Advancing Sustainable Hydropower: Biodiversity Assessment and Management webinar series

ROLE OF THE BIODIVERSITY MANAGEMENT AND ACTION PLANS FOR HYDROPOWER SUSTAINABILITY

April 20, 2021

Presenters:
Leeanne E. Alonso, IFC
Dipesh Bista, Upper Trishuli-1 HPP, NWEDC
Welcome and Housekeeping

Moderator:
Kate Lazarus
Senior Asia ESG Advisory Lead
IFC
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<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter</th>
</tr>
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| 19:00-19:10| Welcome and Housekeeping                                              | Kate Lazarus  
Senior Asia ESG Advisory Lead, IFC                                        |
| 19:10-20:00| Role of the Biodiversity Management and Action Plans for Hydropower Sustainability | Leeanne Alonso, IFC  
Dipesh Bista, Senior Manager E&S, NWEDC                                    |
| 20:00-20:30| Q & A and Conclusions                                                 | *Moderated by:*
Leeanne Alonso, IFC                                                         |
Role of the Biodiversity Management Plan (BMP) and Biodiversity Action Plan (BAP) for Hydropower Sustainability

Presenters:

Leeanne Alonso, Biodiversity Consultant, IFC

Dipesh Bista, Senior Manager, Environment and Social, Nepal Water and Energy Development Company (NWEDC)
Outline of the Presentation

1. Why and When is a BMP or BAP needed?
2. What are a BMP and BAP?
3. Contents of a BMP and BAP
4. Model BMP for the Trishuli River Basin
5. BMP for the Upper Trishuli-1 HPP
THANKS to the following people and organizations for providing material for this presentation:

- **Gina Walsh**, Model Biodiversity Management Plan for Trishuli River Basin, BMP slides
- **Hagler Bailly Pakistan**, Biodiversity Action Plan (BAP) for Gulpur HPP, Pakistan, BAP slides
- **Emma Hume**, The Biodiversity Consultancy, BMP/BAP slides
- **NWEDC**, BMP for the Upper Trishuli-1 HPP, ESIA and BMP
Why and When is a BMP or BAP needed?

To document the actions the project will take to Manage and Mitigate project impacts on Biodiversity

- Development projects, such as hydropower projects, identify environmental and social impacts through the ESIA process.
- If the project will have significant impacts on biodiversity (terrestrial or aquatic, species and habitats), then specific mitigation actions must be developed according to the mitigation hierarchy to avoid and/or reduce the impacts, to restore where possible, and to offset if needed.
- The mitigation actions should be detailed and documented so that the project, contractors, lenders, government and partners all clearly understand how the project will mitigate and monitor its impacts.
- These mitigation actions should be documented in a specific biodiversity focused mitigation plan.

Source: Hagler Bailly Pakistan
Biodiversity Management Documents

International Good Practice, including International Lenders’ Standards such as IFC’s Performance Standard 6 (Biodiversity Management), usually require one or more of the following documents as part of the ESIA:

- **Biodiversity Management Plan (BMP)**
- **Biodiversity Action Plan (BAP)**
- **Biodiversity Monitoring and Evaluation Plan (BMEP)**
- **Contractor Management Plans (ESMMPs)**
- Supplemental plans for specific purposes, such as for biodiversity offsets
- Not all of these documents are required for every project.
IFC’s Performance Standard 6: Requirements for Biodiversity Management

For Projects located in Modified Habitat
- PS6 applies if significant biodiversity values found
- Minimize impacts
- Mitigate as appropriate

For Projects located in Natural Habitat
- No viable alternatives in Modified Habitat
- Views of stakeholders established about impacts
- Need to demonstrate No Net Loss of Biodiversity

For Projects located in Critical Habitat
- No viable alternatives in non-Critical Habitat
- No measurable adverse impacts on CH values or supporting processes
- No net reduction in CR or EN species population over reasonable time period
- Long-term monitoring and evaluation program
- Need to demonstrate Net gain for CH values
- If biodiversity offsets used, provide technical rationale
As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services.
## What are a BMP and BAP?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Biodiversity Action Plan</th>
<th>Biodiversity Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Strategic document</td>
<td>Operational document</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Establishes the biodiversity goals, residual impacts, rationale and actions that will enable a NNL/NG outcome</td>
<td>Details the onsite mitigation measures that will be implemented to avoid, minimise and restore impacts during construction and operations</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>Live document: likely to require updates as the Project develops</td>
<td>Auditable: requires clear timelines, responsibilities and indicators to track each mitigation measure</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Typically Project developer, often requires external partnerships</td>
<td>Typically the Project developer, EPC and contractors</td>
</tr>
</tbody>
</table>

Source: Emma Hume, TBC

BMEP is the monitoring plan used to DEMONSTRATE NNL or NG for either plan
## BMP or BAP?

Biodiversity plans needed will depend on the Biodiversity Values of the area and the Project Impacts

<table>
<thead>
<tr>
<th>Habitat and Biodiversity</th>
<th>Project Impacts on BD</th>
<th>Is NNL or NG required?</th>
<th>Mitigation focus</th>
<th>Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified</td>
<td>Low</td>
<td>No</td>
<td>Within project area</td>
<td>ESMMPs</td>
</tr>
<tr>
<td>Natural</td>
<td>Low</td>
<td>No</td>
<td>Within project area</td>
<td>BMP or ESMMPs</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>No or Yes</td>
<td>Within project area</td>
<td>BMP, (BMEP)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Yes</td>
<td>Within and outside project</td>
<td>BAP, BMEP</td>
</tr>
<tr>
<td>Critical</td>
<td>Low</td>
<td>Yes</td>
<td>Within project area</td>
<td>BAP*, BMEP</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Yes</td>
<td>Within and outside project</td>
<td>BAP*, BMEP</td>
</tr>
</tbody>
</table>

*IFC’s PS6 requires a BAP for projects in Critical Habitat*
Biodiversity Management Plan (BMP)

BMP-equivalents can go by many names, for example:

- Biodiversity Action Plan
- Biodiversity Strategy
- Ecological Management Plan
- Conservation Management Plan
- High Conservation Value Management Plan
- Flora and Fauna Management Plan

They can be stand-alone plans or the actions integrated into one or more plans (e.g., noise, water, air quality). The approach depends on project capacity, management structures, corporate policies or lender/consultant/staff preferences!

The document names do not really matter. What matters is that the Biodiversity Management Actions are clearly documented and detailed.
GN50. Biodiversity-related commitments and mitigation and management actions should be captured in the client’s ESMS. For all projects that have the potential to significantly convert or degrade natural habitats and for projects in critical habitats, these biodiversity actions should be captured in a single dedicated Biodiversity Management Plan (BMP) or integrated into one or more topic-specific management plans (for example, Invasive Species Management Plan, Induced Access Management Plan, Water Management Plan). The BMP or equivalents should be auditable management plans, integrated into a project’s ESMS, which define parties responsible for an action, monitoring and/or verification requirements of an action, and an implementation schedule or frequency for an action. The BMP or equivalents are operational tools for site managers and contractors, with focus on on-site mitigation measures. If biodiversity-related mitigation and management measures appear in other management plans, cross-references to the BMP or to the biodiversity-relevant section in the ESMS should be included. The corresponding monitoring/verification requirements should reflect the principal of adaptive management (see paragraph GN20 of this note), where relevant. Some projects in natural habitats may be required to develop a Biodiversity Action Plan to accompany these documents (see paragraph GN91 of this note).
Contents of a Biodiversity Management Plan (BMP)

To operationalize biodiversity-related management and monitoring as part of a broader Environmental and Social Management Plan (ESMP).

- Implementable & auditable?
- ESIA requirements fully integrated?
- Actions & responsibilities?
- Focus on site-specific mitigation measures?
- Monitoring implementation of site-specific mitigation measures?
- Adaptive management & responsive measures on regular basis?
## Contents of a BMP Mitigation Table

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation Measures</th>
<th>Responsible Party</th>
<th>Timeline</th>
<th>Frequency of implementation</th>
<th>Trigger for implementation</th>
<th>Means of Verification</th>
<th>UT-1 Staff</th>
<th>Responsible for Implementation</th>
<th>Relevant ESMMPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Construction</td>
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<td></td>
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<tr>
<td>Construction</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations</td>
<td></td>
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</tr>
</tbody>
</table>
Role of BMP and BAP for Hydropower Sustainability

- To clearly document the actions to be implemented by a Hydropower Project (and partners) to Mitigate and Manage project impacts on Biodiversity

- For Hydropower, this includes impacts on both Aquatic Ecosystem and Terrestrial Ecosystem, including:

  1. Fish passage and river connectivity
  2. Changes in flow regimes
  3. Habitat impacts
  4. Fauna mortality
  5. Stream morphology and sediment movement
  6. Pollution
### Sample mitigation actions in BMP for Hydropower

See also IFC webinar on January 26, 2021

<table>
<thead>
<tr>
<th>Impact on Biodiversity</th>
<th>Design</th>
<th>Construction</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River Flow</strong></td>
<td>• Operating mode (Run-of-River, Peaking, etc.)&lt;br&gt;• Amplitude/frequency/ ramping of peaking&lt;br&gt;• Height of dam&lt;br&gt;• Reservoir size&lt;br&gt;• EFLoWS modeling&lt;br&gt;• Include EFLoWS release mechanism&lt;br&gt;• Intake position in reservoir&lt;br&gt;• Impoundment management</td>
<td>• Release EFLoWS as needed&lt;br&gt;• Maintain flow through diversion tunnels&lt;br&gt;• Release EFLoWS during reservoir filling per plan (impoundment)</td>
<td>• Release EFLoWS&lt;br&gt;• Monitor EFLoWS release&lt;br&gt;• Follow peaking rules for ramping &amp; flow&lt;br&gt;• Monitor flow rate downstream</td>
</tr>
<tr>
<td><strong>Aquatic Habitat</strong></td>
<td>• Dam location&lt;br&gt;• Length of diversion reach&lt;br&gt;• Flushing plan&lt;br&gt;• Quarry location&lt;br&gt;• Model peaking flows and diversion reach to quantify impact on aquatic habitat&lt;br&gt;• Regulating dam design</td>
<td>• Ensure quarry is not within river bed or sensitive areas&lt;br&gt;• Maintain river flow through construction period&lt;br&gt;• Monitor aquatic biodiversity</td>
<td>• Release EFLoWS&lt;br&gt;• Adjust EFLoWS if too low in diversion&lt;br&gt;• Enhancement of diversion reach (mitigate peaking)&lt;br&gt;• Flushing per plan&lt;br&gt;• Monitor aquatic biodiversity&lt;br&gt;• Operate regulating dam</td>
</tr>
<tr>
<td><strong>Upstream Fish Migration</strong></td>
<td>• Dam location&lt;br&gt;• Fish ladder design&lt;br&gt;• Flow rate thru ladder&lt;br&gt;• Attraction flow for Ffsh ladder&lt;br&gt;• EFLoWS and attraction flows in diversion reach&lt;br&gt;• Connectivity of river to tributaries&lt;br&gt;• Model peaking flows and diversion reach to quantify impact on fish migration</td>
<td>• Monitor if fish congregate below coffer dam&lt;br&gt;• Move fish upstream if deemed necessary</td>
<td>• Release EFLoWS&lt;br&gt;• Maintain fish ladder&lt;br&gt;• Release flow through fish ladder in migration season&lt;br&gt;• Release attraction flow in migration season&lt;br&gt;• Adjust EFLoWS if too low in diversion&lt;br&gt;• Modify channel for better fish migration&lt;br&gt;• Maintain connectivity to tributaries&lt;br&gt;• Monitor fish</td>
</tr>
<tr>
<td><strong>Downstream Fish Migration</strong></td>
<td>• Dam location&lt;br&gt;• Type of turbines&lt;br&gt;• Trash racks bar spacing&lt;br&gt;• Intake screens&lt;br&gt;• Guiding screens&lt;br&gt;• Spillway design&lt;br&gt;• Plunge pool&lt;br&gt;• Flushing gates and process&lt;br&gt;• Fish ladder also for downstream migration</td>
<td>• Maintain flow through diversion tunnels&lt;br&gt;• Ensure fish are not stranded within/below diversion tunnels</td>
<td>• Open gates in monsoon season to allow downstream fish passage&lt;br&gt;• Release flow through fish ladder in migration season&lt;br&gt;• Flushing per plan&lt;br&gt;• Monitor fish</td>
</tr>
</tbody>
</table>
Model BMP for the Trishuli River Basin

- Developed with support of IFC as a Follow up to the “Cumulative Impact Assessment for the Trishuli River Basin” (see IFC Webinar January 19, 2021)

- Presents a model format and contents for a BMP for Hydropower projects in the Trishuli River Basin

- Can serve as a model for other basins in Nepal as well

- To be available in July 2021 as part of the Trishuli Assessment Tool Kit, on IFC Hydro Advisory website
  https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/Hydro+Advisory/

- See IFC Sustainability Webinar Series website:
  https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/company-resources/ifc_sustainability_webinars

- Draft available upon request
Contents of a Biodiversity Action Plan (BAP)

BAPs may be separated from BMP but in some cases may be integrated.

BAP actions are usually off-site and/or include additional specialist studies that fill ESIA gaps, address compliance issues and once complete may inform or change BMP actions.

BAP actions more likely to include external partners.
A Biodiversity Action Plan (BAP) is required for projects located in critical habitat and is recommended for high-risk projects in natural habitats. The BAP describes (i) the composite of actions and a rationale for how the project’s mitigation strategy will achieve net gain (or no net loss), (ii) the approach for how the mitigation hierarchy will be followed, and (iii) the roles and responsibilities for internal staff and external partners. BAPs are living documents that should include agreed-on timelines for regular review and update as new information arises, project implementation progresses, and conservation context changes over time. Where project mitigation measures are included in the project ESMS/BMP (paragraph GN50 of this note), this should be referenced in the BAP. A BAP differs from a BMP in that the latter is an operational document developed largely for site managers and contractors (see paragraph GN50); whereas the BAP will almost always include actions for off-site areas (for example, offsets and additional actions) and involve external partners (for example, implementing partners, reviewers, or advisors). The BAP may also be accompanied by documents that would be developed at a later timeframe, such as an Offset Management Plan or a Biodiversity Evaluation and Monitoring Plan. In these cases, the BAP would be updated to reference these critical documents when they are developed. Depending on the nature and scale of the project, an initial BAP may describe a strategy and timeline for identifying actions to deliver net gain (or no net loss).
BAP Example: Gulpur Hydropower Project, Pakistan
(see also IFC Webinar January 26, 2021)

BAP focuses on achieving Net Gain for Critical Habitat Biodiversity Values:
• Golden Mahseer (Tor putitora) – Endangered migratory fish species
• Kashmir Catfish (Glyptothorax kashmirensis) – Critically Endangered fish species
• Poonch River Mahseer National Park

BAP Actions will focus on reducing External threats to these biodiversity values:
• Illegal over-fishing
• Illegal sand, gravel and boulder mining

BAP Actions include:

Gulpur HPP Biodiversity Action Plan (BAP)
Watch and Ward program
Sediment Mining Plan
Community fishing program
Mahseer hatchery
Kashmir catfish hatchery
Community outreach and education
Government capacity building
Biodiversity Monitoring and Evaluation
Biodiversity Monitoring and Evaluation Plan (BMEP)

Required to monitor habitats and species over life of project in Critical Habitats. Recommended in Natural Habitats.

- In-field monitoring of high biodiversity values
- Monitoring implementation & effectiveness of mitigation
- Monitoring external threats to high biodiversity values

Usually designed in consultation with & undertaken by third-parties with biodiversity monitoring experiences e.g. credible conservation organization or university

Establish acceptable thresholds of variability for biodiversity values

Measurable results outside thresholds for set time periods indicate non-compliance with PS6 and require Adaptive Management

Demonstrate No Net Loss or Net Gain for selected important biodiversity values (all Critical Habitat values)
BMP for the Upper Trishuli-1 Hydropower Project (HPP)

Developer:
Nepal Water and Energy Development Company (NWEDC)

216 MW

32 m high weir

10.7 km diversion reach between dam and power house

Location at 1300 m elevation
Trishuli River Temperature Zones

Upper Trishuli-1 HPP
Located in Cold Water Zone
Fish Studies for Upper Trishuli-1 HPP

- SWECO (2016) – electrofishing and drift nets
- 8 fish species recorded in the area (cold water region)
- Sampling for Cumulative Impact Assessment at 7 sites in the basin (2018), including eDNA
  25 species recorded by eDNA
Common Snow Trout, *Schizothorax richardsonii*

Most abundance species - >90% of catch but considered low population size, possibly due to overfishing
Other fish species from the Trishuli River Basin
# Fish Species documented in UT-1 Area

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Above Dam Site</th>
<th>Diversion Reach</th>
<th>Downstream of Powerhouse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Found</td>
<td>Expected*</td>
<td>Found</td>
</tr>
<tr>
<td><strong>Common snowtrout</strong></td>
<td><em>Schizothorax richardsonii</em></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Dinnawah snowtrout</strong></td>
<td><em>Schizothorax progastus</em></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Suckerthroat catfish</strong></td>
<td><em>Pseudecheneis sulcata</em></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Torrent catfish</strong></td>
<td><em>Euchiloglanis hodgarti</em></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Pharping catfish</strong></td>
<td><em>Glyptosternum</em> <em>(Myersglanis)</em> blythi</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Banded loach</strong></td>
<td><em>Schistura savona</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mottled loach</strong></td>
<td><em>Nemacheilus botia</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rainbox trout</strong> (non-native species)</td>
<td><em>Onchorhyncus mykiss</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong># of species found</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Found
- Expected*
Common Snow Trout Migration through UT-1 HPP Project Area

<table>
<thead>
<tr>
<th>Month/Area</th>
<th>Feb-May</th>
<th>May-July</th>
<th>Aug-Oct</th>
<th>Nov-Jan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream of proposed UT-1 dam</td>
<td>Adults migrate to spawning areas in tributaries upstream of the confluence of the Bhote Khosi and the Langtang Khola</td>
<td>Mix of adults and some young-of-year fish, Spawning in tributaries</td>
<td>Some adults and mostly young-of-year fish moving downstream as river temperatures begin to cool</td>
<td>A few adults, possibly a small resident population, at least during comparatively warmer winters.</td>
</tr>
<tr>
<td>Diversion reach</td>
<td>Adults migrate upstream through the diversion reach to upstream tributaries (none in this reach)</td>
<td>Mix of adults and some young-of-year fish moving upstream</td>
<td>Some adults and mostly young-of-year fish moving downstream as river temperatures begin to cool</td>
<td>A small resident population during comparatively warmer winters.</td>
</tr>
<tr>
<td>Downstream of Powerhouse</td>
<td>Adults and juveniles present, feeding and growing</td>
<td>Adults and juveniles present, feeding and growing</td>
<td>Adults, juveniles, and young-of-year fish present, feeding and growing</td>
<td>Adults, juveniles, and young-of-year fish, water temperatures appear to be warm enough to support them through the winter</td>
</tr>
</tbody>
</table>

Source: NESS 2014
Upper Trishuli-1 HPP BMP

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8. Corporate framework & policies ....................................................................................... 12
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11. References ......................................................................................................................... 77
# Upper Trishuli-1 HPP BMP Main Project Impacts and Mitigation

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flow</strong></td>
<td></td>
</tr>
<tr>
<td>Reduced flow in 11 km Diversion Reach during dry Season</td>
<td>EFloows Assessment, 10% of mean monthly flow</td>
</tr>
<tr>
<td><strong>Aquatic Habitat</strong></td>
<td></td>
</tr>
<tr>
<td>Changes to fish habitat</td>
<td>Connectivity Assessment to evaluate fish movement</td>
</tr>
<tr>
<td>Connectivity to allow fish to move through Diversion reach</td>
<td>Channel modification if needed</td>
</tr>
<tr>
<td><strong>Upstream Fish Migration</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fish Ladder</td>
</tr>
<tr>
<td><strong>Downstream Fish Migration</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Curved spillway and deep pool</td>
</tr>
<tr>
<td></td>
<td>Trash racks and guidance</td>
</tr>
<tr>
<td></td>
<td>Fish ladder, located on other side of dam from intake</td>
</tr>
<tr>
<td><strong>Terrestrial Habitat Loss</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reforestation at 2:1, and 25:1 where required</td>
</tr>
<tr>
<td></td>
<td>Offset of 2.61 ha to add to Langtang NP</td>
</tr>
</tbody>
</table>
## Upper Trishuli-1 HPP BMP Actions to Achieve NNL of Priority Biodiversity Values

<table>
<thead>
<tr>
<th>Priority feature</th>
<th>Project biodiversity goals</th>
<th>Mitigation hierarchy</th>
<th>Significant residual impact?</th>
<th>Offsite offset</th>
<th>Key features of mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trishuli River (Natural Habitat)</td>
<td>NNL</td>
<td>✓</td>
<td></td>
<td></td>
<td>EFlow management for diversion reach, Fish ladder for connectivity, Fish monitoring using indicator species (Common Snowtrout)</td>
</tr>
<tr>
<td>Langtang National Park (Natural Habitat)</td>
<td>NNL</td>
<td>✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>✗</td>
<td>Onsite mitigation, replanting of trees 2:1, Offset for LNP buffer zone</td>
</tr>
</tbody>
</table>
Upper Trishuli-1 HPP BMP Responsible Parties for Mitigation Actions

- The Owner (NWEDC)
- The Engineering, Procurement, Construction (EPC) Contractor
- The Operation and Management (O&M) Contractor
- The Aquatic Monitoring Team (BMEP)
- The Terrestrial Monitoring Team (BMEP)
Upper Trishuli-1 HPP BMP Sample from Mitigation Table – Owner (NWEDC)

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation Measures</th>
<th>Responsible Party</th>
<th>Timeline</th>
<th>Frequency of implementation</th>
<th>Trigger for implementation</th>
<th>Means of Verification</th>
<th>UT-1 Staff</th>
<th>Responsible for Implementation</th>
<th>Relevant MPs</th>
</tr>
</thead>
</table>
| **Design** | Change to flow regimes (water and sediments) due to water diversion | • Design dam to release a minimum environmental flow (EFlows) during the dry months (Jan-April)  
• Dam operation run-of-river (no peaking)  
• Develop an EFlows Management Plan | NWEDC | Prior to the commencement of construction activities for project lifespan | Pre-construction throughout operation. | Upon confirmation of construction phase onset | Development of EFlow adaptive management plan | E&S Manager Environmental Manager  
Senior Civil Engineer  
Hydrologist  
Biodiversity MP  
Sediment MP  
EFlows MP |
| | Blockage of aquatic fauna migration up and downstream | • Design fish ladder for Common snow trout (*Schizothorax richardsonii*) for upstream passage  
• Design spillway for downstream fish passage  
• Design adequate sediment flushing mechanism and schedule for minimum environmental damage downstream | NWEDC | Prior to the commencement of construction activities for project lifespan | Pre-construction throughout operation. | Upon confirmation of construction phase onset | Provision of fish ladder plans and incorporation into project design | E&S Manager Environmental Manager  
Senior Civil Engineer  
Biodiversity MP  
EFlows MP |
| | Change to flow regimes | Installation of flow measuring gauges (meter with recording provisions) both electronic and manual measurement basis to measure EFlows | NWEDC | Prior to the commencement of construction activities | Preconstruction period throughout operation | Upon confirmation of construction phase onset | EFlow monitoring data and appropriate analysis | E&S Manager  
Senior Civil Engineer  
EFlows MP |
| | Changes to aquatic habitat and fish migration | Hire expert fish monitoring advisor to guide mitigation and long-term monitoring program to show NNL  
Create an aquatic monitoring team | NWEDC | Prior to the commencement of construction activities | Preconstruction to operation period to collect baseline and monitoring data | At least 9 months before instream construction begins | Contracts of staff and responsibility, provision of structure of research team/consortium  
Environmental Manager  
Fish Monitoring Advisor  
Environmental Officer | Biodiversity MP  
Biodiversity Evaluation and Monitoring Program |

+ Oversight of all EPC and O&M mitigation activities
**Upper Trishuli-1 HPP BMP Sample from Mitigation Table – EPC**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation Measures</th>
<th>Responsible Party</th>
<th>Timeline</th>
<th>Frequency of implementation</th>
<th>Trigger for implementation</th>
<th>Means of Verification</th>
<th>UT-1 &amp; EPC Staff</th>
<th>Responsible for Implementation</th>
<th>Relevant MPs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong> impacts on river ecosystem and water quality</td>
<td>No spoil will be dumped in river or tributaries</td>
<td>EPC with NWEDC</td>
<td>During construction</td>
<td>Monitor and log daily in construction phase</td>
<td>Onset of construction phase and storage of sediment</td>
<td>Records by Environmental Officer in register</td>
<td>Environmental Manager</td>
<td>Environmental Officer</td>
<td>Biodiversity MP, Construction MP, Waste Management MP, Water Quality MP, Sediment and Erosion MP</td>
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<tr>
<td></td>
<td>No quarry within 500 m of river and tributaries</td>
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<tr>
<td><strong>Impacts of workers on aquatic biodiversity</strong></td>
<td>Prohibit fishing and hunting</td>
<td>EPC with NWEDC</td>
<td>Start as early as pre-construction and continue into construction phase</td>
<td>Training and induction of staff as required and on arrival of new staff. Refresher training 6 monthly</td>
<td>Start of pre-construction workers camp establishment and throughout construction</td>
<td>Records of induction and signed codes of conduct of all new staff</td>
<td>Environmental Manager</td>
<td>Induction and compliance officer</td>
<td>Biodiversity MP, Construction Worker MP, Operation Worker MP</td>
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<td></td>
<td>Prohibit dumping of waste into river</td>
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<td></td>
<td>Develop Biodiversity codes of conduct for employees to outline the rules, procedures, and prohibitions</td>
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<td></td>
<td>Implement appropriate penalties for staff and contractors who disregard the codes of conduct</td>
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<tr>
<td><strong>Noise and vibration associated with construction activities</strong></td>
<td>Monitor noise and vibration in the study area</td>
<td>EPC</td>
<td>During construction</td>
<td>Continuously in the construction phase</td>
<td>At onset of construction phase and use of noise generating machinery weekly.</td>
<td>Noise monitoring comparison with ambient standards</td>
<td>Environmental Manager</td>
<td>Environmental Control Officer (EPC)</td>
<td>Noise and Vibration MP</td>
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<td></td>
<td>Machinery operation to occur only during designated hours</td>
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<tr>
<td></td>
<td>Work to be carried out in daylight</td>
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<tr>
<td><strong>Increased utilization of roads by traffic associated with construction activities.</strong></td>
<td>Signage and speed humps to be used in areas where wildlife crossing is likely</td>
<td>EPC</td>
<td>During construction</td>
<td>Once off in construction phase (signage and driver training), and review of driver training at monthly intervals</td>
<td>Pre-construction phase for driver training and construction of roads for implementation of road safety features</td>
<td>Records of incidents and disciplinary action, and records of codes of conduct</td>
<td>Construction Manager and SEO Access Road Manager</td>
<td>Induction and compliance officer</td>
<td>Traffic MP, Air MP</td>
</tr>
<tr>
<td>Impact</td>
<td>Mitigation Measures</td>
<td>Responsible Party</td>
<td>Timeline</td>
<td>Frequency of implementation</td>
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<tr>
<td><strong>Operation</strong></td>
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</tbody>
</table>
| Change to flow regimes (water and sediments) due to water diversion | • Ensure release of minimum EFlows according to EFlows MP year round  
• Monitor and report EFlows | O&M contractor | During Operations | Continually | At all times | EFlows reporting | Operator | Environmental Officer | EFlows MP |
| Impacts to fish migration from dam blockage | • Operate fish ladder to ensure effective fish passage  
• Ensure the channel in the diversion segment just below the dam is clear so fish may reach fish ladder entrance  
• Establish a flow and temperature monitoring program to optimize fish ladder performance | O&M contractor | Before and during operations. | Monitoring plan to be developed prior to construction monitored weekly during construction. | Operation Phase | Fish monitoring data at fish ladder  
EFlow monitoring data and appropriate analysis | Environmental Manager | Environmental Officer | Biodiversity MP  
EFlows MP  
Biodiversity Evaluation and Monitoring Program |
| Impacts on reservoir water quality | • Removal of dead vegetation or debris on regular basis  
• Regular monitoring of reservoir water quality | O&M contractor | Regularly during operations. | At the beginning of instream construction activities and throughout operations. Monthly for 5 years | Onset of instream construction activities and into operations | Water quality monitoring data and appropriate analysis | Environmental Manager | Environmental Officer | Water Quality MP |
| Increased utilization of roads by traffic associated with operation activities | • Signage and speed humps shall be used in areas where wildlife crossing is likely  
• Training shall be provided to vehicle drivers regarding the driving risks through biodiversity sensitive areas and along remote roads. | NWEDC and O&M contractor | During operations. | | | Record of traffic violations  
Records of signed codes of conduct | | | Traffic MP |
Upper Trishuli-1 HPP
Biodiversity Monitoring and Evaluation Plan (BMEP)

To be developed by NWEDC Environmental Team with Fish Monitoring Advisor

NWEDC will develop an Aquatic Monitoring Team and a Terrestrial Monitoring Team

BMEP will implement the Trishuli Assessment Tool for the aquatic ecosystem (see IFC Webinar February 2, 2021)

Metrics for demonstrating No Net Loss of Biodiversity will focus on:

- Aquatic: Snow Trout and Macroinvertebrates
- Terrestrial: Habitat restoration, selected metrics
Next up in the IFC Webinar Series

❖ **May 11: Freshwater Ecosystem Assessment Handbook**
   Dr. Deep Narayan Shah, *Central Department of Environmental Science, Tribhuvan University, Nepal*
   Dr. Ram Devi Tachamo Shah, *Aquatic Ecology Centre, Kathmandu University, Nepal*
   Dr. Sunita Chaudhary, *ICIMOD, Nepal*

❖ **May 25: Sustainable Sediment Mining and Management during Hydropower Development**
   Dr. Lois Koehnken, *Sediment Specialist and Consultant*
   Dr. Cate Brown, *Freshwater Ecologist, Southern Waters, South Africa*
   Mr. Vaqar Zakaria, *Hagler Bailly Pakistan*

Thank you!