental and social (E&S) data due to lack of any specific lender obligations, Tibet side will also be an issue, so gauging station data at the border with Nepal will need to be considered;
- **VECs:**
  - There is a need to split biodiversity into terrestrial, aquatic, migratory birds and overall habitat changes.
  - Chitwan Annapurna landscape, along the southern portion of the Trishuli River Basin, has a different habitat and topographical profile.
  - Drinking water needs to be considered as a VEC, potentially rural roads as well (can be clubbed into local infrastructure).
- UT 3A construction has resumed. Tunneling is going on. As per NWEDC, this is the only project, other than UT 1 which has considered a fish pass.
- NWEDC is aware of the Koshi Integrated River Basin Management Plan that has been prepared by the Water and Energy Commission Secretariat. No such plan exists for Trishuli.
- From a developers' perspective, the CIA recommendations will need to consider the following:
  - Practical and implementation-oriented actions
  - How to facilitate and integrate the numerous developers, with differing scales and general awareness levels (Lender obligations will drive compliance for some developers, but not all.)

Meeting attended by

1. Mr. Ashok Baniya, NWEDC
2. Mr. Giriraj Adhikari, NWEDC
3. Dr. Arun Venkataraman, ERM
4. Dr. Salil Devakota, NESS
5. Ms. Rutuja Tendolkar, ERM

Investment Board of Nepal (IBN)

Basic details	
Location: IBN Office, Kathmandu	Village: Kathmandu
District: Kathmandu	Date: December 5, 2017

Purpose of the visit: To introduce the CIA for Trishuli River Basin and request for support as and when required. ERM is aware that IBN will only get involved for projects over 500 MW that have a public-private partnership (PPP)–led development strategy.

Key points discussed

- IBN Focus:
  - 500 MW and PPP projects
  - Presently limited to Arun 3, Upper Karnali, and West Seti
  - No large HPPs identified in Trishuli as of now—however, IBN gets involved only once direction is provided by the Ministry of Energy
- Other studies and initiatives:
  - US AID is focusing on river basins in the Far Western Development Region, i.e., Karnali, Mahakali and Rapti Basin.
  - There is a suggestion to connect with Policy Entrepreneurs Incorporated (PEI), which is working with JVS to support the Water and Energy Commission Secretariat (WECS) in developing a basin development strategy for the Kamala River Basin.
  - There are three separate initiatives on transmission lines: a World Bank led initiative for policy development (Nepal Environmental and Scientific Services has been contracted), an Asian Development Bank study, and a Joint Secretary of DoED study. However, these studies are not being coordinated or aligned. It is understood that for all of the transmission line policy initiatives, social issues are a focus area.
  - Hariban Project is funded by the WWF for greening of infrastructure development.
- For transmission lines: permanent land comes under the land acquisition act, whereas right of way comes under the electricity acts. Separate committees are formed and there is no coordination between them
- Key developments as stressors:
  - Trishuli Highway up to China
  - Railway link associated with the One Belt, One Road project
  - Multiple quarries and some limestone mines in Trishuli River Basin
  - International Finance Corporation (IFC) and Ministry of Tourism initiative for regulation of hotels in conservation areas
- DoED guidelines on monitoring of environmental impacts, especially riparian release, are not monitored by developers or the government.
- Decentralization and change in administrative structure implies that *gaon palikas* have more authority to interface with project permits, taxes, and so forth. This needs to be understood, and *gaon palikas* need to be involved as stakeholders as early as possible.
- Other stakeholders will include Nepal Water Conservation Foundation, Niti Foundation, JVS, Nepal Hydropower Journalists Association.

Meeting attended by

1. Ms. Srijana Bhattarai, Social Expert, IBNMr. Prem Khanal, Social Expert, IBN
2. Mr. Neelesh, Environment Expert, IBN
3. Dr. Arun Venkataraman, ERM
4. Dr. Salil Devakota, NESS
5. Ms. Rutuja Tendolkar, ERM

Department of Electricity Development (DoED)

Basic details	
Location: DoED Office, Kathmandu	Village: Kathmandu
District: Kathmandu	Date: December 5, 2017

Purpose of the visit: To introduce the CIA for the Trishuli River Basin and obtain details of HPP developers (most updated list/information).

Key points discussed

- Discussion started on how there was a demand from the *gaon palika* of Thppal Khola (Perfect Energy) on releasing more capacity at the tailrace, as this is just above cremation site of the village.
- GoN reserved projects are projects where the survey license has been cancelled as developers could not meet their commitments and/or the projects did not get developer buy-in. Studies are reconsidered and more details are added to try and address any constraints that potential developers may have identified during their due diligence studies.
- Stressors: Consider the Master Plan of the Department of Roads
- Rasuwa Langtang Storage Project (larger than UT 1, around 300 MW) survey license has been issued. If the Power Purchase Agreement (PPA) is executed, this project will be taken up on a fast track basis.
- There is a transmission line master plan. However, developers link the evacuation to their own project development.
- DoED is encouraging developers to link each other's power evacuation corridors.
- There are no plans to decommission operational projects of the Nepal Electricity Authority (NEA) on Trishuli that are nearing their end of Operation and Maintenance (O&M) concession. Such projects will be repowered, upgraded, or improved.
- DoED will submit an updated list of developers and projects on December 11, 2017.

Meeting attended by

1. Mr. Sanjay Dhungel, Deputy Director General, DoED
2. Mr. Hemantraj Ghimire, Environment Officer, DoED
3. Dr. Salil Devakota, NESS
4. Ms. Rutuja Tendolkar, ERM

Department of Environment (DoENV)

Basic details	
Location: Kathmandu	Name of organization: Department of Environment
District: Kathmandu	Date: December 4, 2017

Purpose of the visit: To understand and obtain the DoENV's views and concerns on cumulative impact in the Trishuli Basin.

Key points discussed

- All the projects in the corridor must meet the national standards for air, water, noise, and soil. The regular and periodic monitoring is essential.
- The projects should follow the Environment Management Plan (EMP) as per the approved EIA. The projects in the Trishuli corridor should consider local level development, agriculture intensification, livelihood restoration, and conservation of aquatic species. There is no coordination between and among developers.
- It is advisable that all the developers in the basin join together and initiate partnership with the government and other entities for overall development of basin.
- All the central-level stakeholders should have meaningful consultations in preparation for basin- level planning.
- The concept should be integrated in an overall national planning through National Planning Commission.

Meeting attended by

1. Mr. Durga P. Dawadi, DoENV
2. Mr. Salil Devkota, NESS
3. Mr. Ramu Subedi, NESS

Inception Visit and Developers Meeting

Ministry of Forests and Soil Conservation (MoFSC)

Basic details	
Location: Department of Forests and Soil Conservation	Village: Kathmandu
District: Kathmandu	Date: December 13, 2017

Purpose of the visit: To obtain the department's concerns on cumulative impacts in the Trishuli River Basin.

Key points discussed

- Baseline status and impacts basic information is available with forest and wildlife officials in the district. The District Forest Office (DFO) and the chief warden of Langtang National Park, who are Dunche, should also be consulted.
- Developers have compiled IEEs and EIAs. Biodiversity baseline information is available in these documents.
- A major concern of the department is the loss of forests and trees cut in the following categories: joint forest management forests, community forests, and government-managed forests.
- Also of major concern are impacts to biodiversity hotspots, red-list species, protected species, habitat fragmentation, aquatic species and forest utilization such as nontimber forest products (NTFPs), and medicinal and aromatic plant collection.
- Impacts to these resources should be clearly assessed and appropriate mitigation proposed.
- During the construction phase, impacts due to labor influx should be considered.
- There was a short discussion in the prevailing guidelines on compensating for forest loss. There are two options:
  1. The project proponent finances compensation in the same forest type adjacent to the project area with planting of indigenous trees similar to the species composition of the impacted area. The compensation area is managed for five years by the project proponent and then returned to the forest department. If suitable land is not available, a financial contribution that will allow for this kind of compensation will be accepted by the government.
  2. For nonprofit organizations like government agencies, each species cut needs to be replanted in a 1:25 ratio. The replanting can be carried out in both government and public land.
- A Forest Resource Assessment Survey has recently been carried out for the whole country. GIS shape-files specifically for the Trishuli Basin are available with Nepal Environmental and Scientific Services (NESS).
- It is also important to obtain reports in soil vulnerability in the basin from the Department of Soil and Water Conservation.

Meeting attended by

1. Sampath Yadav-Deputy Director General/Joint Secretary, Department of Forests
2. Mohan Kafle, Under Secretary, Department of Forests
3. Arun Venkataraman, ERM
4. Ramu Subedi, NESS

Trishuli Hydropower Developer Forum (THDF)

Basic details	
Location: IFC Meeting Room	Village: Kathmandu
District: Bagmati	Date: December 14, 2017

Purpose of the visit: To explain the objectives and process for Trishuli Basin CIA process and obtain responses from hydropower developers on impacts and VECs likely to occur in the basin.

Key points discussed

- Update on the CIA plan and progress since last developer's meeting
- Overview of final Trishuli River Basin CIA terms of reference (TOR) (45 minutes):
  - Incorporation of developer's Input
  - Objectives of the CIA
  - CIA process overview
  - Developer committee role in the CIA process
- Consultations with Developers on the following:
  - Spatial and temporal boundaries of CIA
  - Potential activities, projects, and other stressors
  - Identification of potential VECs
  - Stakeholder Involvement in the CIA;
- Conclusions, next steps and concluding remarks.

Meeting attended by

1. Shyam Upadhyaya, OMCN
2. Dibya Raj Pant, Blue Energy
3. Subarna Das Shrestha, Sanima Hydro
4. Sarad Bashyal, Mailu Khola JVCL
5. Pushkar Bhusal, NWEDC
6. Bijay Sen Khadka, Chilime HPS
7. David Maharjan, Hydrosolutions
8. Ashok Baniya, NWEDC(UT-1)
9. Srijana Bhattarai, IBN
10. Prem Khanal, IBN
11. Sanjeev Budhathoki, Middle Trishuli HEP
12. Rubin Thapa. Middle Trishuli HEP
13. Narayan Rijal, SAN Engineering Solutions
14. Avash Ojha, NEA
15. Salil Devkota, NESS
16. Ramu Subedi, NESS
17. David Blaha, ERM
18. Neena Singh, ERM
19. Arun Venkataraman, ERM
20. Leeanne Alonso, IFC
21. Bhishma Pandit, IFC
22. Upasana Pradhan, IFC

Reconnaissance Visit (February 2018): Basin-Level Consultations

Basic details	
Location: Trishuli River Basin	Village: Consultations between Trishuli Galchi to Rasuwagadhi based on road access
District: Rasuwa and Nuwakot Districts	Date: February 10–13, 2018
Purpose of the visit: Reconnaissance of the basin and to understand preliminary perceptions on spatial and temporal boundaries, cumulative versus localized impacts from hydropower development, stressors and potential VECs.	

Key points discussed

- **Stakeholders consulted and HPPs visited:**
  - Fisheries Research Centre rainbow trout farm (Dhunge), Trishuli, Nuwakot
  - Trishuli HPP pondage (Dhunge), Nuwakot
  - Dupche Rural Municipality and village community consultations
  - Office of Chief Conservation Officer-Langtang National Park consultations
  - Chairperson of Gosaikunda Rural Municipality consultations
  - Chilime Hydro Power House site visit and consultations
  - Rasuwagadhi HPP construction site (tailrace and headworks)
  - District Forest Office (DFO) Rasuwa District consultations
  - District Administration Office (CDO Office), Rasuwa District consultations
  - Langtang National Park–Kalisthan Range Post, Rasuwa consultations
  - Dhaibung Buffer Zone Users Committee, Kalikasthan, Rasuwa consultations
  - Uttar Gaya, Betrawati site visit and consultations with local community
  - Trishuli HPP Power House, Nuwakot site visit and consultations
- **Salient findings from visual observations and stakeholder consultations:**

  Stressors:
  - Most of the downstream sections from Devighat are heavily sand or gravel mined. Sand mines are also prevalent upstream on the Tadi Khola. There are both legal and illegal mines. Local communities believe that water quality and fish abundance are very poor downstream.
  - All communities indicate that building of access roads for village infrastructure has led to loss of soil stability, exacerbating landslides and loss of biodiversity. This has been compounded by deforestation caused by upstream communities.
  - The Galchi-Rasuwgadhi Road is in disrepair along several stretches as a consequence of landslides. We observed road work occurring at several locations with all spoil being dumped in the river.
  - Solid waste management practices in villages and towns along the river is nonexistent. In all towns we crossed there was excessive dumping of waste in the river. The Trishuli engineers indicated that they had to close down the turbines frequently due to dumping of waste.
  - Concerns that increased traffic to and from China will escalate illegal wildlife trade.

  Project impacts:
  - Low flow conditions appear to be a major concern for downstream users. There were protests by the community at Betrawati due to the proposed Trishuli Galchi project, which will divert water released to maintain the Uttar Gaya sacred site, which has at least seven cremation grounds. Impacts on low flows on cremation grounds are likely to be relevant for Devighat, which lies at the confluence of the Tadi Khola and Trishuli River. Both rivers have several dams proposed. We are also informed that the Sanjen Khola has dried up due to diversion of water.

- Building of access roads by hydropower developers, welcomed by local communities, are likely to decrease soil stability, exacerbating landslides and loss of biodiversity. An access road is presently being built in the Langtang National Park.
- Deforestation is occurring along rights-of-way of transmission lines in ecologically sensitive areas. The transmission line for the Chilime HPP passes through the Langtang National Park. We also observed the transmission line for Upper Trishuli 3A being erected on a forest slope and along the banks of the Trishuli River.
- Labor influx is resulting in health issues such as spread of HIV and other venereal diseases.
- Poor management of compensation payment, especially to marginal groups, has rendered them landless and without a future source of livelihood.
- Any biased distribution of compensation and actual disbursement of local benefits is likely to impact vulnerable households.
- While the EIA reports have information on the baseline, the discussion of social impacts (with the exception of UT-1) is very generic and is not satisfactory foe determining VEC conditions and project-induced vulnerabilities.
- Considering the number of projects operational and under late-construction phases in the basin, the stakeholder consultation phase presents an opportunity to collect more specific social impact information by focusing on VDCs and *gaon palikas* in and around these HPPs.
- Some of the data that can be collected include use of compensation, any out-migration of physically displaced households, changes in livelihoods postcompensation, health concerns during construction and postconstruction, and general integration of gender and vulnerable communities into development benefits accrued

Suggestion on VECs:

- Locals reported the presence of four species in the midstream sections of the river: Snow Trout (Schizothorax richardsonii) (Asla), Neolissochilus hexagonolepis (Katle), Garra annandalei (Buduna and/or Nakhata).
- In the upstream and downstream sections, locals did not report many fish. Golden Mahseer (Tor putitora) were reported only if locals were prompted, and it appears that the river has very few of this species.
- There are types of Asla reported in the river; While Buche Asla is *Schizothorax richardsonii*, Chuche Asla is *Schizothoraichthyes progastus*. The two species may not be easily differentiated. However, we did see the former in a restaurant in Betrawati.
- Smooth-coated otter (Lutrogale perspicallata) was not reported to be found in the river.
- Habitats in Langtang National Park through access roads, transmission lines and exploitation by migrant labor force

Cultural sites:

- All consultations indicated the religious site at Uttar Gaya, Bertwati, is greatly threatened by low-flow conditions. Some consultations indicated that the religious site at Devighat is also threatened by low flow.

Social:

- Vulnerable groups impacted by in-migration through disease, mismanagement of compensation, and so forth (already provided under project impacts).

Meeting attended by

1. Arun Venkataraman and Rutuja Tendolkar, ERM
2. Ramu Subedi and Naresh Rimal, NESS
3. Representatives of various stakeholder groups as noted above

Reconnaissance Visit (February 2018): Kathmandu Consultations

Ministry of Federal Affairs and Local Development (MoFALD)

Basic details	
Location: Ministry of Federal Affairs and Local Development	Village: Kathmandu
District: Kathmandu	Date: February 14, 2018
Purpose of the visit: To understand role in mitigation of localized impacts.	

Key points discussed

- Mr. Chakrapani Sharma, presently head of monitoring and evaluation at the ministry, was the architect of the highly acclaimed Environment-Friendly Local Governance Framework (EFLGF). With the new federal structure and decentralization in the new constitution, the local governments need to implement this framework and MoFALD is playing a role in facilitating and capacity building within the rural municipalities and municipalities.
- To ensure that hydropower does not compromise the environmental health of the Trishuli Basin and well-being of local communities, there is a strong need that EIAs and IEEs for future hydro development recognize the EFLGF and incorporate its principles and monitoring framework in their EMPs. He further highlighted that the framework is now under review to align with the new governance structure of Nepal

Meeting attended by

1. Arun Venkataraman, ERM
2. Ramu Subedi, NESS
3. Mr. Chakrapani Sharma, MoFALD

Water and Energy Commission Secretariat (WECS)

Basic details	
Location: WECs	Village: Kathmandu
District: Kathmandu	Date: 2019
Purpose of the visit: To understand basin level planning of river basin initiatives.	

Key points discussed

- WECs explained that while there are no river basin management plans for Nepal, the draft Water Resource Policy in presently being finalized and would be presented before the cabinet a few weeks after the meeting. However, it still does not recognize the new federal structure and will need to be adapted in the future. The Joint Secretary added that WECS is going to prepare a river basin plan for all rivers with support from the World Bank, a task expected to be complete in three years. He highlighted that the new Water Resource Policy considers the CIA as an important component. Due to the future variability in irrigation by springs because of climate change, the Ministry of Irrigation is also contemplating lift irrigation from the river basin.

Meeting attended by

1. Mr. Madhav Belbase, Joint Secretary, WECS
2. Arun Venkataraman, ERM
3. Ramu Subedi, NESS

Key Informant Consultations: Kathmandu Central Stakeholders

Ministry of Forests and Environment (MoFE)

Basic details	
Location: Kathmandu	Name of organization: Ministry of Forests and Environment
District: Kathmandu	Date: December 18, 2017
Purpose of the visit: Understanding the MoFE's views and concerns on cumulative impact in the Trishuli Basin.	

Key points discussed

- The hydropower developers are not complying with the approved EIA report. The compliance with EIA recommendations and preparation of a regular progress report and its submission to the DoENV is essential.
- Effective implementation of the EMP is key.
- Hydroelectric projects must ensure minimum impacts to forest and biodiversity.
- A basin approach is to be followed to manage the issues identified by the CIA study.
- Regular monitoring, reporting, and recording of noncompliance by HPPs and necessary corrective measures are essential for gradual improvement in EMP implementation.
- Institutional development, capacity building, and knowledge management at central-level institutions are important for overall improvement of environmental and social safeguards in the hydropower sector.

Meeting attended by

1. Dr. Maheshwor Dhakal, Joint Secretary, MoFE
2. Mr. Ishwori Paneru, Officer, MoFE
3. Mr. Surendra Raj Pant, Ecologist, MoFE
4. Mr. Salil Devkota, NESS
5. Mr. Ramu Subedi, NESS

Nepal Agriculture Research Council (NARC)

Basic details	
Location: Kathmandu	Name of organization: Nepal Agriculture Research Council
District: Kathmandu	Date: January 9, 2018
Purpose of the visit: Understanding the NARC's views and concerns on cumulative impact in the Trishuli Basin.	

Key points discussed

- NARC has shown concern about the conservation of aquatic species. According to NARC, there are many HPPs in the basin, and only few projects have fish passage provision; the majority of projects have no such provisions.
- The proper baseline study of aquatic species and project-specific measures are recommended. The basin-level planning should incorporate conservation measures and strict monitoring and reporting mechanism to concerned agencies.
- Capacity building and institutional strengthening in research and development in NARC and other government entities are recommended.

Meeting attended by

1. Dr. Tek Bahadur Gurung, Director, NARC
2. Mr. Kishor Kumar Upadhyay, Fisheries biologist, NESS

Ministry of Energy, Water Resources and Irrigation (MoEWRI)

Basic details	
Location: Kathmandu	Name of organization: Ministry of Energy, Water Resources and Irrigation
District: Kathmandu	Date: March 27, 2018

Purpose of the visit: To obtain the views and concerns of the Ministry of Energy, Water Resources and Irrigation on cumulative impacts in the Trishuli Basin.

Key points discussed

- Importance of basin level planning in Nepal
- The efforts made by GoN in basin level planning
- The water resource policy which is in draft stage will highlight some of the important aspect regarding basin level planning
- Since federal structure is already in place, a series of consultation processes involving the newly elected local governments in selected sites would be required.
- It is urgent to come up with basin level planning, all the existing projects in basin should be mainstream to the planned basin level planning
- The development in basin must align with basin plan. The strict follow up and adherence with basin plan is must to avoid haphazard development
- The license for hydropower and other development activities should be in accordance with basin level plan.
- Roles and responsibility of institutions for basin level planning should be clearly spelled out (including the central government, province government, local government)

Meeting attended by

1. Mr. Prawin Raj Aryal, Joint Secretary, Ministry of Energy, Water Resources and Irrigation
2. Mr. Salil Devkota, NESS

Nepal Electricity Authority (NEA)

Basic details	
Location: Kathmandu	Name of organization: Nepal Electricity Authority
District: Kathmandu	Date: April 18, 2018

Purpose of the visit: To obtain the views and concerns of NEA on cumulative impact in the Trishuli Basin.

Key points discussed

- River-basin planning demands coordination among different agencies, which requires quite substantial time in developing understanding and the formation of a committee representing the agencies.
- The integral part of a plan must include infrastructure development, scientific and sustainable management of natural resources, capacity building, institutional strengthening, and building ownership at local level.
- Hydropower (generation) and transmission should be planned in line with a basin plan.
- The modality of partnership with various entities, replicating success stories, and developing realistic activities along with an achievable timeframe are key for the success of implementation of the River Basin Plan.

Meeting attended by

1. Mr. Rajeev Sharma, DMD, NEA
2. Mr. Salil Devkota, NESS

Department of Roads (DoR)

Basic details	
Location: Department of Road	City: Kathmandu Metropolitan City
District: Kathmandu	Date: July 26, 2018

Purpose of the visit: Understanding the availability of infrastructure-related data, especially for roads.

Key points discussed

- The participant interviewee was made aware of the CIA and was specifically asked questions related to infrastructural data available.
- The response from the director was that data are available online: http://dor.gov.np/home/page/road-statistics and other relevant information is available in the web site.
- The information is provided for the different development regions. Other institutional information are also available in the web site.

Meeting attended by

1. Mr. Rabindra N. Shrestha, DoR
2. Dr. Naresh Rimal, NESS

Department of Irrigation (DoI)

Basic details	
Location: Department of Irrigation	City: Lalitpur Metropolitan City
District: Kathmandu	Date: July 13, 2018

Purpose of the visit: Understanding the availability of information on local water mills and irrigation schemes data within the basin.

Key points discussed

- The Department of Irrigation has the Trishuli Basin Inventory Plan.
- The detailed irrigation information on the basin is available in the Irrigation Master Plan that will be available soon.
- Other project-related information can also be obtained at www.doi.gov.np.

Meeting attended by

1. Mr. Shushil Acharya, DoI
2. Dr. Naresh Rimal, NESS

Department of Mines and Geology

Basic details	
Location: Department of Geology	City: Kathmandu Metropolitan City
District: Kathmandu	Date: July 19, 2018

Purpose of the visit: Understanding the availability of information on Current activities, constraints and any other developments in the area.

Key points discussed

- The department is preparing engineering geology map of the Bidur Municipality.
- The report will be published soon.

Meeting attended by

1. Mr. Jay R. Ghimire, Department of Mines and Geology
2. Dr. Naresh Rimal, NESS

Department of Tourism

Basic details	
Location: Department of Tourism	City: Kathmandu Metropolitan City
District: Kathmandu	Date: July 16, 2018

Purpose of the visit: Understanding the availability of information on current activities on Uttargaya confluence and the general religious and tourism profile of the Trishuli River Basin constraints and any other developments in the area.

Key points discussed

- Development should not be seen in a piecemeal basis. Since Nepal doe have coastal areas for recreation, we should use the river banks for recreational activities and maintain its integrity.
- We should be cognizant of Agenda 21 of the United Nations and Sustainable Development Goals of the Government of Nepal.

Meeting attended by

1. Mr. Danduraj Ghimire, Department of Tourism
2. Dr. Naresh Rimal, NESS

Department of Urban Development and Building Construction (DoUDBC)

Basic details	
Location: Department of Urban Development and Building Construction	City: Kathmandu Metropolitan City
District: Kathmandu	Date: August 3, 2018

Purpose of the visit: Understanding the availability of information on waste management, in-migration, and challenges faced and support received.

Key points discussed

- Bidur Municipality is receiving support from the department on the overall urban planning.
- The project is supported by People's Republic of China under the UN Habitat platform.
- The department has conducted population trend analysis.

Meeting attended by

1. Mr. Padma Mainali, Department of Urban Development and Building Construction
2. Dr. Naresh Rimal, NESS

Niti Foundation

Basic details	
Location: Niti Foundation	City: Kathmandu Metropolitan City
District: Kathmandu	Date: August 1, 2018

Purpose of the visit: Understanding the general perceptions toward HPPs.

Key points discussed

- The local hydropower project should improve the quality of hydropower development. However, the producers have rent seeking behavior, and are only concerned with immediate cost recovery. This can negatively impact local shareholders' future in the case of the reduced life of the infrastructure.
- In terms of the social and environmental safeguard, local government should act as a liaison between producers and the community for conflict reduction and creating win-win situations. The producers should refrain from acting like the extractive industry.

Meeting attended by

1. Mr. Mohan Das Manandhar, Niti Foundation
2. Dr. Naresh Rimal, NESS

Institute for Social and Environmental Transition

Basic details	
Location: Institute for Social and Environmental Transition, Nepal	City: Lalitpur Metropolitan City
District: Kathmandu	Date: August 1, 2018
Purpose of the visit: Understanding the general perceptions toward HPPs.	
Key points discussed	
• Besides the energy needs, costs involved, and regulation, the quality of the project and the maintenance of the ecosystem's required water flow and compliance are the most important issues.	
Meeting attended by	
1. Mr. Ajay Dixit, Institute for Social and Environmental Transition 2. Dr. Naresh Rimal, NESS	

Nepal Environment Society

Basic details	
Location: Nepal Environment Society	City: Kathmandu Metropolitan City
District: Kathmandu	Date: August 1, 2018
Purpose of the visit: To sensitize the society about the CIA study and their roles in studies and awareness.	
Key points discussed	
• The role of society in creating awareness and sensitization about the CIA • Involvement of civil society and professional organizations in CIA studies • Implementation of CIA findings • Advocacy for CIA studies at national level.	
Meeting attended by	
1. Dr Madan Koirala, Nepal Environment Society 2. Dr. Jiban Poudel, NESS	

WWF, Nepal

Basic details	
Location: WWF Nepal	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 8, 2018
Purpose of the visit: To obtain the WWF's views and concerns on cumulative impacts in the Trishuli River Basin.	
Key points discussed	
• Discussed were WWF's Nepal work in the Trishuli Basin, key issues and possible impact of HEPs in the basin, and possibility of collaboration for Trishuli management committees. • HEPs should make minimum impact on Biodiversity in the basin. • River basin management plan and approach are key to manage the basin sustainably. • Proper environmental assessment and effective implementation of EMP are crucial.	
Meeting attended by	
1. Mr. Ugan Manadhar, WWF Nepal 2. Mr. Rajesh Sada, WWF Nepal 3. Mr. Ramu Subedi, NESS	

Independent Power Producers Association-Nepal (IPPAN)

Basic details	
Location: Kamaladi	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 8, 2018
Purpose of the visit: To obtain the IPPAN's views and concerns on cumulative impact in the Trishuli Basin.	
Key points discussed	
• Basin-level planning and role of IPPAN as advisory and advocacy in Government of Nepal • Implementation of ESIA on the ground, monitoring of HPPs, resources sharing, and resources allocation to project areas by projects in the basin • Integration of CIA concept in overall basin development	
Meeting attended by	
1. Mr. Kumar Pandey, VP, IPPAN 2. Salil Devkota, NESS	

Contractor's Association of Nepal (CAN)

Basic details	
Location: Anamnagar	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 10, 2018
Purpose of the visit: To inform CAN about CIA study objectives and its importance in basin level planning, obtain the views of the contractors.	
Key points discussed	
• Objectives of the CIA • The CIA study and its implementation • Roles and responsibilities of contractors in overall environmental management of the project	
Meeting attended by	
1. Mr. Hum Nath Koirala, Mr. Pitamber Badu, Member of CAN 2. Salil Devkota, NESS	

College of Applied Sciences–Nepal (Tribhuwan University affiliated Environmental Science College)

Basic details	
Location: Thapathali	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 10, 2018
Purpose of the visit: To find out about understandings of CIA and its coverage in university syllabus.	
Key points discussed	
• Objectives of the CIA • The CIA study and its implementation • The importance of the CIA • Integration of CIA in curriculum • Trainings on CIA	
Meeting attended by	
1. Mr. Naresh Rimal, NESS 2. Dr. Bhupendra Devkota, Principal	

Department of Environment (DoENV)

Basic details	
Location: Kupandole	City: Lalitpur Metropolitan City
District: Kathmandu	Date: June 11, 2018

Purpose of the visit: Find out about Government of Nepal understanding of the CIA and provide orientation regarding the CIA and its applicability in Nepalese context.

Key points discussed

- How CIA could be mainstreamed in the national ESIA
- Compliance
- Institutional strengthening

Meeting attended by

1. Mr. Shanker Poudel
2. Salil Devkota/ Ashish Adhikari, NESS

Department of Industry (DoI)

Basic details	
Location: Tripureshwar	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 12, 2018

Purpose of the visit: To obtain information about industries in Trishuli River corridor, status of industries, environmental and social compliance by industries, status of monitoring, and their understandings of CIA

Key points discussed

- Understanding:
  1. The sand mining and other industries operating in the Trishuli Basin
  2. The status of environmental and social studies conducted by such mines—if not conducted, the reason; and if conducted, the quality of the report, mechanisms for control of illegal quarrying, and the use of CIA in their overall industrial planning in the Trishuli corridor

Meeting attended by

1. Mr. Amit Koirala, Env Unit Chief
2. Salil Devkota/ Ashish Adhikari, NESS

Nepal Bureau of Standards and Metrology (NBSM)

Basic details	
Location: Balaju	City: Kathmandu Metropolitan City
District: Kathmandu	Date: June 13, 2018

Purpose of the visit: Laboratory analysis, quality control of construction materials, role of NBSM in quality assurance

Key points discussed

- To strengthen quality control measures of construction materials by avoiding pollution and over exploitation of natural resources, Nepal Standard requirements

Meeting attended by

1. Lekh Nath Kandel, Director, QC
2. Salil Devkota/ Ashish Adhikari, NESS

Provincial Consultations

Ministry of Industry, Tourisms, Forest and Environment (MoITFE), Gandaki Province

Basic details	
Location: Province Ministry of Industry, Tourisms, Forest and Environment, Gandaki Province	City: Pokhara
District: Kaski	Date: July 22, 2018

Purpose of the visit: To obtain the province's MoITFE views and concerns on cumulative impact in the Trishuli Basin.

Key points discussed

- EPs are to make minimum impact on forest, biodiversity, and local people.
- Ministry of Forests and Environment has set up its structure at the watershed level for management of the watershed.
- Some impact has been seen in forest, land, and biodiversity by HEPs.
- Payment for ecosystem services should be made by the HEPs of Trishuli Basin as it is in Kulekhani HEPs.
- Basin approach should be adopted by the Government of Nepal, and HEPs should be part of this.
- A basin management fund should be created to manage the issues related to river basin.
- Coordination with the province ministry by the HEP developers is important.

Meeting attended by

1. Dr. Buddhi Sagar Paudel, Secretary, MoITFE, Province Government, Gandaki Province
2. Mr. Nirjan Shrestha, Under Secretary, MoITFE, Province Government, Gandaki Province
3. Mr. Ghanendra Khanal, Section Officer, MoITFE, Province Government, Gandaki Province
4. Mr. Ramu Subedi, NESS
5. Mr. Lila Raj Paudyal, NESS

Ministry of Industry, Tourism and Forest and Environment (MoITFE), Province 3

Basic details	
Location: Province Ministry of Industry, Tourisms, Forest and Environment, Province 3	City: Hetauda
District: Makawanpur	Date: July 24, 2018

Purpose of the visit: To obtain the province MoITFE's views and concerns on cumulative impact in the Trishuli Basin.

Key points discussed

- No detail comprehensive study is done on HEPs impacts on biodiversity in the basin.
- The ministry has just been established so yet to develop the province government's policy and plans for basin management.
- The Government of Nepal has adopted a basin approach and is going to set up its structure accordingly.
- HEPs are to make no or minimal impact on biodiversity and should follow Government of Nepal's policy and standards strictly.
- Province government is willing to be a part of any management committees.

Meeting attended by

1. Mr. Shiva Wagle, Secretary, MoITFE, Province Government, Province 3
2. Mr. Ramu Subedi, NESS

District Consultations

Gosaikunda Municipality

Basic details	
Location: Gosaikunda Gaupalika Office	Village: Gosaikunda
District: Rasuwa	Date: July 20, 2018

Purpose of the visit: To obtain Gaupalika's concerns and views on cumulative impacts in the Trishuli Basin.

Key points discussed

- There has been a loss of a few areas of agricultural lands and the related annual crop production of the land.
- The local people used to graze their livestock in barren land after harvesting of crops, which is also restricted.
- Affected people received good compensation in cash for the loss of agricultural land. The amount was 8 to 10 lakh Nepali currency per ropani, which was more than 20 times greater than the actual price.
- The affected people utilized the case for buying land in Bidur and Kathmandu and invested the compensation in the transportation sector for livelihood. Few households misused the compensation for everyday expenses.
- Some of the households used the cash for construction of new buildings as well as repair of old ones damaged by the 2015 earthquake. They lost their land as well as cash.
- The local community depends on the land acquired by hydro-projects for agriculture and grazing livestock in winter.
- Local people received good compensation for the loss and support to livelihood restoration, as well as employment opportunities and shares in the hydroproject.
- There is no impact on drinking water; the local people do not depend on the rivers for water where the project has developed.

Meeting attended by

1. Kaisang Tamang, Chairman
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Rasuwa Health Post

Basic details	
Location: Health Post	Village: Gosaikunda
District: Rasuwa	Date: July 20, 2018

Purpose of the visit: To obtain the Health Post's views and concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- Water-borne diseases are a problem: cough, typhoid, TB, stone, headache, gyeno, diarrhea, ovarian problem in females, broken bones
- There is no any recent diseases outbreak since influx of migrant labor.
- None of the local people were impacted by new diseases.
- During the constriction period, four individuals were injured.

Meeting attended by

1. Health post Incharge of Shyaphru
2. Jeevan Paudel, NESS
3. Prakash Ghimir, NESS
4. Ashish Adhikary, NESS

Parvatikunda Municipality

Basic details	
Location: Gaupalika	Village: Parvatikunda
District: Rasuwa	Date: July 21, 2018

Purpose of the visit: To obtain Gaupalika's views and concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- Local population share of hydropower
- Increased job opportunities, particularly driving
- Electrification in the villages
- Decreased foreign migration trend
- Impact on open grazing of livestock in low altitude zone, especially Haku area during the winter season
- Provided 10% shared to local people by Chilime Hydro project
- No impact to agricultural land and agricultural productivity
- Educated people, especially technicians, got job opportunities at the projects
- No stone and stone mining

Meeting attended by

1. Kami Tashi Waiba, Gaupalika resident
2. Jeevan Paudel- NESS
3. Prakash Ghimire-NESS
4. Ashish Adhikary - NESS
5. Kaisang Tamang- chairman

Dhunche, District Hospital

Basic details	
Location: District Hospital	Village: Dhunche
District: Rasuwa	Date: April 5, 2018

Purpose of the visit: To obtain primary information related to health from the District Hospital with respect to the cumulative impacts in the Trishuli Basin.

Key points discussed

- Water-borne diseases are a problem: cough, typhoid, TB, stone, headache, diarrhea, ovarian problem in female, and broken bones.
- There are no recent diseases outbreaks since influx of migrant labor.
- None of the local people are impacted by new diseases.
- During the constriction period, no individuals were injured.
- For severe disease, District Hospital refers cases to Kathmandu.

Meeting attended by

1. District Health Officer and medical personnel
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Kalikasthan, Primary Health Centre (PHC)

Basic details	
Location: Primary Health Centre	Village: Kalikasthan
District: Rasuwa	Date: April 4, 2018
Purpose of the visit: To obtain the information on health issues from the PHC.	

Key points discussed

- Water-borne diseases are a problem: cough, typhoid, TB, stone, headache, gastric, diarrhea, ovarian problem in female, and broken bones.
- There are no recent diseases outbreak since the influx of migrant labor.
- None of the local people were impacted by new diseases.
- For severe disease, PHC refers cases to Kathmandu.

Meeting attended by

1. Public Health Centre staff
2. Jeevan Paudel, NESS
3. Prakash Ghimir, NESS
4. Ashish Adhikary, NESS

Utargaya Rural Municipality (URM)

Basic details	
Location: Uttargaya RM	Village/City: Betrawati
District: Rasuwa	Date: July 23, 2018
Purpose of the visit: To obtain the local communities' views on and concerns about cumulative impacts in the Trishuli Basin.	

Key points discussed

- About 60 to 70 households were involved in business; some households totally depended on business and some are doing business and agriculture together.
- The foreign migration trend has declined as a result of employment opportunities provided by development project, road construction, and the reconstruction activities after the 2015 earthquake.
- Individual are involved in fishing as a secondary occupation.
- In peak season, two to three kilograms of fish per day can be collected by a fisherman, compared to about one kilogram in lean season.
- They earn about NPR 5,000–6,000 earn per month by fishing.

Meeting attended by

1. Pramod Acharya- Local community member, Betrawati
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

District Coordination Committee (DCC), Nuwakot

Basic details	
Location: District Coordination Committee Office	Village/City: Bidur Bazar
District: Nuwakot	Date: July 23, 2018

Purpose of the visit: To obtain the DCC's views and concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- The DCC is no longer functional so has not been involved actively in HEPs affairs recently.
- Representatives are not aware of the HEP activities going on in the basin.
- Constitutionally the roles of the DDC has been transferred to local government at the municipality or rural municipality level.
- Less impact should be made by the HEPs on biodiversity and local livelihoods.
- Local people and local government should also benefit from the HEPs of the Trishuli Basin.

Meeting attended by

1. Sachyut Raj Upreti, DCC District Coordination Officer
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Belkotgadhi Rural Municipality

Basic details	
Location: Belkotgadi Rural Municipality	Village: Ratmate (Rai and fishing community)
District: Nuwakot	Date: July 24, 2018

Purpose of the visit: To assess the existing situation of Rai and fishing communities and their concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- About 70% of people depend on agriculture, 7% on foreign labor, 5% on service jobs, and 3% in wage labor in this community.
- Rai people are involved in fishing and mining.
- There are landslides due to sand and stone mining.
- Impact on drinking water is seen. Eight to ten wells were located on the bank of the Trishuli River and used by about 200 plus households for household usage.
- Phir-phire (sand refining) was widely occurring in the river, but now government has restricted them to 100 meters from the road and the river, which displaced many Phir-phire.
- Agriculture is gradually declining and foreign employment is increasing.

Meeting attended by

1. Jeevan Paudel, NESS
2. Prakash Ghimire, NESS
3. Ashish Adhikary, NESS
4. Hari Krishna and seven others

Tarkeshwar Rural Municipality

Basic details	
Location: Tarakeshwor RM	Village: Kolputar
District: Nuwakot	Date: September 4, 2018
Purpose of the visit: To obtain The Gaupalika's views and concerns on cumulative impacts in the Trishuli Basin.	

Key points discussed

- HEPs may impact sand mining and aquatic biodiversity.
- Sand mining has created employment to local people: 200–400 persons are involved in sand mining per day, and three to four persons get employment per Phir-phire and earn about 2000 NPR per day.
- Sand mining is the main source of livelihood for people; nonresident people visit to the area for fishing.
- Gaupalika should be consulted during the HEP construction and operation work.

Meeting attended by

1. Binod Tiwari, Gaupalika representative
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

DCC Office, Dhading

Basic details	
Location: District Coordination Committee Office	Village/City: Dhadingbeshi
District: Dhading	Date: July 25, 2018
Purpose of the visit: To obtain the DCC's concerns on cumulative impacts in the Trishuli Basin.	

Key points discussed

- HEPs will have a negative impact in the local community, local people, and the environment.
- There are so many sand mining areas in the river basin, like Galchi to Baireni Area, as well as crusher industries.
- There will be drastic changes in the natural flow of river from the Ghalchi to Bairani stretches of the Trishuli River due to sand- and gravel-mining industries.
- Direct extraction of the sand and gravel and riverbed materials has had a high impact on the local environment and people. It has polluted the river.
- There is a lack of coordination and communication with local government (Gaupalika) and local communities by some proponents of the hydropower project.
- A mechanism for coordination and joint work should be established among the HEP proponents, concerned stakeholders, and local government.

Meeting attended by

1. Jagganath Nepal, Chairperson DCC
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

District Hospital, Dhading

Basic details	
Location: District Hospital	Village/City: Dhadingbeshi
District: Dhading	Date: July 26, 2018

Purpose of the visit: To obtain the information on health issues with respect to the cumulative impacts in the Trishuli Basin.

Key points discussed

- Water-borne diseases such as cough, typhoid, TB, stone, headache, diarrhea, ovarian problems generally result in visits to hospital for the treatment.
- There have been no sexually transmitted diseases.
- There is a problem with air, noise, sound pollution, including the noise generated from construction activities such as vehicle movement and various construction equipment.
- Annually about 1,350 patients visit the district hospital. For major cases, patients are referred to Kathmandu for diagnosis and treatment.

Meeting attended by

1. District health officer in charge and information Officer
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Gandaki Rural Municipality

Basic details	
Location: Gandaki RM	Village: Makaisingh
District: Gorkha	Date: July 27, 2018

Purpose of the visit: To obtain the views and concerns of local communities on cumulative impacts in the Trishuli Basin.

Key points discussed

- Local community:
  - Twenty-five households are affected by the HEP; except for a few, all households have received compensation.
  - Fishing is not a primary occupation of local people; sometime villagers go to the river for fishing for household consumption,
  - Fifty percent of young males are involved in rafting businesses.
- Chepang community:
  - Community is dependent on rain-fed agriculture; only two to three months received sufficient water from rain.
  - Male are largely involved in wage labor outside village.
  - The people are not involved in fishing.
  - A few Chepang youth have jobs in rafting.
  - A few Chepang households are affected by the Super-Trishuli Hydroproject.
  - Women are largely involved in wage labor, especially crossing the loads over Trishuli River.

- Rafting company:
  - There are 150 registered rafting companies in Nepal.
  - Both boys and girls are involved in rafting, although girls' involvement is low.
  - Rafting provides new opportunities to local people; some of young are currently using their skill of rafting.
  - A person can earn about 40,000–50,000 NPR in a season from rafting.

Meeting attended by

1. Manish Singh Thapa, key person
2. Bishnu Silwal, rafting company
3. Jeevan Paude, NESS
4. Prakash Ghimire, NESS
5. Ashish Adhikary, NESS

District Coordination Committee (DCC), Gorkha

Basic details

Location: District Coordination Committee	Gorkha Bazar
District: Gorkha	Date: July 27, 2018

Purpose of the visit: To obtain the DCC's views and concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- There are only a few HEPs project sin the downstream area of the Trishuli river. More HEPs should be constructed in the downstream area of the Trishuli River for minimal negative impact.
- Local people and local government should benefit along with the HEPs.
- Hydropower projects should benefit local people and local government.
- The local people should get reasonable compensation of the lost property by the HEP projects.
- HEPs should support to develop roads, schools, electricity, health post, and water supply in the affected areas.
- HEPs should provide employment opportunity to unskilled and semi-skilled labor of the affected areas.

Meeting attended by

1. Ashok Kumar Gurung, DCC Coordinator
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

District Hospital, Gorkha

Basic details	
Location: District Hospital	Gorkha Bazar
District: Gorkha	Date: July 27, 2018

Purpose of the visit: To obtain health information for the cumulative impacts study of the Trishuli Basin.

Key points discussed

- Water-borne diseases are a problem: cough, typhoid, TB, stone, headache, gyeno, diarrhea, ovarian problem in female, and broken bones.
- There is no any recent disease outbreak since the influx of migrant labor.
- None of the local people have been impacted by new diseases.
- No major diseases and sexually transmitted diseases have been reported.
- Annually, about 2,750 patients visit to this hospital. For severe cases, patients are referred to Kathmandu.

Meeting attended by

1. Raj Kumar Pokherel, health officer in charge
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Ichhakamana Rural Municipality

Basic details	
Location: Ichhakamana RM	Village: Chumkhola
District: Chitwan	Date: July 30, 2018

Purpose of the visit: To obtain Gaupalika's views and concerns on cumulative impacts in the Trishuli Basin.

Key points discussed

- There are few HEPs in downstream areas. Some impact on environment and land has been seen.
- Some local people are affected the Supper Trishuli HEP, including the land area of the Hotel Siddhartha Resort land and Shangrila Petrol Pump.
- There are mixed communities in the Gaupalika. Thakali, Magar, Chepang, and Gurung are the main caste and ethnic groups in this area. Hotel business, agriculture and wage labor are the main occupation of the people living in the Gaupalika.
- Remittance is the one of the major sources of income of the local people. People from the Gaupalika go to city centers such as Kathmandu, Pokhara, and Chitwan and oversees to such destinations as Qatar, Dubai, and the United Arab Emirates for employment.
- HEP should coordinate with the local government while developing and operating HEPs.

Meeting attended by

1. Hom Bahadur Gurung, Gaupalika representative
2. Jeevan Paudel, NESS
3. Prakash Ghimire, NESS
4. Ashish Adhikary, NESS

Basin Level Consultations: Upstream

Archale Pakha BZ–Community Forest User Group (CFUG), Rasuwa

Basic details	
Location: Kalika	Village: Kalika
District: Rasuwa	
Purpose of the visit: To obtain The Department's concerns on cumulative impacts in the Trishuli Basin.	
Important Notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents included cultural sites such as Uttergaya, livelihood and fair compensation to the local people who are affected by the HPPs, human health and livelihoods as access road of HPPs and HPPs construction are causing landslides and pollution, and aquatic life as many local people depend on them for their livelihoods.
- By determining the affected people on the basis of geography (district), some affected people were left out of the entitlements.
- Local people are not aware of the EIA/IEE provision and whether such studies were carried out or not.
- Survey activities were conducted without providing proper communication to local residents, and construction activities were done forcefully without addressing their concerns.
- Explosions conducted during HPPs activities cause vibrations. These vibrations lead to landslides followed by fatalities and displacement of locals. It also caused miscarriages in pregnant humans and animals.
- Aquatic life seems to have deteriorated after the construction of dams for the HPPs. Fishing could be done in huge proportions but is not possible now.
- Policy must be made so that absentee landowners or those directly affected households by the project are provided necessary compensation even if they are not currently residing in the area.
- The religious sites along the river should be preserved.
- Locals should be warned beforehand when conduction explosions may occur; their risks should be properly studied, and if they leads to any damage, affected people should be appropriately compensated

Meeting attended by

1. Mr. Chhatra Bahadur Dhakal, EC member
2. Mr. Shyam Maya Ghale, user
3. Mr. Min Nath Paudel, user
4. Mr. Yubraj Dhakal, user
5. Mr. Tek Bahadur Dhakal, user
6. Mr. Ramu Subedi, NESS
7. Mr. Lila Raj Paudyal, NESS

District Forest Office (DFO), Rasuwa

Basic details	
Location: Rasuwa	Village: Rasuwa
District: Rasuwa	

Purpose of the visit: To obtain the DFO's concerns on cumulative impacts in the Trishuli Basin.

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Key points discussed

- The most important VECs for the respondents included terrestrial and aquatic ecosystem, forest biodiversity, and environment-friendly infrastructure development, including HPPs.
- Parbati Kunda, Gosaikunda, and Uttargaya are examples of holy place in Rasuwa district that have other religious or aesthetic values as well. Rasuwa Gadi is historical place in the district situated on the Nepal-China border. There are other many tourism destinations in the district.
- There are altogether 71 community forest user groups (CFUGs) formed so far in Rasuwa district, out of which about 30% are situated along the Trishuli River.
- Dahalfedi, Dashinkali, and Tetang Community Forests (CF) are highly affected by the HPP. Use rights of about 10 hectares of forest land of Dalfedi CF have been given to the Chilime HPP.
- The Langtang National Park is the habitat of wild animals like red panda, ghoral, thar, musk deer, leopard, bear, and many more birds, reptiles, amphibians and fishes.
- HPPs are being constructed even in the core area of the national park in the recent year; the government has given top priority to hydropower projects, roads, and infrastructures rather than biodiversity and ecosystems.
- There are altogether 10 HPPs under construction in buffer zone area of Lanagtang National park.
- Road and hydropower construction work has been doing using blasting, which directly affects biodiversity, including natural habitat; habitat fragmentation is key concern.
- The HPP has provided compensation (in terms of money) to affected households and institutions but compensation was fixed on a lamp-sump basis, per the negotiation between or among the respective parties. There is no specific compensation criterion. Due to this lack, land that belongs to private owners is quite difficult to take by the HPP to build transmission towers. Due to these difficulties, most of the transmission towers are built in the forest areas whose tenure rights are with the government.
- The Chilime is the first HPP in the district, and it has generated the highest economic opportunity to the local residents.
- HPP developers have no or little concern about the environment, biodiversity, ecosystems, and so forth.
- The hydropower project has provided financial compensation to those CFUGs whose land is in the transmission route (for electric tower construction and RoW as well).
- The governance or the transparency issue seems in most CFUGs to be about the compensation amount provided by the HPP. Groups expense the money haphazardly. Some local elites capture all the money provided, and it is not even deposited in the bank.
- EFlows are less than mentioned in the EMP.
- Enforcement of IEE and IEE by all the HPPs as per the provision of EPA/EPR is essential.
- Monitoring of the implementation of the EMP developed by the HPP is also key.
- The EIA of each HPP has been undertaken, but its implementation is quite poor and not properly done by the HPP companies. An independent monitoring team should be formed to monitor the environmental impact mitigation measures written in the EIA report.

Meeting attended by

1. Rajan Shrestha, acting DFO, Rasuwa
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

District Soil Conservation Office (DSCO), Rasuwa

Basic details

Location: District Soil Conservation Office, Rasuwa Village: Rasuwa

District: Rasuwa

Purpose of the visit: To obtain the DSCO's concerns on cumulative impacts in the Trishuli Basin.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included sustainable watershed management, water source protection, and reduction of landslides and flash floods.
- HPPs are generating employment opportunities for the local people. The Chilime HPP is providing financial support for various community development activities and infrastructure like school construction, drinking water supply and sanitation, trail construction, water source protection, and so forth through local governmental, nongovernmental, and community-based organizations.
- The HPP has also provided local shares, which sufficiently contribute for the economic growth of the affected people.
- The DSCO has prepared the watershed management and water source protection plan of three major watersheds in the district. DSCO Rasuwa will coordinate with the HPP for implementation of those management plans in the future.
- Mostly roadside areas are prone and susceptible to landslides.
- Effective implementation of the IEE and EIA EMP is necessary.
- Regular monitoring of the implementation of the EMP and coordination with DSCO by the HPP developers is essential, as many activities shall be implemented in collaboration

Meeting attended by

1. Nirmala Khatiwada, District Soil Conservation Office
2. Prasant Kumar Thapa, District Soil Conservation Office
3. Nikas Kathayat, District Soil Conservation Office
4. Mr. Ramu Subedi, NESS
5. Mr. Lila Raj Paudyal, NESS

Langtang Area Conservation Concern Society (LACCoS), Rasuwa

Basic details

Location: Langtang Area Conservation Concern Society (LACCoS), Rasuwa Village: Rasuwa

District: Rasuwa

Purpose of the visit: To obtain the society's concerns on cumulative impacts in the Trishuli Basin.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included biodiversity, livelihoods of the local people, pollution-free development, sustainable development, and power for prosperity.
- The HPP has providing money to the local government institutions (DDC and Village Development Committee) and community groups like forest user groups, but it is misused due to lack of proper monitoring. Governance with transparency is the big and challenging issue in the country.
- There is not any negative impact seems so far in the society due to the causes of hydropower in the district, but wild animals have migrated due to the cause of blasting for construction of HPP.

- Major impacts are perceived by respondent included:
  - Socioeconomic impact: Power for prosperity change in lifestyle of the people by the HPP equity local shares
  - Migration of settlement due to the cause of HPP
  - Hard to maintain road due to the cause of heavy load of HPP materials
  - High chances of landslide along the roadside (Trishuli River corridor) due to blasting
- The mitigation measures proposed included provision to allocate 2–5% budget of total HPP cost for environment protection and safeguards; priority should give to the social development so that the ownership of local people would increase toward HPPs.
- HPP should invest in local community infrastructure development.

Meeting attended by

1. Sunil Ghale, treasurer
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Kalikamai Buffer Zone –CFUG Dhaibung, Rasuwa

Basic details

Location: Kalikamai BZ –CFUG Dhaibung, Rasuwa Village: Rasuwa

District: Rasuwa

Purpose of the visit: To obtain The Department's concerns on cumulative impacts in the Trishuli Basin.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included conservation of religious or cultural sites along the river and local development. Bedrawati, Uttar Gaya has religious or cultural values, particularly for the Hindu religion
- This particular location is the main cremation place of the Hindu religions. This is one of the holy sites as well. Natural flow of water in Trisuli River should not be disturbed to such sites by any means.
- Hydropower has acquired greater importance in recent years, but ecology and environment are equally important. Some sort of balance action is needed between environment and development.
- We heard that there is an EIA provision, which is compulsory in each development initiatives, and all HPPs are compelled to follow that recommendation. However, there is lack of awareness among the local population about environmental safeguards agreed to by the HPP during agreement. The local population is also unaware of the roles of the respective stakeholders and people residing in the HPP area.
- Most of the HPP contractors used money and muscle power to accomplish the project.
- Compensation for the land that covered by the tower is provided. However, no compensation is provided for land under the transmission line. This is unfair as the land has restrictions imposed. The landowner cannot build any structure, and financial institutions do not provide loans on land affected by transmission lines. Ergo, the value of the land parcel also diminishes. Government should address these genuine problems by making appropriate policy changes.

Meeting attended by

1. Radhika Devi Neupane
2. Jhamka Nath Neupane
3. Gyan maya Tamang
4. Lalmaya Tamang
5. Khadka Maya Neupane
6. Anjita Tamang
7. Mr. Ramu Subedi, NESS
8. Mr. Lila Raj Paudyal, NESS

Nepal Agro-Forestry Foundation (Local NGO) Kalikasthan, Rasuwa

Basic details

Location: Nepal Agro-forestry Foundation (Local NGO) Kalikasthan, Rasuwa Village: Rasuwa

District: Rasuwa

Purpose of the visit: To obtain the NGO's concerns on cumulative impacts in the Trishuli Basin.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included conservation of agro-biodiversity and protection of natural landscape of holy places along the river basin. The natural landscape and flow of water in Trishuli River at Uttar Gaya Holy place should not be disturbed. Environmental degradation, ecological disturbance, and pollution are other major concerns
- Many stakeholders' view is that most HPPs are not implementing the measures suggested in the EIA and do not recognize public concerns, which create conflict and cause delays.
- It is understood that 10% of water on the river is released as EFlows. This is not followed properly in winter season, which is also the lean season and causes the river to dry up. This affects fishes and other aquatic animals. However, It is difficult to say that reduction of aquatic population is due only to the HPP.
- Landslide occur frequently, but functional coordination and collaboration with district soil conservation office and local government seems to be missing.
- The HPP has direct effects on fish, frogs, and other amphibians. Previously there were many fish in the river, but now their population has drastically decreased.
- HPP companies should follow the provision of EPA and EPR while developing HPPs.
- Sensitize local government on environmental policy and their role on HPP development and mitigating negative impact
- Coordination with local NGOs and local government by the HPP developers should be undertaken.

Meeting attended by

1. Kamal Adhakari
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Kalika Rural Municipality, Rasuwa

Basic details	
Location: Kalika Rural Municipality, Kalikasthan, Rasuwa	Village: Rasuwa
District: Rasuwa	
Purpose of the visit: To obtain the municipality's concerns on cumulative impacts in the Trishuli Basin.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents included conservation of the cultural and religious sites, sustainable supply of water, sustainable development and livelihoods of the local people, and fish resources.
- Uttar Gaya has great religious values for Hindus. Therefore, the local government has the responsibility to protect and conserve this religious site. Environmental degradation, ecological disturbance, encroachment, and pollution in the name of development would not be acceptable to the people and rural municipality.
- The municipality is keen to work with the HPPs for the sustainability of the project and build harmonious relationships between people and project, generating high level of ownership. The HPP should have to work in close coordination with the local government.
- There is no ethnic group totally dependent on fishery for their livelihoods. There were many fish found in the past, but now their population has drastically decreased;
- There is a need to commence independent research by the experts on 10% EFlows. It is difficult to say that reduction of aquatic population is due only to the HPP.
- HPPs have to share the EIA report and the mitigation measures written in the report. They also have to recognize public concerns and be accountable for the clauses in the agreement.
- Consultation and coordination with the local government should be mandatory. It will help local government play a mediation role between and among the concerned parties and individuals, help manage the disputes, and help to accomplish the project in time. The local government representatives should be involved, as a witness to decide on the compensation to the private land needed for the transmission line.
- Local people and the local government representatives also are unaware about various HPP-related policies.
- Local government representative (Gaupalika, Nagarpalika) should be on a monitoring committee of the HPP, which will help develop functional coordination and cooperation with each other. It helps to create a feeling of ownership of the local people toward the HPP.
- There is a need to provide additional financial opportunity to those households affected by transmission lines. (Provide an additional 10% share to those affected by transmission lines.)

Meeting attended by

1. Sita Kumari Paudel (Adhikari), Chairperson
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Basin-Level Consultations: Midstream

Bidur Municipality, Nuwakot

Basic details	
Location:Bidur	Village: Bidur
District: Nuwakot	

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included religious and cremation sites like Devighat and aquatic biodiversity of the river: for example, fish, health, and livelihoods of local people living in and around the HPP site.
- The local people have to face negative impacts of the HPPs while the power generated by the project is used nationwide. The government must address this situation by providing adequate compensation to the affected people.
- There are many projects that acquired land at low compensation but have not started any activity. These parcels should be returned to landowners so that they can utilize the land properly for cultivation.
- There is a lack of proper management of soil, sand, and gravel during construction of roads for HPPs, and blasting procedures cause land degradation and landslides.
- There is a lack of sharing information with the affected people and local government.
- The excessive land used by HPPs is leading to people's landlessness.
- HPPs have led to diminishing fish populations, and releasing only 10% EFlows would not be sufficient to maintain the aquatic ecosystem.
- Funeral ceremonies are performed at every confluence of river, and these have religious importance that will never be compromised by any development initiatives, including HPPs.
- Before construction of the HPP, the developer must consult and coordinate with local people and local government and should listen to their concerns and suggestions.
- HPP should provide local government correct information about the project including the possible impact and suggested mitigating measures.
- The EIA of each HPP has been undertaken, but implementation aspect is quite poor and not properly done by the HPP or other agencies. Therefore, there is a need to form a monitoring committee comprising representatives from local bodies.
- Local people should have priority for employment opportunities in HPPs.
- Skill training must be provided prior to the project-affected people, and human resources should be developed at local level.
- There is no accountable and responsible agency at local level to listen to the complaints and feedback regarding the HPP. Therefore, there should be an agency to respond to the complaints and feedback provided by the local people related to the HPP.

Meeting attended by

1. Sanju Pandit, Mayor
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Federation of Community Forestry Users Nepal (FECOFUN) District Chapter, Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents included ecosystem services, the religious sites along the river, livelihoods of the people who are dependent of the river such as Majhi communities, and conservation of biodiversity along the river basin.
- There are a lot of HPPs, and their quantity may threaten the existence of culturally important sites like Uttar Gayaa and Devighat.
- The number of households affected by the transmission line is very much larger than the HPP footprint itself.
- EFlows might be different in each river. They are dependent upon the use of water by the farmer for irrigation and drinking water supply, the aquatic population, the number of religious sites, and so forth.
- People do not know how and where to invest the money they get as compensation. There is a risk of their wasting money paid to them. There is a need to provide entrepreneurship training to them for better utilization of money.
- Locals do not know how much money is allocated by the HPP for the community development.
- Locals are kept out of the loop throughout the process of HPP construction, which results in various conflicts and may cause unnecessary delays.
- Fishermen and farmers who directly depend on these rivers are hit the hardest.
- Nobody is aware of the findings of EIA and suggested mitigating measures.
- No monitoring committee exists to judge whether the objective of the EIA is met or not.
- Transmission Lines must be either underground or insulated by nonmetallic substances. This helps to reduce risks caused by the lines and prevent deforestation along the right of way (RoW). Hence, the land under the RoW can be used for cultivation.
- Power substations should exist to collect the power and cumulative transmission lines (One Door) should be used for all HPPs rather than using separate lines for each project. This will reduce unnecessary costs of a project.
- To reduce pollutant accumulation and protect aquatic life, EFlows of every river must be researched and may be increased to more than 10%.
- Awareness building should be held on the rightful use of compensation money before distributing the compensation. This helps local people make right decisions.
- EIA implementation must be monitored through a committee formed by local stakeholders (DCO respective agencies and local government).
- The budget allocated for mitigating environmental impact should be spent by local bodies, which helps to increase transparency and trust.
- HPPs must take proper initiative so as not to affect cultural entities, and a dam should not be constructed nearer than 1.0 to 1.5 kilometers from cultural and religious sites like Uttar Gayaa.
- Policy must be formulated to provide the employment opportunities for the HPP-affected people. Increase ownership toward HPPs by local people to reduce emerging conflicts.

Meeting attended by

1. Narayan Prasad Nepal, Chairperson
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Upabhokta Hith Samrakshayan Manch, Bidur Municipality, Nuwakot

Basic details	
Location: Bidur	Village: Bidur
District: Nuwakot	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents include river basin civilization (Nadi Savyata); cultural and religious site such as Uttar Gaya, Jalpa Devi, and Dupcheswor Mahadev; livelihoods of the people who are defendant of the river such as Majhi communities; and conservation of biodiversity along the river basin.
- The quantity of HPPs, this may threaten the existence of culturally important sites like Uttar Gayaa and Devighat.
- Chilime HPPs uplifted the socioeconomic condition of local people through shares and compensation for affected households.
- Pollution in the river due to construction of dams made it difficult to perform cultural and religious activities such as bathing and cremation (funeral process).
- Construction of dams and unregulated EFlows of water caused deposition of pollutants in the river. This caused aquatic life in the river to be endangered to the point of extinction.
- Proper norms should be established clearly dictating reasonable compensation to be given based on rational identification of the affected.
- EFlows of the river should be thoroughly researched and its implementation should be done properly.
- Wildlife displacement has been caused due to drying out of rivers caused by dams, which causes inconvenience to the local people.
- Local government should be given the responsibility of implementing the funds given by the HPP for the overall development of the affected community. It would also monitor the activities proposed in the EIA report.
- EFlows of the river must be regularly monitored.

Meeting attended by

1. Mr. Indra Bahadur Pandit, Chairperson
2. NESS

Kispang Rural Municipality Nuwakot

Basic details	
Location: Kispang	Village: Kispang
District: Nuwakot	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents include aquatic biodiversity; biodiversity conservation, such as free movement of wildlife; sustainable development along the river basin; and preservation of cultural and religious site.
- HPPs proposed to build schools, hospitals, roads, and create employment opportunity in order to claim land, but the propositions were not fulfilled. Such propositions were falsely made or untruthful.
- There is weak emphasis on EIA, biodiversity conservation, sustainable development and livelihood.

- Wildlife displacement has been caused due to drying out of rivers caused by dams, which causes inconvenience to the local people.
- Local government should be given the responsibility of implementing the funds given by the HPP for the overall development of the affected community. Monitoring of the activities proposed in the EIA report is also essential.
- EFlows of the river must be regularly monitored.

Meeting attended by

1. Mr. Narhari Bhatta (Chairperson, Ward 5)
2. Mr. Shankar Oli (Secretary of Kispang Rural Municipality, Ward 5)
3. Mr. Ramu Subedi, NESS
4. Mr. Lila Raj Paudyal, NESS

Janajati Mahasangh (NEFIN), Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include livelihoods and traditional occupation of the Indigenous people (as per the ILO 169) living along the river; fishes in the river, as many local indigenous people such as Kumal and Rai depend on fishing for their living; the cultural sites; and getting fair benefits for the affected/ local people from the HPPs.
- Livelihoods of the local people should not be affected due the HPPs.
- Most of the local people are not aware of the environmental assessment that HPPs conduct.
- Open wires of transmission lines have caused safety issues and various hazards.
- Kumal and Rai people have left their fishing occupation due to drastically decreasing aquatic population.
- Open transmission lines should be replaced with covered wires.
- Compensation amount must be decided as per the policy and procedure. A compensation committee can be formed comprising the local government representatives and respective stakeholders.

Meeting attended by

1. Mr. Bhagawan Rana, Chairperson
2. Mr. Debendra Bahadur Thapa, local residence of Bidur Municipality
3. Mr. Subhakar Thapa, local resident of Bidur Municipality
4. Mr. Prem Maya Purja, local resident of Bidur Municipality
5. Mr. Suryamati Thapa, local resident of Bidur Municipality
6. Mr. Ramu Subedi, NESS
7. Mr. Lila Raj Paudyal, NESS

Pahare Bhaldada Community Forest User Group (CFUG)

Basic details

Location: Kispang | Village: Kispang

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

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Key points discussed

- "Water is more important to me than power. I can live without power but not without water."
- HPPs are paying minimum compensation of trees to be cut in CFUGs.
- Pollution may increase in Trishuli River in the future to such an extent that it might become polluted to the level of Bishnumati River in Kathmandu at present.
- Construction of tunnel has caused water sources to dry out.
- Blasting and deforestation has caused displacement of wildlife in forest.
- Water must be allowed to flow along the river path at least once a week to wash away pollutants and conserve aquatic life. The public must we warned of such activities.
- HPPs must not obstruct the resources necessary for public to sustain everyday life. The project must take responsibility to restore the resources to previous conditions.

Meeting attended by

1. Mr. Jit Bahadur Gurung
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Fishing Communities / Indigenous Peoples Community, Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include fishes in the river, continued supply of water in the river, and employment opportunity for the indigenous communities.
- There is no special fishery group, and nobody is directly involved in fishing for their livelihood, but they are fishing for the use of free time and recreational purposes.
- The fishing activities in the project area are seen as entertainment but not an income source.
- Mainly Rai and Kumal are involved in fishing activities. There used to be plenty of fishes in the Trisuli River about 50 years ago. They used to catch plenty of fishes (4–5 kilograms) within an hour, but in the recent year availability of fishes is almost zero. No fishing at all.
- The varieties of fish are also decreasing compared to a few years back. It might be the effect of widely used pesticides in the off-season to grow the off-season vegetable in their farmland.
- Some mitigation measures can be providing alternative livelihoods to the fisherman and employment opportunities to the fishing communities in the HPPs.

Meeting attended by

1. Mandra dhunga, Nuwakot
2. Mohan Bir Rai
3. Indra Bahadur Rai
4. Rishi Kumar Rai
5. Mr. Ramu Subedi, NESS
6. Mr. Lila Raj Paudyal, NESS

Community and Rural Development Society (an NGO), Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

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Key points discussed

- The most important VECs for the respondents include religious sites such as Uttergaya, livelihoods of the local people, and sustainable development.
- Livelihoods of local people and traditional occupations should not be impacted due to HPP construction.
- Most HPPs have not properly followed the EFlows policies and EIA mitigation measures sufficiently as per the EIA report.
- Most of the local people are concerned about EFlows of water in the river downriver of the dam (10% water should be continue as per the agreement), as in most cases it is not happening.
- **Some mitigation measures can be:**
  - Religious site should be protected.
  - Transmission line should be either underground or covered by insulation wire aiming to minimize risk.
  - Provide compensation should be made to those households who have directly affected by the transmission line.
  - Provide seedlings to carry-out agro-forestry activities under transmission lines.

Meeting attended by

1. Dinesh Rimal
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

District Administration Office, Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents was sustainable infrastructure development.

- Not many negative impacts of HPPs have been seen, and District Administration Office has provided necessary support to HPP developers in the district.
- Land acquisition is taking time in some HPPs.
- Religious sites should be protected.
- Compensation of the land under the transmission line (RoW) should be given on an annual basis and land ownership should be with the landlord.
- Local people should be allowed to cultivate NTFP or perennial crops and fruits under the RoW.
- Formulation of HPP policy and guidelines should be done in a holistic way.

Meeting attended by

1. Nandalal Sharma, Acting CDO
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

District Forest Office, Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

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Key points discussed

- The most important VECs for the respondents were ecosystem services, forest biodiversity, and environment friendly infrastructure development.
- Under the transmission line, NTFPs and spices should be cultivated.
- Transmission lines should be construct along the fire line for the wise use of land situated under the RoW.
- Land under the RoW can be used or managed as a parks, picnic spots, or recreational sites.
- NTFP cultivation and agro-forestry scheme can be undertaken along the RoW.

Meeting attended by

1. Padam Raj Nepal, DFO
2. Mr. Lila Raj Paudyal, NESS

Jalpa Community Forest User Group, Nuwakot

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

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Key points discussed

- The most important VECs for the respondents include conservation of biodiversity, environmentally friendly HPP development, and livelihoods of the local people who are dependent in the river resources.
- Access to information about HPPs, such as EIA, compensation and opportunities for local community, is not provided.

- Community infrastructure like temples, schools, hospitals, guthi, and so forth should not demolished for HPP transmission line or diverted in other ways.
- In the Trishuli corridor there are number of HPPs under construction, some are in operation, and other few are at the initial stage and doing EIA. Constructing RoW in a coordinated way by 3A, 3B, and Chilime HPPs would be good rather constructing RoW separately. It would be cost-effective and sustainable as well.
- Long-term plan should be made for the HPP transmission line.
- The EIA reports need to be shared with the local stakeholders, and mitigation measures should be implemented properly and on time. The local people should be aware of the EIA of the HPP and transmission line.
- Local residents should have access to information regarding HPPs and other information of public importance.
- Local government should take the responsibility to implement the EIA activities on the ground and the monitoring thereof.
- Compensation for the transmission line (RoW) should be done on annual basis.
- High-quality materials should be used to construct the transmission line; otherwise local people will be at risk all the time.

Meeting attended by

1. Hari Pyakurel, Chairperson
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Women's Group Jalpa devi CFUG

Basic details

Location: Bidur | Village: Bidur

District: Nuwakot

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include conservation of water springs and sustainable supply of fodder for cattle and fuelwood for energy, and employment opportunities to local people/women in the HPPs.
- We are not aware of the HPP and its impact as we were not involved directly in the consultation.
- The Chilime HPP is not doing everything properly, so current is passing all the time under this RoW.
- The households, which are nearby the transmission line RoW, are at high risk. Last year the electric wire of a high-tension line was broken down and tied up or connected with the local power supply wire. TV and other electronic devices were burnt and damaged due to the high voltage of power. Luckily, no human casualties took place. Chilime HPP has given compensation for the electronic equipment destroyed. Now we feel that we are at high risk all the time. The risk increases during thunderstorms.
- If we had been aware pf this consequence beforehand, then we would not have allowed the construction of the RoW via our land. Financial institutions also not accepting the land situated under the RoW as collateral while providing a loan.
- Security and safety of the people should be given high priority.

Meeting attended by

1. Women of Jalpa devi CFUG
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Basin-Level Consultations: Downstream

Kipsang Rural Municipality

Basic details	
Location: Kispang Rural Municipality Nuwakot	Village: Kispang
District: Nuwakot	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents included aquatic biodiversity, biodiversity conservation such as free movement of wildlife, sustainable development along the river basin, and preservation of cultural and religious sites.
- Stakeholders consulted communicated that during the land acquisition and planning stages, HPPs proposed to build schools, hospitals, roads, and create employment opportunity in order to claim lands. However, once the land is acquired these propositions are not fulfilled.
- There is weak emphasis on biodiversity conservation, sustainable development, and livelihood restoration in EIA studies.
- One of the major impacts of HPPs is on wildlife due to drying out of rivers.
- As mitigation measures, local government should be given the responsibility of implementing the funds given by the HPP for the overall development of the affected community.
- Local government should also be included in monitoring of the activities to mitigate impacts proposed in the EIA report.
- EFlows of the river must be regularly monitored.

Meeting attended by

1. Mr. Narhari Bhatta, Chairperson, Ward 5
2. Mr. Shankar Oli, Secretary of Kispang Rural Municipality Ward 5
3. Mr. Ramu Subedi, NESS
4. Mr. Lila Raj Paudyal, NESS

Benighat Rural Municipality

Basic details	
Location: Benighat Rural Municipality	Village: Benighat
District: Dhading	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents included the need for cultural and religious sites to function in their traditional rituals, development of local areas, livelihoods of the local people, pollution, and public health.
- Local people are willing to provide land to government if HPPs coordinate and cooperate with local stakeholders on development issues.
- One major concern was lack of timely information disclosure on land impacted due to transmission lines.
- There is lack of awareness on the purpose and scope of EIA studies.

- Raw materials for HPPs such as sand and gravel mining cause pollution at the local level.
- People must be made aware of the short- and long-term impacts of project in advance.
- Necessary provisions of accommodation and compensation must be incorporated in the entitlements.
- HPPs must inform the people in advance before conducting activities such as surveys, EIA, and construction works.
- EIA reports must be presented to local governments and monitoring responsibility must be given to them.

Meeting attended by

1. Mr. Devi Prasad Silwal, Vice Chairperson
2. Mr. Harsa Bahadur Thapa, Administrative Officer
3. Mr. Parsuram Ghimire, Planning Officer
4. Mr. Gaud Raj Upreti, Chairperson of Ward 5
5. Mr. Lila Raj Paudyal, NESS

Rafting Association of Nepal/Royal Beach Camp Benighat, Dhading

Basic details

Location: Benighat | Village: Benighat

District: Dhading

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include river flow, pollution free river, scenic beauty along the river, and aquatic biodiversity.
- Adventure tourism (rafting) in Trishuli River is more important than the power generation potential. Only rafting can earn more revenue than HPPs. No disturbance of the natural landscape should be undertaken.
- The government should understand that HPP development would severely impact tourism in the area, especially from international tourists. Hence, rivers with high tourism potential should not be selected for HPP development.
- There is a concern that licenses are awarded to anybody who comes up with the proposal of building an HPP without conducting proper research on its impact.
- The local population is not made aware of the impacts of HP development.
- The government is exaggerating the need for HPPs for the economic growth of Nepal.
- The government should understand that tourism is also a major sector, which contributes to economic prosperity of Nepal without degrading the environment, ecosystems, and culture. There are other ways to develop without causing the degradation of the environment, such as focusing on tourism and agriculture.
- Pollution due to the sand and gravel mining in the river is also a major concern. They impact river flow and degrade the natural environment, leading to flash floods, landslides, and so forth.
- HPPs should select areas to construct dams and other infrastructures in such a way that it does not affect water required for rafting. Areas that do not have direct impact must be considered.
- Government must strengthen its licensing policy so that only feasible and sustainable projects are issued licenses.
- It is necessary to conduct awareness programs to inform all related parties about the importance of such businesses.
- It is necessary to promote tourism along with infrastructural needs. Activities such as rafting promote tourism and employment opportunities and also contribute to the nation's economy without affecting the natural landscape, environment, and ecosystem.

Meeting attended by

1. Mr. Bishnu Hari Silwal, EC member
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Siddilekh Rural Municipality, Dhading

Basic details

Location: Siddilekh | Village: Siddilekh

District: Dhading

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include sustainable development of Gaupalika, continued supply of water from the water springs, and livelihoods of the local people.
- The government and projects should define specific roles and responsibility of the local government in the HPP development process.
- Ten percent EFlows may be enough only for certain rivers at certain times and may be not sufficient overall.
- Decrease in river flow level may affect cremation Ghats.
- The government is not strict enough and does not take necessary action against the HPP companies that do not abide by the rules.
- They were of the opinion that HPPs are causing massive deforestation that leads to landslides and flood.
- EFlows percentage must be estimated according to local supply needs, as standard EFlows of 10% does not seem appropriate.
- To counter issues of lack of river flow near cremation grounds, individual cremation sites must be merged to create a common one.
- HPPs that are delayed must face consequences or even have their license revoked. Local bodies should have responsibility to initiate or stall the projects in such conditions.

Meeting attended by

1. Mr. Prem Nath Silwal, Chairperson
2. Ms. Kamala Sharma, Vice Chairperson
3. Mr. Ramu Subedi, NESS
4. Mr. Lila Raj Paudyal, NESS

Gajuri Rural Municipality, Dhading

Basic details	
Location: Gajuri	Village: Gajuri
District: Dhading	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents include scenic beauty of the landscape, the need for cultural and religious sites to function in their traditional rituals, the development of local areas and livelihoods of the local people, and control of pollution.
- Survey activities were conducted without giving proper information to the local residents, and construction activities were done without prior agreement and consultations with the community.
- There is lack of awareness and information disclosure on components of the CIA study and its purpose.
- Participation of local government bodies and people in surveys of transmission lines should be ensured to prevent future conflicts between local people and HPP.
- Local bodies should be included for monitoring and implementation of the EIA.
- The beauty and aesthetic of river must be preserved to boost tourism.

Meeting attended by

1. Mr. Rajendra Bikram Basnet, Chairperson
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

Galchhi Rural Municipality, Dhading

Basic details	
Location: Galchhi	Village: Galchhi
District: Dhading	
Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.	
Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.	

Key points discussed

- The most important VECs for the respondents include irrigation from the river, cultural and religious sites able to function in their traditional rituals, development of local areas, and livelihoods of the local people.
- Construct HPPs to reduce dependency on foreign import of electricity. Enough power needs to be generated.
- Compensation is given based on price dictated by the government, which does not meet expectations of many affected people. For example, some people may not want money for their land but may want land instead.
- Affected people must be provided with high compensation and alternative settlement. Delays in HPPs' execution leads to delays in payments and compensation and should be stopped.

Meeting attended by

1. Mr. Krishna Hari Shrestha, Chairperson
2. Mr. Ramu Subedi, NESS
3. Mr. Lila Raj Paudyal, NESS

RIMS- Local NGO, Dhading

Basic details	
Location: Galchhi	Village: Galchhi
District: Dhading	

Purpose of the visit: To understand the major VECs, perceptions toward the HPPs, and key concerns.

Important notice: This document, intended for internal use of ERM, provides a working summary of the main facts captured during the meetings held, not formal minutes. It is therefore deliberately not exhaustive or chronological and, being provided for information, is not intended for official review or approval.

Key points discussed

- The most important VECs for the respondents include governance and livelihoods of local people living along the river: people's rights and access to information, ensuring fair benefits to the affected and local people from the HPPs, creating or maintaining livelihoods of the local people living along the river, such as fishery communities, and treating human health at risk from environmental pollution.
- All respondents opined that hydropower is necessary for the economic development of the nation. However, they further added that every development initiative has positive as well as negative impacts on our society and environment. But the positive impact should outweigh the negative.
- Construction of HPPs and transmission lines have been conducted without proper coordination, interaction, and sharing of information with local residents and affected households.
- There is lack of early awareness among local people about the effects of HPPs on the environment and society.
- Projects overemphasize the positive affects while underplaying or even not revealing the negatives impacts.
- In the winter season, the rivers get highly polluted, which poses risks to aquatic life. Also, nobody knows the long-term impacts on aquatic ecology.
- Policies should be made about minimum distance between two successive HPPs.
- There should be involvement of local bodies and people on documentation, reporting, and addressing of activities and problems of a project and awareness of mechanisms that can be used to bring these to the attention of locals.

Meeting attended by

1. Mr. Chetnath Tripati
2. Mr. Jhanka Khadka, local resident Galchhi Rural Municipality, Dhading
3. Mr. Madhab Khatiwada, local resident Galchhi Rural Municipality, Dhading
4. Mr. Ramu Subedi, NESS
5. Mr. Lila Raj Paudyal, NESS

Representative Photographs

Photo A.1

Fish market survey with local restaurant and trader at Betrawati, Uttargaya Gaupalika, Rasuwa (Upstream)

Photo A.2

Consultation with local communities living near a planned HEP at Uttargaya, Rasuwa (Upstream)

Photo A.3

Consultation with officials of a health post of Kalika Gaunpalika, Rasuwa (Upstream)

Photo A.4

Consultation with officials of a health post of Kalika Gaunpalika, Rasuwa (Upstream)

Photo A.5

FGD with local community living near a HEP in Gosaikunda RM, Rasuwa (Upstream)

Photo A.6

FGD with local community living near a HEP in Gosaikunda RM, Rasuwa (Upstream)

Photo A.7

Consultation meeting with chairperson and locals of Parbatikunda RM, Rasuwa (Upstream)

Photo A.8

Consultation meeting with chairman and locals of Parbatikunda RM, Rasuwa (Upstream)

Photo A.9

Consultation with chairperson of Ward 3 of Kispang RM, Nuwakot (Midstream)

Photo A.10

Consultation with chairperson of Bidur Municipality, Nuwakot (Midstream)

Photo A.11

Consultation with local communities in Bidur Municipality, Nuwakot (Midstream)

Photo A.12

FGD with local women in Pipalchautari, Bidur Municipality, Nuwakot (Midstream)

Photo A.13

FGD with local community in Bidur Municipality (Midstream)

Photo A.14

Consultation with the rep. of the Tundi Aggregate and Sand Refining Company, Nuwakot (Midstream)

Photo A.15

FGD with local communities in Ratomate, Nuwakot (Midstream)

Photo A.16

FGD with Rai community in Belkotgadi RM (Midstream)

Photo A.17

Consultation with local people in Gandaki RM, Gorkha (Downstream)

Photo A.18

FGD with local community in Makaisingh, Gandaki RM, Gorkha (Downstream)

Photo A.19

Consultation with Chepang community in Gorkha (Downstream)

Photo A.20

Consulting with rafting stakeholder at Makaisingh , Gandaki RM, Gorkha, (Downstream)

Photo A.21

Sand and gravel mining site in Trishuli, Dhading (Downstream)

Photo A.22

Consultation with staff of an Aggregate and Sand Refining Company at Siddhalek, Dhading (Downstream)

Photo A.23

Consultation with the officials of District Hospital of Dhading (Downstream)

Photo A.24

Consultation with the coordinator of District Coordination Committee, Dhading (Downstream)

Photo A.25

Consultation with the coordinator of District Coordination Committee, Gorkha (Downstream)

Photo A.26

Consultation with the workers involved in rafting at Fishling, Chitawan (Downstream)

Photo A.27

Rafting in Trishuli River in Fishling, Chitawan (Downstream)

Photo A.28

Rafting in Trishuli River in Fishling, Chitawan (Downstream)

Source: *ERM Project Teams* **Note:** *FGD = focus group discussion; HEP = hydroelectric project*

APPENDIX B: CUMULATIVE IMPACT ASSESSMENT QUESTIONNAIRE: SETTLEMENT FGD

Key questions	Targeted interviewees
VEC (valued environmental component) Identification What are the key environmental and/or social attributes within the project area of influence that your community/stakeholder group values the most? Why? Are any of the following attributes of high value? • Flow regime • Sediment load transport • Aquatic biology • Recreational uses of the river • Forest cover • Specific terrestrial species • Land property/land use • Cultural values • Other?	*Please indicate stakeholder group interviewed*
VEC Current and Future Baseline For a given VEC, what is your knowledge of its current condition (i.e., excellent, good, regular, poor, unknown)? Are you aware of any existing baseline data for that VEC? How is this condition measured/ is there a known threshold? What is an acceptable level for a change of status for this VEC?	*Please indicate stakeholder group interviewed*
Other Projects or Activities Are you aware of other existing or planned projects or activities in the UT-1 project's area of influence or that interact with the VECs? Please provide details or references.	*Please indicate stakeholder group interviewed*
Mitigation Measures and Monitoring Are you aware of any plans, programs, initiatives, strategies designed or planned to manage the condition of that VEC or otherwise in the project's area of influence? Are you aware of any existing efforts to monitor or measure the condition of that VEC? Do you know which entities/institutions are involved?	*Please indicate stakeholder group interviewed*

APPENDIX C: LEGAL AND INSTITUTIONAL GUIDANCE ON HYDROPOWER DEVELOPMENT IN NEPAL

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Constitution of Nepal	• Article 20 (1) human rights: Right to live in clean and healthy environment • Article 24: Right to property, 24(2)(3)—Right to property, compensation to be provided in accordance with law • Article 27: Right to information • Article 32: Right to language and culture—preservation and promote cultural civilization and heritage. • Article 34: Right to labor • Article 35: Right of Children—nonemployment of children in any factory, mine or engaged in similar other hazardous work • Article 37: Right to housing—noninfringement of residence except in accordance with the law • Article 42: Right to social justice—farmers' right to have access to lands • Article 44: Right to the Consumer—right to obtain quality goods and services, right to obtain compensation for injury suffered from any substandard services • Article 51(d) and (e): Policies relating to economy, industry, and commerce; policies relating to agriculture and land reforms • Article 51(f)(2): Policies related to development—priority to environment-friendly development • Article 51(g)(1): Policies related to protection, promotion, and use of natural resources—promotion and protection of environment friendly and sustainable use of natural resources. • Article 51(g)(3): Reliable supply of energy in affordable and easy manner, proper use of energy • Article 51(g)(5): Right to conserve, promote, and make sustainable use of forest, wildlife, birds, vegetation, and biodiversity, by mitigating possible risks to environment from industrial and physical development, while raising awareness of general public about environment cleanliness • Article 51(g)(6): Right to maintain the forest area in necessary lands for ecological balance • Article 51(g)(7): Right to adopt appropriate measures to abolish or mitigate existing or possible adverse environmental impacts on the nature, environment, or biological diversity • Article 51(g)(8): Right to pursue the environmentally sustainable development such as the principles of polluter pays, of precaution in environmental precaution, and of prior informed consent • Article 51(g) (9): Right to make advance warning, preparedness, rescue, relief, and rehabilitation in order to mitigate risks from natural disasters • Article 51(h)(11): Right to manage unplanned settlement and develop planned and systematic settlement	All articles and clauses are mandatory. The specific articles are highlighted under key requirements

Regulatory citation or policy	Key requirement	Relevance for hydropower development
	• Article 51(i): Policies relating to labor and employment • Article 51(j): Policies relating to social justice and inclusion—to identify the freed bonded labors, Kamlari, Harawa, Charawa, tillers, landless, and squatters and rehabilitate them by providing housing, housing plot for residence, and cultivable land or employment for their livelihoods • Related to Article 57 (1): The power of the Federation shall be vested in the matters enumerated in Schedule 5, Article 109. Legislative power of federal parliament shall be enumerated in Schedule 5 no. 14—central level large electricity, irrigations, and other projects; Schedule 5 no. 26—mines excavation; Schedule 5 no. 28—land-use policies, human settlement development policies, tourism policies, environment adaptation; Schedule 5 no. 27—national and international environment management, national parks, wildlife reserves and wetlands, national forest policies, carbon services • Related to Article 57 (2) Article 197: The powers of a state shall be vested in the matters enumerated in Schedule 6. Schedule 6 no. 7—state-level electricity, irrigation, and water supply services, navigation; Schedule 6 no. 16—management of land, land records; Schedule 6 no. 17— exploration and management of mines; Schedule 6 no. 19—use of forest and water management of environment within the state • Related to Article 57(3), Article 109, 162(4), Article 197 Schedule 7 no. 2—supply, distribution, price control, quality, and monitoring of essential goods and services; Schedule 7 no. 6—acquisition, requisitioning of property, and creation of right in property; Schedule 7 no. 13—state boundary river, waterways, environment protection, biological diversity; Schedule 7 no. 15—industries and mines and physical infrastructures; Schedule 7 no. 17—early preparedness for, rescue, relief, and rehabilitation from, natural, and manmade calamities; Schedule 7 no. 23—utilization of forests, mountains, forest conservation areas, and waters stretching in interstate form; Schedule 7 no. 24—land policies and laws relating thereto • Related to Article 57(4), Article 214(2), Article 221 (2), Article 226(1): Schedule 8 no. 7—local level development plans and projects; Schedule 8 no. 10—local market management, environment protection, and biodiversity; Schedule 8 no. 20—disaster management; Schedule 8 no. 21—protection of watersheds, wildlife, mines. and minerals • Related to Article 57 (5), Article 109, Article 162(4), Article 197, Article 214 (2), Article 221(2) and Article 226(1): Schedule 9 no. 5—services such as electricity, water supply, irrigation; Schedule 9 no. 6—service fee, charge, penalty, and royalty from natural resources, tourism fee; Schedule 9 no. 7—forests, wildlife, birds, water uses, environment, ecology, and biodiversity; Schedule 9 no. 8—mines and minerals; Schedule 9 no. 9—disaster management; Schedule 9 no. 14—royalty from natural resources	
Environment Protection Act, 1997 (2053 BS)	• Article 3 mandates IEE/EIA study for development projects; Article 4 prohibits implementation of projects without approval; Articles 5 and 6 describe the approval procedures; Article 7 prohibits emission of pollutants beyond the prescribed standards; Articles 9 and 10 stipulate provisions for the protection of natural heritage and environmental protection area; Article 17 stipulates compensation provisions arising from the discharge of waste and pollution; Article 18 includes provision of punishment for actions against the act and rules, guidelines, and standards formulated under the act; Article 19 stipulates the rights to appeal to the concerned Appellate court against the decision of concerned authority.	The requirements for conducting IEE/EIA of hydropower projects, and its approval processes and other associated requirements.

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Electricity Act, 1992	• This is related to survey, generation, transmission, and distribution of electricity. Electricity includes electric power generated from water, mineral oil, coal, gas, solar energy, wind energy, or from any other sources. Survey, generation, transmission, or distribution of electricity without obtaining license is prohibited under Section 3 of the Electricity Act. Section 4, subsection 1 of the act requires any person or corporate body who wants to conduct survey, generation, transmission, or distribution of electricity over 1 MW to submit an application to the designated authority along with the economic, technical, and environmental study report.	Licensing requirement for electricity generation, transmission, and distribution for developers
Soil and Watershed Conservation Act, 1982 (2039 BS)	• Article 10 prohibits actions within any protected watershed area declared pursuant to Article 3 of this act; Article 24 stipulates there are no obstacles for the Government of Nepal to use and develop of waters resources.	Protected watershed and its conservation requirements.
Muluki Debani Samhita Ain, 2074 (Civil Code)	• Part 4: On Land acquisition, utilization of land, Section 287—restriction on illegal encroachment of land • Section 304: Protection of governmental and public property	Ensures protection of government land and public property, and restriction on illegal encroach-ments of land in project areas
Muluki Aparadha Samhita Ain, 2074 (Criminal Code)	• Part 4: On Public Interest, Section 112—related to protection of environment; Section 113—on obstruction in public places like road, river, or any other public places by doing any work.	All public places should be free from obstruction during construction and operation of project.
Labour Act, 2017 (2074 BS)	• Section 3, classification of job postings; Section 4, appointment letter; Section 5, prohibition on child labor and restriction on minors and women; Section 10, job security; Section 12, retrenchment and reemployment; Sections 16–19, working hours; Sections 20, 21, 22, 23, 25, and 26, remuneration; Sections 27–36, occupational health and safety; Sections 37–44, welfare arrangements; Section 46, special arrangements for construction sites; Sections 50–60, conduct and penalties; Sections 72–82, settlements of labor disputes.	Procedures for hiring of labor and other associated facilities and benefits to labors
Lands Act, 1964 (2021 B.S.)	• Section 7, land ceiling and rights of tenant; Section 12, exemption from upper ceiling; Sections 25, 26, and 29, tenancy rights; Section 51, relating to land use, control of land fragmentation, and plotting.	Land use, tenancy right, and control of land against fragmentation and plotting
Guthi Corporation Act, 1976 (2033 BS) as amended 2010	• Articles 16 and 17 empower the corporation for the management and operation of the Guthi lands and properties and have stipulated the roles and responsibilities to the corporation. Article 18 prohibits the corporation to register the Guthi barren land (Ailani) as a registered land. Article 27 establishes tenancy rights on the Guthi land. Article 30 provisions for tenancy rights to be sold and purchased. Article 32, 33, and 34 provides for revenue and or rent on the Guthi land which will be collected by the corporation. Article 42 includes provisions for reimbursement of land as far as possible, if such lands are acquired by government.	Requirements and procedures to deal with Guthi land in project

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Aquatic Animal Protection Act, 1960 (2017 BS) with amendments in 2055 BS	• Section 5 (5B), provisions of fish ladder and fish hatchery while constructing water diversion structures and requirement of prior permission from the government.	Enforces the requirement for protection of aquatic species in particular rivers, permission requirements, minimal downstream flow requirements, and bans on certain activities such as killing of fish by chemical or current.
National Foundation for Upliftment of Aadibasi/ Janjati Act, 2002 (2058 BS)	The act prescribes a number of provisions to overall improve the lot of the Aadibasi/Janajati by formulating and implementing programs relating to the social, educational, economic, and cultural development through: • Creating an environment for social inclusion of disadvantaged and indigenous people ensuring participation of disadvantaged groups in the mainstream of overall national development of the country, by designing and implementing special programs for disadvantaged groups • Protecting and preserving their culture, language and knowledge and promoting the traditional knowledge, skills, technology, and special knowledge of the Aadibasi/Janajati and providing assistance in its vocational use	Ensures right of Adivashi/ Janajati.
Right to Information Act, 2064 BS (2007)	• The aim of this act is to make the functions of the state open and transparent in accordance with the democratic system and to make it responsible and accountable to the citizens. It intends to make the access of citizens to the information of public importance held in public bodies simple and easy and to protect sensitive information that could have an adverse impact on the interest of the nation and citizens. • Clause 3 of the act ensures the "Right to Information." It says that every citizen shall, subject to this act, have the right to information and they shall have access to the information held in the public Bodies unless confidentiality has been maintained by laws. • Clause 4 of the act describes the "Responsibility of a Public Body" to disseminate information. It mentions that each public body has to respect and protect the right to information of citizens. Public bodies shall have the following responsibilities for the purpose of protecting the right to information of citizens: to classify and update information and make them public; publish and broadcast to make the citizens' access to information simple and easy; to conduct its functions openly and transparently; and to provide appropriate training and orientation to its staffs. • Public bodies may use different national languages and mass media while publishing, broadcasting, or making information public. A public body shall arrange for an information officer for the purpose of disseminating information held in its office. • Clause 7 of the act prescribes the "Procedures of Acquiring Information." It states that a Nepali citizen, who is interested in obtaining any information under this act, shall submit an application before a concerned information officer by stating the reason to receive such information.	Ensures right to information of citizens via regular and meaningful information dissemination through various print and electronic media.

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Ancient Monument Preservation Act, 1956 (2013 BS)	• Section 2 defines the ancient monuments; Sections 3 and 17 empower the government to declare any place or area as a monument site or area; Section 13 restricts transfer, transaction, export, or a collection of ancient monuments and archaeological objects or curio without prior approval of the government.	Inventory of ancient monuments in project-impact areas and following-up the procedures during construction and operation (if such area falls under a project): for example, following procedures in instances of a "chance find."
Local Government Operation Act, 2017	• This act states the roles of local bodies in Nepal. The jurisdiction, roles, and responsibilities of personnel appointed in local bodies are clearly mentioned in this act. • Section 2(K): Regulation of authorized development works, encroachment of public property related to rights of municipality and village committee; Section 11d(2)—tax on local infrastructures • Section 11 (g)(1): Enactment of laws and policies related to local development • Section 11 (g) (2): Regulation of projects related to economic, social, environmental, technical aspects • Section 11 (g)(5): Aspects of urbanization • Section 11 (g)(8): Implementation of federal and provincial project related activities • Section 11 (g)(9): Policies related to planned and safe settlement of cities • Section 11 (g)(13): Related to development projects and plans • Section 11 (J)(12)(13)(18)(19): Related to environmental protection • Section 11 (s)(5): Management and regulation of service related to electricity distribution • Section 11 (t): Related to management of calamities • Section 11 (u): Management related to water resources, wildlife, mines, and minerals • Section 11 (4), (12) (c) (d): related to work, responsibility and right of municipality, village committee, and ward committee	The jurisdiction, roles, and responsibilities of local bodies toward projects. Project's reporting and other responsibilities for local bodies.
Forest Act, 1993 (2049 BS) with amendments in 2055 BS and 2073 BS	• Article 17 includes provision of lease and permit from the government to establish rights on the facilities on the national forest. Article 18 prohibits transfer of facilities or any other rights on the national forest to the others. Article 22 establishes government rights on the forest products of the national forest. Article 25 empowers government to hand over the national forest as community forest to develop, conserve, use, and manage the forest and sell and distribute the forest products independently by fixing their prices according to a work plan. Article 31 empowers the Government of Nepal to grant any part of the national forest in the form of leasehold forest for the purpose of forest conservation. Article 49 prohibits any actions causing harm to the forest other than specified in the act and rules under the act. Article 67 stipulates land rights of the government on the Community Forest, Leasehold Forest, and Religious Forest. Article 68 empowers	

Regulatory citation or policy	Key requirement	Relevance for hydropower development
	government to give assent to use any part of the Government-Managed Forest, Community Forest, Leasehold Forest ,or Religious Forest for the implementation of a given national priority plan or project if there is no alternative for the plan or project implementation.	Project requirements associated with forest-related tasks, including government and community forest
Land Acquisition Act, 1977 (2034 BS)	• Article 3 grants power to the government to acquire any land anywhere for public purposes, subject to compensation under the act. Rule 4 empowers government to acquire land upon request by institutions subject to the payment of compensation and all other expenses under the act Rules 5–8 stipulate provisions and procedures for initiating the initial land-acquisition process and estimating compensation rates. Rules 8 and 9 stipulate procedures and provisions for notification of land acquisition. Rule 11 provides for the right to file complaints by those affected by public notice with regard to the land rights. Rules 13–15 stipulate procedures and provisions of setting compensation Rules 16 and 17 stipulate criteria for setting compensation Rule 19 stipulates disclosure of compensation entitlement through public notification Rule 25 includes provision of complaints against the compensation rates to the Ministry of Home affairs. The decision of the Ministry of Home affairs on the complaint is final.	Procedures for land acquisition and compensation payment for project
Water Resources Act, 1992 (2049 BS)	• Article 3 stipulates the water resource rights of government. Article 4 prohibits use of water resources without obtaining a license, except for specified uses under the act. Article 7 establishes the order of priority for the utilization of water resources. Article 8 stipulates procedures for water resource licensing. Article 16 empowers government to utilize the water resources and acquisition of other lands and property for the development of water resource as stipulated in the act. Article 18 stipulates the right of the government to fix the quality standards of water. Article 19 prohibits pollution of water resources above prescribed pollution tolerance limits. Article 20 prohibits causing harm and adverse effects on the environment while developing a water resource project.	Requirement for obtaining license for project development and establishing priority for different water development (for example, drinking water, irrigation, hydropower)
Electricity Regulations, 1993	• This regulation has been formulated for the implementation of the provisions made in the Electricity Act, 1992. Rule 12 (f) and 13 (g) are related to environmental studies which emphasize that the environmental study report should include the measures to be taken to minimize the adverse effects of the project on physical, biological, and social environments and should also elaborate utilization of local labor, source of materials, benefits to the local people after the completion of the project, training to local people in relation to construction, maintenance and operation, facilities required for construction site, and safety arrangements.	Requirement for environmental studies and preparation of report, emphasizing minimization of project induced impacts
Labour Rules, 1993 (2050 BS)	• Rule 3 and 4 set time for deploying minor and woman at work. Rule 6 stipulates the circumstances in which non-Nepalese citizen may be engaged in work. Rule 11 addresses no discrimination in remuneration. Rules 15–17 stipulate compensation against injury, grievous hurt resulting in physical disability and in case of death.	Related to project labors, compensation, and benefits

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Ancient Monuments Preservation Rules, 2046 BS (1989) with amendments in 2049, 2053, 2056, and 2058 BS	• Rule 4: Approval from the department has to be obtained for any construction work	Related to ancient monument preservation (if applicable for a particular project)
Forest Rules, 1995 (2051 BS) with amendments in 2056 BS, 2059 BS and 2062 BS	• Rule 7 prohibits forest cutting without obtaining a license. Rule 8 stipulates the procedures of licensing for forest products. Rule 65 makes a national priority project developer that uses national forest areas responsible for the compensation of the loss or harm to any local individual or community due to the project, and also makes the developer responsible to cover all expenses required for the cutting, milling ,and transporting the forest products in a forest area to be used.	Forest loss assessment, loss compensation, permission for clearances, approvals, and associated tasks
Environment Protection Rules, 1997 (2054 BS) as amended	• Rule 3 stipulates environmental screening criteria for undertaking the IEE/EIA study. • Rules 4–6 stipulate procedures for determining scope for IEE/EIA, including public notification and approval of IEE/EIA scope of works. • Rules 7 and 10 stipulate provisions for conducting IEE/EIA assessments, including public notifications and public hearings for IEE/EIA works and requirements of recommendation letters from the project development DCOs/Municipalities. • Rule 11 stipulates approval procedures including disclosure of IEE/EIA report. • Rule 12 mandates developers to comply with the approved IEE/EIA provisions to avoid, mitigate, and monitor impacts. • Rule 13 stipulates the responsibility of the concerned body to monitor project implementation • Rule 14 stipulates the responsibility of the ministry to conduct environmental examination of the project two years after construction completion. • Rules 15–20 identify prohibitions and control of pollution. • Rules 26–33 stipulate procedures and provisions for the conservation of Natural Heritage and Environmental Conservation Zones. • Rules 45–47 stipulate procedures and provisions for compensation to those affected by a project.	Procedures for conducting IEE/EIA, approval processes etc.
Hydropower Development Policy, 2001 (2058 BS)	• Section 5, subsection 5.7, environmental protection; subsection 5.8, mitigation planning of the affected resources; subsection 5.20, opportunity for local people in employment • Section 6, subsection 6.1, environmental release, assistance in the land and property acquisition, responsibility for resettlement and rehabilitation of project-affected people; subsection 6.5, provisions of HEP transfer to Government of Nepal; subsection 6.12; royalty payments to local area, licensing provisions for survey and generation, terms of license; subsection 6.13, fee provisions	Licensing provisions for hydropower for survey and generation, royalty payments to local areas, requirement for environmental and social studies,

Regulatory citation or policy	Key requirement	Relevance for hydropower development
		responsibilities for land acquisition and resettlement, minimum downstream release, and so forth

Land Acquisition, Resettlement and Rehabilitation Policy for Infrastructure Development Projects, 2015 (2071 BS)	• Recognizes the need for resettlement and rehabilitation plan to ensure the livelihoods of project-affected persons or households be at least above the preproject conditions
	• Emphasizes that the project development agency conducts meaningful consultation with project: affected persons, communities, and sensitive groups, particularly poor, landless, senior citizens, women, children, indigenous/Janajati groups, disabled, helpless and persons having no legal rights on the operated land while preparing land acquisition, resettlement and rehabilitation plan
	• Requires completion of compensation, resettlement, rehabilitation, and other benefits to the project-affected persons/households prior to the physical and economic displacement by the project
	• Land acquisition process, as far as possible, to be undertaken through a process of negotiation with project-affected persons/households through transparent, free, fair, and justifiable process
	• Requires that land-based compensation and resettlement be provided to persons/households who lose all of their property, or whose livelihood is agriculture based
	• Requires relocation and resettlement of project-affected persons/households close to their current place of residence until and otherwise s/he willingly prefer to relocate him/herself
	• Requires inclusive programs for the enhancement of socioeconomic development of disadvantaged groups, such as marginalized groups that lack access to resources (Dalit, Indigenous or Janajati groups, single women, and so forth)
	• Requires that compensation be paid for built properties, including resettlement and rehabilitation benefits for persons/households who do not have land or legal rights to the currently operated land
	• Requires determination of compensation rates for affected land and property based on scientific methods such that the compensation rates are not less than the minimum market price
	• Requires access on project benefit (share allocations) to the affected persons/households for projects where there is a potential return on investment
	• Requires provision of subsidized rates to the project-affected persons/households for projects providing services
	• Requires the following additional project assistance in addition to compensation and resettlement:
	  • Residential facilities
	  • Goods transportation assistance
	  • Relocation assistance
	  • Relocation for business assistance
	  • House rental assistance
	• Additional assistance as recommended by the plan to address seriously project-affected households and vulnerable groups (Dalit, Janajati or marginalized Indigenous, single women, helpless, disabled, senior citizens, and so forth)
		Process, procedures, for land acquisition, different compensation packages for land acquisition, and compensation

Regulatory citation or policy	Key requirement	Relevance for hydropower development
	• Employment opportunities to seriously project-affected households and vulnerable groups (Dalit, Janajati or marginalized Indigenous, single women, helpless, disabled, senior citizens, and so forth) based on their skills and capabilities • Requires livelihood restoration plan to address the seriously project-affected households and vulnerable groups • Requires an adequate mechanism to listen to, register, and resolve the grievances of the project-affected persons and communities • Requires an effective institution to ensure that the objectives of land acquisition, compensation, resettlement, and rehabilitation action plans are achieved and to evaluate and monitor the effects on the livelihood of the project displaced persons • Requires project development agency to ensure the allocation of resources required for resettlement/rehabilitation and livelihood restoration of the project-affected persons/households	
Forest Policy, 2015 (2071 BS)	• Land-use planning and change in land use categories, conservation of bio-diversity, eco-systems and genetic resources.	Forest-related study and assessment
Land Use Policy (2069 BS)	• The Ministry of Land Reform and Management launched this policy to ensure the optimum use of land and portions of land and aims to encourage optimal use of land for agriculture. The policy also talks of adopting the concept of aggregating parcels of land to acquire land for development projects.	Applicable for selection of land, land-use type, different land identification, and planning for project
Climate Change Policy, 2011 (2067 BS), GoN	• Includes climate adaptation and disaster risk reduction; low carbon development and climate resilience; access to financial resources and utilization; capacity building, peoples' participation, and empowerment; study, research, technology transfer, climate friendly natural resources management ,and institutional set up with legal provisions; and importance of monitoring and evaluation.	In identification of greenhouse gasses, climate change, and other disaster-related issues and mitigations
Convention on Biological Diversity, 1992	• Article 14 of the convention introduces appropriate procedures requiring project EIA.	
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973	• Article II of the convention classifies species as appendix I, II, and III species that are subjected to regulation so as not to endanger their survival.	
United Nations Framework Convention on Climate Change, 1992	• Article 4 (f): Impact assessment to avoid or mitigate or adapt to climate change	

Regulatory citation or policy	Key requirement	Relevance for hydropower development
United Nations Declaration on the Rights of Indigenous Peoples, 2007	• The declaration sets out the individual and collective rights of indigenous peoples, as well as their rights to culture, identity, language, employment, health, education, and other issues (Articles 1–4). It also "emphasizes the rights of indigenous peoples to maintain and strengthen their own institutions, cultures and traditions "(Article 5) and to pursue "their development in keeping with their own needs and aspirations (Article 23)." It "prohibits discrimination against indigenous peoples" (Article 21), and it "promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development (Articles 25–30)."***	
Convention (No.169) Concerning Indigenous and Tribal Peoples in Independent Countries, 1989	• Article 7: The right of the indigenous and tribal people to decide their own priorities for the process of development • Articles 12–15: The safeguards of rights of the indigenous people in the land and natural resources in territories traditionally occupied by them • Article 16: Participation in the decision-making process and resettlement process with full compensation of the resulting loss or injury	
The Fourteenth Plan (2073/74–2075/76)	• The plan prioritizes independent, fair and socially oriented national economy and well-being of Nepalese people. The Three Year Plan envisions ranking Nepal to middle-income country status along with social justice and welfare.	
National Water Plan Nepal, 2005	• Part D, Section 6: Environmental management, inclusive of impact identification, mitigation actions, monitoring, auditing, and institutional mechanism.	
Nepal National Biodiversity Strategy and Action Plan, 2014–2020	• The action plan aims to (i) address the underlying causes of biodiversity across government and society; (ii) reduce the direct pressure on biodiversity and promote sustainable use; (iii) improve the status of biodiversity by safeguarding ecosystem, species, and genetic diversity; (iv) enhance the benefits to all from biodiversity and ecosystem services; and (v) enhance implementation through participatory planning knowledge management and capacity building.	
Nepal Biodiversity Strategy Implementation Plan, 2006	• Action plan FO1: Forest biodiversity conservation through community participation • Action plan PA1: Species conservation and habitat management in protected area • Action plan CS2: Landscape level biodiversity conservation.	
Nepal Biodiversity Strategy 2002	• Chapter 5, Section 5.1, Subsection 5.1.1, landscape planning; Subsection 5.1.4, in-situ conservation of habitat and species; Subsection 5.1.8, cross-sectoral coordination for bio-diversity conservation; Subsection 5.1.13, IEE/EIA of development projects to avoid significant impacts on biodiversity and implement the provisions to minimize the impacts • Section 5.2, Subsection 5.2.1 (5.2.1.2), cross-sectoral coordination for protected area conservation	
Water Resources Strategy Nepal, 2002	• Section 4: Social development principles, and environmental sustainability principles • Section 5: Strategic output 2—sustainable management of watersheds and aquatic ecosystems; strategic output 5—cost-effective and sustainable hydropower development	

Regulatory citation or policy	Key requirement	Relevance for hydropower development
National Conservation Strategy, Nepal, 1988	• The policy principles include (i) ensure the sustainable use of Nepal's land and renewable resources; (ii) preserve the biological diversity of Nepal to maintain and improve the variety and quality of crops and livestock, and maintain the variety of wild species both plant and animal; and (iii) maintain the essential ecological and life-support systems such as soil regeneration, nutrient recycling, and the protection and cleansing of water and air.	
National Energy Crisis Resolution and Energy Development Decade Concept Paper (2072 BS)	• The concept paper was approved by the cabinet decision of 2072/08/08. The overall objective of the concept paper is to avoid the hindrances and hassles in construction of hydropower projects without violating the existing legal requirements.	
Forest Encroachment Control Strategy, 2012	• Emphasizes achieving 40 percent forest coverage through avoidance and control of forest encroachment and reclaiming of encroached forest areas.	
National EIA Guidelines, 2017, MoPE	• Generic information on the procedures for EIA scoping, terms-of-reference preparation, baseline environmental studies, information disclosure, public consultation, prediction and evaluation of impacts, mitigation prescriptions, monitoring and EIA report preparation in line with the EPA, and the EPR.	Guidelines for preparation of EIA report
Department of Electricity Development Manuals	• Specific environmental manuals for hydropower development studies. A total of seven manuals have been prepared by DoED to cover different components of EIA, environmental management and monitoring. These include: • Manual for Preparing Scoping Document for Environmental Impact Assessment (EIA) of Hydropower Project (2001) • Manual for Public Involvement in the Environmental Impact Assessment (EIA) Process of Hydropower Project (2001) • Manual for Preparing Terms of References (ToR) for Environmental Impact Assessment (EIA) of Hydropower Projects, with Notes on EIA Report Preparation, (2001) • Manual for Preparing Environmental Management Plan (EMP) for Hydropower Projects, (2002) • Manual for Developing and Reviewing Water Quality Monitoring Plans and Results for Hydropower Projects, (2002) • Manual for Conducting Public Hearings in the Environmental Impact Assessment Process for Hydropower Projects (2004) • Manual for Addressing Gender Issues in Environmental impact Assessment/ Initial Environmental examination for Hydropower Projects, (2005)	Provide directions and guidelines through various manuals for conducting various tasks under EIA
Guidelines on Land Use of Forest Area for other Purposes (Ban Chhetra ko Jagga Anya Prayojan ko Lagi Upalab-dha Garaune Karyabidhi, 2063 BS), 2006	• The guidelines address conditions required to make forest lands available to development projects and the required compensatory measures for the loss of forest land use and forest products.	Provide guidelines for use of forest land, compensatory forestation requirements

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Forest Products Collection, Sale and Distribution Guidelines, 2000 (2057 BS)	• The guidelines specifies various procedure and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume, and so forth.	Related to forest products loss calculation, clearance, and loss calculations
EIA Guidelines for Forestry Sector, 1995 (2051 BS)	• The guideline specifies the EIA procedures to be followed while undertaking environmental studies that involve forest areas.	Procedures to be followed for EIA study in forest area
Community Forest Development Guidelines, 2006 (2065 BS)	• Guidelines set the processes and procedures to identify and build capacity within the Community Forest User Groups, prepare Community Forest management plans, and implement Community Forest management plans.	Procedures dealing with community forest in project areas
Community Forest Inventory Guidelines, 2005 (2062 BS)	• Community Forest Inventory Guidelines detail the process and procedures for evaluating the forest stock and it's harvesting potential in Community Forests.	In case of community forest–related cases
Environmental Management Guidelines (Road), 1999 (2056 BS)	• The guideline for roads focuses on the major issues for environmental management while developing or upgrading a road corridor. It sets procedures for environmental assessment and highlights the potential impacts and mitigation measures for road projects.	Requirements related to a project's own access roads and main access road

MoPE Guide to Environmental Management Plans of Hydropower Projects 2006 (2063 B.S.)	• MoPE has published guidelines for conducting IEE/EIA of hydropower development projects, which detail methods and procedures for the preparation of environmental management plans, environmental auditing and environmental monitoring plans:
	  • A Guide to Environmental Management Plans of Hydropower Projects (MoEST, 2006)
	  • A Guide to Environmental Auditing of Hydropower Projects (MoEST, 2006)
	  • A Guide to Environmental Monitoring of Hydropower Projects (MoEST, 2006)
		Details of EMP contents in EIA report

EIA Guidelines for Water Resource Sector, 1994 (2050 BS)	• The guidelines set procedures for (i) identification of positive and negative impacts of water resource projects over both short-term and long-term periods on natural and human environments; (ii) development of mitigation management and monitoring plans; and (iii) public hearings and interaction with affected groups, NGOs, donors, and relevant government agencies.	
Guideline for Physical Infrastructure Development and Operation in Protected Areas, 2008 (2065 BS)	• Sets guidelines for infrastructure development in protected areas	Project requirements for infrastructure development

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystem, 2008	• Sets guidelines of the water quality for the protection of aquatic ecosystem	Water quality to be maintained by project for aquatic ecosystem conservation
Nepal Water Quality Guidelines for Recreation, 2008	• Sets guidelines of the water quality that can be used for recreational purpose	
Nepal Vehicle Mass Emission Standard, 2012 (2069 BS)	• Compliance to Type I to Type V tests for vehicles fueled with gasoline and diesel imported for a project	Projects vehicle standards
Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters (2058 BS)	• Tolerance limits of effluent discharged into inland surface waters	Projects waste water quality prior disposal in inland surface water
National Ambient Air Quality Standards for Nepal, 2012 (2069 BS)	• Limits of ambient air quality parameters around construction sites	Projects air quality threshold during construction and operation phase
National Drinking Water Quality Standards, 2006 (2063 BS)	• Quality of drinking water supply in the project camps and construction sites	Drinking water quality for staff and workers during construction and operation phase
National Ambient Sound Quality Standard, 2012 (2069 BS)	• Noise levels for different land-use categories and noise generating equipment	Noise levels to maintain during construction and operation phase of project

Regulatory citation or policy	Key requirement	Relevance for hydropower development
Exhaust Emission Standards for Diesel Generating Sets, 2012 (2069 BS)	• Emissions standards for exhaust emissions of diesel plants/generating sets	Standards for diesel plant/ generator sets used in projects
National Indoor Air Quality Standards, 2009(2066 BS)	• The time weighted (1~24hrs) standards are given for PM_{10}, $PM_{2.5}$, CO, carbon dioxide (CO_2) for indoor environments. The units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$). Monitoring of carbon dioxide is to ensure the adequacy of the ventilation of the monitoring sites. The provision for measurement of $PM_{2.5}$ is preferred; the $PM_{2.5}$ values can be converted to the corresponding PM_{10} values by application of a $PM_{2.5}$/ PM_{10} ratio of 0.5.	Air quality standards to be maintained by project during construction and operation phase

APPENDIX D: EFLOWS ASSESSMENT OF THE TRISHULI RIVER BASIN

Contents

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Acronyms and Abbreviations

°C	Degree Celsius
BES	Baseline Ecological Status
CIA	Cumulative Impact Assessment
DMU	Discrete Management Units
DRIFT	Downstream Response to Imposed Flow Transformation
DSS	Decision Support System
EF	EFlows
EFlows	Environmental Flows
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ESSA	Environmental Social System Assessment
HEP	Hydroelectric Project
HPP	Hydropower Project
IBAs	Important Bird Areas
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBAs	Key Biodiversity Areas
NCMG	National Mission for Clean Ganga
PS	Performance Standards
UT	Upper Trishuli

Units

m^3/sec	Cubic meters/second
Mg	Milligrammes
MW	Mega Watts

1. Introduction

The Trishuli River is a transboundary river and drains the catchment of one of the eight subbasins of the Gandaki River Basin in Central Nepal. It covers an area of 32,000 square kilometers, which is 13 percent of the total Gandaki area. The Trishuli watershed lies within the physiographic zones defined by an average altitude range of 250 meters to 2000 meters and high valley landscapes.

The Trishuli River originates in the Tibet Autonomous Region of the People's Republic of China, where it is known as Bhotekoshi. The catchment area of Trishuli River is 6,624.7 square kilometers up to the confluence with the Budhi Gandaki, for a river length of 120 kilometers. The approximately106 kilometers of Trishuli River within Nepal shows a gradient of about 3 percent in the initial 40 kilometers, with rapids dominating the longitudinal profile, but there are no impassable falls for fish.[1] The elevation range in this 40 kilometers varies from 800 meters to 2,000 meters.

The Environmental Flow (EFlows) Assessment was carried out as part of the Cumulative Impact Assessment and Management: Hydropower Development in the Trishuli River Basin, Nepal. The Downstream Response to Imposed Flow Transformations (DRIFT) model is used for the EFlows Assessment. The EFlows Assessment team qualitatively apply the lessons learned from evaluating EFlowss using the DRIFT model for other hydropower projects in the Trishuli Basin and elsewhere in the Himalayan region to assess the likely impacts of hydropower developments on river biodiversity and ecosystems and make recommendations on management measures to minimize these impacts.

The EFlows Study Area

For the CIA study, the study area includes entire catchment of Trishuli River in the upper reaches (also including the part that lies in Tibet) and the lower reach up to the point immediately downstream of Super Trishuli Hydropower Plant (HPP). For the EFlows Assessment, the upper limit of the EFlows study area is the Chinese border whereas the lower limit is immediately downstream of Super Trishuli HPP, same as that of the study area of the CIA.

As shown in Map D1.1 and the Google Earth image in Photo D1.1, the EFlows study area lies downstream of Chinese border close to Rasuwagadhi Hydropower Project (HPP), and upstream of confluence of the Super Trishuli HPP. A total of 6 *existing*, 7 *under-construction*, 1 *committed*, and 23 planned projects in this study area are shown in the map with different color codes and listed in Table D1.1. The list includes 24 projects that were included in the DRIFT model, and an additional 12 that were not modelled but the impact of which was assessed extrapolating the impacts of the 24 that were modeled.

1 See ESSA Technologies. 2014. *Cumulative Impact Assessment-Upper Trishuli-1 Hydropower Project.* Ottawa. App D, 12.

Map D1.1: HPPs and EFlows Sites in the EFlows Study Area

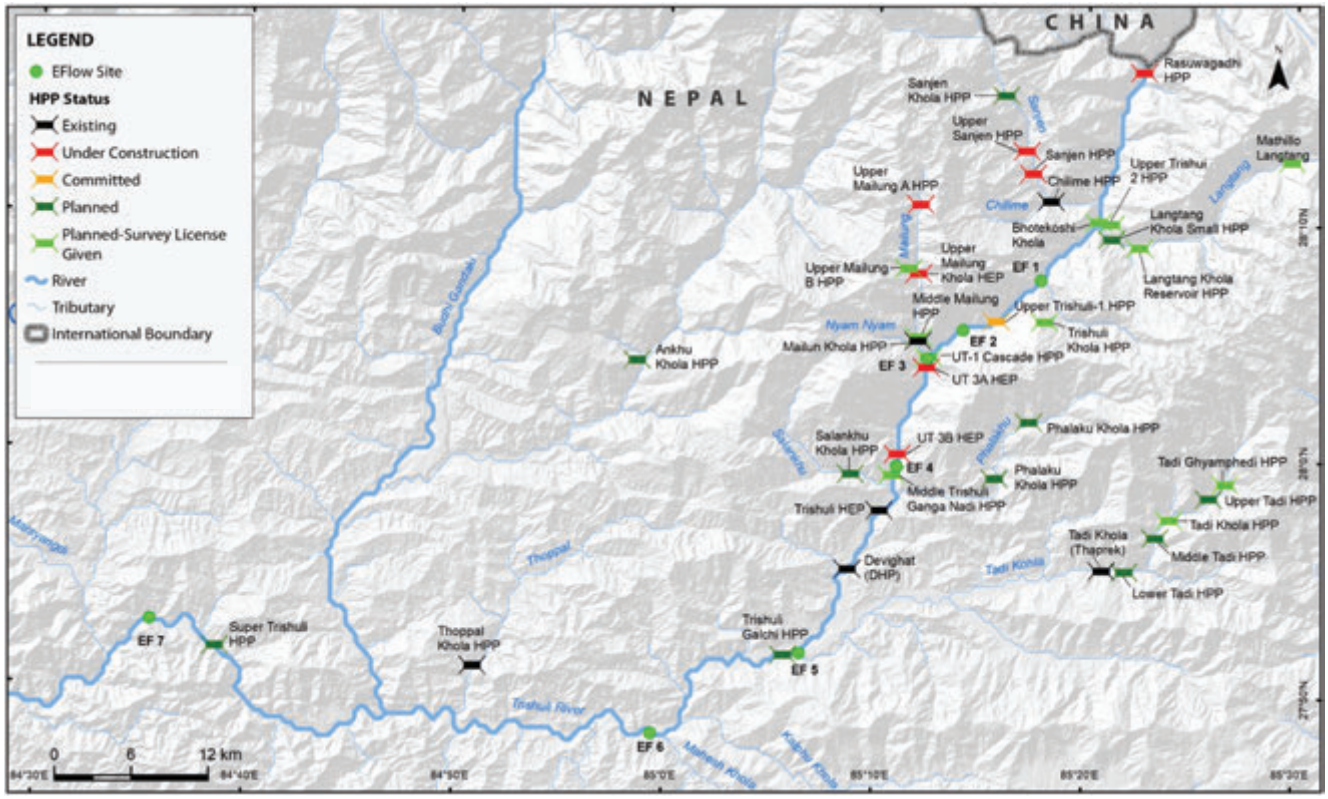


Photo D1.1: Location of EFlows Sites

Table D1.1: Hydropower Projects Used in DRIFT DSS

No	Project status/stage	MW	River
	Existing/Operational		
1	Chilime (CHP)	22.0	Chilime Khola
2	Mailung Khola HPP	5.0	Mailung Khola
3	Trishuli (THP)	24.0	Trishuli Mainstem
4	Devighat (DHP)	14.0	Trishuli Mainstem
5	Tadi Khola (Thaprek) HPP	5.0	Tadi Khola
6	Thoppal HPP	2.0	Thoppal Khola
	Under-Construction		
1	Rasuwagadhi (RGHEP)	111.0	Trishuli Mainstem
2	Upper Sanjen (USHEP) (NEA SPV)	15.0	Chilime Khola
3	Sanjen Hydro Project (SHEP) (NEA SPV)	42.0	Chilime Khola
4	Upper Mailung A HEP	6.0	Mailung Khola
5	Upper Mailung Khola HEP (Molina Power)	14.0	Mailung Khola
6	Upper Trishuli-3A HPP (UT-3A)	60.0	Trishuli Mainstem
7	Upper Trishuli-3B HPP (UT-3B)	37.0	Trishuli Mainstem
	Committed		
1	Upper Trishuli-1 HPP (UT-1)	216.0	Trishuli Mainstem
	Planned		
1	Sanjen Khola HEP (Salasungi Power)	78.0	Chilime Khola
2	Langtang Khola Small HPP	10.0	Langtang Khola
3	Salankhu Khola HPP	2.5.0	Salankhu Khola
4	Phalaku Khola HPP	15.0	Betrabati Khola
5	Phalaku Khola HPP	5.0	Betrabati Khola
6	Upper Tadi HPP	11.0	Tadi Khola
7	Middle Tadi HPP	5.5	Tadi Khola
8	Lower Tadi HPP	5.0	Tadi Khola
9	Trishuli Galchi HPP	75.0	Trishuli Mainstem
10	Super Trishuli HPP	100.0	Trishuli Mainstem
11	Upper Trishui-2 HPP	102.0	Trishuli Mainstem
12	Bhotekoshi Khola HPP	44.0	Bhotekoshi Khola
13	Mathillo Langtang HPP	24.35	Langtang Khola
14	Langtang Khola Reservoir HPP	310.0	Langtang Khola
15	Trishuli Khola HPP	4.4	Trishuli Khola
16	Upper Trishuli-1 Cascade HPP	24.6	Trishuli Mainstem
17	Upper Mailung B HPP	7.5	Mailung Khola
18	Middle Mailung HPP	10.0	Mailung Khola
19	Middle Trishuli Ganga Nadi HPP	65.0	Trishuli Mainstem
20	Tadi Ghyamphedi HPP	4.7	Tadi Khola
21	Tadi Khola HPP	4.0	Tadi Khola

Source: *ERM.*

Note: *DSS = Decision Support System; HEP = hydroelectric project; MW = megawatts.*

EFlows Assessment

EFlows Sites

Seven EFlows sites have been chosen on the main Trishuli River in the EFlows study area. In addition, migration nodes have been established to represent the tributaries. Table D1.2 provides a brief description and rationale for selection of sites.

Table D1.2: EFlows Sites and Rationale for Selection

EFlows site	Location	Latitude	Longitude	Comments
EFlows 1	Upstream UT-1 HPP (216 MW) dam	28° 07' 35.84"	85° 17' 50.37"	This site is same as that modelled in DRIFT EFlows Assessment for the Upper Trishuli 1 HPP. This site has been chosen to illustrate the impact of barrier created by UT-1 HPP to migration of the Snow Trout.
EFlows 2	Between UT-1 weir and tailrace	28° 5' 27.89"	85° 14' 7.76"	This site is same as that modelled in DRIFT EFlows Assessment for the Upper Trishuli 1 HPP. This site has been chosen to assess the impact of varying level of EFlows release from the UT-1 dam in the low-flow section of the river created by diversion of river water into power generation tunnels.
EFlows 3	Downstream of UT-1 tailrace	28° 4' 13.71"	85° 12' 28.76"	This site is same as that modelled in DRIFT EFlows Assessment for the Upper Trishuli 1 HPP. This site has been chosen to show recovery associated with restoration of river flow as the water diverted for power generation is released back into the river. This site and the reach downstream, however, will be impacted by variations in flow if the UT-1 power plant is operated in peaking mode.
EFlows 4	Downstream of UT-3B (37 MW)	27°59' 39.92"	85° 11' 2.94"	UT-3B is a cascade of UT-3A (60 MW, Photo D1.2 and Photo D1.3) and both the projects are under-construction. The site has been chosen to capture the barrier effects created by UT-3A dam on fish migration. Similarly, effect of tributaries such as Salankhu/ Phalankhu on the fish migration and breeding can be captured.
EFlows 5	Upstream of Tadi confluence	27°51' 41.17"	85° 6' 30.62"	This EFlows Site is chosen up stream confluence of Tadi tributary with Trishuli River. This site has been chosen to study the barrier effects created by existing hydropower projects viz., Trishuli HEP (24 MW, Photo D1.4) and Devighat HPP (14.1 MW) on the fish migration and also to study the effect of changing water temperature to aquatic life due to mixing of tributaries into the main river.
EFlows 6	Downstream of Mahesh Khola confluence	27°48' 12.99"	84° 59' 28.22"	This EFlows Site is selected downstream of the confluence of Mahesh Khola. This site lies fairly on the mild slope of the river. The warm water from Mahesh Khola entering into the cool water of the Trishuli River will create a different condition for fish species which will be of interest for this study.
EFlows 7	Downstream of Super Trishuli HPP	27° 52' 43.47	84° 35' 32.03"	This EFlows Site is located immediately downstream of Super Trishuli HPP (100 MW). This is to include the possible barrier effect created by Super Trishuli dam.

Continued on the next page

EFlows site	Location	Latitude	Longitude	Comments
EFlows 8	Chilime Khola			Migration and breeding node, not to be modelled in DRIFT
EFlows 9	Mailung River			Migration and breeding node, not to be modelled in DRIFT
EFlows 10	Salankhu and Phalankhu Rivers			Migration and breeding node, not to be modelled in DRIFT
EFlows 11	Tadi Khola			Migration and breeding node, not to be modelled in DRIFT

Photo D1.2: Dam Site of UT-3A, 2015

Source: *Halvard Kaasa.*

Photo D1.3: Trishuli River Downstream of UT-3B, 2015

Source: *Halvard Kaasa.*

Photo D1.4: View of Existing Trishuli HPP from Upstream, 2016

Source: *Fish Passage Workshop Trishuli, 2016.*

The EFlows sites have not been located in the tributaries, although they might have potential in terms of breeding and migration. *This is to limit the scope of the study within the main river.* However, for illustrative purposes, one EFlows site each has been placed in four tributaries: Chilime Khola, Mailung Khola, Salankhu Khola, and Tadi Khola (different from the main EFlows sites).

Although the Budhi Gandaki River lies upstream of the proposed EFlows site 7 and could be mitigation against the barrier effect created by Super Trishuli HPP dam depending on whether or not there might be future developments in the river, *we have not included it in our study and is outside of scope of work*.

Indicator Fish Species and Distribution

Indicator fish species considered in the EFlows Assessment are the following:

- Snow Trout *Schizothorax richardsonii*, this is representative of other Snow Trout (*Schizothorax*) species of the Trishuli River.
- Golden Mahseer *Tor putitora*, this is representative of other Mahseer (*Tor*) species of the Trishuli River.
- Buduna *Garra annandalei* (Photo D1.5), this is representative of other *Garra* species of the Trishuli River.
- Indian Catfish *Glyptothorax indicus*, this is representative of other *Glyptothorax* species of the Trishuli River.

The first two are migratory species while the remaining two are nonmigratory or resident species.

Construction of dams is likely to impact both the resident and migratory fish species. The migratory species will be affected by the barrier created by the dams as well as alterations in flows, while the nonmigratory species will be affected by alterations in flows. Indicator species were also selected to cover the entire EFlows study area based on their temperature preference. Snow Trout is found in cold-cool water zone, Mahseer and Indian Catfish in cool water zone while Buduna is found in cool-warm water zone. The following is an indicative delineation of these zones, as illustrated in Map D1.2.

- The Trishuli River upstream of the confluence with Salankhu Khola is a cold-water zone. Maximum summer temperatures in this zone are estimated to range between 16°C and 18°C.
- The Trishuli River downstream of the confluence with Salankhu Khola and upstream of the site of Super Trishuli dam is a cold-cool water zone. Maximum summer temperatures in this zone are estimated to range between 20°C and 22°C.

Photo D1.5: Buduna (*Garra annandalei*) from Andheri Khola, Tributary of Trishuli River, 2015

Source: *Halvard Kaasa.*

- The Trishuli River downstream of site of Super Trishuli dam is cool-warm-water zone. Summer temperatures in this zone are estimated to range between 23°C and 26°C.

Map D1.3 shows the regional distribution of the two migratory species selected as indicators for the EFlows Assessment, the Snow Trout and the Mahseer, and the "Discrete Management Units" (DMUs)[2] in which these species are presently confined in. The range of Mahseer is limited to elevations of the order of 300 meters to 1,100 meters, while the Snow Trout covers the entire range of Mahseer and migrates further up the streams to elevations of the order of 500 meters to 3,000 meters.

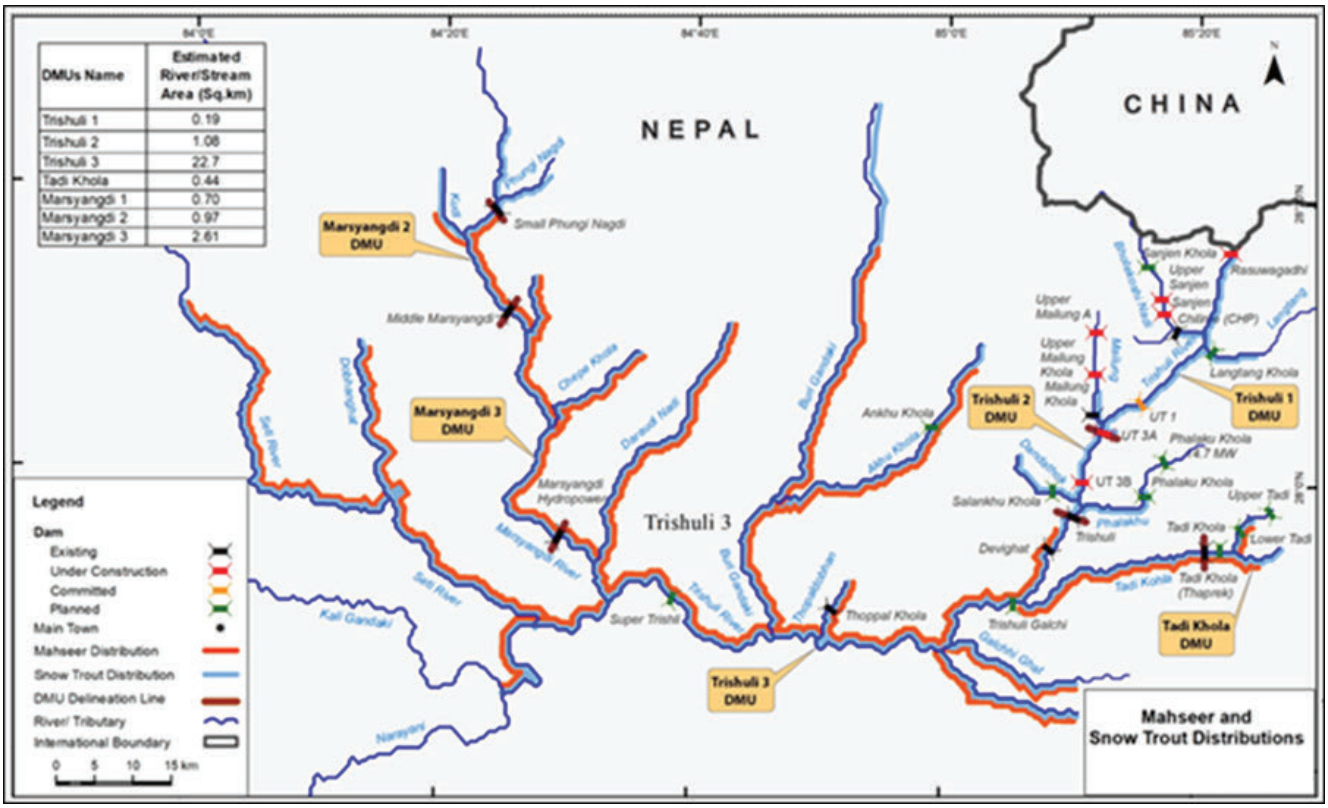
Elevation Profile of Trishuli River

Figure D1.1 illustrates the elevation profile of the Trishuli River, distribution of elevation and temperature zones, as well as location of EFlows sites. The upper reach of the EFlows study area from the Chinese border up to the Upper Trishuli-3B HPP is steep with an average slope of 3 percent. From Upper Trishuli-3B to just above the Tadi Khola confluence, the river is moderately steep with an average slope of 1 percent. From there onward up to the EFlows site 7 (downstream of Super Trishuli), the Trishuli River has a relatively mild slope with an average slope of 0.3 percent.

Map D1.2: Delineation of Temperature Zones across the Basin

2 As per Criteria 1 through 3 of IFC PS6 (2012), the DMU is what the project should determine is a sensible boundary (ecological or political) which defines the area of habitat to be considered for the Critical Habitat Assessment. This discrete management unit is an area with a definable boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas (adapted from the definition of discreteness by the Alliance for Zero Extinction). A discrete management unit may or may not have an actual management boundary (for example, legally protected areas, World Heritage sites, Key Biodiversity Areas (KBAs), Important Bird Areas (IBAs) community reserves, and so forth) but could also be defined by some other sensible ecologically definable boundary (for example, watershed, interfluvial zone, intact forest patch within patchy modified habitat, grass land habitat, and so forth). The delineation of the management unit will depend on the species (and, at times, subspecies) of concern.

Map D1.3: DMU Delineation for Snow Trout and Mahseer



Note: *DMU = Discrete Management Unit.*

Scenarios

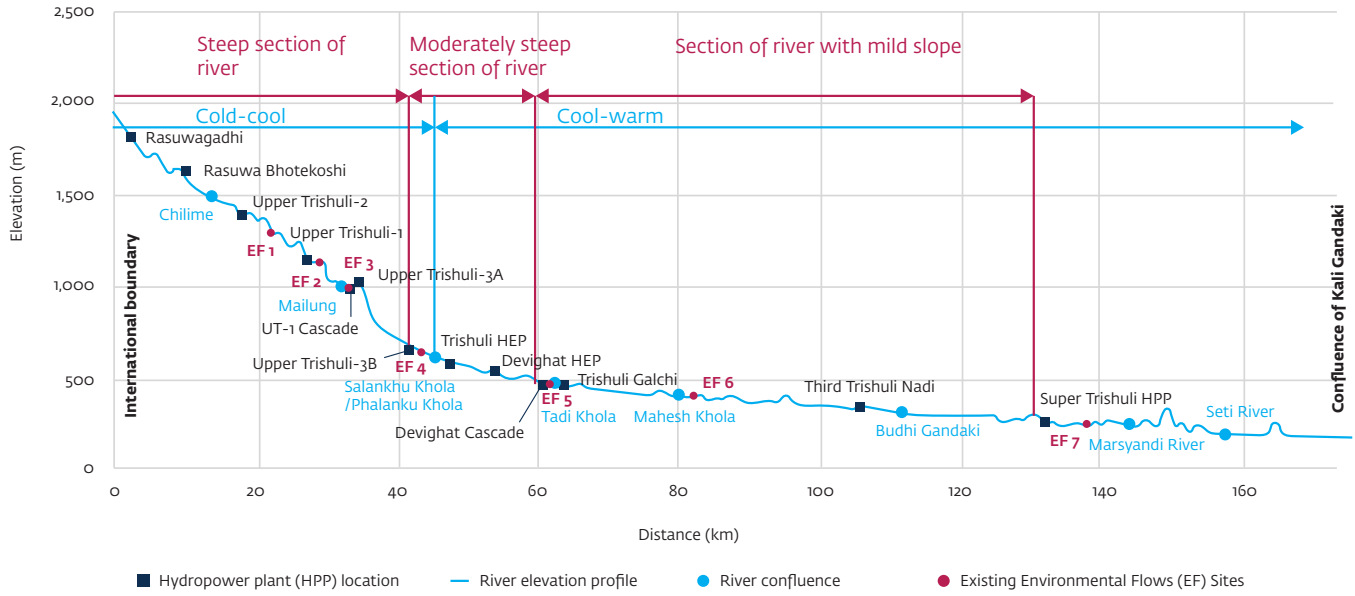
The following scenarios are being used in the DRIFT for the EFlows Assessment of the Trishuli Basin:

1. **Scenario 1, Existing Projects:** This scenario represents the present conditions in which 6 of the existing projects as listed in Table D1.1 are operational.

2. **Scenario 2 (10 years), Existing + Under-Construction + Committed Projects:** This scenario represents the expected conditions in which 6 of the existing projects, 7 of under-construction project, and the UT-1 project (which is the only project that has presently been committed) as listed in Table D1.1 are operational.

3. **Full Development (50 years):** This scenario represents conditions in which all of the above as well as 10 planned projects are operational (the results of this scenario were however further extrapolated for 11 projects representing the "planned/survey license given" scenario within the overall full development scenario).

Figure D1.1: Elevation Profile of the Trishuli River with Slope and Division of Temperature Zones



2. Data and Assumptions

Project Delineation

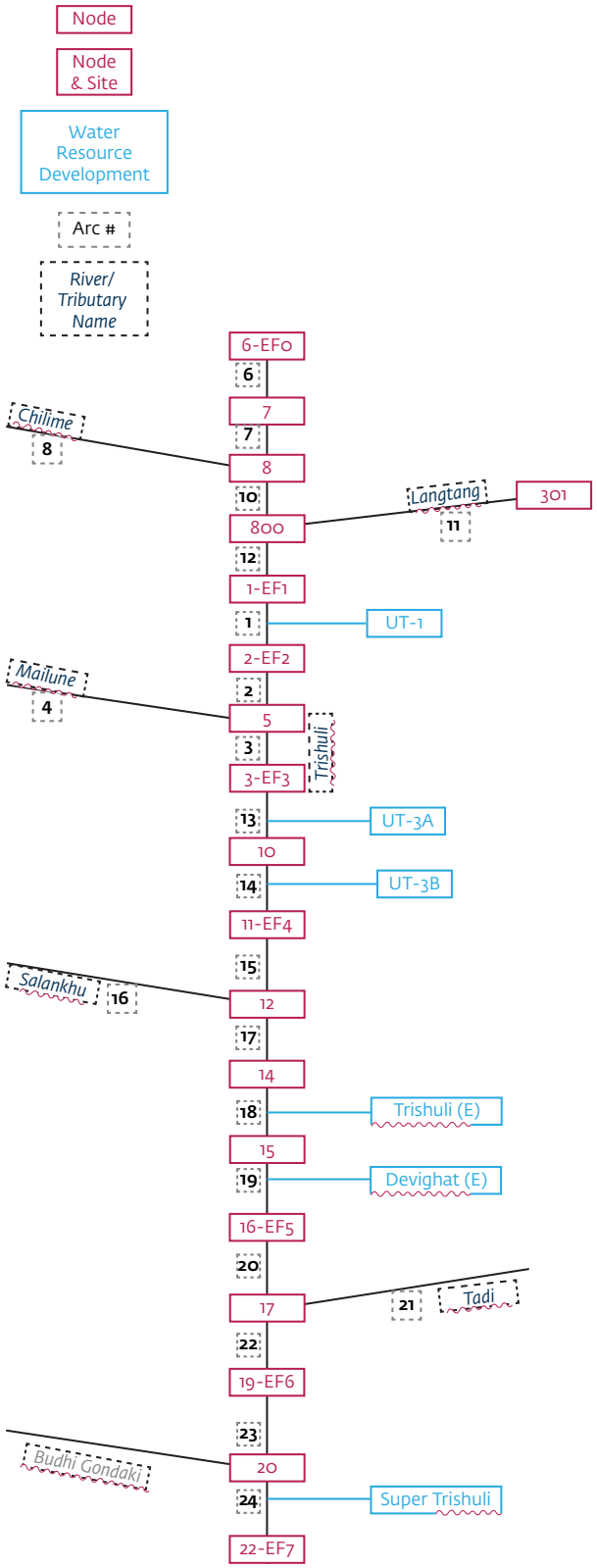
Nodes and arcs are the basic requirements of DRIFT DSS setup and must be added before any of the other activities can be completed. Once they have been specified, the zones, sites, and infrastructure can be added. The relationships between these effectively create a map of the river system. Nodes may be defined at the following:

- Sites
- Where zones begin and end (if these are between sites)
- Tributary confluences
- Upstream of impoundments or other infrastructure where these are upstream of the study reach if these impact on connectivity.

Arcs are segments of river that join nodes. One or more arcs combine to form a zone. And sites are locations where biophysical sampling has been done, or for which biophysical information is available. All the information in the DSS is linked to and reported in relation to a site (and in the integrity maps section of analysis, they are reported by zone).

In this study, project delineation is carried out such that each HPP is located between two nodes. Nodes are defined at the starting point of the project boundary (that is, at the Chinese Border), at tributaries and tributary confluences, and at EFlows sites. Arcs are connecting each node and the sites defined are the EFlows sites. Paths are defined to indicate both ways of migration at each site. Setup layout for the EFlows Assessment is as shown in Figure D2.1.

Figure D2.1: Setup Layout for EFlows Assessment



Indicator Groups

Following groups of indicators have been selected for modeling:

- Fish: This indicator is defined throughout the project area, that is, in the main river as well as in the tributaries according to distribution as discussed in the section "Indicator Fish Species and Distribution" in chapter 1.
- Algae: Defined for main river only
- Invertebrates: Defined for the main river only
- Geomorphology: Defined in the main river as well as the tributaries as it is strongly related to fish

Response Curves

For fish, the response curves from the Neelum-Jhelum Basin have been utilized for modelling of the Trishuli Basin, since both have similar species and are Himalayan Rivers. For other indicators, available information and expert judgment is being used for preparing the response curves.

Connectivity Barrier of HPPs

Fish ladders are being considered in modelling of fish migration in the main river. However, fish ladders are not considered in the tributaries, since there are other factors acting on and affecting fish migration between the tributaries and main river. An example is loss of connectivity due to reservoirs created by the dams, which are not being considered in this analysis for tributaries.

The following is the rationale used for the connectivity dependence of fish:

- Without fish ladders, the upstream connectivity reduction will be 100 percent (that is, UT-1 blocks 100 percent movement up from EFlows [EF] 2 to EF 1) for any dam.
- Without fish ladders, the downstream barrier to movement will be 90 percent (that is, UT-1 blocks 90 percent of fish from moving downstream from EF 1 to EF 2).
- If there are chains of dams (as on Chilime Khola tributary):
    - The connectivity-barrier effect will be slightly reduced, moving "away" from the site in question. Reduction in barrier can be based on the amount of habitat, perhaps the "biological length" dammed by each dam on the tributary.
- For dependence response curves from EF 5 to EF 4:
    - A relative portion of the population above EF 4 and below EF 5 will be considered in winter, in summer, and over the whole year.
    - The importance of the EF 5 population to that at EF 4 will be considered; if EF 5 is no longer there to "feed" EF 4, for example, in the case of Mahseer, it will pretty much die out above EF 4, because there is no breeding habitat, further upstream is too cold, so the percent dependence of EF 4 on EF 5 is pretty much 100 percent.

The following rationale will be used for barrier-connectivity dependence of sediments:

- For bed load, percent reduction is taken to be 10 percent in the main river and 5 percent in the tributaries. For a typical run-of-river project, bed load reduction due to barrier effect is usually not the case. Very small amounts of the bed load will be held back by the dam; the rest will pass through it.

For suspended load, percent reduction is taken as 5 percent in both the main river and the tributaries.

3. Hydrology

The baseline and scenario hydrological daily time series data for the first three EFlows sites were used from the previous EFlows study of Upper Trishuli-1 HEP. These data were provided by Nepal Water and Energy Development Company, the developer of UT-1 HEP. These are based largely on flow data obtained from the Department of Hydrology and Meteorology gauging station at Betrawati. The best available long-term hydrological data were for the period 1967 to 2013, and so this was the period on which the EFlows Assessment was based.

Details of the hydrological data available for the Upper Trishuli-1 HEP and the procedures undertaken to obtain then are covered in *Detail Design Report-II, Civil of UT-1 HEP.*

The baseline and scenario hydrological daily time series for the other scenarios were calculated using the "catchment area ratio approach."

The hydrological record for the Trishuli River suggests that this is a flood-pulse system, with four well-defined seasons (Figure D3.1). Once the seasons were defined, DRIFT calculated a suite of ecologically relevant flow indicators that were used by the specialists to determine the flow-related links to the ecosystem indicators. The flow indicators and the reasons for their selection as indicators are given in Table D3.2. Each flow indicator was calculated for each year in the hydrological record, thereby deriving an annual times-series of 47 years for each flow indicator.

The flow indicators are used as drivers of change in other aspects of the river ecosystem. They are reported in the results to provide context for and understanding about the ecosystem responses. They are not used in the calculation of ecosystem integrity.

Figure D3.1: One Year (1967) of the Baseline Hydrological Record at EFlows Site 4, Showing the Seasonal Divisions, from Left to Right, into Dry, Transitional 1, Wet, Transitional 2, and Back into Dry (m^3/sec =cubic meters/sec)

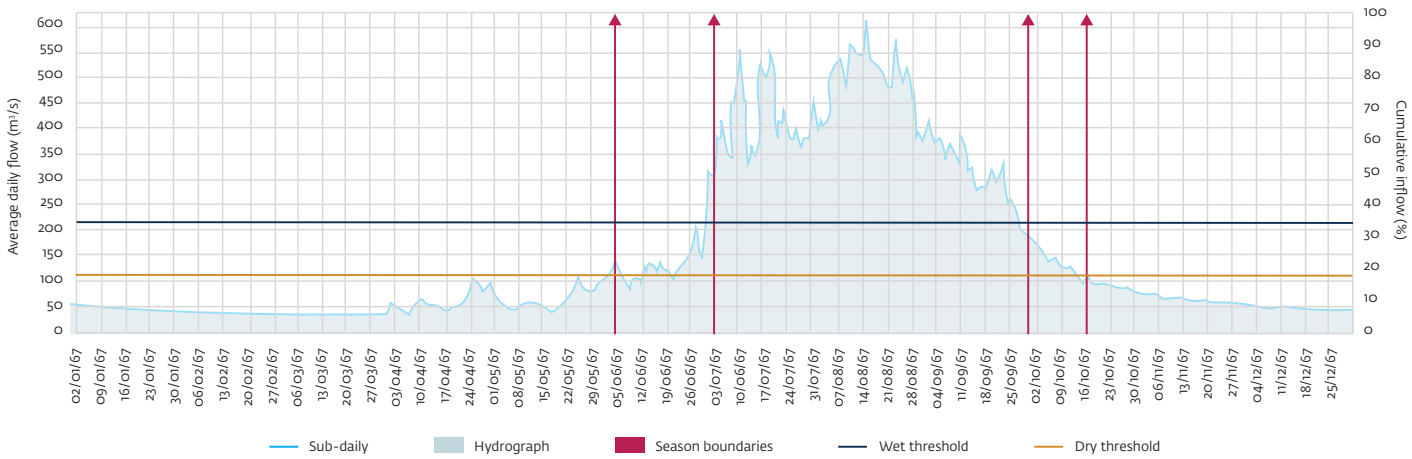


Table D3.1: Parameters Used for Seasonal Divisions

Division	Parameter
Start of the hydrological year	January
End of dry season	4 x minimum dry season discharge
Start of wet season	1.1 x mean annual discharge
End of transition 2	4 x minimum dry season discharge, and the recession rate <0.1 m^3/day over 10 days

Table D3.2: Flow Indicators Used in the Trishuli River

Indicator	Reason for selection as indicators
Mean annual runoff	Gives an indication of annual abstraction/addition of water, if any.
Dry season minimum five-day discharge	Dry season minimum day-day average flows influence available habitat area, fish movement, and winter temperatures (buffering)
Dry season onset	Onset and duration of seasons: • Link with climatic factors • Cues fruiting and flowering • Cues migration and breeding • Support life-history patterns
Dry season duration	The dry season is typically the harshest season for aquatic life to survive. This is the time when flows are low, water quality influences potentially stronger, and temperatures (either hot or cold) are most challenging. Increases in the duration of this harsh period can have significant influence on overall chances of survival.
Dry season average daily volume	Dry periods: • Promote in-channel growth • Support larval stages • Maintain intra-annual variability
Wet season onset	Onset and duration of seasons: • Link with climatic factors • Cues fruiting and flowering • Cues migration/breeding • Support life-history patterns
Wet season duration	Important for supporting life-stages, such as hatching and growth of young. The wet season is also when most erosion and deposition occurs due to the higher shear stress and sediment loads in the river.
Wet season flood volume	Floods: • dictate channel form • flush and deposit sediment and debris • promotes habitat diversity • support floodplains • distribute seeds • facilitate connectivity • control terrestrial encroachment

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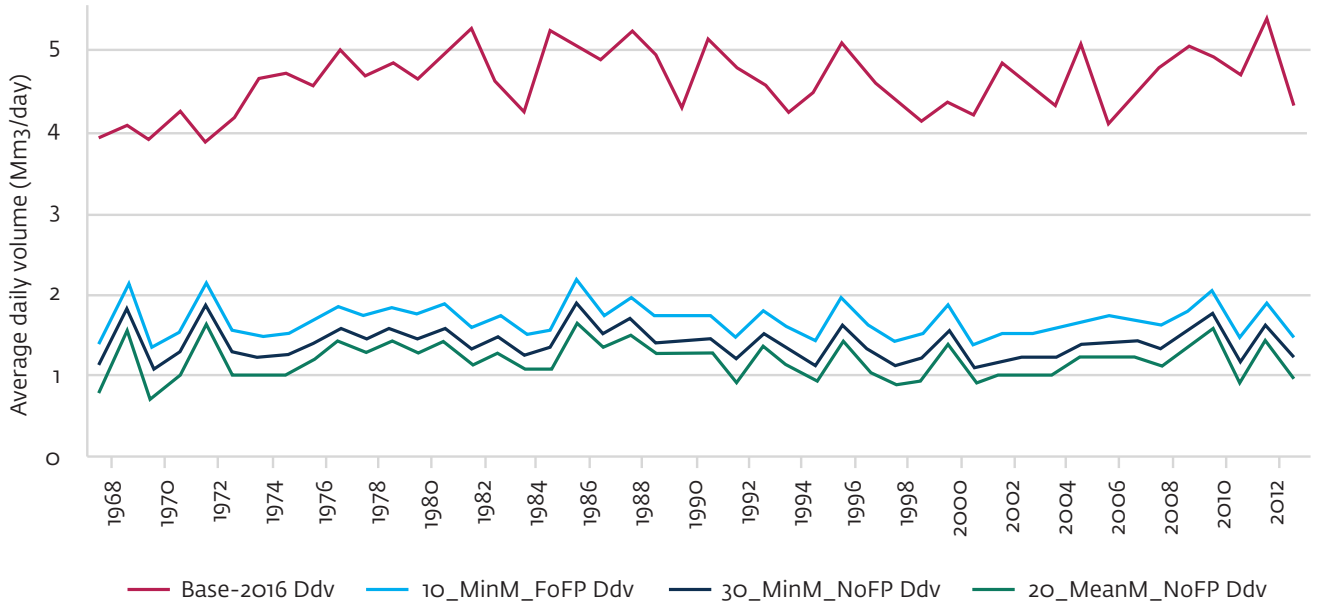
Indicator	Reason for selection as indicators
Transition1 and Transition 2 average daily volume	Dry-wet-dry transitions: • Distribute sediments and nutrients flushed from the watershed • Distribute seeds • Support migration of adults and larvae
Transition 2 recession slope	Transition 2 recession shape refers to the speed at which the flows change from wet season flows to dry season flows. Under natural conditions this is usually a relatively gentle transition, but this can change with impoundments. If it is a very quick transition, there can be issues of bank collapse and/or stranding similar to those described for "within-day range in discharge."

The scenarios used in this assessment did not include consideration of peaking-power operations. If this scenario was considered then the additional flow indicators linked to daily range in discharge—wet, transition, and dry seasons—would be selected. Changes in water level over short periods are important for a number of reasons:

- The shear stress changes rapidly as the flow rate changes, affecting both the water surface slope and the depth of the river. Thus, conditions for erosion but also for animals and plants change rapidly over this time, often to a point where they can no longer maintain their position in the channel, resulting in wash-away.
- Rapid decreases in flow can also lead to stranding of animals as flows recede from an area quicker than the animals can respond.
- As water levels decrease, riverbanks may not drain as quickly as the river recedes, leading to an over pressuring within the banks that reduces bank stability.

Figure D3.2 shows examples of annual time-series of a DRIFT flow indicator with average daily volume in the dry season (showing four scenarios).

Figure D3.2: Examples of Annual Time-Series of a DRIFT Flow Indicator: Average Daily Volume in the Dry Season (showing four scenarios)



4. Fish Indicators Used in the EFlows Assessment and Their Flow-Related Needs

The Trishuli River is a fast-flowing river with higher gradient (approximately 3 percent) in the initial length followed by moderate slope (approximately 1 percent) and mild slope (approximately 0.3 percent) as the river reaches plains (see profile of the river in Figure D1.1). The river is rich in fish biodiversity, especially the cold-water fish like Snow Trout. As outlined in the section "Indicator Fish Species and Distribution" in chapter 1, the following four fish indicators were selected as indicators for EFlows Assessment:

- Snow Trout (*Schizothorax richardsonii*)
- Golden Mahseer (*Tor putitora*)
- Buduna (*Garra annandalei*)
- Indian Catfish (*Glyptothorax indicus*)

The first two species are migratory, whereas the remaining two are nonmigratory or resident fish species. All the species selected as indicators demonstrate a comparatively higher degree of specialization in habitat preference in the study area. In other words, the habitat range of these species was observed to terminate either moving upstream or downstream within the study area. Changes in flow regime are therefore likely to have a comparatively high level of impact on these species. The Snow Trout is found in the entire study area, whereas the Golden Mahseer, the Buduna, and the *Glyptothorax* are reported to be found at or below EFlows site 4.

The Snow Trout prefers to live among rocks and is primarily a bottom feeder, preferably feeding near big submerged stones. It is mainly herbivorous, feeding mainly on algal slimes, aquatic plants, and detritus but also aquatic insect larvae encrusted on the rocks (Vishwanath 2010). The Snow Trout has two spawning periods, March–April and October–November. It migrates from lakes and rivers of the valley to the adjoining tributaries to find suitable places for breeding, mainly in side streams or a side channels along the main river bed (Jhingran 1991; Welcomme 1985; and Sunder 1997).

A summary of key life history aspects of the Snow Trout is provided in Table D4.1. It includes the preferences for flow-dependent habitat, breeding, and migratory behavior.

Table D4.1: Summary of Key Life History Aspects and Flow Related Needs of Snow Trout

Habitat, food, and temporal pattern		Juveniles		Adults (nonbreeding)		Spawning	
		Information/ data	References	Information/data	References	Information/data	References
Habitat and flow preferences	Description of habitat	-	-	Found in rivers and streams of mountainous areas of the Himalayas, India, Afghanistan, and Nepal	Menon 1999; Sunder et al. 1999; Talwar and Jhingran 1991	Clear water on gravelly or stony grounds or on fine pebbles (50–80 millimeter diameter)	Shrestha and Khanna 1976

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Table D4.1: Summary of Key Life History Aspects and Flow Related Needs of Snow Trout *(continued)*

Habitat, food, and temporal pattern		Juveniles		Adults (nonbreeding)		Spawning	
		Information/ data	References	Information/data	References	Information/data	References
Habitat and flow preferences *(continued)*	Altitude	-	-	The Snow Trout is found in abundance in the 1,875 meter to 3,125 meters above sea level zone and prefers rapid, pool, and riffle types of habitats	IUCN Red List of Threatened Species (Vishwanath, W.)	-	-
	Substrate	Stones and gravels	Raina and Petr 1999	Rocks and big submerged stones	IUCN Red List of Threatened Species (Vishwanath 2010)	Developing eggs and larvae have been seen in semi-stagnant nursery beds along riverbanks interspaced with gravel and stones	Raina and Petr 1999
	Depth	<0.75 meters	Shrestha and Khanna 1976	1–3 meters	NCMG n.d.	1–3 meters	Shrestha and Khanna 1976
	Velocity	0–2 meters per second	Shrestha and Khanna 1976	2–8.4 m/s (Note: the upper value may not be high as this would pose energetic constraints for fish and needs to be verified).	NCMG n.d.	2–8.4 meters per second	Shrestha and Khanna 1976
	Temperature	10–18 °C	Shrestha and Khanna 1976	7.2–22 °C	NCMG n.d.	12–15 °C	Shrestha and Khanna 1976
	Dissolved O_2	6–8 mg/l	http://www.fao.org/docrep/005/y3994e/y3994e0q.htm	6–8 mg/l	Rai et al. n.d.	10–15 mg/l	Sunder 1997; Shrestha and Khanna 1976

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Table D4.1: Summary of Key Life History Aspects and Flow Related Needs of Snow Trout *(continued)*

Habitat, food, and temporal pattern	Juveniles		Adults (nonbreeding)		Spawning	
	Information/ data	References	Information/data	References	Information/data	References
Food preferences	Invertebrates, algae		Omnivorous and opportunist feeder. Mainly algae, fish, and invertebrates.	Shrestha 1990; Jhingran 1991	n/a	n/a

Additional information	Information/data	References
Migration	Snow Trout migrate upstream at the start of the monsoon season in March–April and downstream at the end of this season in October–November for spawning.	Shrestha 1990; Negi 1994; Talwar and Jhingran 1991
Triggers	Breeding is triggered by snowmelt and rise in turbidity. Fish move to breeding grounds in shallow side pools, side channels, and tributaries of the river with cobbles and gravely beds. Eggs hatch in this season, and fries and fingerlings remain in shallow waters in side channels.	Jhingran 1991; Welcomme 1985; Sunder 1997
Spawning behavior	Snow Trout spawns when two years old, depending on food supply. Mature Snow Trout has a change in color during the breeding time. Mature males develop tubercles on either side of the snout, faint yellow color of the body, and reddish color of fins. Females spawn in natural as well as in artificial environments. This fish can spawn naturally or by stripping the wild/cultured mature female during the spawning season. It spawns in September/October and March/April.	Rai et al. n.d.

Months	Flow conditions	Fish Behavior	References
May/June	Onset of flood season	Snow Trout spawn in spring. By this time of the year, the fish eggs reach their final stage of maturity provided the aquatic system provides sufficient food required for proper development of eggs. Once the eggs reach their final stage of maturity, the fish are ready to spawn under various triggers like the snowmelt, rise in water temperature, comparatively higher turbidity level, swelling of rivers, creation of side channels, and so forth, mainly linked with the monsoon rains and snowmelt in the upper reaches of the Himalayan rivers.	Negi 1994; Rafique and Qureshi 1997; Talwar and Jhingran 1991
October–November	Onset of winter season	Snow Trout migrates downstream during winter as water temperatures decline in the upper reaches of the rivers, and a part of population may spawn at this time. It is not found in the upper reaches of the rivers in the cold winter months.	EF Assessment UT-1 HEP, ESSA, Nov. 2014; Shrestha 1990; Sivakumar 2008; Talwar and Jhingran 1991

For other indicator fish species, for example, Mahseer, Buduna and Indian Catfish, the preferences for flow-dependent habitat, breeding, and migratory behavior as well as a summary of the annual cycle of breeding and growth of these fish are shown in Table D4.2, Table D4.3, and Table D4.4.

The variations in the abundance of fish species in response to variations in selected flow indicators for the Trishuli River are described in terms of a series of response curves. (See chapter 7, "Response Curves.")

Table D4.2: Preferences for Flow–dependent Habitat, Breeding, and Migratory Behavior of the Mahseer

	Adults	Juveniles	Spawning
Depth of water	0.5–2.0 meters	0.1–0.3 meters	0.3–0.5 meters
Velocity	0–3 meters per second	0–0.5 meters per second	0.5–1.0 meters per second
Habitat	Inhibit streams, pools and lakes. Found in rapid streams with rocky bed.	Slow-moving water with rocky bed.	Spawning is done in well-oxygenated and calm water with gravel bed.
Substrate	Rocky, stony	Cobbles	Stones, cobbles
Temperature	15–25 °C	20–25 °C	21–25°C
Dissolved O_2	6–8 milligrammes/litre (mg/l)	6–8 mg/l	6–8 mg/l
Food	Omnivorous, food consists of macroinvertebrates, dipteran larvae and plant matter.	Diatoms, ciliates, rotifers, crustaceans and fish fry.	Planktons
Spawning period	**May–August**		
Breeding period and trigger	May–August in the flood season. Breeding is triggered by arise in temperature after the dry season. Breeds both in river as well as in tributaries in suitable habitat.		
Movement pattern	From Mangla reservoir or deep waters to breeding areas in side nullahs. It migrates upstream from the main river into rivulets mainly during the southwest monsoon. Migration process is due to the reproductive biology of the fish and also in search of fresh feeding grounds.		
Movement triggers	Rise in water temperature, swollen river and expansion of habitat.		
Other flow–related needs	Is sensitive to pollution.		

Table D4.3: Preferences for Flow-Dependent Habitat, Breeding, and Migratory Behavior of the Buduna

	Adults	Juveniles	Spawning
Depth	0.3–0.7 meters	0.1–0.5 meters	0.2–0.3 meters
Velocity	1–2 meters per second	0.3–0.5 meters per second	0–0.5 meters per second
Habitat	Slow moving water with boulders, rocks	Slow moving water with rocky beds	Side channels with vegetation and shallow pools
Substrate	Rocky	Rocky	Cobble
Temperature	16–24°C	18–22°C	18–22°C
Dissolved O_2	4–6 mg/l	4–6 mg/l	4–6 mg/l
Food	Algae and diatoms, detritus	Algae and diatoms	–
Breeding period and trigger	May–August in the Flood Season. Breeding is triggered by rise in temperature after the Dry Season. Spawning in side channels in shallow waters (10–20 centimeters) with boulders, vegetation, and low currents.		
Movement pattern	Shows seasonal movement.		
Movement timing	During fall and spring season.		
Movement triggers	Availability of side pools with shallow waters, rise in temperature		
Other flow-related needs	Is sensitive to pollution. Can tolerate turbidity.		

Table D4.4: Preferences for Flow-Dependent Habitat, Breeding, and Migratory Behavior of the Indian Catfish

	Adults	Juveniles	Spawning
Depth	Shallow (<1.0 meters)	Shallow (<0.5 meters)	Shallow (<0.5 meters)
Velocity	Slow (0.5–2.0 meters per second), can tolerate floods by taking shelter under boulders and in shallow backwater pools.	Slow (0.5–1.0 meters per second)	Slow (0.5–1.0 meters per second)
Habitat	Side pools with mild water current along the fast-flowing water. The river bottom with fine gravel and gravel mixed with sand	Side channels with mild water current and gravely river bed	Riffles, shallow pools, with gravely beds
Substrate	Gravely or gravely/sandy	Gravely or gravely/sandy	Gravely or gravely/sandy
Temperature	15–22 °C	15–22 °C	15–22 °C
Dissolved O_2	6–8 mg/l and can survive 5–6 mg/l	6–8 mg/l	6–8 mg/l
Food	Insect larvae, micro-invertebrate	Micro-invertebrates	–
Breeding period and trigger	Late April–August in the flood Season/ snowmelt high flow. Breeding is triggered by rise in temperature after the Dry Season. Spawning in side channels in shallow waters (10–20 centimeters) with gravely and gravel-sand mixed river beds and low currents.		
Movement pattern	Shows limited dispersal movements for spawning and feeding		
Movement timing	Limited movement at the onset of wet season for breeding feeding and also at the onset of dry season for overwintering		
Movement triggers	Swollen rivers, change in water temperature, day length, change in turbidity		
Other flow-related needs	Is sensitive to pollution. Can tolerate turbidity.		

5. Ecosystem Indicators

Ecosystem indicators comprised riverine components that respond to a change in river flow (or sediment) by changing their abundance, concentration, or extent (area). The ecosystem indicators that are selected to capture the response to changes in water flow and longitudinal connectivity are most influential in the life history of the fish species considered. This is shown in Table D5.1.

Each indicator is linked with other indicators deemed to be driving change. The aim is not to try to capture every conceivable link, but rather to restrict the links to those that are most meaningful and can be used to predict the bulk of the likely responses to a change in the supply of water, sediment, or longitudinal connectivity. For migratory fish species, links were also made upstream and downstream to sites to ensure that the effects of disruption of these migration routes by HPPs could also be captured.

Table D5.1: Ecosystem Indicators Used in the Trishuli River DRIFT DSS

EFlows Sites	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Geomorphology							
Bedload inflows	✓	✓	✓	✓	✓	✓	✓
Suspended sediment inflows	✓	✓	✓	✓	✓	✓	✓
Suspended sediment load	✓	✓	✓	✓	✓	✓	✓
Exposed sand and gravel bars	✓	✓	✓	✓	✓	✓	✓
Exposed cobble and boulder bars	✓	✓	✓	✓	✓	✓	✓
Median bed sediment size (armouring)	✓	✓	✓	✓	✓	✓	✓
Area of secondary channels, backwaters	✓	✓	✓	✓	✓	✓	✓
Algae							
Algae	✓	✓	✓	✓	✓	✓	✓
Macro-invertebrates							
EPT abundance	✓	✓	✓	✓	✓	✓	✓
Fish							
Alwan snot trout guild	✓	✓	✓	✓	✓	✓	✓
Garra guild				✓	✓	✓	✓
Glyptothorax				✓	✓	✓	✓
				✓	✓	✓	✓

6. Ecological Status

The descriptions for Ecological Status categories are provided in Table D6.1.

Baseline Ecological Status of the EFlows Sites

The baseline ecological status (BES) used for the Trishuli River in this assessment is summarized in Table D6.2.

The EFlows Assessment team visited the EFlows sites 2 to 7 in March 2018. The EIA study report, CIA study report, and other assessments of UT-1 HEP provide a basis for deciding the BES of the EFlows sites 1, 2, and 3, which lie in the UT-1 project boundary. As the Trishuli River follows a mild slope from EFlows site 5 and downward to EFlows site 6, a substantial sand and gravel mining was seen at site. Most of the aggregate machines were operating along the banks of the Trishuli River in this stretch. Therefore, the EFlows Assessment team rated the BES of the EFlows sites 5 and 6 to be low. However, as the river flows further down, the river health is not as degraded compared to the above two sites and also with relatively clear water from Buddhi Gandaki, a large tributary of the Trishuli River, which it joins above the EFlows site 7. The team therefore rated the EFlows site 7 as in better condition.

Table D6.1: Categories for Baseline Ecological Status

Ecological category	Description of the habitat condition
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 changed and the changes are irreversible.

Source: *After Kleynhans 1997.*

Table D6.2: BES of the EFlows Sites on the Trishuli River

Discipline	EFlows Site 1	EFlows Site 2	EFlows Site 3	EFlows Site 4	EFlows Site 5	EFlows Site 6	EFlows Site 7
Geomorphology	A/B	A/B	A/B	A/B	B/C	C	B
Algae	B	B	B	B	B/C	D	B
Macro-invertebrates	B	B	B	B	C	D	B
Fish	B/C	B/C	B/C	B/C	B/C	C	B
Overall ecosystem integrity	B	B	B	B	B/C	C	B

7. Response Curves

The response curves do not address any of the scenarios directly. The curves are drawn for a range of possible changes in each linked indicator, regardless of what is expected to occur in any of the scenarios. For this reason, some of the explanations and/or X-axes refer to conditions that are unlikely to occur under any of the scenarios but are needed for completion of the response curves. In addition, each response curve has a shape that assumes that all other conditions (indicators) remain at baseline.

The relationships are similar across all areas, although the actual curves may differ slightly from what is shown here. For the exact relationship used for each focus area please refer to the DSS. The focus area used as an example is denoted in the caption.

The response curves relationships used for this assessment were not derived specifically for the assessment for the Trishuli River. For fish, the response curves from the Neelum-Jhelum Basin have been utilized for modeling of Trishuli Basin, since the river basins have similar species and are Himalayan Rivers. For other indicators, available information and expert judgement was used for preparing the response curves.

The linked indicators, the response curves and the explanations of the shape of the response curves for each of the indicators, using EFlows site 4 as an example, are tabulated as follows:

Table D7.1 Exposed Sand and Gravel Bars

Table D7.2 Exposed Cobble and Boulder Bars

Table D7.3 Median Bed Sediment Size

Table D7.4 Area of Secondary Channels and Backwaters

Table D7.5 Algae

Table D7.6 Ephemeroptera, Plecoptera, and Trichoptera (EPT)

Table D7.7 Snow Trout

Table D7.1: Exposed Sand and Gravel Bars

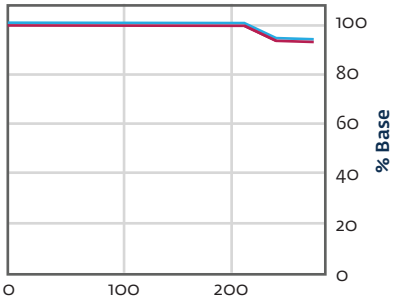
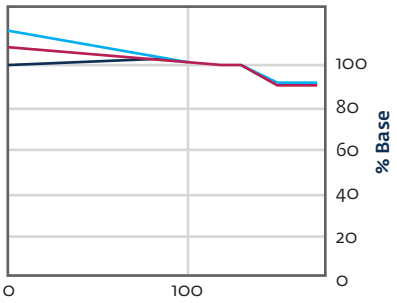
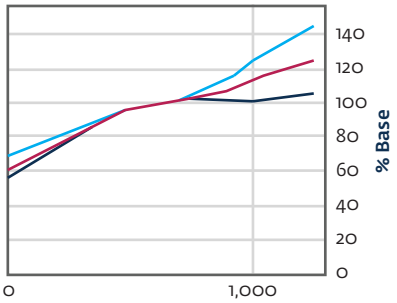
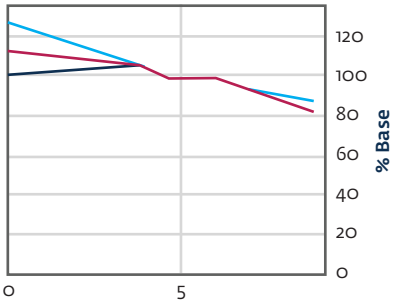
Linked indicator and response curve	Explanation
a. Dry season duration (D Season) Desc / Days / Y1 / Y2 Min 0.000 0.000 Min base 154.000 0.000 179.000 0.000 Median 204.000 0.000 222.000 -0.100 Max base 240.000 -0.300 Max base 276.000 -0.400 	During the dry season when sediment levels are low, finer sediment is scoured from the active channel, leading to a slow loss of sand and gravel bars. The longer the dry season, the more erosion of bars will occur.
b. Wet season duration (F season) Desc / Days / Y1 / Y2 Min 0.000 0.500 Min base 84.000 0.100 98.000 0.050 Median 112.000 0.000 131.500 -0.100 Max base 151.000 -0.500 Max base 173.650 -0.600 	Longer wet seasons mean a longer period of high flows with relatively lower sediment loads. (In this river observed data suggest that the peak sediment loads generally occur early in the wet season, prior to peak discharge.) Thus, longer wet seasons may mean greater erosion (widening and deepening) in the main channel, causing some reduction of sand and gravel.
c. Max 5d wet season Q (F season) Desc / m3/s / Y1 / Y2 Min 0.000 -2.000 Min base 391.480 -0.500 522.460 -0.100 Median 653.440 0.000 873.940 0.300 Max base 1094.440 1.200 Max base 1258.606 1.500 	Larger floods are associated with higher sediment loads, and with widespread channel instability and reworking of the channel bed and banks. Large floods will thus introduce more sediment and create more sand and gravel bars during the flood season (which can be exposed as sand and gravel bars during the dry season).
d. Dry season ave daily vol (D season) Desc / Mm3/d / Y1 / Y2 Min 0.000 1.000 Min base 3.800 0.200 4.283 0.100 Median 4.675 0.000 6.286 -0.200 Max base 7.896 -0.600 Max base 9.081 -1.000 	Lower flows mean that more bars will be exposed.

Table D7.2: Exposed cobble and boulder bars

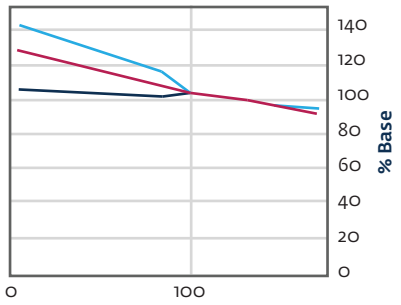
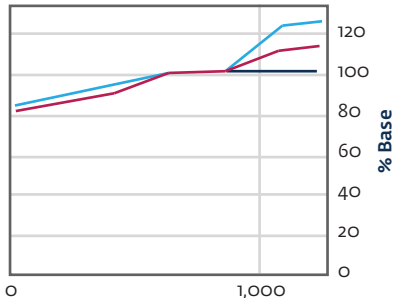
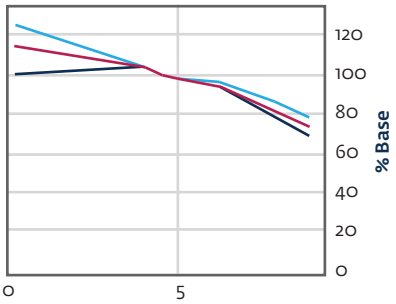
Linked indicator and response curve	Explanation
a. Wet season duration (F season) Desc / Days / Y1 / Y2 Min 0.000 1.500 Min base 84.000 0.500 98.000 0.100 Median 112.000 0.000 131.500 -0.100 Max base 151.000 -0.300 Max base 173.650 -0.500 	Longer wet seasons mean a longer period of high flows with relatively lower sediment loads. (In this river observed data suggest that the peak sediment loads generally occur early in the wet season, prior to peak discharge.) Thus, longer wet seasons may mean greater erosion (widening and deepening) in the main channel, with some potential loss of cobble bars.
b. Max 5d wet season Q (F season) Desc / m3/s / Y1 / Y2 Min 0.000 -1.000 Min base 391.480 -0.500 522.460 -0.250 Median 653.440 0.000 873.940 0.100 Max base 1094.440 0.900 Max base 1258.606 1.000 	Very large floods tend to redistribute sediments across the channel, and in rivers with a cobble matrix these events should enlarge existing and create additional bars. Very small floods may not overcome thresholds to redistribute bed sediments across the valley floor, allowing bars over time to be incorporated in to the bank.
c. Dry season ave daily vol (D season) Desc / Mm3/d / Y1 / Y2 Min 0.000 1.000 Min base 3.890 0.200 4.283 0.100 Median 4.675 0.000 6.286 -0.300 Max base 7.896 -0.900 Max base 9.081 -1.500 	Lower flows mean that more bars will be exposed

Table D7.3: Median bed sedimentsize

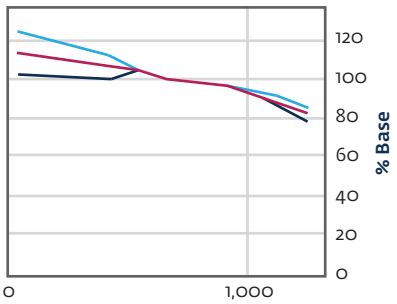
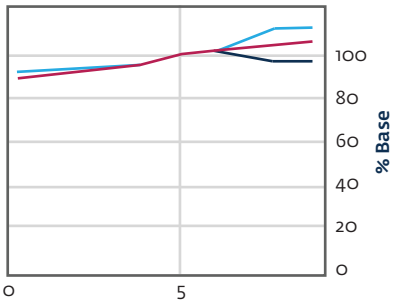
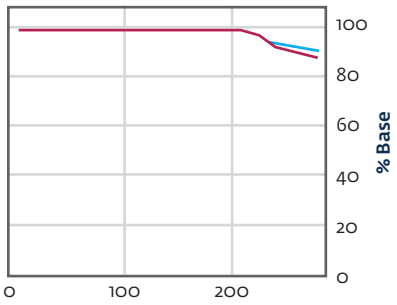
Linked indicator and response curve	Explanation
a. Max 5d wet season Q (F season) Desc / m3/s / Y1 / Y2 Min / 0.000 / 1.000 Min base / 391.480 / 0.350 / 522.460 / 0.150 Median / 653.440 / 0.000 / 873.940 / -0.200 Max base / 1094.440 / -0.600 Max base / 1258.606 / -1.000 	Larger floods are associated with higher sediment loads, and with widespread channel instability and reworking of the channel bed and banks. Large floods will thus reset the channel sediments, resulting in overall finer average bed sediment conditions.
b. Dry season ave daily vol (D season) Desc / Mm3/d / Y1 / Y2 Min / 0.000 / -0.500 Min base / 3.890 / -0.150 / 4.283 / -0.050 Median / 4.675 / 0.000 / 6.286 / 0.150 Max base / 7.896 / 0.250 Max base / 9.081 / 0.350 	The lower the dry season discharge, the more fines that can deposited on the channel bed and thus the smaller the mean bed sediment size will become. The higher the dry season discharge, the more fines that will be removed and the coarser the (now armored) channel bed will become.

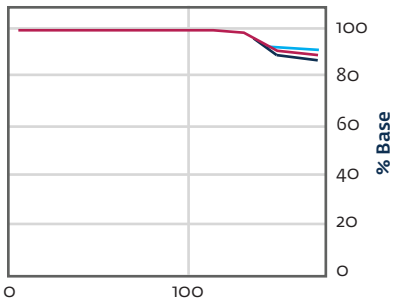
Table D7.4: Area of Secondary Channels and Backwaters

Linked indicator and response curve	Explanation
a. Dry season duration (D Season)	During the dry season when sediment levels are low, the active channel bed slowly erodes, increasing capacity and leading to a slow abandonment of secondary channels. The longer the dry season, the more secondary channel abandonment will occur. This process will be exacerbated by reductions in sediment from upstream dams.
b. Wet season duration (F season)	Longer wet seasons mean a longer period of high flows with relatively lower sediment loads. (In this river observed data suggest that the peak sediment loads generally occur early in the wet season, prior to peak discharge.) Thus, longer wet seasons may mean greater erosion (widening/ deepening) in the main channel, causing some loss of secondary channels.
c. Max 5d wet season Q (F season)	Very large floods will over-widen the channel and erode areas for secondary channels to form. Very small or failed floods may not be able to counteract channel narrowing of the low flow season.
d. Dry season ave daily vol (D season)	The higher the average dry season flows, the more secondary channels will remain active during the low flow season (and thus available for instream biota).

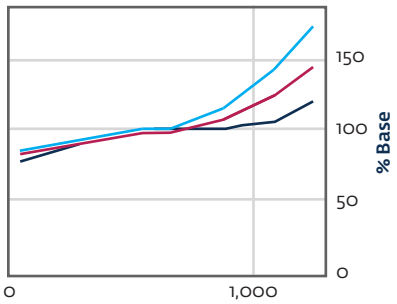
Desc	Days	Y1	Y2
Min	0.000	0.000	
Min base	154.000	0.000	
	179.000	9.000	
Median	204.000	0.000	
	222.000	-0.100	
Max base	240.000	-0.400	
Max base	276.000	-0.600	



Desc	Days	Y1	Y2
Min	0.000	0.000	
Min base	84.000	0.000	
	98.000	0.000	
Median	112.000	0.000	
	131.500	-0.100	
Max base	151.000	-0.500	
Max base	173.650	-0.600	



Desc	m3/s	Y1	Y2
Min	0.000	-1.000	
Min base	391.480	-0.300	
	522.460	-0.100	
Median	653.440	0.000	
	873.940	0.500	
Max base	1094.440	1.500	
Max base	1258.606	2.000	



Desc	Mm3/d	Y1	Y2
Min	0.000	-4.000	
Min base	3.890	-0.500	
	4.283	-0.200	
Median	4.675	0.000	
	6.286	0.200	
Max base	7.896	0.800	
Max base	9.081	1.000	

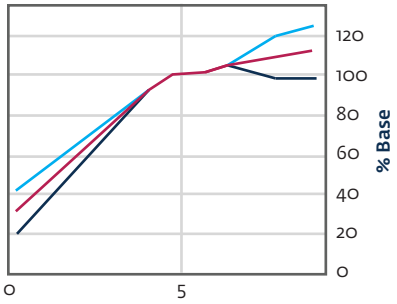
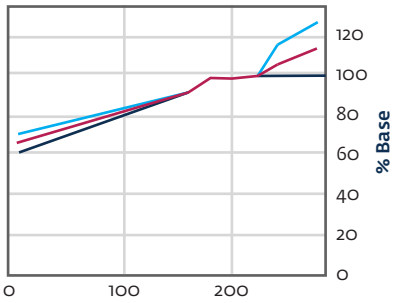


Table D7.5: Algae

Linked indicator and response curve	Explanation
a. Dry season duration (D Season)	Longer dry season means more time for algae to become established and temperatures also favorable toward the end of the dry season.

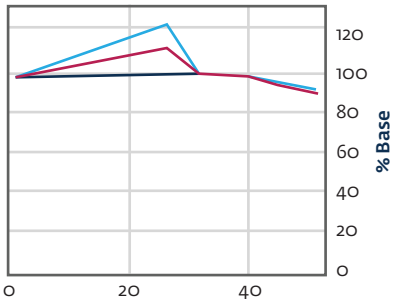
Desc	Days	Y1	Y2
Min	0.000	-2.000	
Min base	154.000	-0.500	
	179.000	-0.100	
Median	204.000	0.000	
	222.000	0.000	
Max base	240.000	5.000	
Max base	276.000	1.000	



b. Min 5d dry season Q (D season)

Lower discharge means calmer conditions, better for algae, to a point. At 0 cumecs (one cubic meter of water per second) the river will freeze.

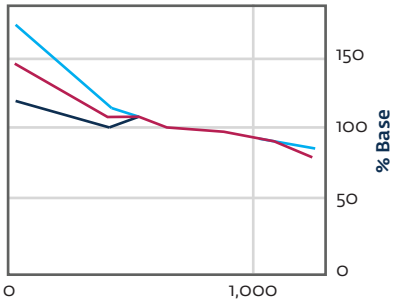
Desc	m3/s	Y1	Y2
Min	0.000	0.000	
Min base	25.620	1.000	
	30.570	0.100	
Median	35.520	0.000	
	40.260	0.000	
Max base	45.000	-0.250	
Max base	51.750	-0.500	



c. Max 5d wet season Q (F season)

Lower peak flows and warm conditions will favor algae growth. Higher turbidity and currents will adversely affect the population.

Desc	m3/s	Y1	Y2
Min	0.000	2.000	
Min base	391.480	0.500	
	522.460	0.200	
Median	653.440	0.000	
	873.940	-0.200	
Max base	1094.440	-0.500	
Max base	1258.606	-1.000	



d. Median bed sediment size [armouring] (F season)

The more stable (armored) the bed, the greater the flows necessary to remove algae.

Desc	%Base	Y1	Y2
Min	0.000	-0.300	
Min base	25.000	-0.200	
	50.000	-0.100	
Median	100.000	0.000	
	150.000	0.000	
Max base	200.000	0.500	
Max base	250.000	1.000	

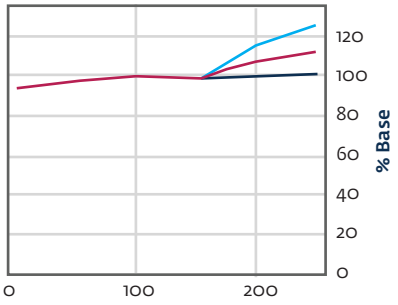
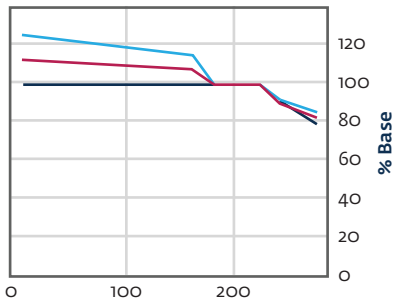


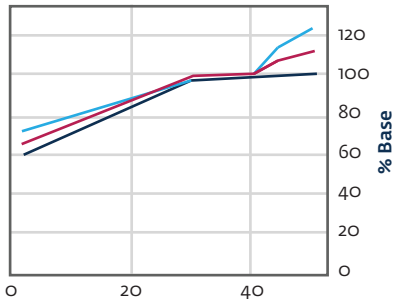
Table D7.6: Ephemeroptera, Plecoptera, and Trichoptera (EPT)

Linked indicator and response curve	Explanation
a. Dry season duration (D Season)	Aquatic invertebrates have life histories that are adapted to wide variations in seasonal flows, but populations are likely to drop slightly if the low-flow period is too long. A longer period of low flows is also likely to increase the risks of mortality as a result of high water temperature once the seasons change.
b. Min 5d dry season Q (D season)	With less discharge there is less wetted area.
c. Wet season onset (F season)	Delayed onset will affect cues for emergence/laying eggs
d. Wet season duration (F season)	The absence of a wet period will not provide the cues needed for hatching of eggs. Sufficient wet season duration is required to provide time for eggs to mature and hatch.

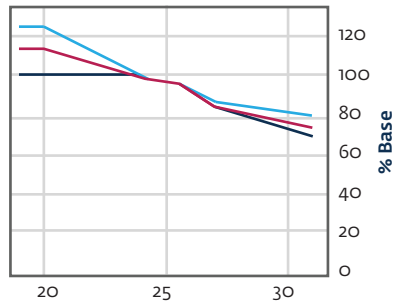
Desc	Days	Y1	Y2
Min	0.000	1.000	
Min base	154.000	0.500	
	179.000	0.000	
Median	204.000	0.000	
	222.000	0.000	
Max base	240.000	-0.500	
Max base	276.000	-1.000	



Desc	m3/s	Y1	Y2
Min	0.000	-2.000	
Min base	25.620	-0.250	
	30.570	0.000	
Median	35.520	0.000	
	40.260	0.000	
Max base	45.000	0.500	
Max base	51.750	1.000	



Desc	Cal week	Y1	Y2
Min	19.000	1.000	
Min base	20.000	1.000	
	22.000	0.500	
Median	24.000	0.000	
	25.500	-0.200	
Max base	27.000	-0.900	
Max base	31.050	-1.500	



Desc	Days	Y1	Y2
Min	0.000	-2.000	
Min base	84.000	-0.500	
	98.000	0.000	
Median	112.000	0.000	
	131.500	0.000	
Max base	151.000	0.400	
Max base	173.650	0.500	

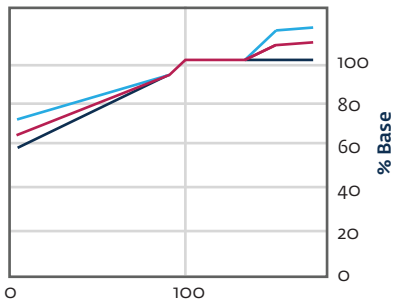


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Table D7.6: Ephemeroptera, Plecoptera, and Trichoptera (EPT) *(continued)*

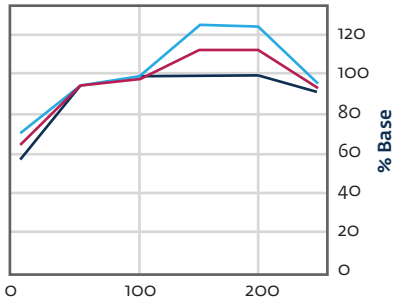
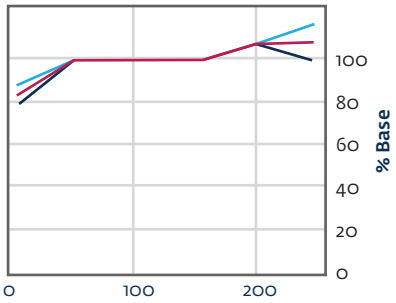
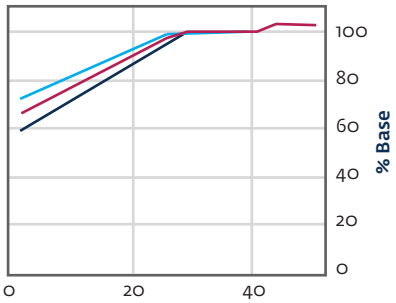
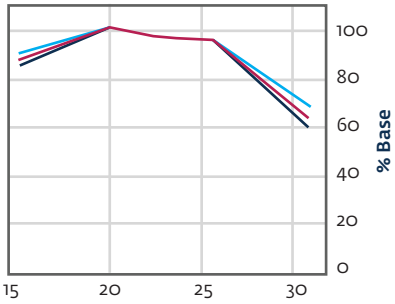
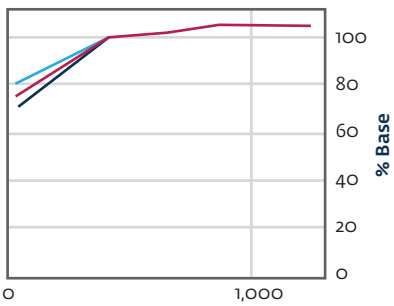
Linked indicator and response curve	Explanation
e. Median bed sediment size [armouring] (D season) Desc / %Base / Y1 / Y2 Min 0.000 -2.000 Min base 25.000 -1.000 50.000 -0.250 Median 100.000 0.000 150.000 1.000 Max base 200.000 1.000 Max base 150.000 -0.250 	Fine sediments are difficult to attach to, EPT will do better with a more armored bed up to a point beyond which they will decline again.
f. Algae (F season) Desc / %Base / Y1 / Y2 Min 0.000 -1.000 Min base 25.000 -0.500 50.000 0.000 Median 100.000 0.000 150.000 0.000 Max base 200.000 0.200 Max base 250.000 0.500 	EPT eat algae.

Table D7.7: Snow Trout

Linked indicator and response curve	Explanation
a. Min 5d dry season Q (D season) Desc / m3/s / Y1 / Y2 Min 0.000 -2.000 Min base 25.620 -0.150 30.570 0.000 Median 35.520 0.000 40.260 0.000 Max base 45.000 0.100 Max base 51.750 0.100 	Lower flows mean lower water levels, low temperatures as a result of lack of buffering. Can tolerate low temperatures and high turbidity. Field surveys in winter recorded temperatures of around 8°C, and air temperatures around 8–9°C.

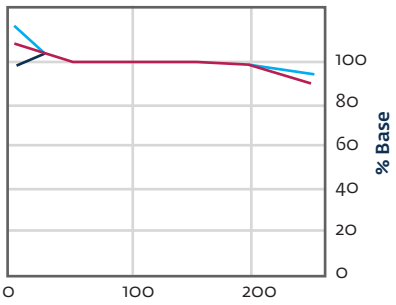
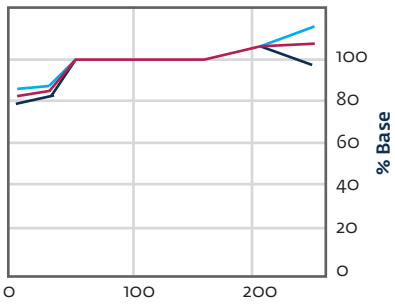
Continued on next page

Table D7.7: Snow Trout *(continued)*

Linked indicator and response curve	Explanation
b. Wet season onset (F season) Desc / Cal week / Y1 / Y2 Min / 15.000 / -0.500 Min base / 20.000 / 0.200 22.000 / 0.050 Median / 24.000 / 0.000 25.500 / 0.000 Max base / 27.000 / -0.500 Max base / 31.050 / -2.000 	The Snow Trout breeds during summer season from May to August (Negi 1994). By this time of the year, the fish eggs reach their final stage of maturity provided the aquatic system provides sufficient food required for proper development of eggs. Once the eggs reach to their final stage of maturity, the fish is ready to spawn under various triggers like the snowmelt, rise in water temperature, comparatively higher turbidity level, swelling of rivers, creation of side channels and so forth, mainly linked with the monsoon rains and snowmelt in the upper reaches of the Himalayan rivers (Rafique and Qureshi 1997). The breeding triggers, however, should coincide with the maturity of eggs in the ovary of fish for successful spawning. Early onset of the flood season (a month before the median) is predicted to lead to better food availability early in the season, which would help the proper development of eggs leading to improved breeding. In years when there is a delayed onset of the flood season, it is predicted that the fish would have mature eggs but could miss the necessary triggers for breeding. Eggs could perish within the fish and be reabsorbed. Failure of the flood season would mean that breeding habitats in the side channels do not become available, resulting in the failure of breeding.
c. Max 5d wet season Q (F season) Desc / m3/s / Y1 / Y2 Min / 0.000 / -1.500 Min base / 391.480 / -0.150 522.460 / -0.050 Median / 653.440 / 0.000 873.940 / 0.100 Max base / 1094.440 / 0.100 Max base / 1258.606 / 0.100 	Lower flows in the wet season means lower water levels: may result in higher water temperatures as a result of lack of buffering. Can tolerate a range of water temperatures 8°C to 22°C (Sharma 1989) [optimal temperature 15–16°C]. Field surveys in summer recorded temperatures of around 14–160C.

Continued on next page

Table D7.7: Snow Trout *(continued)*

Linked indicator and response curve	Explanation
d. Exposed sand and gravel bars (D season) Desc %Base Y1 Y2 Min 0.000 0.500 Min base 25.000 0.100 50.000 0.000 Median 100.000 0.000 150.000 0.000 Max base 200.000 -0.100 Max base 250.000 -0.500 	Prefer breeding habitat is side streams and back waters with gravel, rocky, cobbly bed. Pools and crevices preferred for wintering. Expanding sand and gravel bars will deteriorate habitat quality (pools and riffles).
e. Median bed sediment size [armouring] (F season) Desc %Base Y1 Y2 Min 0.000 -1.000 Min base 25.000 -0.800 50.000 0.000 Median 100.000 0.000 150.000 0.000 Max base 200.000 0.200 Max base 250.000 0.500 	The fish favor areas with gravel and algae. Gravel beds, free of fine sediment, provide habitat for attached algae and are the feeding and breeding grounds for snow trout. Armoring would increase the availability of food for this fish, while fine sediment in the bed would reduce the area available for algal growth (Talwar and Jhingran 1991; Raina and Petr 1999). With decreasing particle sizes, there would be a higher chance of embeddedness of the spawning areas. The smaller particles fill the interstitial spaces and make it hard for attached algae to grow on the gravely and cobble bed resulting in less fish food production and hence a considerable decrease in fish population. Accumulation of larger particles in the river bed (armoring) result in a growth of attached algae, which is food for the fish. It also becomes the breeding habitat for fish as they prefers the gravely and cobble bed for breeding. Consequently, the armoring of the bed results in a modest increase in fish population.

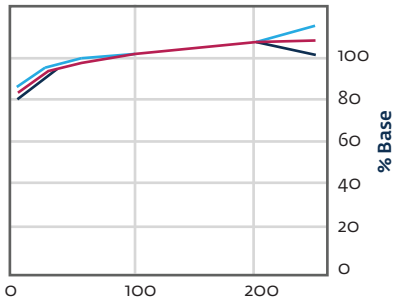
Continued on next page

Table D7.7: Snow Trout *(continued)*

Linked indicator and response curve	Explanation

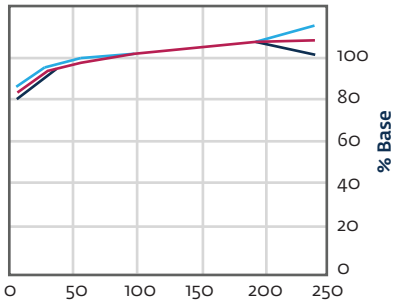
f. Areas of secondary channels, backwaters (D season)

Desc	%Base	Y1	Y2
Min	0.000	-1.000	
Min base	25.000	0.500	
	50.000	-0.200	
Median	100.000	0.000	
	150.000	0.100	
Max base	200.000	0.200	
Max base	250.000	0.300	



g. Algae (D season)

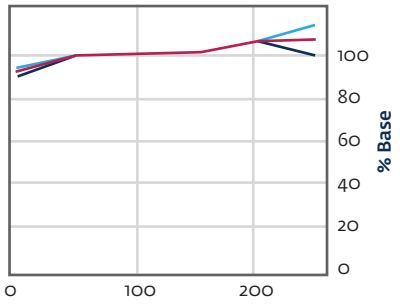
Desc	%Base	Y1	Y2
Min	0.000	-1.000	
Min base	25.000	-0.500	
	50.000	-0.200	
Median	100.000	0.000	
	150.000	0.100	
Max base	200.000	0.200	
Max base	250.000	0.300	



Snow Trout are omnivorous and feed on algae and aquatic invertebrates, mainly EPT (Raina and Petr 1999). Its mouth is adapted to scraping algae from stones (Rai et al. n.d.).

h. EPT abundance (F season)

Desc	%Base	Y1	Y2
Min	0.000	-0.500	
Min base	25.000	-0.250	
	50.000	-0.050	
Median	100.000	0.000	
	150.000	0.000	
Max base	200.000	0.200	
Max base	250.000	0.300	



Snow Trout are omnivorous and feed on algae and aquatic invertebrates, mainly EPT (Raina and Petr 1999). They are opportunist feeders and their dependence on invertebrates varies depending on the season and stage of maturity. In years with low EPT productivity, the fish would have less invertebrate food and the population would be compromised (Jhingran 1991). In years with high EPT productivity, all age classes of fish would have better growth and fattening for overwintering and a high fecundity rate, which would lead to overall higher numbers.

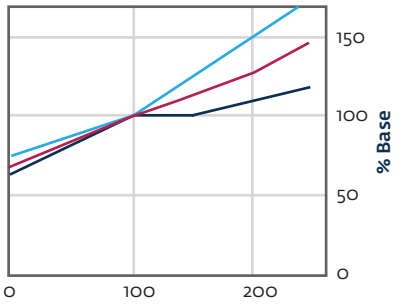
Continued on next page

Table D7.7: Snow Trout *(continued)*

Linked indicator and response curve	Explanation
i. Alwan snow trout guild (F season, Site = Site 5, Step = -1)	Snow Trout migrate up from EFlows site 5
j. Comp: Alwan snow trout (F season, Site = Site 3)	Snow Trout moving down from EFlows site 3.
k. Comp2: Alwan snow trout (F season, Site = Site EFSal, Step = -1)	Snow Trout migrate to EFlows site 4 from the Salankhu tributary.

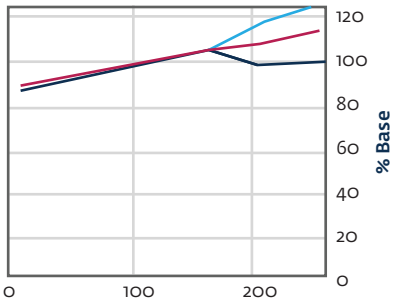
i.

Desc	%Base	Y1	Y2
Min	0.000	-1.737	
Min base	25.000	-1.303	
	50.000	-0.868	
Median	100.000	0.000	
	150.000	1.000	
Max base	200.000	1.640	
Max base	250.000	2.020	



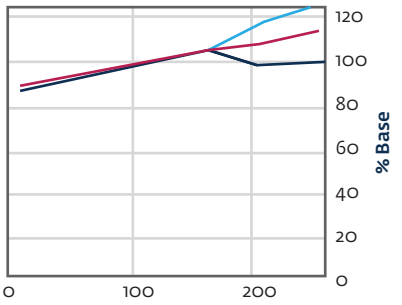
j.

Desc	%Base	Y1	Y2
Min	0.000	-0.579	
Min base	25.000	-0.434	
	50.000	-0.289	
Median	100.000	0.000	
	150.000	0.189	
Max base	200.000	0.625	
Max base	250.000	1.000	



k.

Desc	%Base	Y1	Y2
Min	0.000	-5.790	
Min base	25.000	-0.434	
	50.000	-0.289	
Median	100.000	0.000	
	150.000	-0.189	
Max base	200.000	0.625	
Max base	250.000	1.001	



8. Scenarios Evaluated

The following scenarios were evaluated:

1. Scenario 1: Existing Projects

2. Scenario 2: Existing and Under-construction (Scenario 2a) and Committed (Scenario 2b)

3. Scenario 3: Full Development (Existing + Under-Construction + Committed + Planned Projects)

Apart from the 24 HPPs listed in Table D8.1 for which the DRIFT assessment was conducted, an additional 11 HPPs listed in Table D8.2 (categorized as "planned—survey license given") were also accounted for in the cumulative impact assessment. These additional HPPs were not modeled in the DRIFT DSS. However, on the basis of expert judgment, impacts from these 11 additional projects were estimated based on extrapolation of DRIFT DSS results for the 24 HPPs.

Assumption for Barriers to Fish

The influence of the weir and reservoir of different HPPs on Snow Trout and Mahseer populations at the various sites is partially attributable to the barrier created to the movement of fish between breeding and feeding areas, or between the main stream and tributaries. To account for this influence, the DRIFT DSS considered the influence of weirs on the movement of Snow Trout and Mahseer between the EFlows sites.

Within the DRIFT DSS, the barrier effect of water resource developments is modelled through specifying percentage reductions (or increases) in the "connectivity" between one site and another. Connectivity effects are specified per indicator.

The impact of the barrier on fish is dictated by a combination of migration success and dependence on migration. For instance, a population of fish may depend on getting past a barrier in order to access spawning and/or breeding grounds, and there may be no other location where the fish breed: this population would be highly dependent on migration.

Table D8.1: Scenarios Selected for the Assessment Including HPPs

Scenarios	Code	Name of HPP	Operation used in scenario	Barrier effect on fish (reduction)		Barrier effect on sediments (reduction)	
				Upstream	Downstream	Bed load	Suspended load
Existing projects	Existing	Chilime HEP	Base load	100%	90%	10%	5%
		Mailung Khola HPP	Base load	100%	90%	10%	5%
		Trishuli HEP	Base load	100%	90%	10%	5%
		Devighat HEP	Base load	100%	90%	10%	5%
		Tadi Khola HPP1	Base load	100%	90%	10%	5%
		Thoppal Khola HPP	N/A				

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Table D8.1: Scenarios Selected for the Assessment Including HPPs *(continued)*

Scenarios	Code	Name of HPP	Operation used in scenario	Barrier effect on fish (reduction)		Barrier effect on sediments (reduction)	
				Upstream	Downstream	Bed load	Suspended load
		Upper Sanjen HPP	Base load	100%	90%	5%	5%
		Sanjen HPP	Base load	100%	90%	10%	5%
		Upper Mailung A HEP	Base load	100%	90%	5%	5%
		Upper Mailung Khola HEP	Base load	100%	90%	5%	5%
		UT-3A HEP	Base load	100%	90%	10%	5%
		UT-3B HEP	Base load	100%	90%	10%	5%
Existing, under-construction, and committed projects	Committed	UT-1	Base load	100%	90%	10%	5%
Existing, under-construction, committed, and planned projects	Full development	Sanjen Khola HEP (Salasungi Power)	Base load	100%	90%	10%	5%
		Langtang Khola Small HPP	Base load	100%	90%	10%	5%
		Salankhu Khola HPP	Base load	100%	90%	10%	5%
		Phalaku Khola HPP	Base load	100%	90%	10%	5%
		Phalaku Khola HPP	Base load	100%	90%	10%	5%
		Upper Tadi HPP	Base load	100%	90%	10%	5%
		Middle Tadi Khola HHP	Base load	100%	90%	10%	5%
		Lower Tadi	Base load	100%	90%	10%	5%
		Trishuli Galchi HPP	Base load	100%	90%	10%	5%
		Super Trishuli HPP	Base load	100%	90%	10%	5%

Table D8.2: Project Accounted for Cumulative Impact Assessment of Trishuli Basin Based on Extrapolation of DRIFT DSS Results

No.	HPPs planned/survey license given	MW	River
1	Upper Trishui-2 HPP	102.0	Trishuli Mainstem
2	Bhotekoshi Khola HPP	44.0	Bhotekoshi Khola
3	Mathillo Langtang HPP	24.35	Langtang Khola
4	Langtang Khola Reservoir HPP	310.0	Langtang Khola
5	Trishuli Khola HPP	4.4	Trishuli Khola
6	Upper Trishuli 1 Cascade HPP	24.6	Trishuli Mainstem
7	Upper Mailung B HPP	7.5	Mailung Khola
8	Middle Mailung HPP	10.0	Mailung Khola
9	Middle Trishuli Ganga Nadi HPP	65.0	Trishuli Mainstem
10	Tadi Ghyamphedi HPP	4.7	Tadi Khola
11	Tadi Khola HPP	4.0	Tadi Khola

9. Results of Scenario Analyses

For each scenario, the predicted changes in the river ecosystem are evaluated per site as:

1. estimated mean percentage change from baseline in the abundance, area, or concentration of key indicators, and

2. a time-series of abundance, area, or concentration of key indicators under the flow regime resulting from each scenario.

Integrity ratings were calculated from the abundance changes by assigning a positive or negative sign to changes in abundance depending on whether an increase in abundance is a move toward natural or away. The integrity ratings for each indicator were then combined to provide an *overall ecosystem integrity*. The ecological integrity ratings (after Kleynhans 1996) are shown in Table D9.1.

The overall ecosystem integrity for each EFlows site associated with each scenario is summarized in Table D9.2. Projects categorized as "planned/survey license given" were also accounted for in the cumulative impact assessment based on extrapolation of DRIFT DSS results for the 24 HPPs that were modeled. Overall ecosystem integrity estimated in this manner for the Planned/survey license given is provided in the last column in table D9.2.

The fish integrity is shown in Table D9.3.

Most of the sites are not affected by flow changes as a result of HPPs, but depending on the scenarios, they may be affected by the barrier effect created by the weirs of these HPPs.

Table D9.1 Ecological Integrity Ratings

Ecological category	Corresponding DRIFT overall integrity score	Description of the habitat condition
A	>-0.25	Unmodified. Still in a natural condition.
B	>-0.75	Slightly modified. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged.
C	>-1.5	Moderately modified. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged.
D	>-2.5	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	>-3.5	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	<-3.5	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 completely altered and the changes are irreversible.

Source: *Kleynhans 1996.*

Table D9.2: Overall Integrity for Each Site Associated with Each Scenario

EFlows site/ reach	Existing (Scenario 1)	Under-construction (Scenario 2a)	Under-construction and committed (Scenario 2b)	Full development (Scenario 3)
EFlows Site 1	B	B/C	C/D	D
EFlows Site 2	B	B/C	E	E
EFlows Site 3	C	C/D	D	E
EFlows Site 4	C	C	C	D
EFlows Site 5	C	C	C	D
EFlows Site 6	C/D	C/D	C/D	D
EFlows Site 7	B	B	B	C

Table D9.3: Fish Integrity for Each EFlows Site Associated with Each Scenario

EFlows site/ reach	Existing (Scenario 1)	Under-construction (Scenario 2a)	Under-construction and committed (Scenario 2b)	Full development (Scenario 3)
EFlows Site 1	C	D	F	F
EFlows Site 2	C	D	F	F
EFlows Site 3	D	F	F	F
EFlows Site 4	D	D	D	E
EFlows Site 5	D	D	D	E
EFlows Site 6	C/D	C/D	C/D	E
EFlows Site 7	B	B	B	C

Survey License Given Projects

The impact on overall ecosystem integrity with addition of projects under the planned—survey license will deteriorate further mainly due to the impact of the additional barriers created for the migratory fish, primarily for Snow Trout at all EFlows sites, and for Mahseer at EFlows site 5, which is the extent of its distribution in the Trishuli River.

EFlows site 1: The population of fish will decline further with additional hydropower projects under the planned/survey license given scenario. There will be marginal impact on the fish population in Langtang Khola, as this tributary is snowmelt fed and does not offer much in the way of breeding and spawning grounds for fish. The impacts on the fish in Chilime Khola (which already has two under-construction and one existing project) will be also marginal. However, additional HPPs in Trishuli Khola will impact this fish. Overall ecosystem integrity is estimated to drop from C/D to D at EFlows site 1 with the additional HPPs in the planned/survey license given scenario.

EFlows site 2: The population of fish will drop further at EFlows site 2 due to addition of UT-1 cascade in the planned/survey license given scenario. However, ecosystem integrity, which is already very low at this site with 24 HPPs in place, will remain at E.

EFlows site 3: The population of fish will significantly drop at EFlows site 3 with the addition of three HPPs: UT-1 cascade, Middle Mailung and Upper Mailung B. Fish breeding in main Trishuli River and Mailung Khola will be found at this site in the summer, but the fish will be trapped between the dams and will not be able to access favorable feeding and breeding areas. The breeding in Mailung Khola will further decline with the additional HPPs in this tributary. The contribution of Mailung Khola to population of fish in the main Trishuli River at EFlows site 3 will therefore decline further. The overall ecosystem integrity will drop from D to E category.

EFlows site 4: The population of fish will drop further at EFlows site 4 due to addition of Middle Trishuli Ganga Nandi HPP in the planned/survey license given scenario. The overall ecosystem integrity will drop from C/D to D at this site.

EFlows sites 5, 6, and 7: Additional projects will not have a significant incremental impact on the population of fish, and overall ecosystem integrity will remain same at these sites.

Additional projects in Tadi Khola tributary will have impacts on the fish populations in the upper reaches of Tadi Khol. However, these projects will not have a significant incremental impact on the population of both the Snow Trout and Mahseer in the main Trishuli River. As Existing projects on Tadi Khola have already isolated the upstream breeding and feeding areas of these fish from the Trishuli River.

Impacts on Indicator Fish Species

The summary of mean percentage changes relative to the baseline (which equals 100 percent) for indicators fish species at different EFlows sites under different scenarios as calculated by the DRIFT model is shown in Table D9.4.

Snow Trout (*Schizothorax*)

Table D9.4 includes the predicted impacts for the Snow Trout. This is a large-sized commercially important migratory fish that is captured and sold in the summer season. This fish requires a lotic or river habitat for breeding. Its population is decreasing due to introduction of exotics, damming of the rivers, and overfishing. It migrates to different parts of the Trishuli River during winter and summer seasons depending upon the seasonal temperature changes and is therefore prone to impacts as a result of any change in temperature regime, flow patterns, and damming. This is illustrated by the decline in its population seen in the baseline

1. With UT-1 HPP in place under Committed Scenario, the Snow Trout population is likely to decrease significantly at EFlows site 1 due to barrier to both upstream and downstream migration created by the dam.

2. Operation of the UT-1 project (committed) will result in low flows at EFlows site 2, severely impacting the population of Snow Trout.

3. At EFlows site 3, even though the flow downstream of tailrace of UT-1 is restored, the barrier to migration created by UT-3A (under-construction) has a significant impact on the population of this fish.

4. EFlows site 4 is already degraded due to extensive sediment mining. Fish populations are therefore expected to be low at this site (Table D9.4)

5. The planned projects, namely Trishuli Ghaki and Super Trishuli, present barriers to migration of Snow Trout, significantly impacting the population of this fish at EFlows sites 5 and 6 and restricting the access of the fish to breeding areas located in Tadi Khola tributary.

6. The population of this fish is relatively unaffected at EFlows site 7 where the fish have access to breeding areas in a number of tributaries downstream and can also breed in the river, in which the flow is not as turbulent as at upstream sites. The temperature at this site is also moderated by the tributaries that flow in to the river such as Budhi Gandakai and Kali Gandaki further downstream.

Table D9.4: The Mean Percentage Changes (relative to scenario 1 baseline of 100%) for the Indicator Fish Species

Fish species	EFlows site	Existing	Under-construction	Committed	Planned (10 projects)
Snow Trout	1	-8.0	-16.6	-53.1	-58.5
	2	-9.5	-21.4	-92.8	-93.0
	3	-26.0	-57.5	-66.0	-66.1
	4	-45.7	-55.0	-55.0	-68.5
	5	-25.6	-25.7	-25.8	-61.9
	6	-18.0	-18.3	-18.4	-68.3
	7	-3.9	-4.4	-4.6	-16.3
Mahseer	4	-59.4	-58.3	-57.9	-85.7
	5	-55.2	-53.0	-52.6	-88.0
	6	-29.9	-28.2	-27.7	-71.8
	7	-16.8	-15.3	-14.8	-54.0
Buduna	4	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0
	6	0.0	0.0	0.0	0.0
	7	0.0	0.0	0.0	0.0
Indian Catfish	4	0.0	0.2	0.3	0.3
	5	0.6	1.0	1.1	1.3
	6	0.2	0.3	0.3	0.5
	7	0.1	0.2	0.2	0.4

Note: *Change representing a decline in condition relative to baseline is marked as follows: Orange = change >40–70%; red = change >70%.*

The anticipated impacts on Snow Trout with the addition of projects under the planned/survey licenses given scenario are as follows:

1. With the addition of projects under the planned/survey license given scenario, the population of Snow Trout will deteriorate further, mainly due to the impact of the additional barriers created, which will stop seasonal migration as well as access to spawning grounds.

2. The population of Snow Trout will be marginally impacted in Langtang Khola and Chilime Khola. However, additional HPPs in Trishuli Khola will significantly impact this fish, and the overall population of this fish at EFlows site 1 will drop further.

3. The population of Snow Trout will also decline further at EFlows site 2, as its population will be trapped within the low-flow area of UT-1 and impoundments of UT-1 cascade. The fish at EFlows site 2 will not be able to access their spawning and seasonal migration grounds.

4. The addition of UT-1 cascade, Middle Mailung HPP, and Upper Mailung B HPP will result in a decline in Snow Trout population at EFlows site 3. Fish will breed in main Trishuli River and Mailung Khola in summers at this site. However, the fish will be trapped between the UT-1 cascade and UT-3A dams and will not be able to access feeding, migration, and breeding areas upstream of UT-1 cascade and downstream of UT-3A dam.

5. The population of Snow Trout will also be trapped at EFlows site 4 with the addition of Middle Trishuli Ganga Nandi HPP. The fish will lose access to their feeding and breeding grounds at this site and population will drop further.

6. At EFlows sites 5, 6, and 7 and the additional projects in the planned/survey license given scenario will not have a significant incremental impact on the population of Snow Trout, as projects in this scenario are located upstream of these sites.

Mahseer (*Tor*)

Table D9.4 shows the predicted impacts for the Mahseer. The Mahseer also face intense human pressures such as fishing and mining. This fish inhabit fast-flowing stretches and pools. They can colonize impoundments, and so may survive within the reservoirs, but they require flowing water for breeding. This is an economically important fish both from a food and ecotourism perspective. While this fish will survive in the main stem of the Trishuli River, the reservoir with fine sediments in the bed will not provide a preferred habitat for this fish, and it will not be able to breed in the reservoirs. The tributaries in which Mahseer breeds are located mainly downstream of the EFlows site 4.

1. The Mahseer is already is already degraded at EFlows site 4 due to extensive sediment mining. The population of this fish is therefore expected to be low at this site. This is also a long-distant migratory fish that migrates from EFlows site 4 downward all the way up to the Ganges. However, existing projects (for example, Trishuli HPP and Devighat HPP) have already set barriers to its migration.

2. The impacts on this fish at EFlows site 5 will also be similar to EFlows site 4.

3. The planned projects, namely Trishuli Ghaki and Super Trishuli, present barriers to the migration of this fish, which is significantly impacting the population of this fish at EFlows sites 6 and 7 and restricting the access of this fish to its overwintering areas located in downstream section of river.

4. With the addition of projects under the planned/survey license given scenario, the population of Mahseer will deteriorate mainly at EFlows site 5, as this fish is not found upstream of existing Trishuli HEP. Its population at sites 6 and 7 will not be affected further as there are no additional projects under the planned/survey license given category below EFlows site 5.

Buduna (*Garra*)

Table D9.4 shows the predicted impacts for the Buduna. This fish is adapted to river conditions and does not prefer a lake or lentic environment, although some fish may be found in the reservoirs. Relatively low levels of flow release are sufficient to support the population of this fish. This is the reason this fish is showing no change under different scenarios. The additional projects under the planned/survey license given category will not have any incremental impact on population of Buduna as there are no additional projects in this scenario within the occurrence range of this species.

Indian Catfish (*Glyptothorax*)

Table D9.4 show predicted changes for the Indian Catfish. This is a benthopelagic and carnivorous species, which occurs only in fast-flowing hill streams and feeds on aquatic insect larvae. It is a small fish with no significant direct fishing pressures. As the fish is small and is not likely to swim through the reservoir, the population in the remaining stretches will become isolated but the population there will be sustained. This fish is likely to suffer very insignificant change due to project developments under different scenarios. Being a nonmigratory fish species, its population is not likely to reduce in any of scenarios. The additional projects under the planned/survey license given category will not have any incremental impact on population of Indian Catfish as there are no additional projects in this scenario within the occurrence range of this species.

10. Conclusions

The indicators used in the EFlows Assessment of the Trishuli Basin depict that the current plans of hydropower development in the Trishuli River and its tributaries are likely to affect the aquatic ecology of the Trishuli River. However, provided adequate provision is made for successful upstream and downstream passage of fish species past the weirs, the bulk of its impact should be minimized within the stretch of the river considered in this assessment.

Altogether five scenarios were evaluated at seven major EFlows sites:

1. Upstream of UT-1 dam site
2. Dewatered reach of the UT-1 HEP
3. Downstream of UT-1 tailrace
4. Downstream of UT-3B tailrace
5. Upstream of Tadi Khola Confluence
6. Downstream of Mahesh Khola confluence
7. Downstream of Super Trishuli HPP

As shown in Table D9.4, the Snow Trout populations will be significantly affected at EFlows sites 1 to 3, moderately affected at EFlows site 4, and the effects will be lower moving downward from EFlows site 5, as the connectivity barrier effects will be reduced and contributions from the tributaries in the snow trout population will be more. Golden Mahseer is, however, likely to suffer much under different scenarios, the severe case being the Super Trishuli HPP in place.

The results presented here concentrate on the summary information contained in the assessment of ecological integrity. This gives an indication of the overall situation of biodiversity in the Trishuli Basin if full development is carried out. It is very useful to look at more detailed indictor results of each site as these underline the fact that under the committed and the planned scenarios, it will be very difficult to prevent loss of fish species.

The response curves used in the EFlows Assessment of Neelum-Jhelum Basin in Pakistan have been utilized for this assessment, since the two river basins are similar and they have similar fish species. Regarding sediments, experience of typical run-of-river hydropower projects in Nepal have been applied for defining the connectivity issues in DRIFT DSS.

All of the indicators fish species will be significantly impacted by the reservoirs and low-flow section created by the HPPs. The *Garra* and *Glyptothorax* species will be practically eliminated in these sections as they cannot survive in lake environments and need cobble beds for feeding and shelter. The migratory Snow Trout and Mahseer also need a flowing river environment for survival and growth. However, the reservoirs will sustain the populations of these species and will provide refuge in winters.

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APPENDIX E: PROJECT DESCRIPTIONS

Project name as per DoED website (24 Nov. 2017)	Capacity (MW) as per DoED website	Status as per DoED website	Location (river, GP, district)	District	IEE/EIA needed	Dam coordinates		Power house coordinates		Reservoir coordinates		Project located on main river or tributary	Name of river or tributary	Dam height (m)	Power house capacity (MW)	Length of river between dam and power-house (km)
						Lat.	Long.	Lat.	Long.	Lat.	Long.					
Existing																
Devighat (DHP)	14.1	Operational	Trishuli River	Nuwakot	Yes	NA	NA	27° 53' 16.8"	85° 08' 02.76"	NA	NA	River	Trishuli	NA	NA	NA
Trishuli	24	Operational	Trishuli River	Nuwakot		27° 57' 46.78"	85° 10' 13.43"	27° 55' 17.1"	85° 08' 45.45"	27° 56' 13.5"	85° 09' 7.44"	River	Trishuli	NA	24	NA
Chilime (CHP)	22.1	Operational	Chilime Khola	Rasuwa		28° 11' 33"	88° 18' 10"	28° 9' 52"	88° 19' 59"	28° 11' 17"	88° 18' 26"	Tributary	Chilime	Diversion only	22.1	7
Mailung Khola HEP	5	Operational	Mailun Khola	Rasuwa	Yes	28° 04' 56"	85° 11' 58"	28° 04' 13"	85° 12' 26"	NA	NA	Tributary	Mailung Khola	NA	5	NA
Thoppal Khola HPP	1.65	Operational	Thoppal Khola	Dhading	Yes	27° 49' 17"	84° 50' 31"	NA	NA	NA	NA	Tributary	Thopal	3.5	1.4	NA
Tadi Khola (Thaprek) HPP	5	Operational	Tadi Khola	Nuwakot	Yes	27° 55' 21"	85° 20' 54"	27° 55' 22"	85° 19' 38"	NA	NA	Tributary	Tadi Khola	NA	5	NA
Under Construction																
Rasuwagadhi (RGHEP)	111	Construction license issued	Trishuli River	Rasuwa		28° 16' 39"	85° 12' 03"	28° 14' 25"	85° 21' 22"	NA	NA	River	Bhote Koshi	9	100	NA
UT 3A HEP	60	Construction license issued	Trishuli River	Rasuwa	Yes	28° 03' 39"	85° 23' 03"	28° 03' 08"	85° 12' 18"	NA	NA	River	Trishuli	NA	60	NA
UT 3B HEP	37	Construction license issued	Trishuli River	Nuwakot	Yes	27° 59' 12"	85° 10' 11"	NA	NA	NA	NA	River	Trishuli	Cascade	37	NA
Upper Mailung Khola HEP	14.3	Construction license issued	Mailung Khola	Rasuwa		28° 07' 48.70" N	85° 11' 57.65" E	28° 06' 03.30" N	85° 11' 46.69" E	NA	NA	Tributary	Mailung Khola	5.11	14.3	2.98
Upper Mailung A HEP	6.42	Construction license issued	Mailung Khola	Rasuwa	Yes	28° 09' 45"	85° 11' 00"	NA	NA	NA	NA	Tributary	Mailung Khola	14.8	NA	NA
Upper Sanjen (USHEP)	14.8	Construction license issued	Sanjen Khola	Rasuwa	Yes	28° 13' 00"	85° 16' 30"	NA	NA	NA	NA	Tributary	Sanjen Khola	NA	NA	NA

Project name as per DoED website (24 Nov. 2017)	Length of reservoir upstream of dam (km)	If tunnel exists, length of tunnel (km)	Type of operation (please tick)			If the project has an EFlows requirement what is this? (cumecs)	Has the project provided a monthy EFlows schedule?	How many days of sediment flushing will be carried out?	When will sediment flushing be carried out?	What is the frequency of flushing?	Is a fish pass ladder planned for the project?	If so, what is the design?	Has the project provided average monthly discharges for all years monitoring has taken place?	Has the project provided baseline water quality reports?	Has the project provided baseline water temperature monitoring reports?
			Continuous run of the river	Run of the river of a daily basis (seasonal peaking)	Peaking only										
Existing															
Devighat (DHP)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trishuli	Pondage is downstream of dam for peaking purposes	NA	No	NA	✓	Not provided, but half the dam can accommodate spillway	NA	NA	NA	NA	No, but fish may be able to migrate through the spill way.	NA	NA	NA	NA
Chilime (CHP)	Pondage upstream	3.36	No	NA	✓	No EFlows (as all water is diverted from the Chillime Khola into the tail race)	NA	During rainy season only	On alternate days	NA	No	NA	NA	NA	NA
Mailung Khola HEP	NA	NA	✓	NA	No		NA	NA	NA	NA	No	NA	NA	NA	NA
Thoppal Khola HPP	NA	NA	✓	NA	No		NA	NA	NA	NA	No	NA	NA	NA	NA
Tadi Khola (Thaprek) HPP	NA	NA	✓	NA	No		NA	NA	NA	NA	No	NA	NA	NA	NA
Under Construction															
Rasuwagadhi (RGHEP)	No reservoir	4.375	✓	NA	No	Not provided but likely to be 10 % of minimum monthly flow.	NA	NA	NA	NA	Yes	NA	NA	NA	NA
UT 3A HEP	No reservoir	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA
UT 3B HEP	No reservoir	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA	NA	NA	NA
Upper Mailung Khola HEP	0.03	2.3	✓	NA	No	0.102	No	Settling basin-regular flushing; reservoir-flushing once in f/Y, if needed.	12 hr, if needed.	NA	No	NA	No	Yes	No
Upper Mailung A HEP	NA	NA	✓	NA	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Sanjen (USHEP)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Continued on next page

Project name as per DoED website (24 Nov. 2017)	Capacity (MW) as per DoED website	Status as per DoED website	Location (river, GP, district)	District	IEE/EIA needed	Dam coordinates		Power house coordinates		Reservoir coordinates		Project located on main river of tributary	Name of river or tributary	Dam height (m)	Power house capacity (MW)	Length of river between dam and power-house (km)
						Lat.	Long.	Lat.	Long.	Lat.	Long.					
Under Construction *(continued)*																
Sanjen Hydro Project (SHEP)	42.5	Construction license issued	Sanjen Khola	Rasuwa	Yes	28° 11' 00"	85° 16' 30"	NA	NA	NA	NA	Tributary	Sanjen Khola	NA	NA	NA
Committed																
UT 1	216	Construction license issued	Trishuli River	Rasuwa		28° 07' 32" N	85° 18' 03" E	28° 04' 37" N	85° 12' 40" E	NA	NA	River	Trishuli	29.5	216	12
Planned																
Super Trishuli Hydro Project	100	Applied for construction license for generation	Trishuli River	Rasuwa		27°51' 37"N	84° 38' 39"E	At toe of dam		NA	NA	River	Trishuli	24.5	100	Power-house at toe of dam
Sanjen Khola HEP	78	Construction license issued	Sanjen Khola	Rasuwa		28° 14' 26"	85° 15' 00"	NA	NA	NA	NA	Tributary	Sanjen Khola	2.31	78	5
Upper Tadi HPP	11	Construction license issued	Tadi Khola	Nuwakot		NA	NA	NA	NA	NA	NA	Tributary	Tadi Khola	3	11	
Tadi Khola Hydro Project	5	Construction license issued	Tadi Khola	Nuwakot	Yes	27° 56' 04"	85° 22' 53"	NA	NA	NA	NA	Tributary	Tadi Khola	5	NA	NA
Lower Tadi	4.993	Construction license issued	Tadi Khola	Nuwakot	Yes	27° 55' 05"	85° 21' 08"	NA	NA	NA	NA	Tributary	Tadi Khola	4.933	NA	NA
Langtang Khola Small Hydropower Project	10	Construction license issued	Langtang	Rasuwa	Yes	28° 09' 05"	85° 20' 34"	NA	NA	NA	NA	Tributary	Langtang Khola	NA	NA	NA
Salankhu Khola HPP	2.5	Construction license issued	Salankhu Khola	Nuwakot		27° 59' 00"	85° 07' 30"	NA	NA	NA	NA	Tributary	Salankhu Khola	2.5	2.2	NA
Phalaku Khola HPP	5	Construction license issued	Phalaku Khola	Rasuwa	Yes	27° 58' 09"	85° 15' 17"	NA	NA	NA	NA	Tributary	Phalanku Khola	NA	NA	NA
Phalaku Khola HPP	14.7	Construction license issued	Phalaku Khola	Rasuwa	Yes	28° 00' 15"	85° 16' 10"	NA	NA	NA	NA	Tributary	Phalanku Khola	NA	NA	NA
Trishuli Galchi HPP	75	Construction license issued	Trishuli River	Nuwakot		27° 51' 48" N	85° 05' 47 " E	27° 47' 52" N	84° 58' 20" N	NA	NA	River	Trishuli	2.5	75	8.15
Ankhu Khola HPP	49.5	Construction license	Ankhu Khola	Dhading	Not in the basin but IEE is available	28° 04' 00" N	84° 58' 35" E	28° 07' 00" N	85° 01' 04" E	NA	NA	Tributary	Ankhu Khola	7.5	42.9	6

Project name as per DoED website (24 Nov. 2017)	Length of reservoir upstream of dam (km)	If tunnel exists, length of tunnel (km)	Type of operation (please tick)			If the project has an EFlows requirement what is this? (cumecs)	Has the project provided a monthy EFlows schedule?	How many days of sediment flushing will be carried out?	When will sediment flushing be carried out?	What is the frequency of flushing?	Is a fish pass ladder planned for the project?	If so, what is the design?	Has the project provided average monthly discharges for all years monitoring has taken place?	Has the project provided baseline water quality reports?	Has the project provided baseline water temperature monitoring reports?
			Continuous run of the river	Run of the river of a daily basis (seasonal peaking)	Peaking only										
Under Construction *(continued)*															
Sanjen Hydro Project (SHEP)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Committed															
UT 1	No reservoir	9.7		✓		See next column	Yes	44 times a year (Nov-Apr: 1 each month, May-3, June-6, July-12, Aug-9, Sep-6, Oct-2), 3 hrs. for 1 time	3.67 times/ month	NA	Yes	NA	Yes	Yes	Yes
Planned															
Super Trishuli Hydro Project	5	No	✓	✓	No	10.62	No	"Winter Monsson"	"One or twice More frequent"	NA	NA	NA	NA	Yes	Yes
Sanjen Khola HEP	No reservoir	4.413	✓	NA	No	0.196	No	NA	NA	NA	No	NA	No	Yes	Yes
Upper Tadi HPP	No reservoir	2.416	✓	NA	NA	6.3	No	NA	NA	NA	No	NA	No	No	No
Tadi Khola Hydro Project	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lower Tadi	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Langtang Khola Small Hydropower Project	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salankhu Khola HPP	No reservoir	3.209	✓	NA	NA	0.043	No	NA	NA	NA	NA	NA	NA	NA	NA
Phalaku Khola HPP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phalaku Khola HPP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trishuli Galchi HPP	3	8.15	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ankhu Khola HPP	No reservoir	5.197	✓	NA	NA	See next column	Yes	NA	NA	NA	Yes	Denil Type	Yes	Yes	Yes

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