

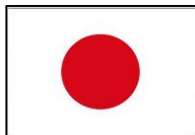
ADVANCING SUSTAINABLE HYDROPOWER: BIODIVERSITY ASSESSMENT AND MANAGEMENT WEBINAR SERIES

CUMULATIVE IMPACT ASSESSMENT OF THE TRISHULI RIVER BASIN, NEPAL January 19, 2021



Creating Markets, Creating Opportunities

IN PARTNERSHIP WITH



Norwegian Ministry
of Foreign Affairs

Pablo Cardinale
Leeanne Alonso
Kate Lazarus

Agenda

Time	Event	Presenter
19:00-19:05	Welcome remarks	Babacar Faye Resident Representative, IFC, Nepal
19:05-19:10	Welcome remarks	Jan Erik Studsrød Counsellor/Energy and Climate Royal Norwegian Embassy, Nepal
19:10-19:20	Cumulative Impact Assessment (CIA) and Basin-wide planning in Nepal: Introduction to the Trishuli Basin CIA	Pablo Cardinale Principal Environmental Specialist, IFC
19:20-20:00	Key findings of the CIA and next steps	Leeanne Alonso Biodiversity Consultant, IFC
20:00-20:25	Q & A	Moderated by Kate Lazarus Senior Asia ESG Advisory Lead, IFC
20:25-20:30	Closing Remarks	Pablo Cardinale, Leeanne Alonso & Kate Lazarus

Opening Remarks



Babacar Faye
Resident Representative
IFC, Nepal

Opening Remarks



Jan Erik Studsrød,
Counsellor/Energy and Climate
Royal Norwegian Embassy, Nepal

Cumulative Impact Assessment: Introduction to the CIA and its application in the Trishuli Basin, Nepal



Presenter:

Pablo Cardinale

Principal Environment Specialist

IFC

CIA-related Regulatory Framework and Guidelines in Nepal

CIA consideration for Environmental Impact Assessment (EIA)

- Environmental Protection Act (2019)
- Hydropower EIA Manual (2018)
- Upcoming CIA Guidelines / Framework, DOED (2020)

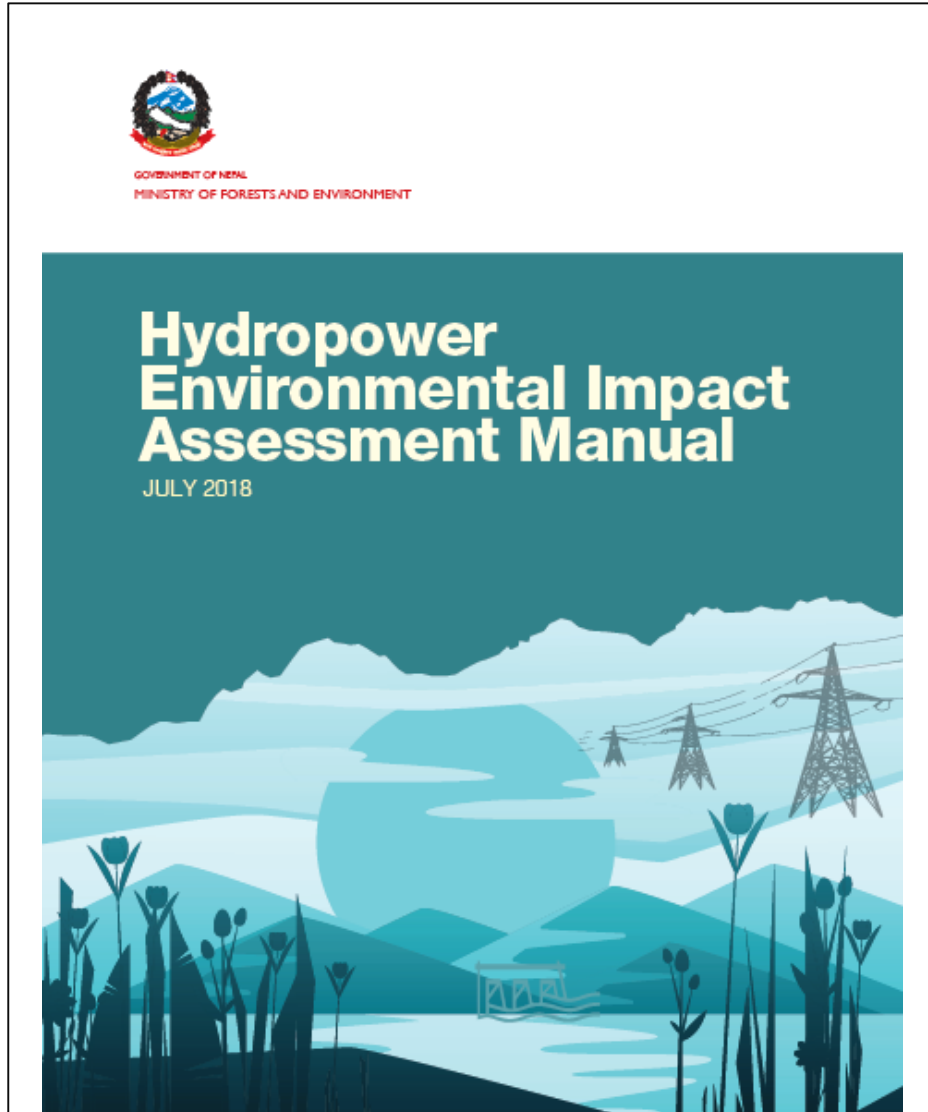
Guidelines enabling implementation of E&S safeguards

- Environmental-friendly Local Governance Framework (2013)
- Guideline for Physical Infrastructure Development and Operation in Protected Areas (2008)
- Land Acquisition, R&R Policy for Infrastructure Development Projects (2015)

Financial Institutions

- NRB – Environmental and Social Risk Management Guidelines (2018)
- IFC Performance Standards (2012)
- IFC CIA Good Practice Handbook (2013)
- IFC EHS Guidelines for Hydropower (2018)
- WBG Environmental Flows for Hydropower (2018)

Hydropower EIA Manual



Available Online at:

http://mofe.gov.np/downloadfile/Hydropower%20Environmental%20Impact%20Assessment%20Manual_1537854204.pdf

What are Cumulative Impacts?

- Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to as “developments”) when added to other existing, planned, and/or reasonably anticipated future ones.
- For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.



“death by a thousand cuts”

Why Assess Cumulative Impacts?

The major environmental and social management challenges that we face today – loss of biodiversity, the decline of ocean fisheries, desertification, or climate change - are all the result of cumulative impacts from a large number of activities that are for the most part individually insignificant, but which together have had global repercussions.



How do we perform a CIA?

18 5 41 9 1 76 3 22

Eighteen, five, forty-one, nine, one,
seventy six, three, twenty two

CIA : We use same tools as ESIA, same information, data, similar uncertainties, knowledge, **BUT** a different perspective

ESIA vs CIA

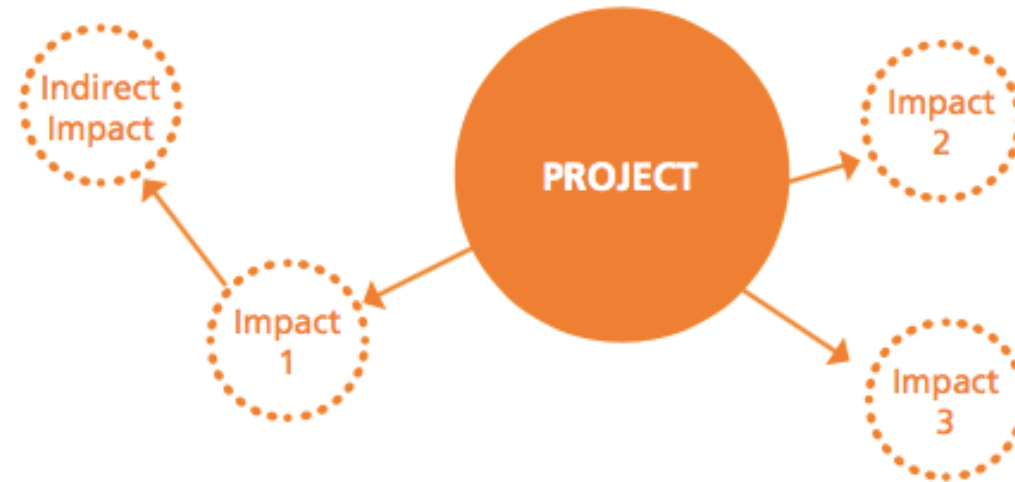
Basic Conceptual Assessment Paradigm Change.

1. Focus: Project Impacts vs Condition of Valued Environmental and Social Components (VECs).
2. Scope: Expanded spatial and temporal boundaries for the analysis.



Environmental and Social Impact Assessment (ESIA)

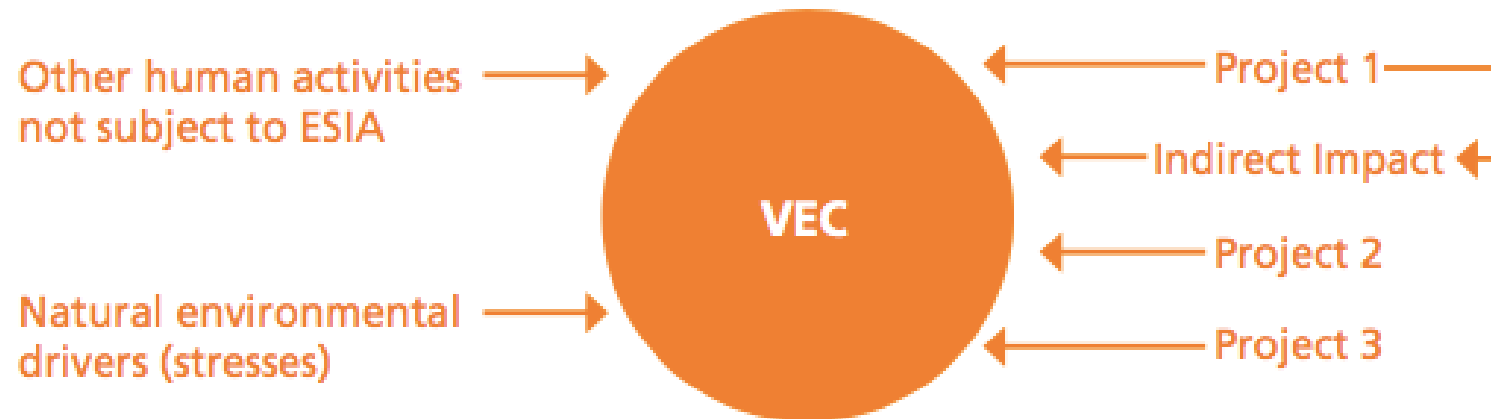
FIGURE 3. ESIA: PROJECT-CENTERED PERSPECTIVE



An ESIA describes the setting, impacts and mitigation actions for a
SPECIFIC PROJECT

Cumulative Impact Assessment (CIA)

FIGURE 4. CIA: VEC-CENTERED PERSPECTIVE



CIA focuses on the valued environmental and social components (VECs) of the broader area, assessing how the VECs will be impacted under scenarios with current, planned and future development projects as well as other stressors. A wide range of VECs are assessed.

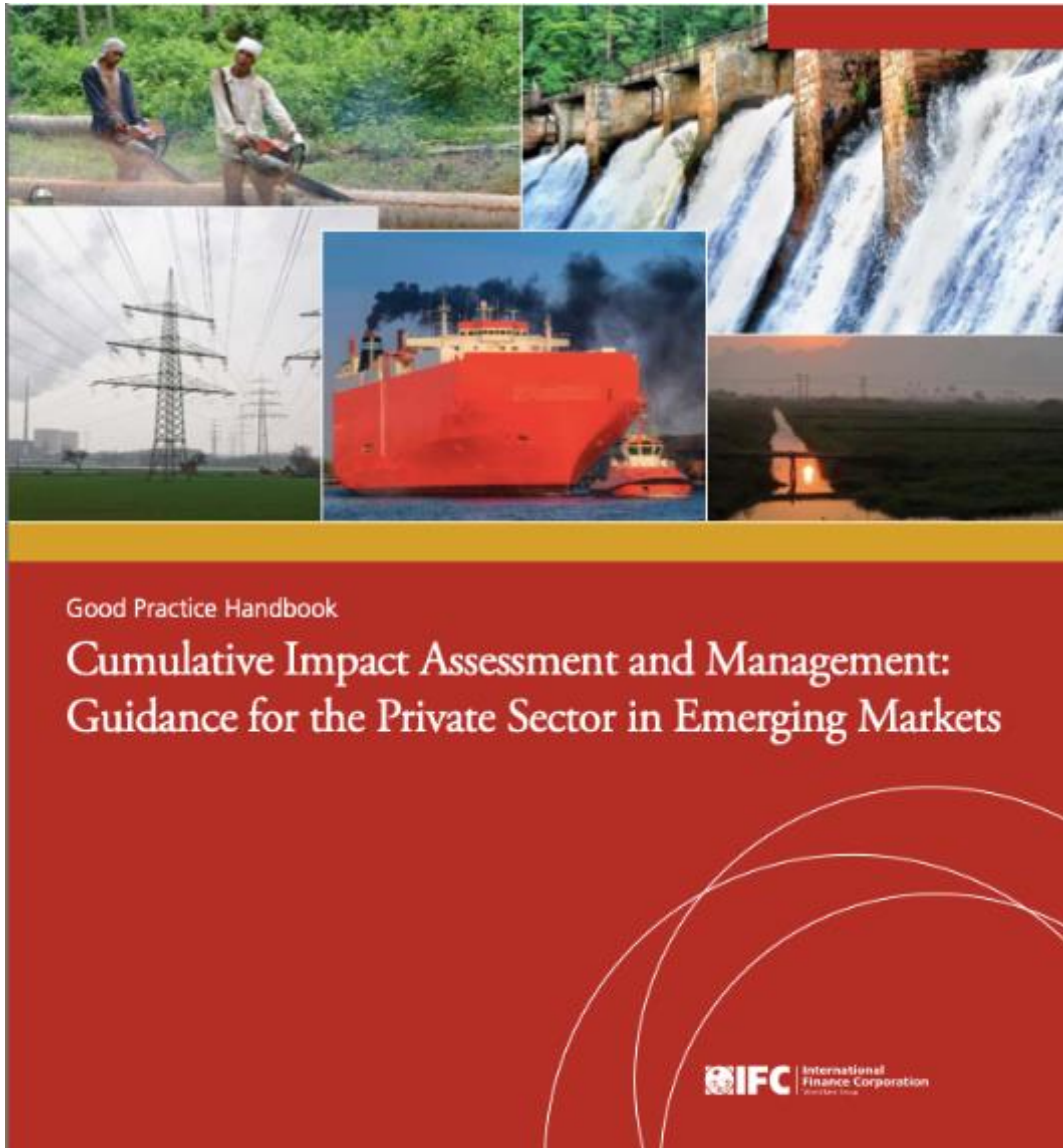
Valued Environmental and Social Components (VECs)

Sensitive environmental or social receptors, affected resource, ecosystem, or human community:

- ***Air shed***
- ***Watershed***
- ***Forest resource***
- ***Resident wildlife***
- ***Migratory wildlife***
- ***Fisheries resource***
- ***Historic / Socio-cultural resource***
- ***Land use***
- ***Community Structure***
- ***Coastal zone***
- ***Recreational***

VEC	Cumulative Effect / Change of condition
Air	<ul style="list-style-type: none"> •Health hazard, poor visibility from elevated levels of ozone or particulates.
Surface Water	<ul style="list-style-type: none"> •Water quality degradation from multiple point-source discharges. •Water shortages from uses that exceed capacity
Ground Water	<ul style="list-style-type: none"> •Aquifer depletion
Land and Soil	<ul style="list-style-type: none"> •Diminished land fertility / productivity
Wetlands	<ul style="list-style-type: none"> •Diminished flood control capacity
Ecosystems	<ul style="list-style-type: none"> •Habitat fragmentation •Loss of fish and wildlife populations
Socioeconomics	<ul style="list-style-type: none"> •Overburden services •Unstable labor markets
Community structure	<ul style="list-style-type: none"> •Changes in community dynamics as a result of displacement of critical community members.
Cultural Resource	<ul style="list-style-type: none"> •Cultural site degradation / vandalism •Fragmentation of historic district

IFC Good Practice Handbook on Cumulative Impact Assessment



Available Online at:

https://www.ifc.org/wps/wcm/connect/58fb524c-3f82-462b-918f-0ca1af135334/IFC_GoodPracticeHandbook_CumulativeImpactAssessment.pdf?MOD=AJPERES&CVID=kbnYgl5

CIAM - Six Step Process

Step 1: Scoping.

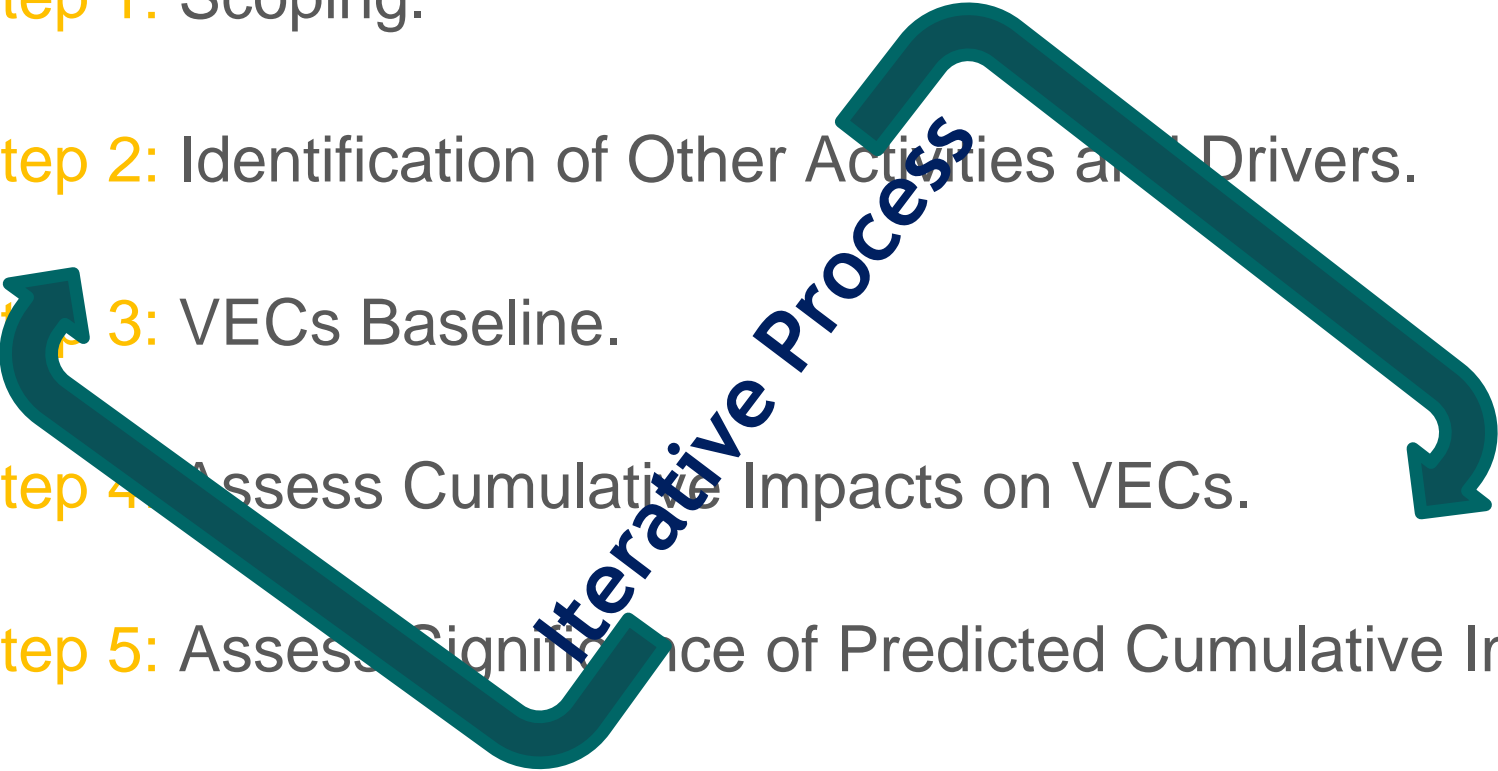
Step 2: Identification of Other Activities and Drivers.

Step 3: VECs Baseline.

Step 4: Assess Cumulative Impacts on VECs.

Step 5: Assess Significance of Predicted Cumulative Impacts.

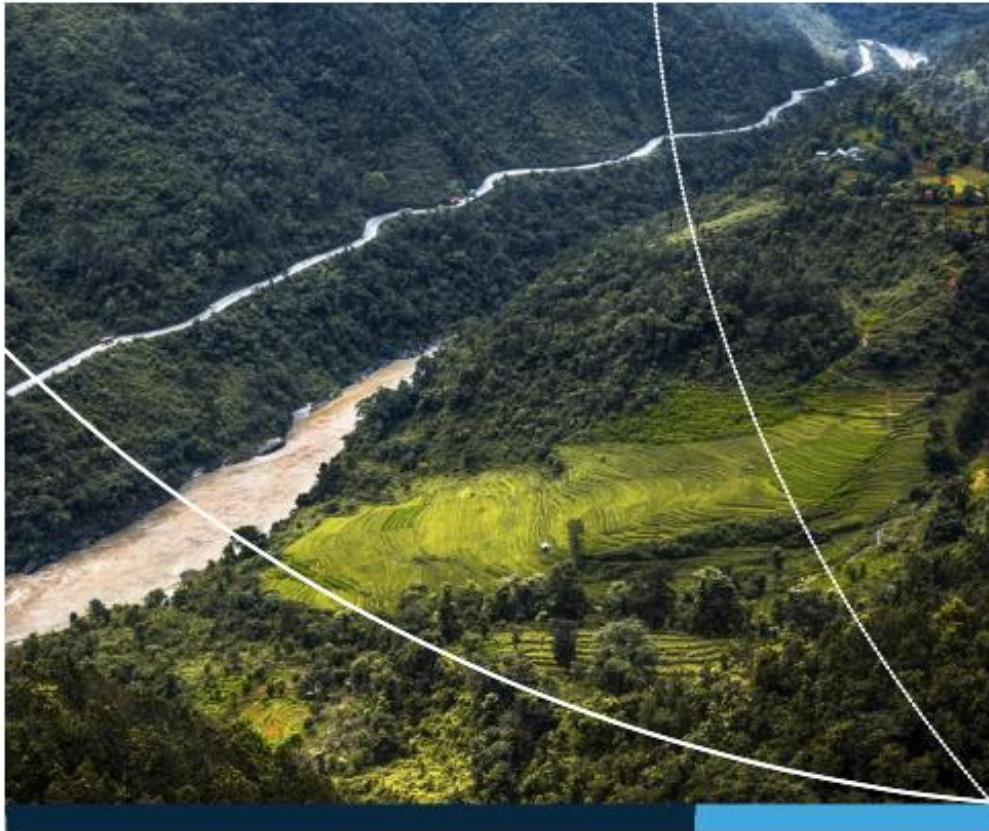
Step 6: Design Management Strategies.



Iterative Process



Stakeholder Engagement



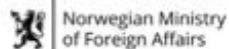
Cumulative Impact Assessment (CIA) of the Trishuli River Basin, Nepal

The need for a CIA was identified as High due to the existing and planned development of multiple hydropower projects in the basin

Cumulative Impact Assessment
and Management:

**HYDROPOWER DEVELOPMENT IN THE TRISHULI
RIVER BASIN, NEPAL**

IN PARTNERSHIP WITH



Available online at:

https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_report_cia-trishuli

Trishuli River Basin CIA Project Team



- Kate Lazarus
- Pablo Cardinale
- Leeanne Alonso
- Upasana Pradhan Shrestha



- David Blaha
- Arun Venkataraman
- Neena Singh
- Rutuja Tendolkar
- Halvard Kaasa (Independent Expert)



- Salil Devkota
- Ramu Subedi
- Naresh Rimal



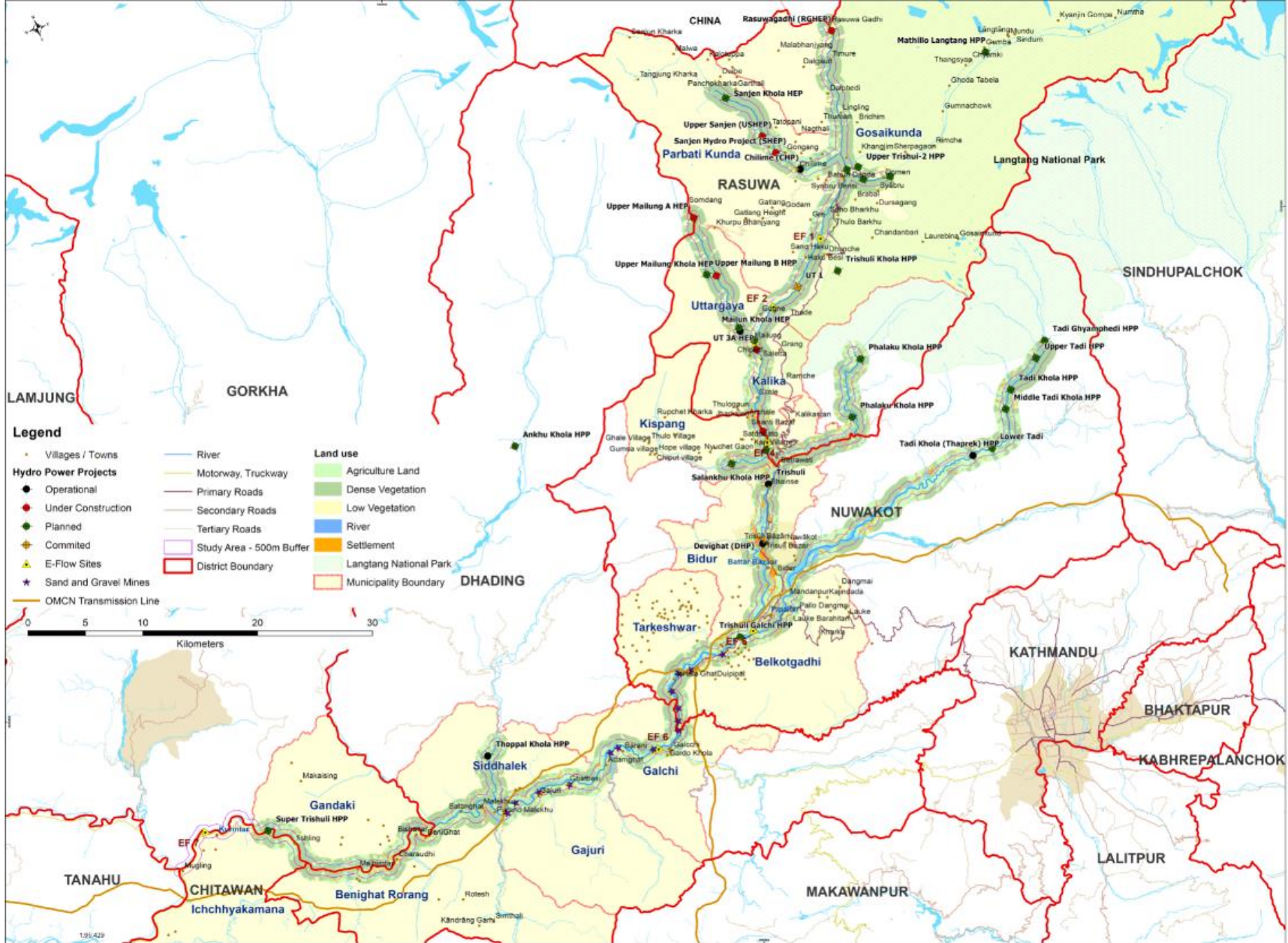
- Vaqar Zakaria
- Narayan Rijal (SANS)
- Cate Brown (Southern Waters)

Trishuli River Basin Study Context

- ~130 km trans-boundary river in north-central Nepal.
- One of the key sub-basins of the Gandaki Basin.
- Steep mountainous topography makes the basin vulnerable to natural disasters but also attractive to hydropower.
- Langtang National Park and buffer area of Shivpuri National Park.
- Main economic activities include forestry, agriculture, and participation in tourism-related activities from rafting and religious sites.
- Brahmin Chhetri, Gurung, Magar, Tamang, Newar, Thakali, Tharu, Bhote and Dalit are the major ethnic groups in the region (the majority of the people follow Hinduism and Buddhism).



CIA Spatial Boundary



Temporal Boundary: 50 years

Extensive Stakeholder Consultation for the CIA

Stakeholder groups included:

- Groups that directly benefit from proposed developments
- Groups that are directly negatively affected by proposed developments
- Those who directly interact with the ecosystem components that overlap with the proposed developments
- Those who indirectly influence the use or conditions of those environmental and social components—such as regulatory groups, external research agencies, local, national nongovernmental organizations (NGOs)

A total of **52** stakeholder groups were identified that are a subset of the following broad categories:

- *Hydropower developers*
- *Government authorities (ministries and national authorities)*
- *District authorities*
- *Local authorities*
- *Local and national NGOs*
- *International NGOs*
- *External agencies*
- *Research agencies*
- *Affected communities*
- *Lenders and project proponents*



Key findings of the CIA and next steps

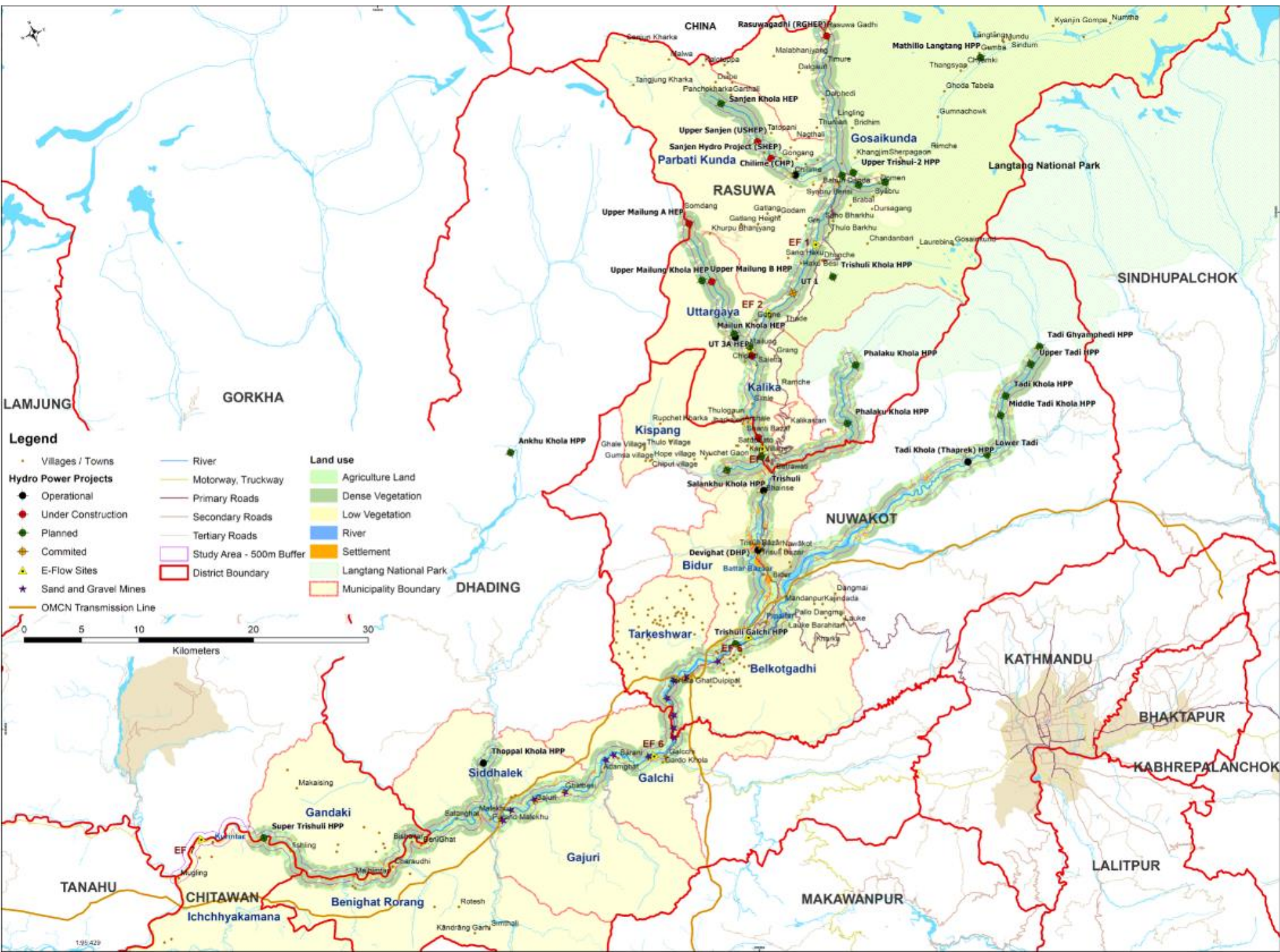


Presenter:

Leeanne Alonso

Biodiversity Consultant

IFC



Trishuli River Basin

Trishuli River Temperature Zones



Lower Trishuli River (Cool to Warm Water Zone) ~ 200 m asl



Middle Trishuli River (Cold to Cool Water Zone) ~500 m asl






Upper Trishuli River (Cold Water Zone) 1000+ m asl



Chilime Khola

Hydropower Projects (HPPs) in the Trishuli River Basin as of June 2018

Status	Main stem projects	Capacity (MW)	Tributary	Capacity (MW)
Operational 	2	38	4	43
	Trishuli	24	Chilime	22
	Devighat	14	Mailung Khola	5
			Tadi Khola	14
			Thoppal Khola	2
Under construction 	3	208	4	78
	Rasuwadga	111	Upper Sanjen	14.8
	Upper Trishuli - 3A (UT-3A)	60	Sanjen Hydro	42.5
	Upper Trishuli - 3B (UT-3B)	37	Upper Mailung A	6.42
			Upper Mailung Khola	14.3
Planned 	6	582.6	17	581
	Upper Trishuli-1 (UT-1)	216	Sanjen Khola	78
	Trishuli Galchi	75	Langtang Khola Small	10
	Super Trishuli	100	Salankhu Khola	2.5
	Upper Trishuli 2	102	Phalaku Khola	14.7
	Upper Trishuli 1 Cascade	24.6	Phalaku Khola	5
	Middle Trishuli Ganga Nadi	65	Upper Tadi	11
			Middle Tadi Khola	5
			Lower Tadi	4.993
			Ankhu Khola	49.5
			Bhotekoshi Khola	33.5
			Mathillo Langtang	24.35
			Langtang Khola	310
		Trishuli Khola	4.409	
		Upper Mailung B	7.5	
		Middle Mailung	10	
		Tadi Ghyamphedi	4.7	
		Tadi Khola	5.5	

Hydropower Development in the Trishuli River (DoED June 2018)



six operational hydro projects aggregating to 81 MW

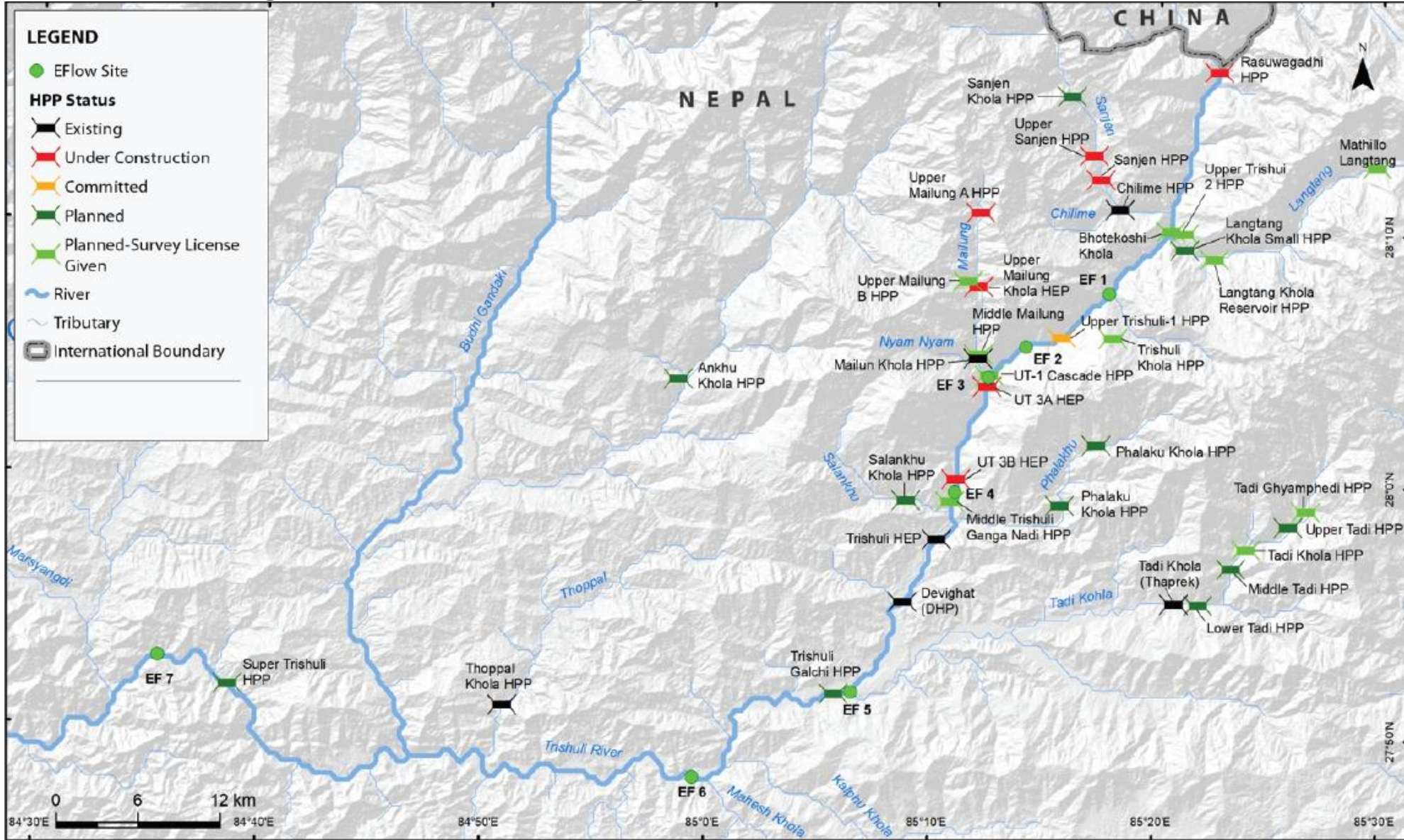


seven under-construction hydro projects aggregating to 286 MW

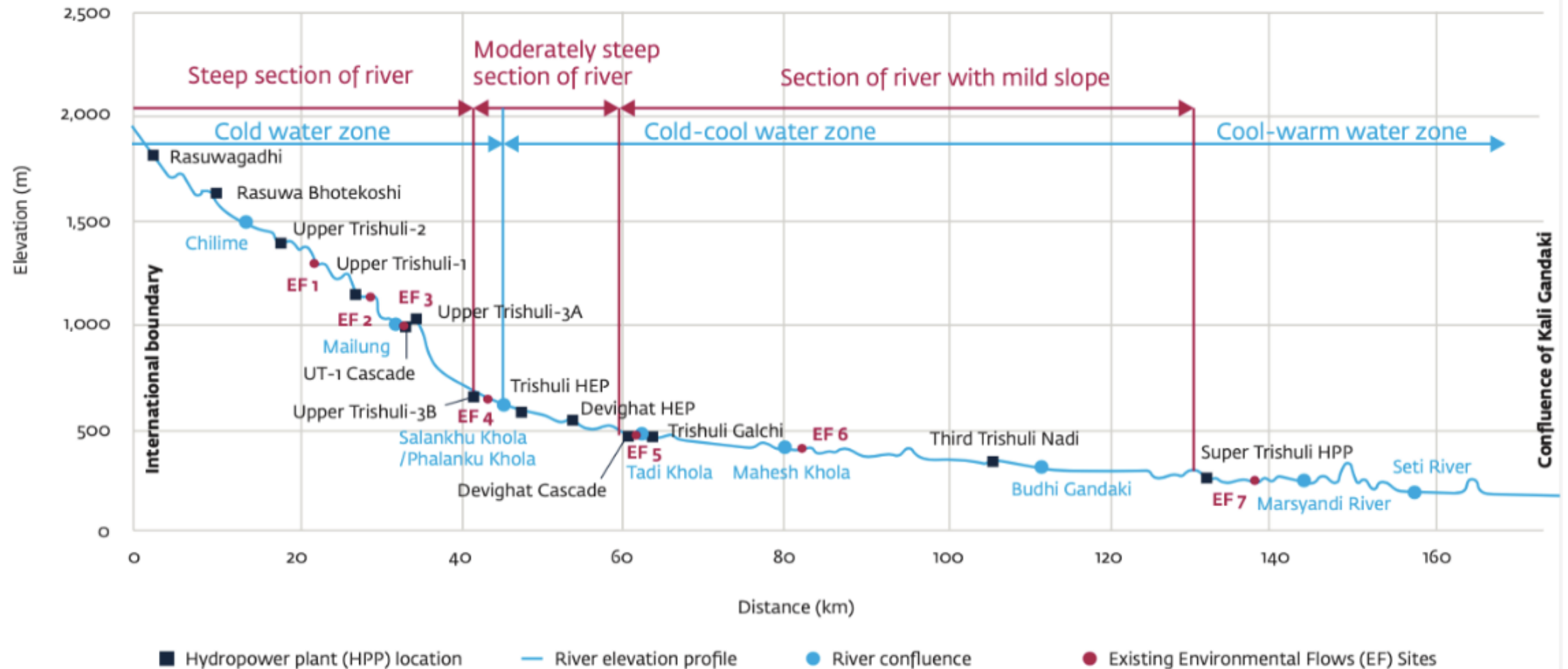


twenty-three committed/planned hydro projects that aggregate to 1,163 MW

Planned Hydropower Projects in the Trishuli River Basin



Trishuli River Elevation Gradient and Hydropower Projects



Source: DRIFT Model Report, September 2018, Appendix D.

Trishuli HPP



Upper Trishuli – 3A HPP



Tadi Khola HPP



Another HPP under construction upstream using sand and gravel from the river



Additional Stressors identified in the Trishuli Basin



Climate Change and Extreme Events

- Climate change-induced phenomena (such as glacial lake outburst floods and variability in runoff) pose significant implications to hydropower, land use, and rural livelihoods.
- Temperatures have already been observed to be rising, and are projected to increase further over the coming decades.



Slope Stability and the Aftermath of the 2015 Earthquake

- Road and bridge construction has also increased landslides and disposal of soil into the Trishuli River. Following the earthquake and aftershocks, districts within the basin were among those severely impacted with respect to damage to life and property, loss of forest cover, increased sedimentation, damage to tourism infrastructure, and displacement of local communities.



Sand and Sediment Mining in the Trishuli River

- More than 500 small- and large-scale sand and sediment mining enterprises are located in Nuwakot and Dhading districts. The implication is significant lowering of riverbeds and river pollution from rock crushing. Slush drained by these mines and crusher industries are a major pollution source.



Rapid Urbanization

- Upgrades along Prithvi Highway, proposed infrastructure developments such as the One Belt and One Road Project, and proximity to the border with China have stimulated urbanization within the basin. This has also resulted in in-migration and competition for scarce resources, haphazard access road development, and solid waste dumping into the Trishuli River.

Sand and Gravel Mining

1,000+ trucks are registered in Dhading District to carry sand and gravel to Kathmandu and other cities





Sand and Gravel Mining

400+ sand-mining, -washing, and -crushing industries in Dhading and Nuwakot Districts

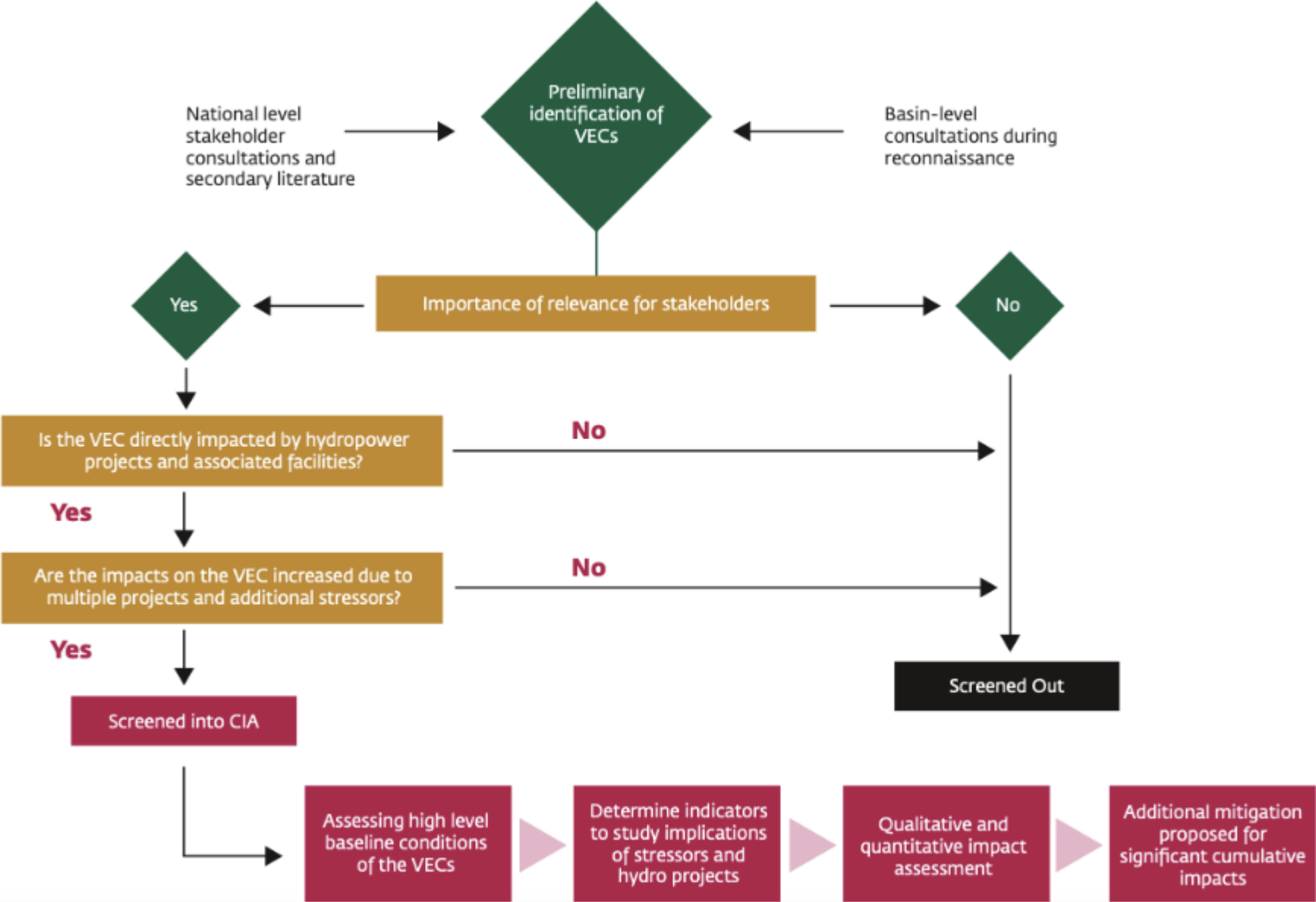


Road Construction along the Trishuli River

Cumulative Impact Assessment of the Trishuli River Basin

- ❖ Compiles a baseline of environmental and social information for the basin
- ❖ Draws attention to cumulative impacts
- ❖ Documents the extent and magnitude of cumulative impacts
- ❖ Documents locations of cumulative impacts
- ❖ Documents the types of cumulative impacts and receptors
- ❖ Documents stakeholder views of the cumulative impacts
- ❖ Makes recommendations for mitigation and management to reduce the cumulative impacts

Cumulative Impact Assessment Process



VECs: Selected Valued Environmental/Social Components for the CIA

Identified VEC	Assessment approach
Aquatic Habitat 	Set up of the Downstream Response to Imposed Flow Transformations (DRIFT) model and assessment of outcomes linked to scenarios
Terrestrial Habitat and Langtang National Park 	Qualitative assessment of impacts from hydropower, transmission lines, and stressors working in concert
Cultural and Religious Sites 	Qualitative assessment of low flow areas using the results from DRIFT in order to ascertain feasibility of controlled releases
Livelihoods 	<ul style="list-style-type: none"> • Interpretation of DRIFT results for river-based livelihoods and ecosystem services • Impact significance of impact and mitigation information of 8 hydropower projects
Water Resources 	<ul style="list-style-type: none"> • Qualitative assessment of implications on water resources on springs • Mapping of specific sites where high TDS/fecal coliform has been detected to under-construction projects and urban areas

Downstream Response to Instream Flow Transformations (DRIFT) model

- DRIFT was used to predict impacts of hydropower project scenarios on the ecological integrity and fish abundance of habitats at selected sites along the Trishuli River mainstem.
- Lessons learned from evaluating EFlows in other projects within the basin and elsewhere in the Himalayan Region were incorporated.
- Input parameters were used to set up the DRIFT model:
 - Data on indicators from 7 EFlows sites on the main Trishuli river
 - Daily time series hydrological data
 - Fish
 - Geomorphology
 - Algae
 - Macro-invertebrates
- Four indicator fish species were evaluated, which are dependent on the other Indicators
 - Snow Trout (Asala, *Schizothorax richardsonii*)
 - Golden Mahseer (Sahar, *Tor putitora*)
 - Buduna (*Garra annandalei*)
 - Indian Catfish (*Glyptothorax indicus*)

Fish Diversity in the Trishuli River Basin

- ❖ 60 fish species have been documented by traditional cast nets, electrofishing and environmental DNA (eDNA)
- ❖ Most recent fish data from Upper Trishuli – 1 Hydropower Project ESIA research (NESS, Sweco, CMDN, IFC)
- ❖ Fish distributions are generally determined by water temperature, which corresponds to elevation
- ❖ Many species of long-range and mid-range migratory species, including:
 - Golden Mahaseer (Sahar), *Tor putitora*, IUCN Red List Globally Endangered
 - Common Snow Trout (Asala), *Schizothorax richardsonii*, IUCN Red List Vulnerable

Golden Mahaseer, *Tor putitora*



Golden Mahaseer, *Tor putitora*



Common Snow Trout, *Schizothorax richardsonii*



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 gravelly river bed	Riffles, shallow pools, with gravelly beds
Substrate	Gravelly or gravelly/sandy	Gravelly or gravelly/sandy	Gravelly or gravelly/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 gravelly 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.		

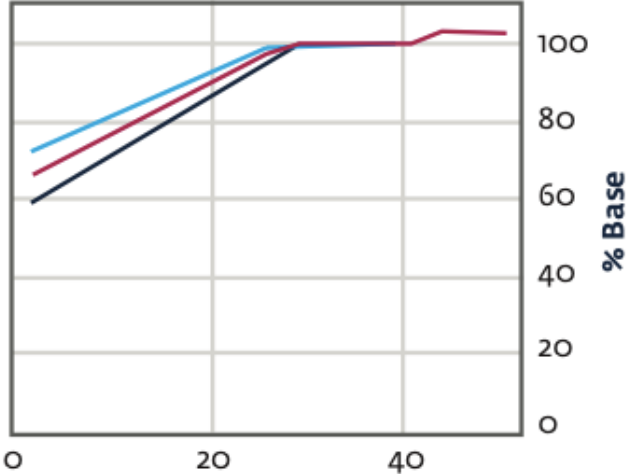
DRIFT Response Curves

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.

DRIFT Linked Indicators

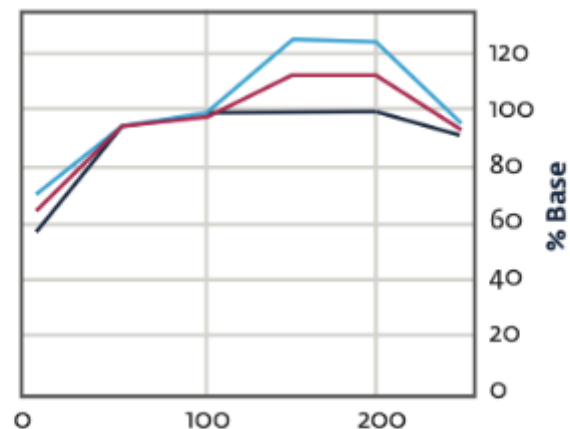
Table D7.6: Ephemeroptera, Plecoptera, and Trichoptera (EPT)

(continued)

Linked indicator and response curve	Explanation
-------------------------------------	-------------

e. Median bed sediment size [armouring] (D season)

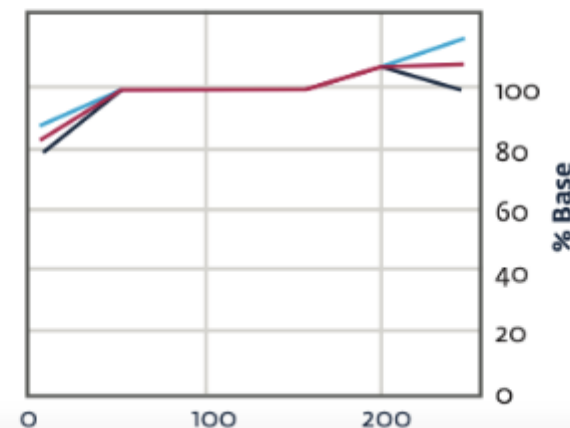
Desc	%Base	Y1	Y2
Min	0.000	-2.000	
Min base	25.000	-1.000	
	50.000	-0.250	
Median	100.000	0.000	
	150.000	1.000	
Max base	200.000	1.000	
Max base	150.000	-0.250	



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.

Assumptions used in the DRIFT Assessment

Assumptions on:

- connectivity for upstream and downstream fish migration
- connectivity for sediment flow

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%
		Tadi Khola HPP1	Base load	100%	90%	10%	5%

VEC: Aquatic Habitat



Aquatic Ecological Integrity Assessment Ratings

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: Kleyhans 1996.

Scenarios Evaluated with DRIFT

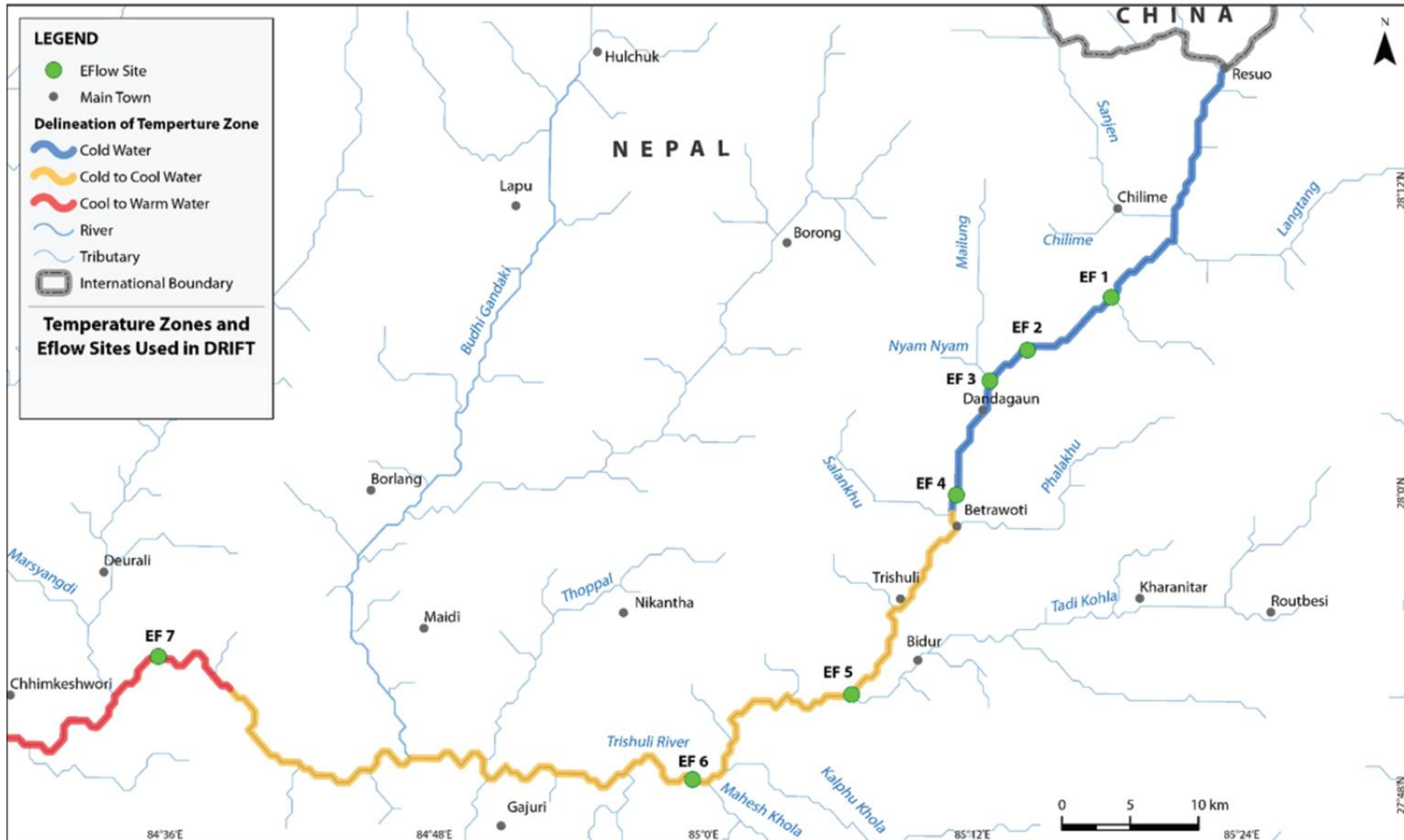
Scenario 1: Existing Hydropower Projects (6 projects)

Scenario 2a: Under-construction Hydropower Projects (13 projects)

Scenario 2b: Under-construction and Committed Hydropower Projects (14 projects)

Scenario 3: Full Development (36 projects)

EFlows sites sampled for DRIFT



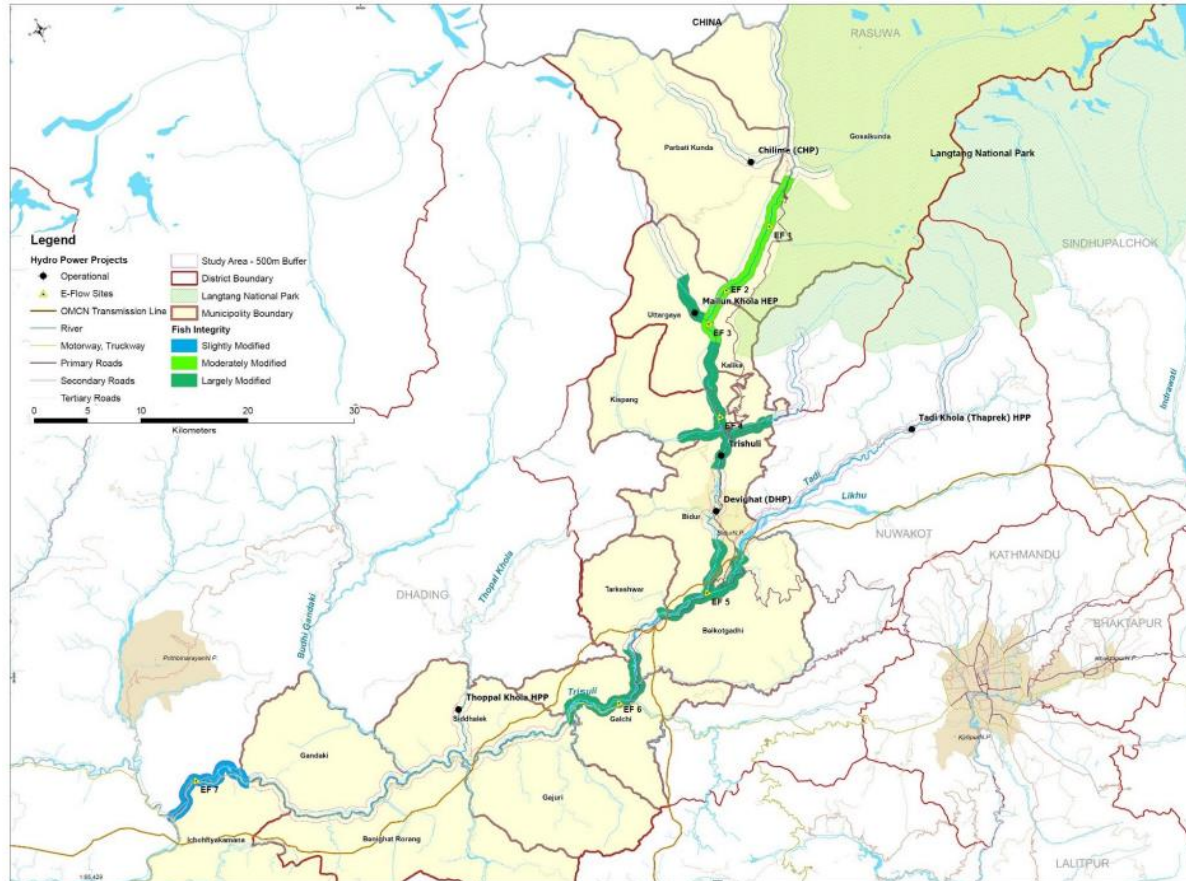
Overall Aquatic Ecological Integrity DRIFT Results

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

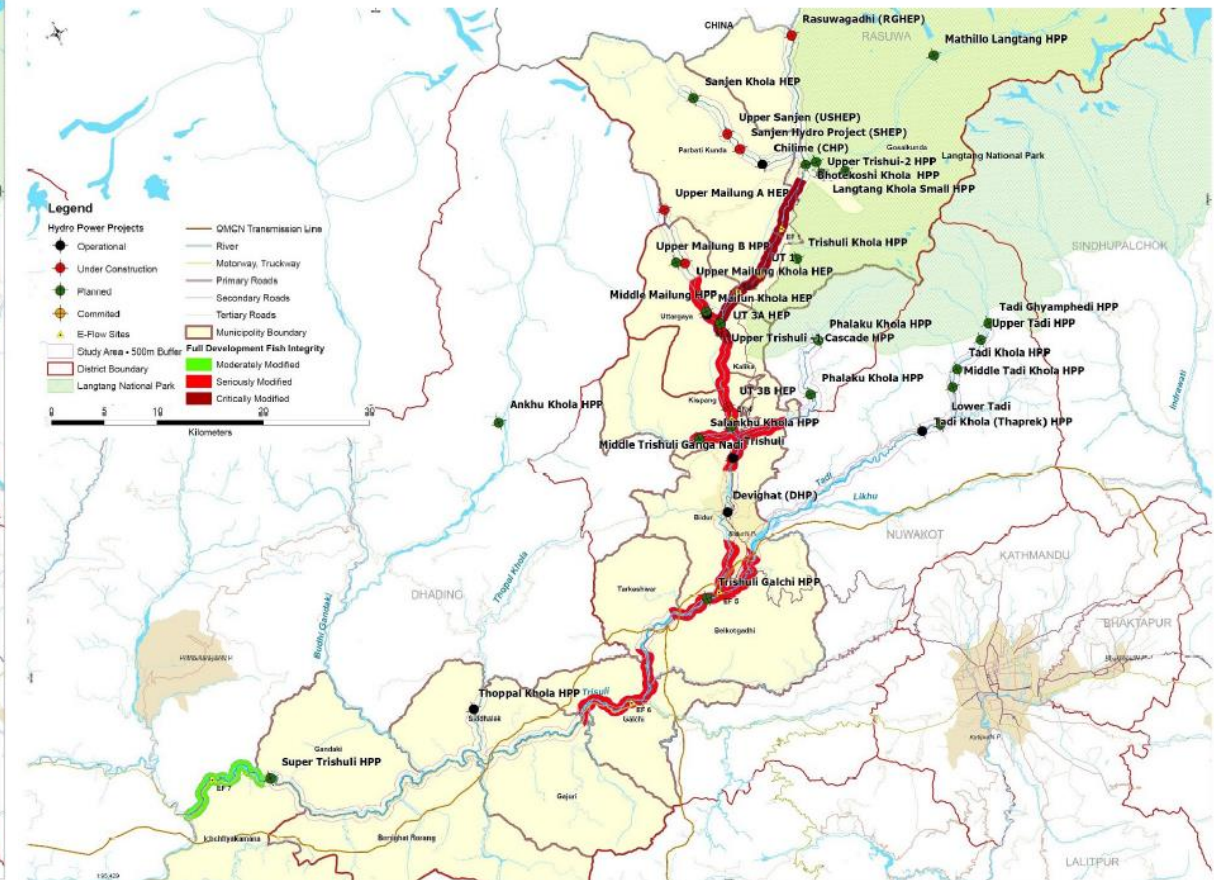
EFlows site/ reach		Existing (Scenario 1)	Under- construction (Scenario 2a)	Under- construction and committed (Scenario 2b)	Full development (Scenario 3)
EFlows Site 1	Upstream	B	B/C	C/D	D
EFlows Site 2		B	B/C	E	E
EFlows Site 3		C	C/D	D	E
EFlows Site 4		C	C	C	D
EFlows Site 5		C	C	C	D
EFlows Site 6		C/D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

Ecosystem Integrity: Existing and Full-development Scenarios

a. Existing scenario (Scenario 1)



b. Full-development scenario (Scenario 3)

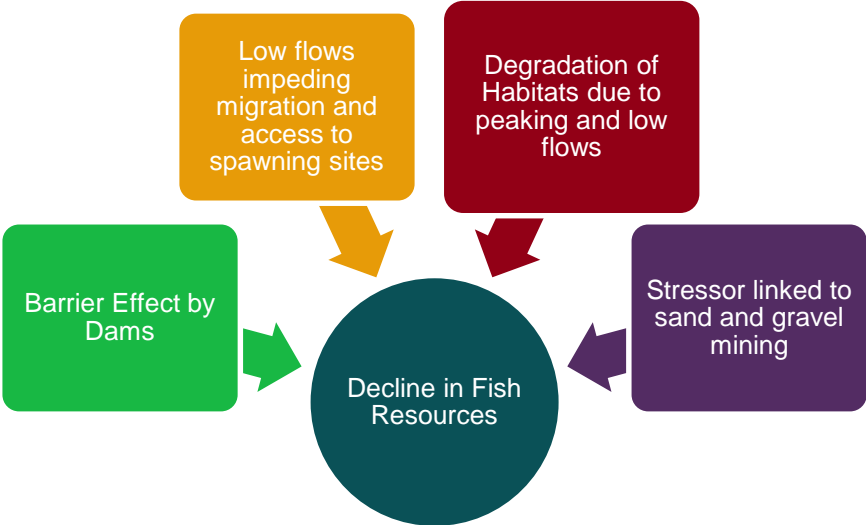
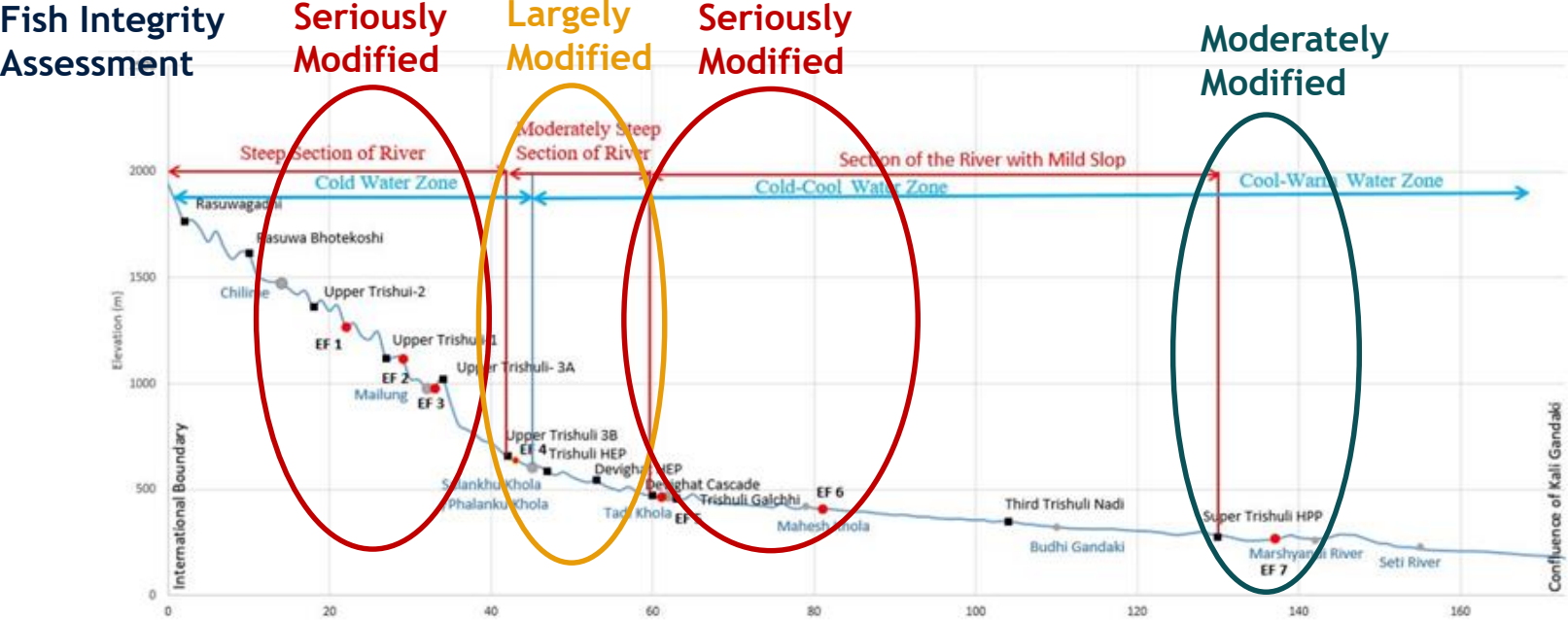


Fish Integrity DRIFT Results

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

Cumulative Impacts on Fish in the Main River





VEC: Terrestrial Habitat and Langtang National Park

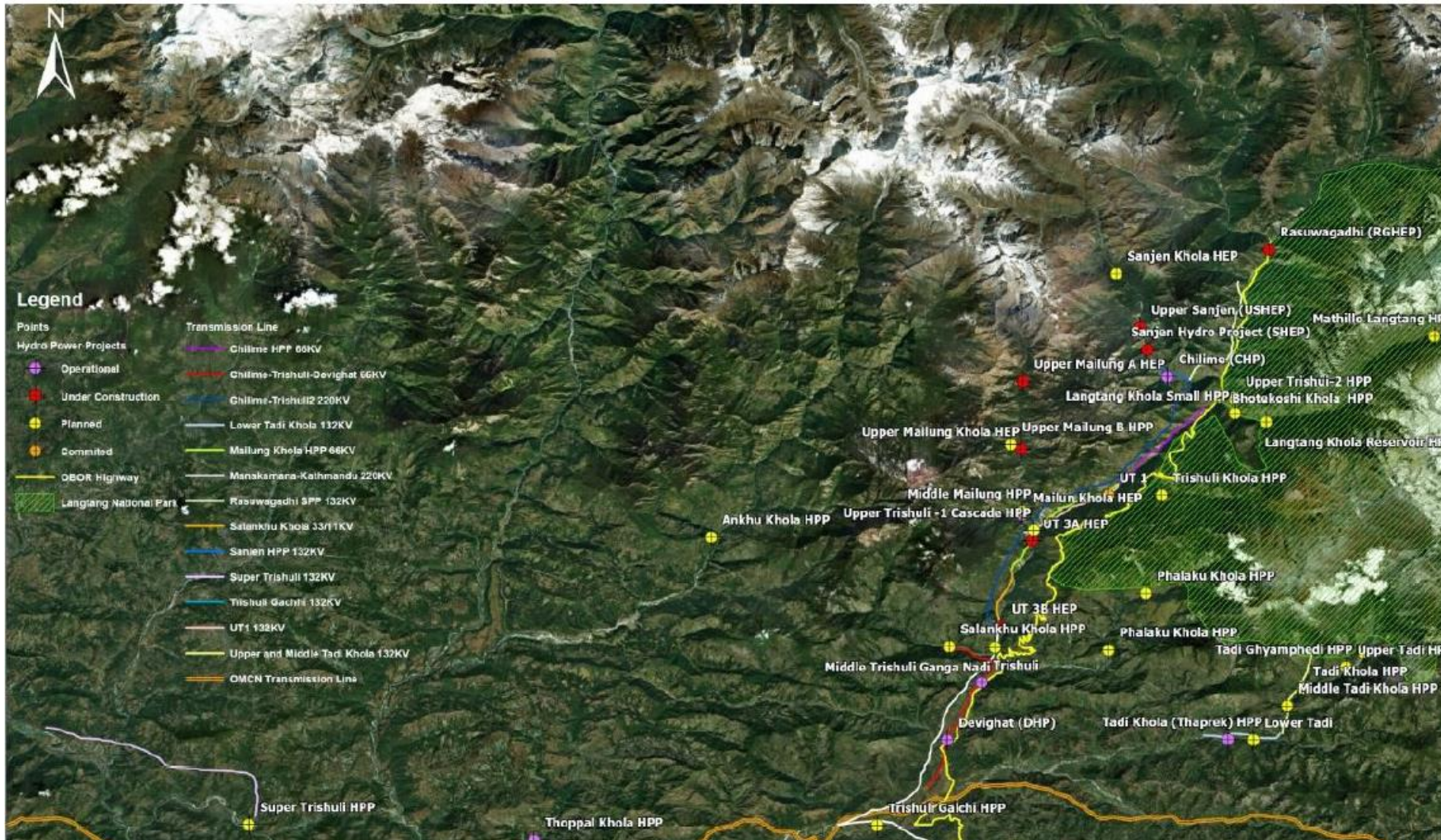


Legend:

- Trekking Trail
- Highway
- Secondary Road
- Seasonal Road
- - - Track
- Airport
- National Park
- Major Place
- Lake
- Glacier
- River
- Mountain / Peak
- Pass
- Check Post
- Hot spring
- Post Office
- Telephone
- Health Post

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Transmission Lines from Hydropower Projects

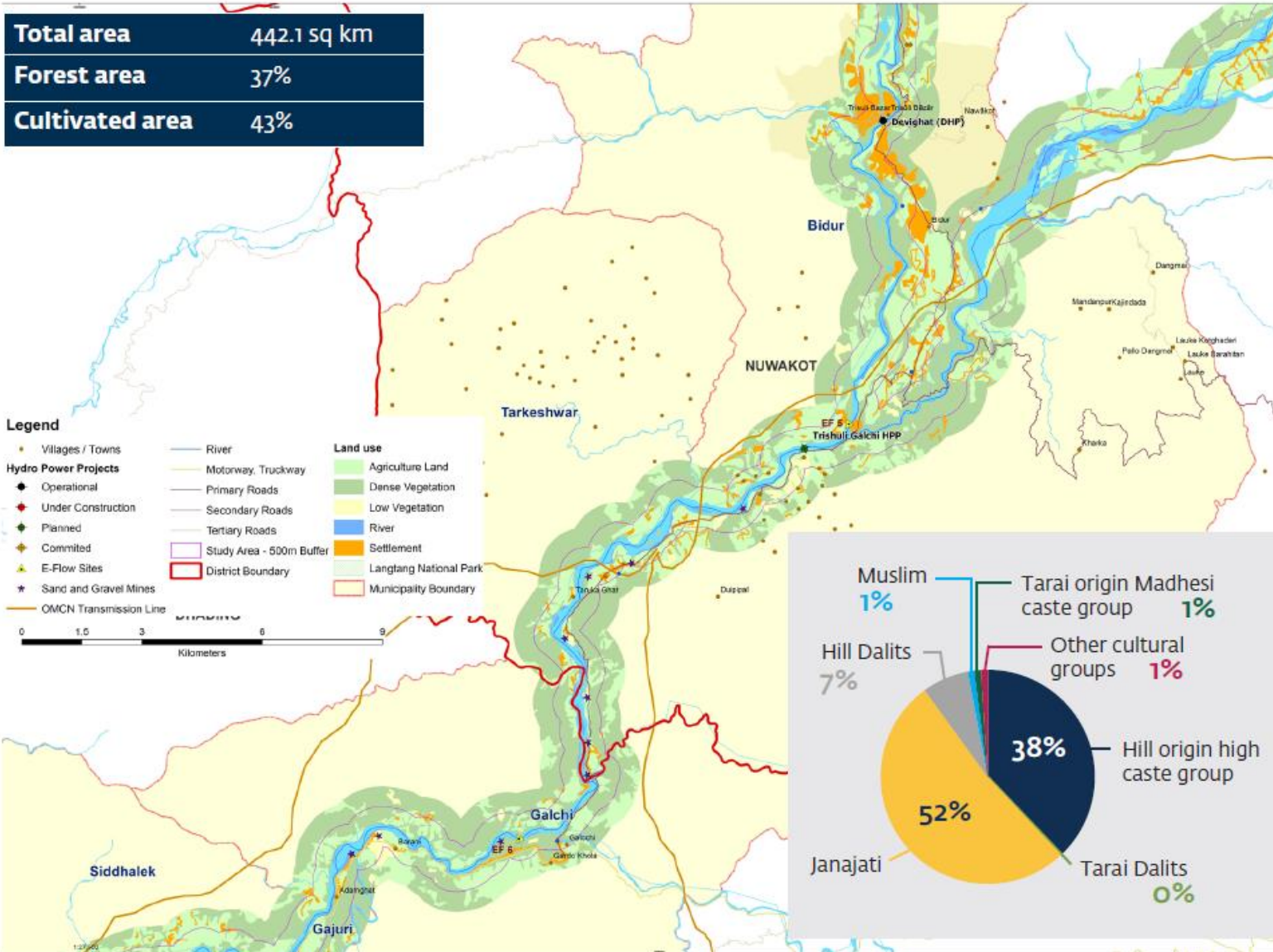


Impacts and Mitigation for Terrestrial Habitat and Langtang National Park

Source of impact	Mitigation
<p>Potential impacts from access road construction within LNP include:</p> <ul style="list-style-type: none"> • Land instability (landslide, erosion) • Loss of topsoil • Impact on flora and fauna through illegal extraction and hunting • Disturbance to wildlife dispersal • Solid waste and gaseous pollution in LNP 	<ul style="list-style-type: none"> • Avoid development of access roads for hydropower projects through LNP • If there are no alternatives, use commonly constructed access roads on a shared basis between hydropower projects.
<p>Transmission lines are likely to pose electrocution risks to large-bodied birds such as storks, cranes, vultures, and large raptors. The LNP has several such species that may be impacted by the transmission lines.</p>	<p>If impacts to LNP due to the transmission line (TL) alignment are unavoidable:</p> <ul style="list-style-type: none"> • Use shared TLs by all hydropower projects in the basin • Use insulated conductors in the TL system • Compensate the LNP for right-of-way impact along the alignment • Maintain clearance as per existing and future standards • Place bird diverters across conductors in an appropriate manner to enhance visibility; should glow at night for nocturnal migrants
<p>While the footprint of civil structures is likely to be small when compared to the total area of the park, localized impacts and potential increase in illegal extraction may be expected.</p>	<ul style="list-style-type: none"> • Place proper fencing around project structure to reduce risks of death or injury to mammals. • Prepare and implement blasting/explosive management plan, to avoid damage to habitats in the LNP.
<p>Worker camps and engineer accommodation: Even though the footprint may be minimal, workers and other staff of hydropower projects may indulge in illegal extraction of biodiversity resources within the LNP. There could be further impacts of improper solid or liquid waste disposal from these camps.</p>	<ul style="list-style-type: none"> • Prepare and implement workers code of conduct. • Use hoarding boards in local languages for skilled and unskilled workers on illegal activities within the LNP. • Punish unethical, illegal activities of workers (for example, for killing of wildlife and consuming game meat, setting fires). • Solid and liquid waste management plan and consequent action for such camps

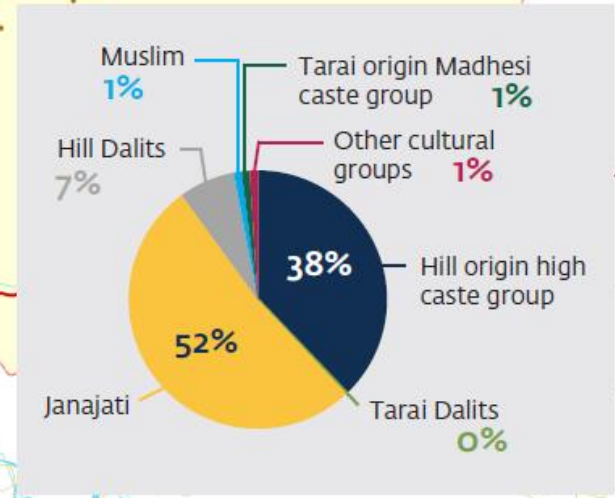
Social Baseline Studies

Map 7.2.1 Midstream Study Region



Data included:

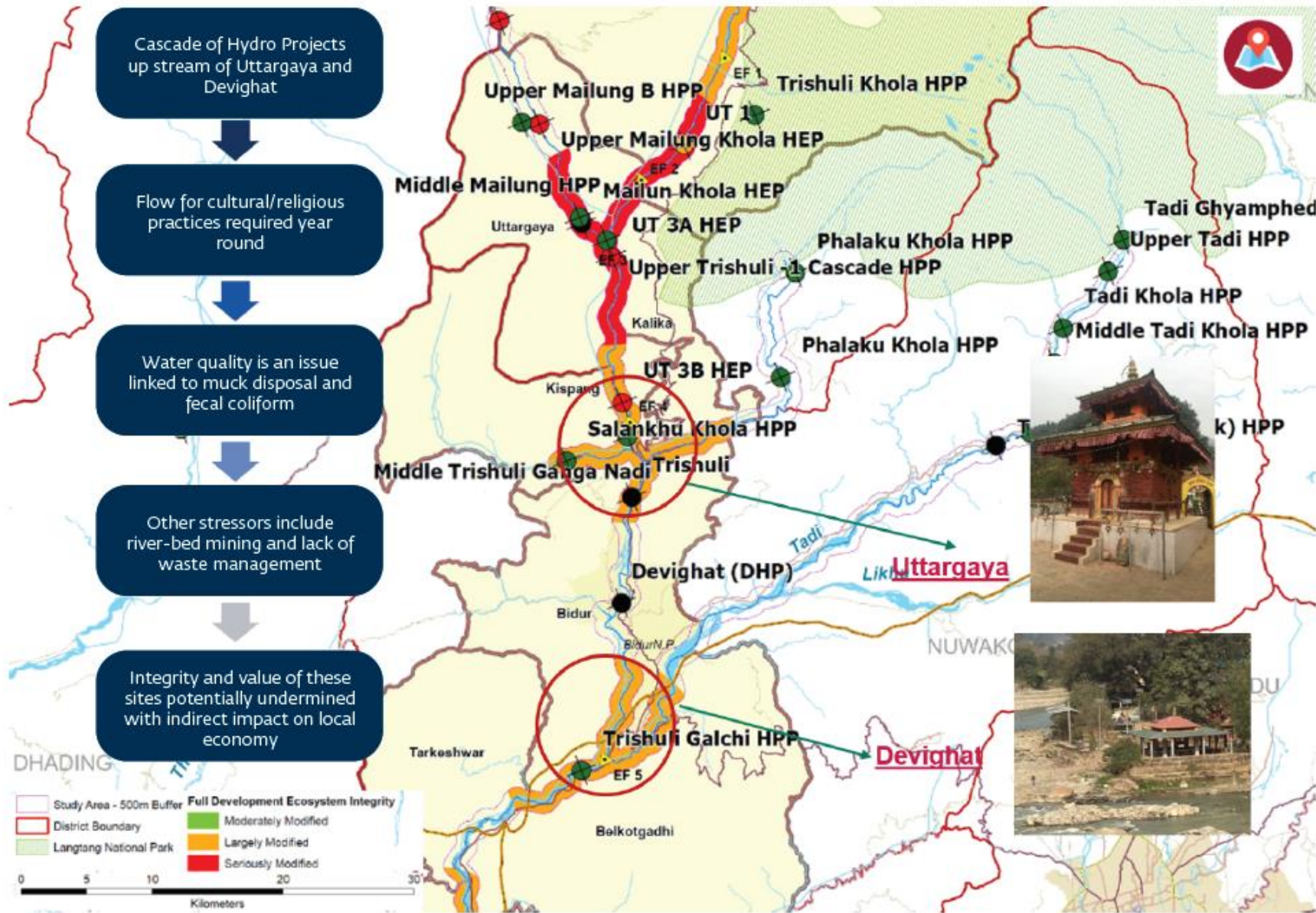
- Demographics
- Livelihoods
- In-migration
- Health
- Employment
- Land ownership
- Cultural Sites
- Water Resources





Many people
displaced by 2015
earthquake

VEC: Cultural and Religious Sites



Cascade of Hydro Projects up stream of Uttargaya and Devighat

Flow for cultural/religious practices required year round

Water quality is an issue linked to muck disposal and fecal coliform

Other stressors include river-bed mining and lack of waste management

Integrity and value of these sites potentially undermined with indirect impact on local economy

- Cumulative impacts were evaluated based on water quality and flow.
- Flow impacts are expected to be more project specific than cumulative and best managed as part of individual project ESIA review process, e.g. EFlows release

Gosaikunda Lake within Langtang National Park – no cumulative impacts



VEC: Livelihoods

- Cumulative impacts were evaluated based on DRIFT-modelled changes to overall **fish integrity**. Fish abundance will be impacted, although relatively few families rely exclusively on fishing as a livelihood, mainly from the Rai, Magar, and Dalit communities.
- Minor impact significance to livelihoods is expected overall, except for local communities who support rafting and tourism activities. There will be localized impact linked to Super Trishuli HPP.



VEC: Water Resources

- Cumulative impacts were evaluated as part of the DRIFT model of Aquatic Habitat Ecosystem Integrity
- Mostly non-hydropower stressors including sand/gravel mining, disposal of soil and pollution
- Significance analysis of water quality based on turbidity and coliform levels at various sections along the river indicates that the impacts of these stressors are significant

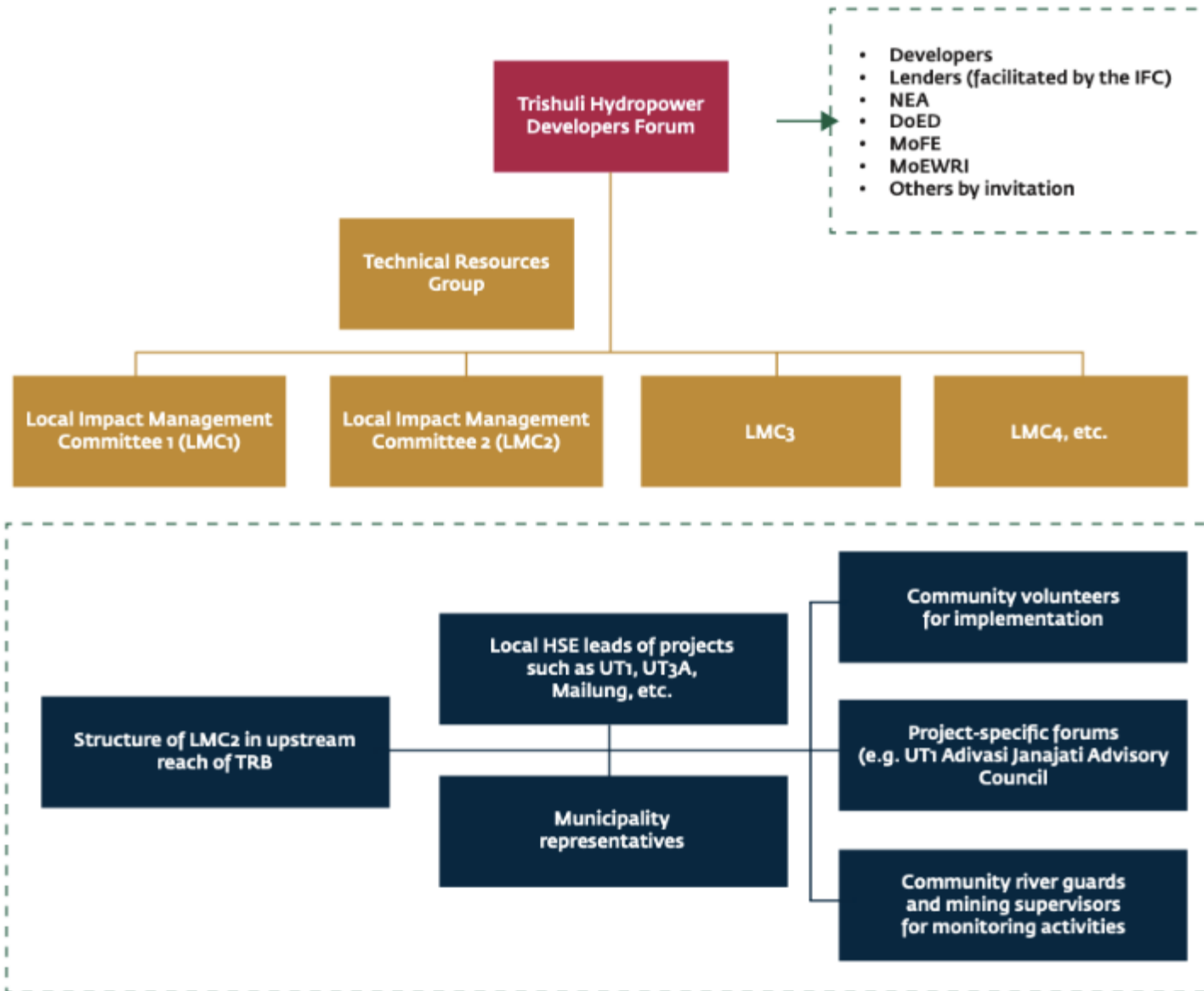


Managing Cumulative Impacts

- ❖ The CIA report includes recommended mitigation actions for each VEC for:
 - Hydropower Developers
 - Government Authorities
 - Local Communities
- ❖ January 26 Webinar will provide an overview of Mitigation Measures for Biodiversity
- ❖ EFlows Release is essential from all HPPs during dry season
- ❖ Fish Passage (upstream and downstream) on all HPPs would greatly reduce impacts on fish - possible to add to existing HPPs?

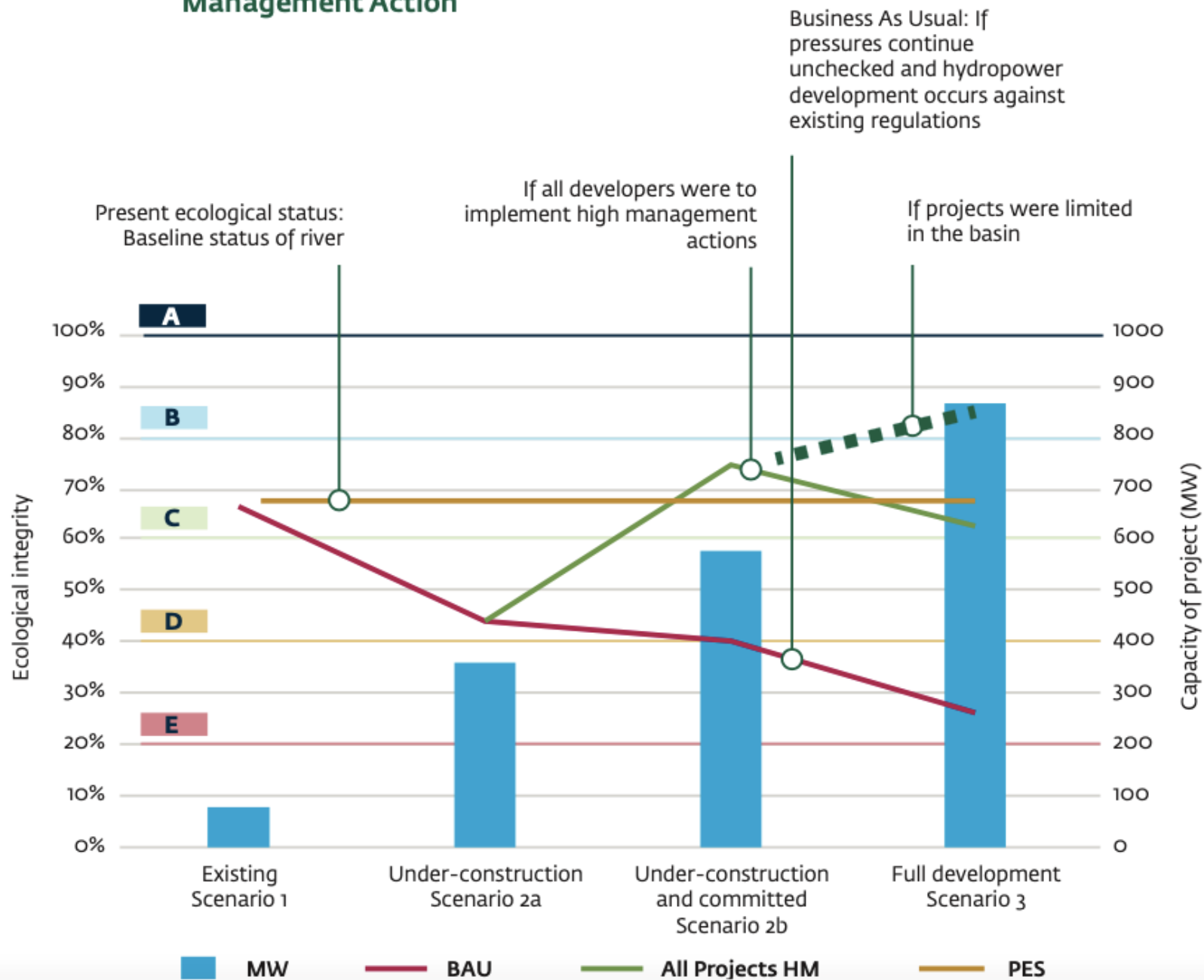


Proposed High Management Action



Could be modelled after watershed management plans in the Koshi Basin and Karnali Basin (Paani program)

Figure ES.4 Comparative Analysis of the Business-as-Usual Scenario and High-Management Action



High Management Action – will require Collaboration

Trishuli Hydropower Developer's Forum

- Developers and Government sign a Charter to collaborate
- Mitigation actions for hydropower projects and developers

Local Impact Management Committees

- Community Based River Guards
- Sustainable Fishing Plans
- Commercial Fish Farms
- Sustainable Sediment Mining Plans
- Watershed Management
- No-go Areas for Hydropower Development
- Mahaseer and Snow Trout Sanctuaries

Proposed High Management Action

Theme	Description	Responsibility
Developer's Charter on Sustainable Hydropower in the Trishuli River Basin	<p>This is anticipated to be a vision- and commitment-driven document that will include the following:</p> <ul style="list-style-type: none"> • Applying a uniform set of standards for including fish passes in the design of projects based on a review of contemporary and innovative designs for fish passes in conjunction with leading experts in this discipline • Developing guidelines to prepare and implement an environmental flow management framework for each HPP based on available secondary guidance on adaptive management (This should be project- or reach-specific, keeping in mind ecological, cultural, and social sensitivities inherent for the river reach.) • Researching and developing a robust standard methodology for aquatic baseline surveys and monitoring for Environmental and Social Impact Assessments (ESIAs) to be used by all HPPs and possibly adopted into government regulations (and training HPP and government staff in methodologies) • Assessing land-based and livelihood impacts from projects in order to develop and fund livelihood restoration measures (focused on fishing, skills development, and agricultural intensification schemes as identified in the recent free, prior, and informed consent agreement for UT-1) as a form of local community development around HPPs • Expanding the regulatory EMPs into a comprehensive Environment and Social Management Plan (such as in the case of Upper Trishuli-1), which will incorporate safeguards to manage localized social impacts linked to in-migration, resource requirements, and community health and safety • Conducting issue- and theme-specific studies for sensitivities within the area of influence of the HPP, such as assessment of flows for cultural practices; inventory of springs, and so forth • Developing principles for all future land acquisition based on avoidance measures, compensation at replacement cost, informed consultation and participation, and emphasis on livelihood restoration of affected communities • Supporting suppliers of sand, gravel, and aggregates to implement sustainable mining techniques • Creating overarching framework on contractor management with specific safeguards to manage unregulated fishing, access into forest areas, muck disposal, and any other waste dumping related to project-induced influx • Developing and monitoring project-specific grievance redress mechanisms 	Trishuli Hydropower Developers Forum (THDP) with support from Local Impact Management Committees (LMCs) as per Chapter 10

Proposed High Management Action

Theme	Description	Responsibility
Community-based river guards across river reaches	<p>Each LMC will deploy community-based river guards and associated field-level supervision to undertake the following:</p> <ul style="list-style-type: none"> • Detect violation of restrictions, rules, and regulations approved by the LMC for protection of the river and tributaries and take corrective actions as permissible • Maintain contact with the local community and promote awareness and education on the importance of natural resources (including illegal sand mining and unregulated fishing) • Support implementation of incentive-based measures such as community-based sustainable fishing • Collect data on status of protection and awareness, record grievances, and report 	LMCs as per Chapter 10
Preparation and implementation of Sustainable Fishing Plans	<p>Mechanisms on regulated fishing managed by local communities in coordination with hydropower developers can be prepared by LMCs with support from the Technical Resource Group. The basic principles followed include establishing a conservation program, conducting research to estimate sustainable harvesting quotas, setting up a system of permitting for harvesting, utilizing the revenues generated to manage the conservation and harvesting program, and monitoring to ensure the program objectives—including protection of fish populations and sustainability of the program—are met.</p>	LMCs as per Chapter 10
Development of indigenous fish hatcheries for fish stocking	<p>Where an HPP limits the access of the fish to its breeding areas that are generally located in the tributaries, stocking of fish bred in a hatchery can be considered as a means for mitigating the loss of breeding areas. It is advisable to consider captive breeding and stocking as a measure that is supplemental to other management measures such as protection, habitat management, and fish passes, rather than a substitute for them.</p>	LMCs as per Chapter 10 supported by Fishery Research Center (Fisheries Research Stations Nuwakot and Dhunche).
Farming of commercially valuable fish species	<p>Providing alternative means of incomes or livelihoods through promotion of fish farming can help reduce anthropogenic pressures on the river ecosystems. There are several Brown Trout (<i>Salmo Trutta</i>) and Rainbow Trout (<i>Oncorhynchus mykiss</i>) farms, some of them started with international assistance (for example, JICA) with considerable capacity and commitment. Such farms should be developed in areas where indigenous fish stocks are depleted due to overfishing. It is to be emphasized here that farming of indigenous fish species is far more preferable than farming invasive trout species that may compete and suppress wild populations of indigenous species.</p>	LMCs as per Chapter 10 supported by Fisheries Research Centre
Preparation and implementation of Sustainable Sediment Mining Plans	<p>Given that it is entirely plausible that the demand for sediment will continue to increase in the foreseeable future, achieving the high management will necessitate management and control that will limit the impact of mining on the river and its tributaries in the face of increased demand and volumes being abstracted. These mining plans will be elaborated to include the following:</p>	LMCs as per Chapter 10 with potential assistance from the District Coordination Committee

Proposed High Management Action

Watershed management	<p>A watershed management program can help improve water quality in the basin and play a critical role in protection of biodiversity and river-based livelihoods. Actions that can be supported by the THDF and LMCs include (i) programs focusing on areas needing reforestation to meet community requirements for fuel wood and timber, while being watchful of the limits of sustainable harvesting to reduce erosion and risk of landslides; and (ii) land use management. The watershed management program should also have a link to any basin-level plans, benefit-sharing plans. It should be developed and implemented in partnership with the provincial government to allow for the coordinated planning and implementation of watershed and community investment initiatives. Suggestions for management of water use in both agriculture and households and management of water quality at the local level must also be included.</p>	LMCs as per Chapter 10
Delineating no-go areas for hydropower development	<p>Management committees should strongly advocate for the setting aside of stretches of river and tributaries that are of high ecological importance and can help in preservation of key features of aquatic biodiversity in the basin. They can include spawning grounds of fish and stretches and certain tributaries that are still in pristine condition. An example is the undammed Nyam khola, a tributary of the Mailung Khola, which is an important source site for Common Snow Trout of the Mailung Khola downstream of the dewatered area of the Mailung Khola HPP. LMCs, through the THDF, will recommend certain no-go areas for consideration by DoED, NEA, and MoEWRI. The Technical Resource Group will support in capacity building and in reaching out to the provincial and national government ministries and departments to identify and manage these no-go areas.</p>	LMCs as per Chapter 10
Mahseer and Snow Trout sanctuary	<p>Consider designating one or more important fish spawning tributaries (for example, the Tadi Khola) as a Mahseer and Snow Trout sanctuary, which would remain free flowing (that is, no hydropower development) and develop and foster domestic wastewater treatment and solid waste management to improve water quality and riparian and river health.</p>	THDF with support from the LMCs

Q & A Session



Moderator:

Kate Lazarus

Senior Asia ESG Advisory Lead

IFC

Closing Remarks

Pablo Cardinale
Leeanne Alonso
Kate Lazarus

Need to improve knowledge of Aquatic Biodiversity and Ecosystems

- ❖ A better understanding of the current status of aquatic biodiversity and ecosystem is needed for the Trishuli River Basin.
- ❖ Follow up actions led by IFC have included:
 - Workshop on Aquatic Biodiversity Assessment and Monitoring (November 2019) to develop the [Trishuli Assessment Tool](#), a standard methodology for improving aquatic sampling that includes more robust techniques such as electrofishing and environmental DNA
 - Field testing of the Trishuli Assessment Tool (February 2020)
 - Webinar workshop on the Trishuli Assessment Tool (February 2 – 18, 2021)



Next Steps

IFC is offering a 6 webinar workshop on the [Trishuli Assessment Tool](#): a standardized field methodology for aquatic biodiversity assessment and monitoring

Join us to learn about this new approach designed by Nepalese and International aquatic specialists

- ❖ February 2: Overview of the Trishuli Assessment Tool
- ❖ February 4: Electrofishing
- ❖ February 9: Environmental DNA (eDNA)
- ❖ February 11: Macroinvertebrate Sampling
- ❖ February 17: Himalayan Fish Identification
- ❖ February 18: Data Analysis for Long-term Monitoring

Next Webinar in the IFC Advancing Sustainable Hydropower Series

International Good Practice for Biodiversity Mitigation for Hydropower Projects

Tuesday, January 26, 2021

Time: 19:00-20:30 (Nepal time)

Speakers:

- Atle Harby, Sintef, Norway
- Ana Bustos Adeva, Sintef, Norway
- Fareeha Irfan Ovais, Hagler Bailly Pakistan



An aerial photograph of a lush green valley. A wide, muddy river flows through the center. On the right side, there are terraced agricultural fields. A winding road or path is visible on the left side of the valley. The surrounding hills are covered in dense forest.

**Thank you for your
participation!!!**