ENVIRONMENT & SOCIAL IMPACT ASSESSMENT (ESIA)

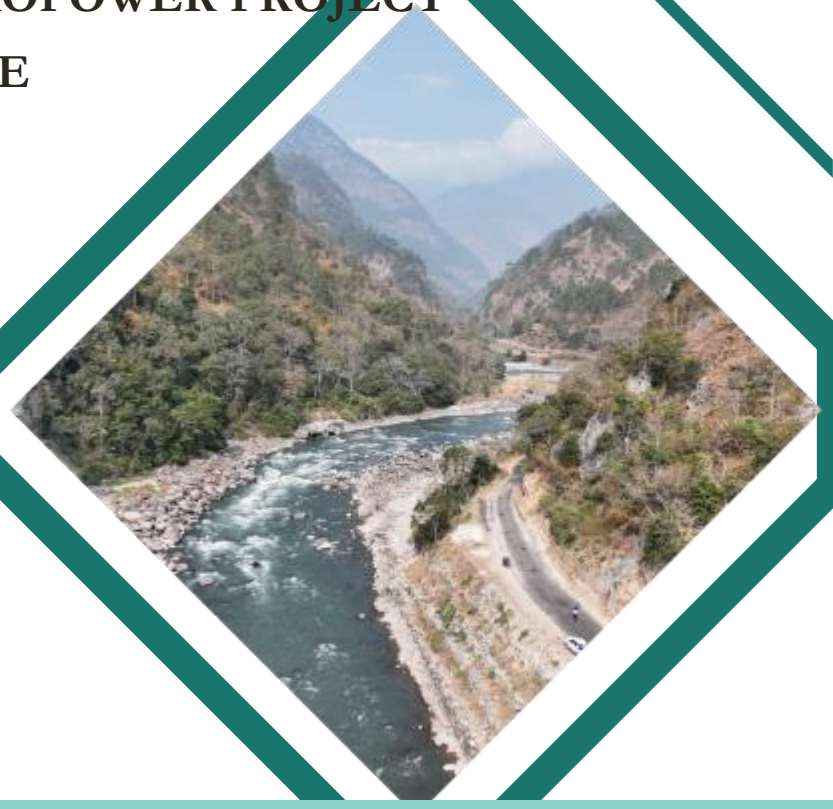
BIODIVERSITY MANAGEMENT PLAN (BMP)

DRAFT

1125 MW DORJILUNG HYROPOWER PROJECT

MONGAR AND LHUENTSE

BHUTAN



MARCH 2025

DRUK GREEN POWER CORPORATION LIMITED (DGPC)
THIMPHU, BHUTAN

Disclaimer:

This Environmental and Social Impact Assessment (ESIA) for the Dorjilung Hydro-electrical Power Project[1] was prepared by the Druk Green Power Corporation Limited, Royal Government of Bhutan (RGoB), and follows Good International Industry Practices (GIIP) and the Bank's Environmental and Social Framework (ESF).

The review of this ESIA is a key part of the Bank's due diligence process and is currently ongoing. This ESIA may still contain gaps to fully address all pertinent E&S issues in the project. Any gaps in this ESIA will be filled through supplemental studies, assessments, and/or plans that will be completed in a reasonable timeframe to ensure compliance with the ESF.

For the benefit of potentially project affected people (PAP) and other interested stakeholders, and in alignment with the Bank's Policy on Access to Information this ESIA is being disclosed as soon as it became available. The disclosure of this ESIA, however, should not be considered as a final clearance of the ESIA by the World Bank.

[1] Synonymously called "Dorjilung Hydropower Project (DHPP)"

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS USED IN THE TEXT

Acronym	Description
AoA	Area of Analysis
BC-7	Biodiversity Corridor #7
BMP	Biodiversity Management Plan
BU	Biodiversity Unit
BWS	Bumdeling Wildlife Sanctuary
CC	Construction Contractor
CH	Critical Habitat
CR	Critically Endangered
DGPC	Druk Green Power Corporation Limited
DoFPS	Department of Forests and Park Services
E&S	Environmental and Social

Acronym	Description
EFlow	Environmental Flow
EN	Endangered
EPC	Engineering-Procurement-Construction
ESF	World Bank Environmental and Social Framework
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environment and Social Management Plan
ESS6	World Bank Environmental and Social Standard on Biodiversity Conservation and Sustainable Management of Living Natural Resources
FAO	Food and Agricultural Organization
FFSBC	Freshwater Fisheries Society of British Columbia
FNCA	Forest and Nature Conservation Act of Bhutan, 2023
HPP	Hydropower Project
IBA	Important Bird Area
IAS	Invasive Alien Species
IUCN	International Union for the Conservation of Nature
KBA	Key Biodiversity Area
KHP	Kurichhu Hydropower Plant
KPI	Key Performance Indicator
LC	Least Concern
MoU	Memorandum of Understanding
NCD	Nature Conservation Division, Department of Forests and Park Services, Bhutan
NE	Not Evaluated
NGO	Non-Governmental Organization
NGS	Net Gain Strategy
NRDCRLF	National Research and Development Centre for Riverine and Lake Fisheries
NT	Near Threatened
PIU	Project Implementation Unit
PNP	Phruemsengla National Park
RGoB	Royal Government of Bhutan
RR	Range Restricted
RSPN	Royal Society for Protection of Nature
SAR	Search And Rescue
UWIFoRT	Ugyen Wangchuck Institute for Forestry Research & Training
VU	Vulnerable
WCNP	Wangchuck Centennial National Park

1 EXECUTIVE SUMMARY

This document serves as the Biodiversity Management Plan (BMP) to present mitigation to address impacts to biodiversity caused by the Dorjilung Hydropower Project, in eastern Bhutan. The Project will be implemented under the Environmental and Social Framework (ESF), and this BMP is compiled to meet requirements of the Environmental and Social Standards (ESS), ESS6 of the World Bank.

The main objective of this BMP is to manage project impacts on biodiversity to meet the requirements of ESS6. Specifically, the objectives of this BMP are:

- To develop and implement measures to achieve No Net Loss, and where feasible, preferably a net gain of biodiversity through appropriate measures put in place in accordance with the mitigation hierarchy in response to impacts to natural habitat.
- To present a mitigation strategy to achieve net gains for the biodiversity features for which critical habitat is designated through an approach that is proportional to the project impacts.
- Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of affected protected areas.

This BMP forecasts a total budget over USD 16.5 million, as presented in the following table. The BMP separates mitigation required to address project impacts from the Biodiversity Net Gain Strategy developed to address the above objectives.

Cost Estimate	**Amount (USD)**
Mitigation to address project Impacts	$ 4,236,445
Biodiversity Net Gain Strategy	$ 12,415,000
Total Budget for this BMP	**$ 16,651,445**

1.1 Measures to Address Project Impacts

Measures to address project impacts have been structured into 16 activity groups as listed in the table below. An implementation schedule and schedule of roles and responsibilities are developed to guide the implementation of these activities. Several activities are costed elsewhere in the Environmental and Social Impact Assessment (ESIA), with costs for activities relevant to the BMP estimated for the Preconstruction and Construction phases and for 10 years of the Operations Phase. A key action will involve establishment of a Biodiversity Unit led by the Biodiversity Manager deputed from the Department of Forestry and Parks (DoFPS) who will be supported by terrestrial and aquatic ecologists.

Activities to address Project Impacts	**Preconstruction & Construction**	**Operations (10 years)**	**Total (USD)**
Establish a Biodiversity Unit (BU) and logistics	$ 1,330,000	$ 730,000	$ 2,060,000
2. Incorporate Biodiversity Protection and Code of Conduct into the Natural Resource Mgmt. Policy	PIU operational costs are not budgeted here		
3. Incorporate Biodiversity Protection Requirements into Tender Documents			
4. Raise Awareness of Biodiversity among Staff, Contractors & Local People	$ 68,000	$ 58,000	$ 126,000
5. Equipment and capacity building for the Biodiversity Unit	$ 460,000	$ 270,000	$ 730,000
6. Implement Biodiversity Friendly Approaches with the Social Influx MP	$ 150,000	$ 100,000	$ 250,000
7. Consider Additional Biodiversity Protection to enhance ESMP Plans	$ 150,000	$ 100,000	$ 250,000

Activities to address Project Impacts	Preconstruction & Construction	Operations (10 years)	Total (USD)
8. Surveys for Birds and Nesting Activity	$ 50,000	$ 60,000	$ 110,000
9. Preconstruction surveys for *Hoya bhutanica*, Orchids and other Epiphytes	$ 80,000		$ 80,000
10. Control IAS in Construction Sites	Costs are included in EPC budgets, Biodiversity Unit costs are included above		
11. Avoid Animal Mortality during Construction			
12. Avoid Animal Mortality during Operations			
13. Rescue Trapped and Injured Animals in Construction Sites and their Vicinity	$ 80,000	$ 40,000	$ 120,000
14. Incorporate Safe Wildlife Crossings along New Roads (survey and monitoring costs)	$ 70,000	$ 20,000	$ 90,000
15. Ensure Implementation of the EFlow Management Plan	Costs estimated in the EFlow Management Plan		
16. Implement a Migratory Fish Catch-&- Release Protocol	$ 40,000	$ 100,000	$ 140,000
17. Monitoring BMP implementation	$ 200,000	$ 80,445	$ 280,445
Total (USD)	**$ 2,678,000**	**$ 1,558,445**	**$ 4,236,445**

1.2 Biodiversity Net Gain Strategy

The Project area supports sensitive biodiversity, including extensive natural habitat, legally protected areas and numerous species that qualify as critical habitat features. The Biodiversity Net Gain Strategy is structured into six net gain components as listed in the following budget table.

Net Gain Component	Amount
1. Support to protected areas, conservation initiatives and Corridor Functionality Study	$ 3,500,000
2. Conservation measures for Endangered birds	$ 60,000
3. Afforestation to compensate natural habitat loss	$ 800,000
4. Propagation of *Hoya bhutanica* and saving orchids	$ 180,000
5. Establish and operate a fish hatchery	$ 7,810,000
6. Distribution study of range restricted fish	$ 65,000
Total budget for Net Gain Strategy	**$ 12,415,000**

Mitigating biodiversity loss is always challenging, but there is confidence that implementation of the Biodiversity Net Gain Strategy will achieve the BMP objectives. The following approaches will be adopted:

Afforestation to offset Natural Habitat Loss: An area of 606 hectares (1497.46 acres) of natural habitat, comprising both forest and aquatic ecosystems, will be lost due to the development of the project. To offset this impact, an afforestation program will be implemented to restore tree cover over an area equivalent to the habitat affected. This program will prioritize degraded landscapes within community forest reserves, which will enhance forest habitats while also benefiting adjacent aquatic ecosystems through improved habitat quality. Aquatic habitats will additionally be supported through the professional management of a fish hatchery (outlined below).

Fish Hatchery to Mitigate Aquatic Impacts: To address impacts on fish populations and aquatic ecosystems, the project will construct and operate a large-scale hatchery to culture and release various fish species across the Kuri Chhu catchment. The hatchery will have the capacity to produce sufficient fish fingerlings to sustain fish populations within the Kuri Chhu and potentially other river systems in Bhutan. A manifesto of conservation principles will guide the hatchery's operations, focusing on preserving genetic diversity, preventing the spread of diseases, and enhancing natural habitats. This initiative is expected to play a significant role in achieving Net Gain for aquatic habitats.

Three fish species have been provisionally identified as critical habitat species due to their restricted ranges. However, this status may stem from insufficient distribution data rather than genuinely narrow ranges. To address this uncertainty, an eDNA study will be conducted across the Kuri Chhu catchment. This study will assess the distribution of these species, re-evaluate their critical habitat status, and determine whether additional conservation measures are needed.

Support to Protected Areas: The project reservoir will disrupt the Biological Corridor #7 (BC-7), a legally protected area for wildlife connectivity. Although a conservation management plan for BC-7 has been developed, divisional DoFPS staff have reported limited financial resources for its implementation. With the financial support provided under this Biodiversity Management Plan (BMP), significant improvements in BC-7's management effectiveness are anticipated. These resources will also support nearby protected areas, fostering better integration of BC-7 with the surrounding network of protected habitats.

A Corridor Functionality Study, proposed by the Chief Forest Officer of Mongar, will guide management strategies for the BC-7. This study will involve relevant functional divisions of DoFPS or the Nature Conservation Division (NCD), leveraging their expertise in wildlife monitoring techniques such as camera trapping and tracking. The study will assess wildlife movement patterns, identify alternative corridors, and inform adaptive management strategies. These efforts are expected to enhance the ecological integrity of BC-7 and its connectivity with adjacent protected areas.

Large Mammal Conservation: Large mammals identified as critical habitat species include the Bengal Tiger, Dhole, and Red Panda. Enhanced management of BC-7, supported by findings from the Corridor Functionality Study, will provide better protection for these species. The study will also assess prey populations and investigate alternative movement corridors that may naturally develop. This adaptive approach will ensure long-term connectivity and ecological functionality for these critical species.

Bird Species Conservation: The Pallas's Fish Eagle and White-bellied Heron may experience some impacts from altered hydrology caused by the project. However, both species have shown adaptability by foraging in the nearby KHP reservoir and are expected to benefit from the creation of the project reservoir, which will be stocked with fish. To further support these species, nesting platforms will be installed in safe, strategic locations to enhance nesting success. This measure will encourage the birds to fully utilize the new foraging opportunities, contributing to their conservation and ensuring long-term habitat suitability.

Conservation of Hoya and Epiphytic Orchids: The endangered *Hoya bhutanica*, an epiphyte, is found in areas that will be impacted by project activities. Given that Hoya species are easily propagated, this plant can be multiplied in large numbers and distributed for use in the afforestation program, project landscaping, and local monasteries, where it can be nurtured and appreciated. This initiative offers a significant opportunity to achieve Net Gain for the species.

Additionally, many epiphytic orchids growing on trees along the Kuri Chhu will be affected by reservoir inundation. Orchids hold ecological and cultural significance and are already cultivated in local monasteries

and religious sites. To conserve these plants, the project will collaborate with monasteries and the DoFPS to collect orchids and other epiphytes from the affected area. These plants will be cultivated in monasteries, where dedicated care will enhance understanding of their ecological requirements. Over time, orchid seeds will naturally disperse back into the environment, supporting regeneration and promoting broader biodiversity benefits.

Integrating Conservation into Local Culture: The integration of biodiversity conservation into local cultural practices, such as nurturing plants in monasteries and religious sites, creates a powerful multiplier effect for the Net Gain Strategy. By engaging local communities and fostering cultural appreciation for biodiversity, this approach ensures the survival of species like *Hoya bhutanica* and native orchids while strengthening the connection between people and their natural environment. This holistic approach promises lasting ecological, cultural, and community benefits.

2 INTRODUCTION

In 2020, the Royal Government of Bhutan (RGoB), through the Department of Hydropower and Power Systems of the Ministry of Economic Affairs, requested World Bank assistance to develop its human and institutional capacity by applying this renewed framework to develop specific projects. The proposed 1125 MW Dorjilung Hydropower Project (Dorjilung HPP, the Project) was selected as a priority development and will be developed, implemented and operated by Druk Green Power Corporation Limited (DGPC).

Artelia and Phuensum Consultancy Services have prepared an Environmental and Social Impact Assessment (ESIA) and associated reports to meet the requirements of the World Bank Environmental and Social Framework (ESF) and applicable requirements of the RGoB. The revised Environmental and Social (E&S) documentation will form part of the Dorjilung Hydropower Project Detailed Project Report.

This Biodiversity Management Plan (BMP) has been prepared as part of the E&S documentation for the Dorjilung Hydropower Project. The BMP is a project wide planning document to inform the later preparation of the operational documents.

This BMP serves as a planning document developed based on analyses at the ESIA level and relies on all the measures developed in the project's Environment and Social Management Plan (ESMP), those allowing the preservation of the physical environment and the management of social influxes. This BMP must therefore be considered a component of ESMP. This BMP is intended to serve as a living document that requires regular review and updating as new information arises, project implementation progresses, and conservation context changes over time.

2.1.1 Structure of this Document

This document has been structured to align with the Indicative Content of a BMP provided in the ESS6 Guidance Notes, and comprises the following sections:

1. EXECUTIVE SUMMARY
2. INTRODUCTION
3. OBJECTIVES
4. BACKGROUND INFORMATION
5. PROJECT MITIGATION REQUIREMENTS
6. BIODIVERSITY NET GAIN STRATEGY
7. IMPLEMENTATION SCHEDULES
8. INSTITUTIONAL RESPONSIBILITIES
9. COST ESTIMATE
10. IMPORTANT REFERENCES

3 OBJECTIVES

The Dorjilung HPP will be implemented in accordance with the ESF. The ESF comprises 10 ESSs with ESS6 addressing Biodiversity Conservation and Sustainable Management of Living Natural Resources.

ESS6 has the following objectives:

- To protect and conserve biodiversity and habitats.
- To apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity.
- To promote the sustainable management of living natural resources.
- To support livelihoods of local communities, including Indigenous Peoples, and inclusive economic development, through the adoption of practices that integrate conservation needs and development priorities.

The main objective of this BMP is to manage project impacts on biodiversity to meet the requirements of ESS6. The specific objectives of this BMP are:

- To develop and implement measures to achieve No Net Loss, and where feasible, preferably a net gain of biodiversity through appropriate measures put in place in accordance with the mitigation hierarchy in response to impacts to natural habitat.
- To present a mitigation strategy to achieve net gains for the biodiversity features for which critical habitat is designated through an approach that is proportional to the project impacts.
- Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of affected protected areas.

4 BACKGROUND INFORMATION

4.1 Project Description

The Dorjilung HPP (the Project) is located on the Kuri Chhu River in eastern Bhutan, which originates in the Tibet Autonomous Region of People's Republic of China, crosses into Bhutan approximately 70 km North of the Project, and then flows south from the Project to join the Manas River, a transboundary river in the Himalayan foothills in southern Bhutan.

The location and layout of Dorjilung HPP are presented in Figure 1 and Figure 2 with important design features provided in **Error! Reference source not found.**. The Dorjilung dam site and powerhouse will b e located in the province of Mongar Dzongkhag with parts of the reservoir extending north into the province of Lhuentse Dzongkhag. The dam site is located about 7 km downstream of Autsho. The dewatered section from the dam to the powerhouse is approximately 16 km long and the Powerhouse would be near Lingmethang. The powerhouse will be approximately 10km upstream of the existing Kuri Chhu Hydropower Plant (KHP), with the dam wall located approximately 36km upstream of the KHP. Key specifications of the Project are presented in the following Table 1.

Table 1: Summary of Important Project Design Features

HPP Parameter	Dorjilung HPP values
Average discharge	287 m^3 /s
Design flood	16,225 m^3/s (PMF + end moraine glacial lake)
Reservoir-gross storage	44.17 Mm^3
Reservoir-live storage	12.62 Mm^3
Full Supply Level (FSL)	+850 m
Reservoir area at FSL	145.82 ha
Minimum Operating Level	+840 m
Dam type	RCC/Concrete gravity
Crest length of dam	241 m
Crest elevation of dam	+853 meters above sea level
Maximum height of dam	139.5 m of which 85m will be above the riverbed level
Spillway gates	6 gates 9.0 m (w) x 15.10 m (h)
Headrace tunnel	Single 14,974 m long concrete-lined - 11 m diameter finished
Surge Shaft	Single 135 m high restricted orifice - 26 m diameter, circular
Pressure shaft	3 nos. 332.8 m (PS-1 & PS-3) & 313.5 m (PS-2) long steel-lined penstocks of 5.5 m diameter finished
Powerhouse	Underground with dimensions 210 m (l) x 23 (w) 60.5 m (h)
Tailrace tunnel	2 nos., 350 & 360 m long, concrete-lined with 8 m diameter
Normal tail water level	+544 m
Dewatered reach: dam to tailrace	About 16 km
Watershed area	8,782 km^2 (of which 5,183 km^2 are outside Bhutan)
Installed capacity	6 units at 187.5 MW = 1,125 MW
Type of turbine	Francis, vertical setting
Rated design discharge	451 m^3 /s
Gross head	306 m
Annual energy generation at 90%	4,504 GWh
Firm power	153 MW (deducting 6 cumecs for e-flow)

Figure 1: Location of Dorjilung HPP in Bhutan (source: DGPC)

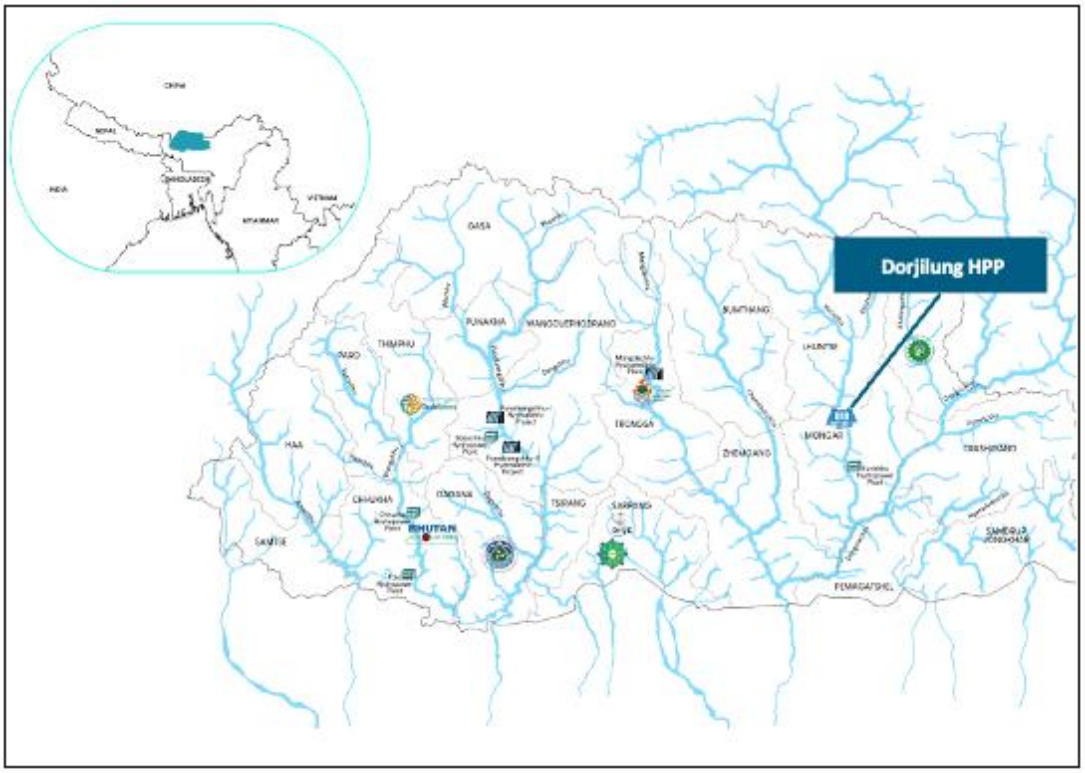
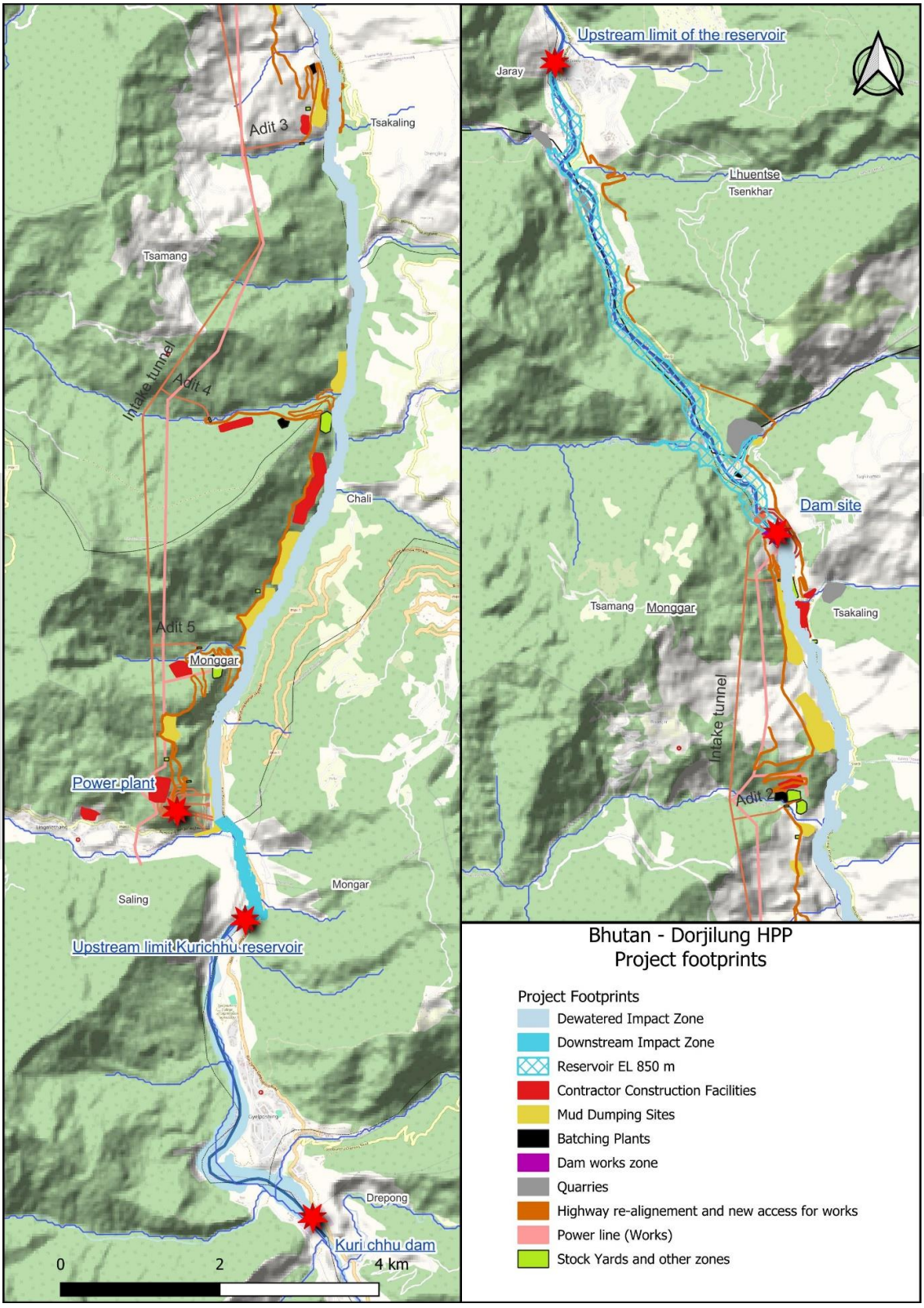


Figure 2: General Arrangement of Dorjilung HPP (source: Artelia)



4.2 Biodiversity Baseline Summary

This section presents a summary of the detailed biodiversity baseline presented in the Project ESIA (ESIA Volume 1 Part B, Chapter 7), which is based on literature review; engagement with local communities, targeted field survey and inventories on terrestrial and aquatic fauna and flora. This summary has been expanded to include data collected by the Nature Conservation Division (NCD), Department of Forests and Park Services (DoFPS), Ministry of Energy and Natural Resources (MoENR), Bhutan. The following terrestrial field surveys were conducted:

- Pre-monsoon survey from May 15 to May 30, 2023, for terrestrial flora and fauna focusing on mammals and birds and opportunist observations for other groups, conducted by Artelia.
- End monsoon survey dedicated herpetofauna conducted by Artelia in Sept 2023.
- Post monsoon survey for terrestrial flora and fauna, conducted by Artelia in Oct/Nov 2023.
- A camera trapping study, conducted by the NCD, from late Dec-2023 to mid-Feb-2024,

The following aquatic field surveys were conducted:

- The pre-monsoon conducted by Artelia in Apr/May 2023.
- The post monsoon field survey conducted by Artelia in Oct/Nov 2023,
- eDNA assessment conducted by the NCD in Jan-2024.

4.2.1 Occurrence of Modified and Natural Habitats

A landcover analysis provided within the ESIA identified 15 landcover units within an Area of Analysis (AoA) based on a 10 km radius of the affected Kuri Chhu River. Landcover units were identified and classified into modified and natural habitats based on the definitions within ESS6 and compared against the Project footprint. Table 2 presents the estimated loss of 606 ha of natural habitat.

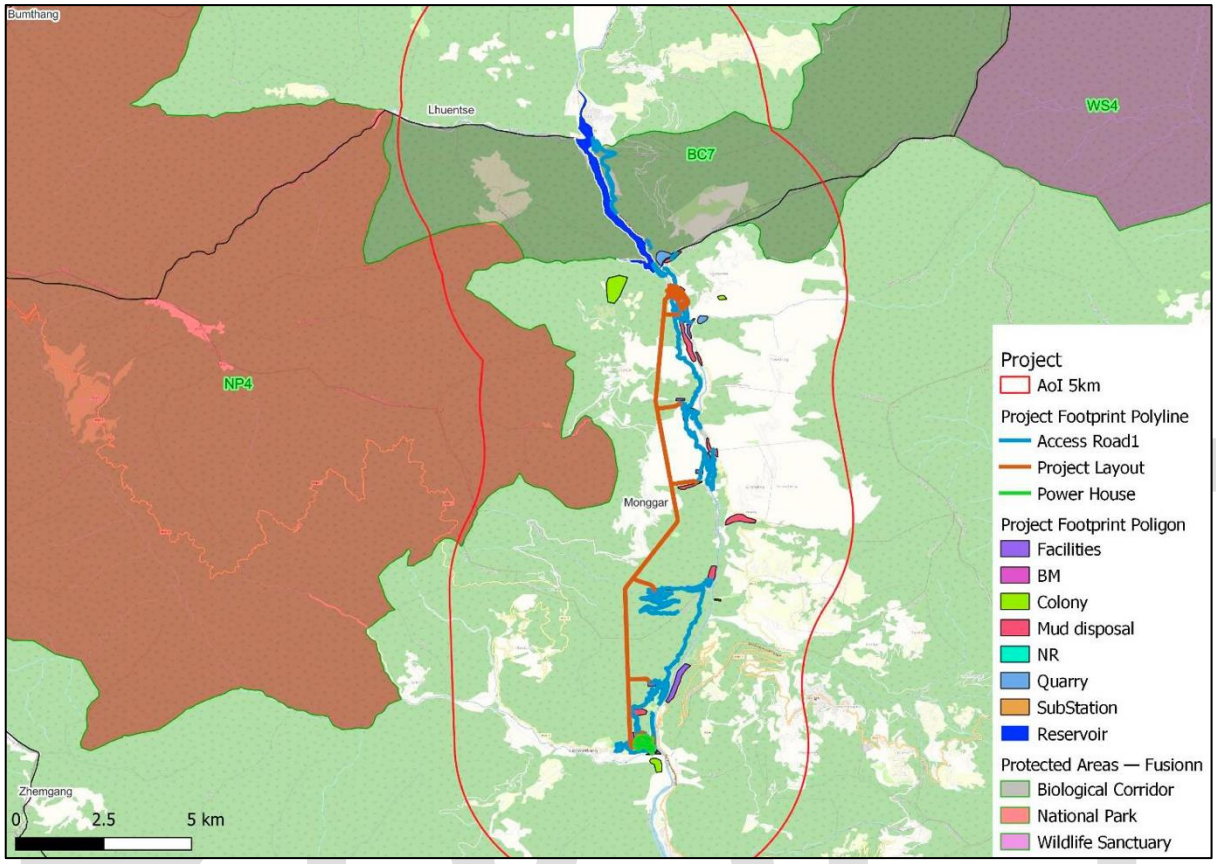
Table 2: Landcover assessment and Project Area of Impact

Habitat type	Landcover	Total Extent within AOA		Project Impact		Combined Impact
		Ha	Acres	Ha	Acres	
Natural habitats	Riparian Forest	359.8	889.1	132.6	327.7	1,497 acres (605.9 ha) Comprising: 69% Forest 2% Shrubs 29% River
	Broadleaf Forest	49,862.4	123,210.0	38.7	95.6	
	Chirpine Forest	15,563.6	38,457.7	248.8	614.7	
	Fir Forest	15.7	38.8			
	Mixed conifer Forest	1,470.0	3,632.4			
	Shrubs	2,717.50	6,714.9	12.0	29.6	
	Rivers	526	1,299.7	173.9	429.6	
	Meadows	127.5	315.1			
	Landslides	101.2	250.1			
Modified habitats	Chhuzhing	537.6	1,328.4			61.6 acres (24.9 ha)
	Kamzhing	2,777.5	6,863.2	4.3	10.7	
	Orchards	7.2	17.8	0.1	0.2	
	Non-Built up	4.9	12.1			
	Built up	162.2	400.8	0.7	1.8	
	Road/track & buffer	1,498.8	3,703.5	19.8	48.9	
Total area		**75,732**	**18,7134**	**631**	**1,559**	

4.2.2 Protected Areas

Various legally protected areas occur within the vicinity of the Project as illustrated in Figure 3.

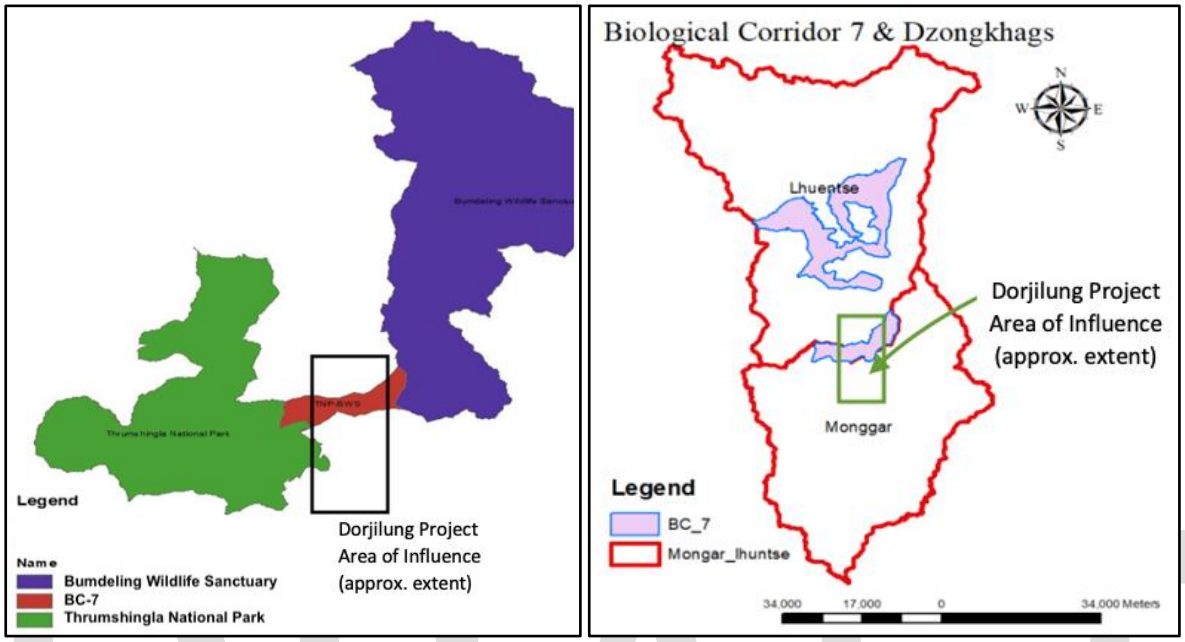
Figure 3: Project infrastructure relative to protected areas (source: Artelia)



The Phrumsengla (Thrumshing La) National Park (IUCN category II) is a large park covering 906 km² that is internationally recognized as an Important Bird Area (IBA). The Bumdeling Wildlife Sanctuary (IUCN Category IV) covers 1,534 km² and is also recognized as an IBA. Conservation management plans are available for both protected areas. A small part of the Project AoA extends into each of these areas, but no project components are located within, and no direct impacts to these protected areas are expected because of the project.

The Biological Corridor #7 (BC-7) is categorized as an IUCN Category VI area, which is the lowest level of protection afforded to protected areas. This corridor exists as several linkages (arms) between the above protected areas and was created to protect the movement of focal species such as Tiger, Red Panda and Musk Deer. The southern corridor will be bisected by the reservoir resulting from the dam constructed by the Project. The Kurichhu River forms a natural barrier, although this barrier will be enlarged by the Project reservoir with an impact primarily on terrestrial fauna. An approved Conservation Management Plan is available for the period Jan 2023 to Dec 2032, two ESMPs are available online, dated 2020 and 2022. The BC-7 has recently been expanded as the 2022 ESMP illustrates a larger area with several northern arms compared to the 2020 document (Figure 4). The 2020 ESMP outlines activities for waterhole restoration and boundary demarcation, while the 2022 ESMP addresses maintenance of the beat office and check post.

Figure 4: Former extent (left) and the expanded extent (right) of BC-7 with multiple arms, from the BC-7 ESMP 2020 and BC-7 ESMP 2022 respectively (with the approx. Project extent)



4.2.3 Presence of Threatened Species

Flora

Field surveys detected 286 plant species from 93 families, with the following threatened plants identified:

- *Hoya bhutanica* (family: Apocynaceae), Endangered at global and national level and considered as protected in Bhutan by national legislation
- *Piper pedicallatum* (family: Piperaceae), Vulnerable at global IUCN level but not listed in the national red list species
- *Tectona grandis* (family: Lamiaceae), introduced and not listed in the national red list species, but considered as protected in Bhutan by national legislation
- *Eucalyptus obliqua* (family: Myrtaceae), introduced and not listed in the national red list species

A total of 27 plant species (including at least 20 orchids) detected in the Project AoA are listed in SCHEDULE II and seven species listed in SCHEDULE III of the Forest and Nature Conservation Act (2023). No SCHEDULE I plant species were found.

Fauna

Field surveys by Artelia identified 11 mammal species, while 22 species were identified through the camera trapping survey by NCD, which yields a combined list of 23 mammals for the Project AoA (Table 3). No critically endangered species were detected, but endangered species include Bengal Tiger, Dhole and Red Panda.

Table 3: Summary of Mammal Diversity in the Greater Vicinity of the Project

Family Name	Common Name *(Scientific Name)*	FNCA Schedules (2023)	IUCN Red List	Artelia Surveys	NCD Camera Trapping
Primates					

Family Name	Common Name *(Scientific Name)*	FNCA Schedules (2023)	IUCN Red List	Artelia Surveys	NCD Camera Trapping
Cercopithecidae	Assamese macaque (*Macaca assamensis)*	III	NT	Yes	Yes
	Capped Langur (*Trachypithecus pileatus tenebricus)*	II	VU (EN)*	Yes	Yes
Carnivores					
Ursidae	Asiatic Black Bear *(Ursus thibetanus)*	II	VU		Yes
Ailuridae	Red Panda *(Ailurus fulgens)*	II	EN		Yes
Canidae	Dhole / Wild Dog (*Cuon alpinus)*	II	EN	Yes	Yes
Felidae	Bengal Tiger *(Panthera tigris)*	I	EN		Yes
	Common Leopard (*Panthera pardus)*	II	VU	Yes	Yes
	Leopard Cat (*Prionailurus bengalensis)*	II	LC	Yes	Yes
	Clouded Leopard *(Neofelis nebulosa)*	I	VU		Yes
	Marbled Cat *(Pardofelis marmorata)*	II	NT		Yes
	Asiatic Golden Cat (*Catopuma temminckii)*	II	NT		Yes
Mustelidae	Asian Small-clawed Otter (*Aonyx cinereus)*	II	VU	Yes	
	Yellow-throated Marten (*Martes flavigula)*	III	LC	Yes	Yes
	Siberian Weasel *(Mustela sibirica)*	III	LC		Yes
	Yellow-bellied Weasel *(Mustela kathiah)*	III	LC		Yes
Viverridae	Masked Palm Civet *(Paguma larvata)*	-	LC		Yes
Large Herbivores					
Bovidae	Goral (*Naemorhedus goral)*	II	NT	Yes	Yes
	Himalayan Serow *(Capricornis thar)*	II	VU		Yes
Cervidae	Barking Deer (*Muntiacus muntjak)*	III	LC	Yes	Yes
	Sambar (*Rusa unicolor)*	II	VU	Yes	Yes
Suidae	Wild Pig (*Sus scrofa)*	-	LC	Yes	Yes
Rodents					
Hystricidae	Himalayan Crestless Porcupine *(Hystyrix brachyura)*	III	LC		Yes
Sciuridae	Orange-bellied Himalayan Squirrel *(Dremomys lokriah)*	III	LC		Yes

* Capped Langur (*Trachypithecus pileatus)* is listed as Vulnerable on the IUCN Red List, while the subspecies *T. p. tenebricus* is listed as Endangered by the Global Biodiversity Information Forum (GBIF).

At least 198 bird species were identified, with Pallas's Fish Eagle the only endangered species. Foraging habitat exists for this eagle on the reservoir of the KHP which is 10 km south from Project site. The critically endangered White-bellied Heron (*Ardea insignis*) is reported to frequent the KHP reservoir but was not detected during field surveys. The water bodies above the KHP are probably used for foraging by the White-bellied Heron. Various critically endangered vultures could potentially occur but the AoA does not support residential vulture populations.

A total of 24 reptiles and amphibian species were identified in the field, but no CR, EN or restricted range species were detected. Only the King Cobra (*Ophiophagus hannah*) which is listed as VU on the IUCN Red List was sighted.

4.2.4 Aquatic Ecology

The Project is located on the Kuri Chhu River which has a pristine water quality and is considered a natural habitat (Table 2). The aquatic habitats are grouped into 2 types:

- Kuri Chhu mainstream: River width above 50m, fast flowing water current (up to 4 m/s registered during the field mission) with the riverbed composed of medium size gravels, rocks, and boulders. A few sand patches were observed.
- Tributaries: River width from 5 m to 8.5 m, tributaries with fast flowing water (0.2 m/s for one station and other stations 1.1 m/s to 3.6 m/s), the riverbed is composed of large boulders, natural rocks (diameters > 250 mm) and a few sand patches. Tributaries show the largest range of aquatic habitat, with the following examples:
    - Khalangzey (connecting the Kuri Chhu in the dewatered section) varying from 2 m to 4 m width, with large boulders and sandy areas, fast flooding waters and pools of standing water. The stream is shaded by riparian vegetation.
    - The Kharicchu has an 8.5m width, fast flowing water and is surrounded by riparian vegetation.
    - Fawan (upstream tributary), has an 8m width, with fast current and pools of standing water.

Field assessment of aquatic species suggest the aquatic habitat has a high sensitivity. The tributaries are narrower, shallower and with lower velocity than the Kuri Chhu and present a higher diversity of aquatic habitats than the main river. Anthropogenic modification of the riverbed and riverbank were not observed.

Fish Species

Field surveys by Artelia identified 13 fish species while eDNA studies by NCD identified 14 species. Results are consolidated into Table 4 which yields a potential list of at least 19 fish species for the Project area, but some are not identified to species level. Copper Mahseer was detected, but no evidence of Golden Mahseer was detected in the Project AoA. The KHP downstream of the Project site operates a fish ladder but is considered not accessible to Golden Mahseer. Three fish species are considered range restricted but this requires confirmation as there is a lack of online data regarding their distribution.

Table 4: Summary of Fish identified in the Greater Vicinity of the Project

Common Name ***Species Name***	**IUCN Red List Status**	**Artelia Surveys**	**NCD eDNA Survey**	**Remarks**
Indian Mottled Eel (*Anguilla bengalensis)*	NT		Yes	Migratory - freshwater eel that breeds in the marine environment.
Carp species (*Cyprinus sp.)*	-		Yes	
Tunga garra *(Garra annandalei)*	LC	Yes		
Khasi garra *(Garra lissorhynchus)*	LC	Yes		
Stone sucker fish (*Garra quadratirostris*)	NE	Yes		
Sosoroid Catfish (*Glyptothorax annandalei)*	LC	(Yes)	Yes	
Rohu (*Labeo rohita)*	LC		Yes	
Trout (*Salmo sp.)*	-		Yes	
Snow Trout (*Schizothorax richardsonii)*	VU	Yes	Yes	Locally migratory
Catfish *(Tachysurus sp.)*	-		Yes	
Catfish *(Parachiloglanis bhutanensis)*	NE, (RR)	Yes		Endemic to Bhutan
Catfish *(Parachiloglanis dangmechuensis)*	NE, (RR)	Yes	(Yes)	Considered endemic to Bhutan
Suckerthroat Catfish (*Parachiloglanis sulcata)*	LC		Yes	
Copper Mahseer (*Neolissochilus hexagonolepis)*	NT	Yes		Migratory
Pseudecheneis sulcata	LC	Yes		
Psilorhynchus homaloptera	LC	Yes		
Stone loach (*Schistura sp.)*	-	Yes	Yes	
Schizothorax sp.	-	Yes		

Common Name *Species Name*	IUCN Red List Status	Artelia Surveys	NCD eDNA Survey	Remarks
Torrent Catfish *(Creteuchiloglanis bumdelingensis)*	NE, (RR)	Yes	(Yes)	Considered endemic to Bhutan
Note: Parentheses for observations indicate identification to genus level but not confirmed to species level. Key to threatened status: NT – Near Threatened; LC – Least Concern; NE – Not evaluated on the IUCN Red List; RR – Range Restricted; (RR) - Lack of data available but considered range restricted.				

4.3 Critical Habitat Status

Critical habitats are determined based on the following ESS6 criteria:

(a) habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches;

(b) habitat of significant importance to endemic or restricted-range species;

(c) habitat supporting globally or nationally significant concentrations of migratory or congregatory species;

(d) highly threatened or unique ecosystems;

(e) ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

The ESIA provides an ESS6-aligned assessment of Critical Habitat using a method developed in South Asia. The approach involves four steps based on an AoA. The AoA is defined for this project in Section 4.2. Step 1 is to generate a list of threatened and range-restricted species. Step 2 requires screening of those species based on their likelihood of occurrence. Step 3 determines which species or features qualify against the ESS6 criteria. Six guidelines are presented in the box below to guide this analysis. Step 4 determines which critical habitat features will be impacted and require net gain outcomes, with an assessment of the feasibility of such measures. Guidelines for the Step 3 Assessment of Critical Habitat

(i) Recognized areas of high biodiversity value (such as legally protected areas, KBA, IBAs, Alliance for Zero Extinction sites, Ramsar Wetlands of International Importance and Natural World Heritage Sites) and the reasons for which they are designated can provide useful indicators of potential critical habitat.

(ii) ESS6 Criterion (a) requires an assessment against both global (IUCN) and national red list ratings. ESS6 footnote 13 states that where the threatened status of a species is listed differently on the (global) IUCN Red List and national/regional lists, assessment of the impact of net reduction should be based on the national/regional population. This is interpreted as a requirement to follow a precautionary approach and to prioritize assessment of species reduction (project impact) to the lesser population of a species (i.e. the national assessment) over the global (IUCN) assessment.

(iii) By definition, CR species face an extremely high risk of extinction and their continued survival in the wild is in a critical state. Therefore, if a surviving population of a CR species is present in the AoA, the habitat is considered to have significant importance for the species under ESS6 Criterion (a).

(iv) Where a significant proportion of the national, regional or global population of a species is present or has a likely presence within the AoA, the habitat is considered to have significant importance for the species under ESS6 Criterion (a), (b) and/or (c). Projects are encouraged to develop their own measurement of significance. For this Project assessment, presence (or likely presence) of ±1% of the global or national population within the AoA is considered significant.

(v) ESS6 Criterion (b) can additionally be achieved for range-restricted species where the full extent of the critical habitat AoA overlaps a significant proportion of a species' distribution range (±1% is considered significant for this assessment).

(vi) ESS6 Criteria (d) and (e) are to be assessed on a case-by-case basis using specialist input and reliable data sources with consideration given to the presence of conservation initiatives, legally protected areas and internationally recognized areas of high biodiversity value and the reasons for which they are designated.

4.3.1 Summary of Critical Habitat Features for the Project

Development of a national red list of threatened species has been initiated for Bhutan; however, it is incomplete and not suitable for this assessment of critical habitat. Analysis of threatened status therefore depends primarily on data within the IUCN Red List supported by national estimates of population size.

The ESIA provides an assessment of critical habitat, which is revised here to incorporate data received from camera trapping and eDNA studies conducted by the NCD. An overview of critical habitat features is presented in Table 5 identifying which species would require net gain measures.

Table 5: Overview of Critical Habitat Features and their relevance to the Project

Common Name (Scientific Name)	Critical Habitat Qualification and Potential Impact	Requires Net Gain Measures
Biodiversity Corridor #7 (BC-7)	The BC-7 supports a diversity of EN predators and the prey populations to sustain them, it also serves as a link between larger protected areas. The BC-7 thus qualifies as a critical habitat and will be impacted.	Priority critical habitat feature, requires mitigation as per the BMP Objectives.
Mammals		
Bengal Tiger (*Panthera tigris*)	Present in the area and may be impacted by severance of the BC-7.	Requires Net Gain, priority critical habitat species.
Dhole / Wild Dog (*Cuon alpinus)*	Present and relatively abundant in camera trapping results and may be impacted by severance of the BC-7.	Yes, but both species may benefit from BC-7 and Tiger conservation measures.
Red Panda (*Ailurus fulgens*)	Present in the area and potentially affected by indirect impacts.	
Capped Langur (*Trachypithecus pileatus tenebricus*)	Recorded during surveys. Listed as VU on the IUCN Red List, but the subspecies is EN (see Table 3). These monkeys are widespread in eastern Bhutan, and have adapted to modified habitats. Not a CH species for the Project.	No net gain measures required.
Chinese Pangolin (*Manis pentadactyla*)	No evidence of presence and a wide distribution makes this pangolin an uncertain critical habitat feature.	No net gain measures required.
Birds		
Pallas's Fish-eagle (*Haliaeetus leucoryphus*)	Present and may be both positively and negatively impacted by the Project reservoir.	No significant residual impacts are expected, NG measures are provided but not obligatory.
White-bellied Heron *(Ardea insignis)*	CR status, occasionally visits KHP within the AoA, but could benefit from the Project reservoir.	
White-rumped Vulture (*Gyps bengalensis*) Red-headed Vulture (*Sarcogyps calvus*)	No known populations resident in the AoA, potentially critical habitat features, but unlikely to be significantly impacted.	Net gain measures are not required.
Dark-rumped Swift (*Apus acuticauda*)	Presence is not confirmed and unlikely to be significantly impacted.	No net gain measures required.
Fish		
Catfish species (*Creteuchiloglanis bumdelingensis;* (*Parachiloglanis bhutanensis*); and (*P. dangmechuensis)*	Present but critical habitat qualification is based on uncertain restricted range status of each fish species. These fish are most prominent in the tributaries, and the effects of impacts to the river main stem is uncertain.	Restricted range status of these fish needs to be clarified to determine if Net Gain measures are required.
Indian Mottled Eel (*Anguilla bengalensis)*	Migratory species but identified from eDNA with no actual specimen observed, and there is no evidence of important congregations.	Requires confirmation of a significant population, to determine if Net Gain measures are required.
Butterfly		
Bhutan Swallowtail (*Bhutanitis ludlowi*)	Potentially present, but a high-altitude species that will not be significantly impacted.	No net gain measures required.
Floral (Plant)		
Hoya bhutanica	Reported in the project footprint where it will be impacted by construction activities.	No significant residual impacts are expected, NG measures are provided but not obligatory.

Based on the results in Table 5, the following critical habitat features will require net gain measures for their conservation in response to project impacts, which is feasible to achieve:

- Biological Corridor #7 – the Project reservoir will result in severance of the BC-7, but the significance of the impact is difficult to assess. A Corridor Functionality Study is proposed to assess significance of the impact, together with support to DoFPS to enhance the conservation aims and effective management of the area will yield Net Gain outcomes.
- Bengal Tiger – likely to be impacted, but management support to the BC-7 will benefit tigers, and no additional actions are necessary.
- Dhole / Wild Dog – impacted in a similar manner to tigers, management support to the BC-7 will benefit Dhole and other predators, and no additional actions are necessary.
- Red Panda – potentially indirectly impacted by an influx of workers which is mitigated. Management support to the BC-7 will likely benefit Red Panda, and no additional actions are necessary.
- Pallas's Fish Eagle – could be impacted, but has adapted its foraging to the KHP reservoir. The Project reservoir will likely also benefit this species. Provision of nesting platforms is a low-cost net gain action that may benefit this species
- White-bellied Heron – could be impacted and benefit in a similar manner to Pallas's Fish Eagle, provision of nesting platforms may also benefit this species.
- *Hoya bhutanica* – this plant is growing in areas that will be lost due to project activities and measures are needed to protect it. However, Hoya plants are easily propagated, and mitigation should be adequate to address impacts without the need for additional net gain actions.

The above requirements have guided development of the Biodiversity Net Gain Strategy (Section 6), with an analysis of Net Gain achievements provided in Section 6.8.

5 PROJECT MITIGATION REQUIREMENTS

This Section presents the mitigation necessary to address direct and indirect project impacts to biodiversity. The ESIA provides a detailed assessment of project impacts. Key impacts to biodiversity are abbreviated and summarized in Table 6 with some amendment for inclusion of the revised results of the critical habitat assessment. Table 7 presents a summary of the actions to address project impacts with details presented thereafter. Mitigation to address impacts that trigger ESS6 net gain requirements are provided in the Biodiversity Net Gain Strategy (Chapter 6).

Table 6: Overview of Project Impacts to Biodiversity

Description of Impact		Pre-mitigation Significance	Residual Significance (pre-Net Gain actions)
Impacts during the Preconstruction and Construction Phase			
Severance of BC-7 and impacts to protected areas		Substantial	Substantial
Impacts to critical habitat species	Mammals (Tiger, Dhole, Red Panda, Langur)	**High**	Substantial
	Birds (Pallas's Fish Eagle, White-bellied Heron)	Substantial	Moderate/Low
	Fish (3 restricted-range catfish sp.)	**High**	Moderate
	Flora (*Hoya bhutanica*)	**High**	Low
Loss and degradation of terrestrial natural habitats		**High**	Moderate
Loss of riparian forest		**High**	Substantial
Loss and modification of aquatic natural habitats		**High**	Substantial
Ecological fragmentation of aquatic habitats		**High**	Substantial
Impacts during the Operational Phase			
Variation of water quality in the reservoir and downstream		Substantial	Moderate
Variation of the sediment load		Substantial	Moderate
Flushing sediment from the reservoir		Substantial	Moderate
Risk of fish mortality related to the operation		Substantial	Moderate
Impacts of peaking activity		Substantial	Moderate
Risk of invasive species proliferation		Substantial	Moderate
Impacts of operation shutdown and outage		Substantial	Low

Table 7: Overview of Activities to Address Project Impacts to Biodiversity

BMP Activities	Project Phase	Type of Mitigation	Responsibility
1. Establish a Biodiversity Unit as a component of the PIU	All phases	Organization	PIU
2. Implement a natural resource management policy with biodiversity protection and staff code of conduct	Pre-constr.	Organization	PIU
3. Incorporate biodiversity protection requirements into tender documents	Pre-constr.	Organization	PIU
4. Raise awareness of biodiversity protection among project staff, contractors, subcontractors and local people	All phases	Awareness	PIU
5. Equipment and Capacity building for the Biodiversity Unit	All phases	Training	PIU

BMP Activities	Project Phase	Type of Mitigation	Responsibility
6. Implement biodiversity friendly approaches in conjunction with the social influx management plan	Construction	Avoid & reduce	PIU
7. Consider additional biodiversity protection measures to enhance ESMP management plans	Construction	Avoid & reduce	Contractor
8. Preconstruction surveys for bird and bird nesting activity	Pre-constr.	Avoid & reduce	Contractor
9. Preconstruction surveys for *Hoya bhutanica,* orchids and other epiphytes	Pre-constr.	Avoid & reduce	PIU
10. Control invasive alien species in construction sites	Construction	Avoid & reduce	Contractor
11. Avoid animal mortality during construction work	Construction	Avoid & reduce	Contractor
12. Avoid animal mortality during operations	Operations	Avoid & reduce	PIU
13. Rescue trapped and injured animals in construction sites and their vicinity	All phases	Avoid & reduce	PIU/Contractor
14. Incorporate safe wildlife crossings along new roads	Construction	Avoid & reduce	PIU/Contractor
15. Ensure implementation of the EFlow Management Plan	Operations	Avoid & reduce	PIU
16. Implement a migratory fish catch-&-release protocol	Operations	Avoid & reduce	PIU
17. Monitor the effectiveness of BMP implementation	All phases	Monitoring	PIU

5.1 Details of Mitigation to address Project Impacts

5.1.1 Establish a Biodiversity Unit as a component of the PIU

Type of mitigation: Organization	Target biodiversity: General	Responsibility: PIU

- The DGPC will establish a Biodiversity Unit (BU) for biodiversity protection and implementation of the BMP, as a part of the PIU ESHS Division/Department. The BU will be formalized within the PIU organizational chart that identifies the functions of the managers and the relationships between them.
- The BU will be led by a biodiversity manager deputed from DoFPS. The biodiversity manager will be supported by an aquatic ecologist and a terrestrial ecologist. The BU may also include representatives of the project's management and E&S performance managers and relevant third parties, with support from external biodiversity specialists as required.
- The BU will monitor the work areas to identify key biodiversity sensitivities and assess possible mitigation options; assist the Construction Contractor (CC) as required to implement the BMP. This unit will collaborate with conservation authorities and NGOs active in Bhutan and regionally. The DoFPS and National Research and Development Centre for Riverine and Lake Fisheries (NRDCRLF) should be engaged to provide such expertise during project development and operation.
- Integration of PPA-01 Appointment of the PIU-ESHS Manager.

Table 8: Budget Estimation for establishment of the Biodiversity Unit within the PIU

Position	Monthly Salary	Applicable Period		Amount (USD)	
		Preconstr. & Construction	Operations Phase	Preconstr. & Construction	Operations Phase
Biodiversity Manager	$ 4,000	8.5 years	10 years	$ 408,000	$ 480,000
Aquatic ecologist	$ 2,500	8.5 years		$ 255,000	

Position	Monthly Salary	Applicable Period		Amount (USD)	
		Preconstr. & Construction	Operations Phase	Preconstr. & Construction	Operations Phase
Terrestrial ecologist	$ 2,500	8.5 years		$ 255,000	
Logistics	Lumpsum			$ 412,000	$ 250,000
Total PIU BU Setup Costs (USD)				**$ 1,330,000**	**$ 730,000**

5.1.2 Implement a Natural Resource Management Policy with Biodiversity Protection and Staff Code of Conduct

Type of mitigation: Organization	Target biodiversity: General	Responsibility: PIU

- DGPC will develop and implement a Biodiversity Protection and Natural Resource Management Policy for the Project. This document will present:
  (i) Commitment to follow international good practices in biodiversity protection aligned with international agreements on biodiversity protection;
  (ii) The orientations and objectives pursued by DGPC in terms of biodiversity conservation and an outline of the commitments to achieve this; and
  (iii) Commitment to report on the status of affected natural resources and on developments in the protection strategy, including the results of BMP implementation.
- The Biodiversity Protection and Natural Resource Management Policy will be disseminated to and popularized with all construction and operating site personnel.
- The PIU will incorporate a code of conduct for staff, contractors and their workers into its biodiversity policies. The Code of conduct will include a set of rules to limit the impacts to biodiversity associated with the large workforce. Topics to be included are: (1) Restricted entry into unauthorized areas/protected areas; (2) Restrictions on ownership of hunting rifles, transport of weapons, ammunition; (3) Controls on hunting and fishing in the project area; (4) Prohibit the sale of bushmeat and hunting products; (5) Controls on harvesting firewood or construction timber; and (6) Obligations on personnel to report violations of these rules.

5.1.3 Incorporate Biodiversity Protection Requirements into Tender Documents

Type of mitigation: Organization	Target biodiversity: General	Responsibility: PIU

- Objectives and relevant activities required in this BMP will be integrated into tender documents for the recruitment of contractors (see PPA-03: Preparation of contractor ESHS specification).
- Relevant calls for tender will specify the responsibilities of contractors and their subcontractors for implementation of the BMP, whereby contractors need to integrate a structure dedicated to biodiversity management and collaborate with the PIU-BU.
- For additional requirements, refer to the following measures of this BMP:
  - Raise awareness of biodiversity protection among project staff and contractors,
  - Incorporate additional measures to protect biodiversity into ESMP management plans,
  - Control invasive alien species (flora and African Giant Snail) in construction sites,
  - Prevent animal mortality during construction work, and
  - Biodiversity Net Gain Strategy (Section 6).

5.1.4 4. Raise Awareness of Biodiversity Protection among Project Staff, Contractors, Sub-contractors and Local People

Type of mitigation: Awareness	Target biodiversity: General	Responsibility: PIU

- Organize regular information/awareness sessions for PIU staff, contractors and subcontractors on issues relevant to biodiversity protection in the area. Topics to be covered depend on the functions and capacity of the audience.
- Organize regular information/awareness-raising activities for the people living near the project on issues related to the protection of biodiversity in the area. Adapt topics and messages to the evolution of the project during the construction and operation phases and using intervention methods best suited to the target audiences.
- Depending on the theme, collaborate as necessary with external stakeholders who can contribute their experience, expertise or logistics (e.g., conservation NGOs, local governments and authorities, consulting firms, experts).

5.1.5 Equipment and Capacity Building for the Biodiversity Unit

Type of mitigation: Training	Target biodiversity: General	Responsibility: PIU

- Provide ongoing training for the BU on the strategy and objectives of ESMP and BMP and the mandated responsibilities. Also maintain up-to-date knowledge of the ESS6 requirements, national legislation, current best practices, and any other topics relevant to the performance of their mandate.
- Include BU members in the DGPC skills development package.
- Where possible, retain the capacity of Project ecologists by extending their contracts into the operational phase.
- Formalize the training of ecologists into the Capacity building plan for the various participants involved in ESMP implementation and monitoring.
- Provide relevant biodiversity-specific training, such as the management of dangerous animals, common and venomous snakes. Collaboration must be established with relevant specialists with expertise in the management dangerous species such as large felines, bears, wild dogs and wild pigs before works.
- Procure appropriate equipment for the Biodiversity Manager and Project ecologists to conduct surveys, including avifaunal surveys (binoculars, appropriate zoom camera, identification guides, audio-listening devices and portable sound speaker); mammal surveys (sufficient camera traps, memory cards and batteries); and fish sampling gear (underwater camera, multiparameter water probe, electrofishing, fyke nets, cast nets, macroinvertebrate sampling nets, eDNA kit), field GPS and other gear as deemed necessary.

Table 9: Budget estimation for equipment and capacity building of the Biodiversity Unit

Equipment Costs (USD)					
Mammal survey	**Amount**	**Bird monitoring**	**Amount**	**Aquatic survey**	**Amount**
Camera traps	$ 6,000	Camera and zoom	$ 4,000	Water meter	$ 3,000
Swarovski Binoculars	$ 2,500	Swarovski Binoculars	$ 2,500	Underwater camera	$ 500
Memory cards	$ 1,000	Identification guides	$ 400	Electrofishing kit	$ 6,000
		SM4 Song meters	$ 3,000	Macroinvert. kick nets	$ 200
				Plankton sampling	$ 200
				Safety equipment	$ 500
				Fyke and cast nets	$ 200
Subtotal	**$ 9,500**	**Subtotal**	**$ 9,900**	**Subtotal**	**$ 10,600**

Cost Item	Amount per Phase (USD)	
	Preconstr. & Construction	Operations (10-year period)
Subtotal for Equipment + unspecified equipment	$ 30,000	
Additional unspecified equipment	$ 40,000	
Equipment Repair and Replacement Costs	$ 30,000	
Training Budget (1,200/day) Construction - 50 days, Operations 10 days/year	$ 60,000	$ 120,000
PIU BU Operational budget (lumpsum per phase)	$ 300,000	$ 150,000
Total (USD)	**$ 460,000**	**$ 270,000**

5.1.6 Implement Biodiversity Friendly Approaches in conjunction with the Social Influx Management Plan

Type of mitigation: Avoid & reduce	Target biodiversity: General	Responsibility: PIU

- The Project is expected to trigger a social influx which will be managed with the Influx management Plan, Stakeholder Engagement Plan, Labour Management Procedures, Code of Conduct and a Grievance Mechanism.
- Prior to construction, the PIU will collaborate with the DoFPS and national police forces to address the increased risk of poaching resulting from an influx of workers. Collaboration may include the organization of random control points during the construction and operation phases that target the potential possession of guns, traps, detect the potential meat consumption and the illegal capture and killing of wild animals. Such findings will be subject to sanctions (written in workers contract).
- Implement the World Bank's Good Practice Note on combatting illegal wildlife trade.
- A code of conduct will be prepared to guide appropriate responses in case of interaction with dangerous wildlife such as primates, snakes, tigers, leopards and other big fauna potentially present on site.
- Access to all specific sites will be controlled and temporary construction roads will be closed once no longer required by the Project to prevent unnecessary access to natural areas.

5.1.7 Consider Additional Biodiversity Protection Measures to enhance ESMP Management Plans

Type of mitigation: Avoid & reduce	Target biodiversity: General	Responsibility: Contractor

- The ESMP requires the main contractors to compile and implement various management plans, including Erosion and Sediment Control, Muck Disposal, Waste and Hazardous Substances Management, Explosive and Blasting, Water Quality Monitoring, Emissions, Dust and Noise Management, Vegetation Clearing, Landscaping and Re-vegetation, Traffic Management, Site cleaning and Rehabilitation, Reservoir impoundment and Labor Influx Management.
- Effective implementation of the BMP is dependent on the ESMP as preservation of the physical environment is essential to the protection of biodiversity. However, many additional measures can be incorporated to enhance the protection of biodiversity with support from the PIU Biodiversity Unit. Examples of measures include the following:
  - Avoid or minimise disturbances during sensitive periods for species of concern (refer to Activity 5.1.8: Preconstruction Survey for Birds), including (i) activity schedules should be compatible with all the species biological cycle, (ii) Blasting in the vicinity of natural habitats should avoid birds breeding period from March to May, (iii) Crushing activities at the vicinity of cliffs must avoid breeding period from March to May, (iv) Land clearing activities must avoid birds breeding period, and (v) Reservoir impoundment should avoid the fish breeding period.
  - Develop a light management plan - (i) Environment expert to identify the lighting constraints in the proximity of sensitive areas (close to cliffs, primary forest, and away from other light sources) (ii) Reduce night work in sensitive areas to avoid fauna behavioural disturbance, (iii) apply directional lighting to limit the spread into unnecessary areas; and (iv) for uses other than safety, work activities must be

planned during daylight as much as possible to limit the use of lights and turn off night lights as much as possible.

- Additional measures for Land clearing activities in the Vegetation Clearing Plan (PAC-12) to include: (i) Unnecessary clearing will be avoided, and areas to be cleared will be clearly indicated to limit additional clearing. (ii) Fauna must be flushed from the area and allowed opportunity to escape before any clearing activity. Special attention must be given to small mammals and lesser species (crawling species and slow-moving species) as large mammals are easily seen and have greater capacity to escape; and (iii) Structure clearing activities to facilitate faunal escape, such as a centrifugal clearing to avoid creating islands of vegetation that become traps.
- Additional measure for the Road Traffic Management (PAC-16): Signage at large crossing points will be installed. A protocol is required to report the collisions with animals. This should include identifying the species, date, time and GPS coordinate of the event (to highlight hotspots), and any other comments about the situation. Solutions for safe passage of fauna must be applied to areas with frequent vehicle animal collisions.
- Additional measure for the Reservoir First Impoundment Management Plan (PAC-22): (i) avoid the fish breeding period to limit the physical modification of breeding areas, (ii) the reservoir should be filled during the high flow period from June to September, and (iii) schedule a slow impoundment of the reservoir (4 weeks to be confirmed by the EFlow assessment) to allow fish to escape upstream. The relevant experts are to be consulted at each stage to validate the protocol and that all components are taken into consideration.

5.1.8 Surveys for Birds and Bird Nesting Activity

Type of mitigation: Avoid & reduce	Target biodiversity: Birds	Responsibility: Contractor

- Pallas's Fish Eagle and White-bellied Heron qualify as critical habitat species and have net gain actions proposed. Other important birds include two vultures and Dark-rumped swift.
- Avifaunal preconstruction surveys will be conducted to improve the knowledge of bird species present, breeding and/or migrating through the area. Known nesting sites will be documented, with particular attention to conservation important bird species, and to bird nesting behaviour that is at risk due to Project activities. Bird surveys will be conducted in the sites prior to being blasted or cleared of vegetation for the project purposes.
- Bird surveys can use a variety of techniques as deemed appropriate by the Biodiversity Manager and appropriate equipment will need to be procured, refer to Capacity Building for Project Ecologists (Mitigation Item 5.1.5).
- The protocols will be proposed by the PIU-BU. If nesting sites are found in areas of risk, an appropriate plan for managing and monitoring the site or nest relocation will be developed and implemented.
- Birds provide useful indicators of environmental conditions, for example cormorant abundance provides an easily accessible indicator of fish abundance along the Kuri Chhu. Use of bird indicators and monitoring techniques will be developed to provide such insights into environmental performance of the Project.

5.1.9 Preconstruction surveys for Hoya bhutanica, Orchids and other Epiphytes

Type of mitigation: Avoid & reduce	Target biodiversity: CH Flora	Responsibility: Contractor

- *Hoya bhutanica*, an endemic and range-restricted plant species that is present in areas where complete loss of habitat cannot be avoided.
- The riparian vegetation that will be lost due to reservoir inundation supports many orchids and other epiphytic plants, which are highlighted within the BC-7 Conservation Management Plan.
- A preconstruction survey to detect *Hoya bhutanica,* orchids and other epiphytic plants will be conducted based on protocols proposed by the terrestrial ecologist of the BU. Surveys will target the flowering season when these plants are most-easily detected and identified.

- If locations with *Hoya bhutanica* are found, appropriate measures need to be applied as determined by the PIU-BU Manager. Suggested measures include (i) where possible, safeguarding the location with a 100 m protected perimeter, to protect the plant, inform the people on site and restrict access, and (ii) if the avoidance and protection is not feasible, safely translocate the plant to a horticultural nursery where is can be multiplied through appropriate propagation techniques, for re-establishment in the wild, incorporation into afforestation programs and Project landscaping activities, as outlined in the Biodiversity Net Gain Strategy (Section 6.4).
- Locations with orchids and other epiphytic plants will be documented and a plan developed to safely remove these plants, as outlined in the Biodiversity Net Gain Strategy (Section 6.4).

5.1.10 Control Invasive Alien Species in Construction Sites

Type of mitigation: Avoid & reduce	Target biodiversity: IAS	Responsibility: Contractor

- Introduction of new invasive alien species (IAS) is a risk associated with the influx of workers from different backgrounds and countries, and the arrival of trucks and machinery. The introduction of new IAS can have a negative impact on local biodiversity and an IAS control plan is required that includes the following measures:
- Raise awareness among the workers to present the IAS present on site so they can recognize them and act accordingly.
- Inspect supply sites outside the project area for the presence of IAS before delivery of equipment and materials and require the supplier to control IAS detected or use an alternative site.
- Apply a thorough cleaning of all machinery to ensure the absence of IAS before transport to the project site and or project zone, and before the exit of machines outside the project area and or the project zone.
- Favour the backfilling of excavated materials with local material to reduce the dependence on external backfill.
- Rapidly eradicate IAS observed for the first time in the project zone.
- Favour the implementation of biological, mechanical (removal by hand), or thermal vegetation control methods for the elimination of IAS. If the use of herbicide chemicals is unavoidable, apply precautions in accordance with the Hazardous Materials Management Plan and/or the International Finance Corporation (IFC) EHS Guidelines:
  - Train site personnel in the proper and safe handling, application and use of herbicides, with particular attention to the control of discharges into surface waters
  - Use only the following authorized products: herbicides manufactured under license, registered, and approved by the competent authority and in accordance with the International Code of Conduct on the Distribution and Use of Pesticides of the Food and Agriculture Organization of the United Nations Agriculture (FAO) and Herbicides labelled in accordance with international norms and standards, such as the Revised FAO Guidelines for the Proper Labelling of Pesticides.

5.1.11 Avoid Animal Mortality during Construction Work

Type of mitigation: Avoid & reduce	Target biodiversity: Fauna	Responsibility: Contractor

- Develop procedures involving the DoFPS and the PIU-BU to be applied when dangerous animals are encountered.
- Survey the presence and signs of fauna with emphasis on dangerous wildlife (tigers, leopards, bears, wild dogs, wild pigs, venomous snakes, monkey) that may be present in the vicinity of works and may need to cross the project area. Use results to proactively identify areas where potentially dangerous animals may be present and adapt the organization of construction sites accordingly. Sufficient camera traps will be procured and used for the purpose of such surveys.
- For roads and construction sites, position appropriate signage warning road users of the presence of wildlife, limit vehicle speeds, and requite site personnel to behave appropriately in the event of the presence of potentially dangerous or sensitive wildlife.

- Regular surveys of evidence of wildlife presence will be conducted to adapt the location of appropriate signage and guidance on response procedures.
- For earthworks such trenches, pits, sloughs, settling pits, etc:
  - Use protective fencing to prevent animals from entering work areas. Fences must be inspected regularly to ensure their effectiveness.
  - Provide escape routes that allow animals that fall into a pit or trench to escape on their own.
  - Cover temporary trenches and pits (where feasible given the dimensions) to prevent small and large animals from being trapped there.
  - Monitor and inspect work areas regularly for the presence of animals. Any animals trapped there are to be safely relocated to a suitable habitat.
- Many wildlife species (such as deer and felines) move at night. Quiet periods without noise, vibration, crowds or dust of several consecutive hours reduce disruption of their movements and their risk of mortality. For example, a twilight period and a quiet nighttime period (2 a.m. until sunrise or from sunset until 2 a.m.) must be put in place where possible.
- Document all vehicle-animal collisions, injured animals and near-miss situations with wildlife and analyse to identify high collision risk areas (refer to above Mitigation Item 5.1.7).

5.1.12 Avoid Animal Mortality during Operations

Type of mitigation: Avoid & reduce	Target biodiversity: Fauna	Responsibility: PIU

- Install appropriate fencing around the head race tunnel to prevent large wildlife from getting trapped there (design measure).
- Install an ichthyological grid and/or appropriate barriers such as bar grilles, rectangular mesh grilles, or perforated plates on water intakes (<4 cm) to prevent fish mortality (design measure). A dedicated study may be necessary to determine the appropriate grid size considering (i) the size and behaviour of the target species, (ii) the operating constraints and (iii) the feasibility of setting up a fish migration system (downstream only).
- Powerline (design measure): use raptor-friendly tower designs, install bird visibility devices and equip towers with devices to prevent primates from climbing and being electrocuted. The following design measures need to be applied:
  - Power Line Configuration: Configure power lines in a way that large birds cannot touch two lines at once, preventing electrocution. Himalayan Griffon is the largest flying bird that could occur, and an approx. 3 m spread is needed between wires for power line configuration and insulation.
  - Insulate power lines to prevent electrocution, particularly in areas where large birds are present.
  - Install bird flight diverters on power lines and guard cable to make the power lines more visible to birds, reducing the risk of collision.
  - Install perch deterrents on poles to discourage birds from landing and touching power lines.
  - Provide safe perches for birds and nesting platforms away from power lines. Refer to the Biodiversity Net Gain Strategy (Section 6.2).
  - Where possible, use underground cabling instead of overhead power lines.
  - Avoid routing power lines near wetlands, migratory paths, or other areas with concentrations of birds vulnerable to collision and electrocution.
  - Regularly monitor power lines for bird collisions and electrocutions and report any incidents to the relevant authorities.
- Primate mortality prevention on powerlines - most of the actions for birds are effective for reducing harm to primates, but following additional practice should be considered:
  - Regularly prune trees near power lines to discourage monkeys from climbing them.
  - Install anti-climbing devices such as baffle-shaped devices or slippery metal sleeves on the poles. Coating the poles with a non-toxic, slippery substance (grease) can deter monkeys from climbing.

Metal collars with spikes can be installed on pole. The spikes don't harm the monkeys but make it uncomfortable for them to climb.

5.1.13 Rescue Trapped and Injured Animals in Construction Sites and their Vicinity

Type of mitigation: Avoid & reduce	Target biodiversity: Fauna	Responsibility: PIU/Contractor
• A procedure is required for responding to encounters with wildlife in distress in addition to above measures to avoid animal mortality on work sites. • Employees must report any sightings or evidence of injured or trapped animals through an established procedure. • The reporting procedure requires a chain of communication between pre-identified internal and external stakeholders, including DoFPS and stakeholders responsible for wildlife conservation, to rapidly establish the appropriate scope of response and associated arrangements. • The procedure must be communicated to all staff, contractors, their subcontractors and any other operations personnel who may encounter distressed animals in the course of their duties. • Prior collaboration must be established with partners specialized in the health, safeguarding and rescue of wildlife species in Bhutan. • The BU in collaboration with the DoFPS will identify safe animal release locations of similar habitat in advance as a proactive measure so that animals can be promptly released.		

5.1.14 Incorporate Safe Wildlife Crossings along New Roads

Type of mitigation: Avoid & reduce	Target biodiversity: Fauna	Responsibility: PIU/Contractor
• The reservoir will flood the road to access Autsho, and a new road needs to be constructed. • Camera trapping studies will be conducted in the area to assess the species and abundance of wildlife in the area surrounding the new route, and to establish likely prominent crossing points. Results will be enhanced through consultation with communities and DoFPS managers of BC-7. • Ensure the road design incorporates appropriate safe crossings appropriate to the wildlife that occurs there. Culverts are likely to provide underpass permeability for wildlife, but crossings must be compliant with guidelines provided by ADB and the Wildlife Institute of India for the South Asia Region. • Costs of wildlife crossings will be incorporated into the road design, but budget is provided in this BMP for field surveys to guide the development of crossings into the road design, and subsequent monitoring of wildlife use of those crossings.		

5.1.15 Ensure Implementation of the EFlow Management Plan

Type of mitigation: Avoid & reduce	Target biodiversity: Aquatic	Responsibility: PIU
• The EFlow Management Plan (see ESMP documents) presents a series of measures to manage potential impacts to the aquatic habitat and associated ecology. Its implementation will ensure an adequate supply of water to sustain the aquatic ecology and associated riparian forest. • The PIU is responsible for implementation of this EFlow Management Plan.		

5.1.16 Implement a Migratory Fish Catch-and-Release Protocol

Type of mitigation: Avoid & reduce	Target biodiversity: Fish	Responsibility: PIU
• A rich diversity of fish, including migratory species occur in the river and its tributaries. Fish migrations will be disrupted by the dam and measures are required to sustain these migrations.		

- A catch-and-release program is likely the most effective measure to sustain the river connectivity for migratory fish, particularly Snow trout, as a fish ladder is not feasible. The dam height will be at least 85m above the riverbed level (**Error! Reference source not found.**), which is beyond the capacity of fish to c limb. A fish ladder also requires a substantial volume of water to be diverted from power generation units, which affects financial feasibility of the Project.
- A catch-and-release protocol designed by an aquatic ecologist needs to be implemented during the Operations phase. The protocol must address development of several capture zones on either side of the dam, transportation procedures with adequately sized tanks, equipment, record keeping, skills and capacity building.
- The protocol will need to be adapted regularly based on learning from its successes and failures, taking into consideration the number of fish captured, and the effort needed for their transportation.
- Ongoing monitoring of fish ecology in the Kuri Chhu and tributaries will be necessary to establish the presence of migratory fish that will benefit from a catch-&-release program. Experiences gained from catch-and-release will contribute to long-term monitoring and improved understanding of the fish ecology. Refer to bird surveys (Mitigation Item 5.1.8) to complement fish monitoring.
- Establishment of a fish hatchery is outlined in the Biodiversity Net Gain Strategy (Section 6.5) to sustain populations of the dominant fish species that naturally occur in the Kuri Chhu based on the cumulative impacts of this Project and other hydropower schemes in the catchment.

5.2 Measures for Monitoring Implementation of the BMP

5.2.1 Monitor the Effectiveness of BMP Implementation

Type of mitigation: Monitoring	Target biodiversity: General	Responsibility: PIU

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- Table 10 presents objectives and Key Performance Indicators (KPIs) for each activity of the BMP. Note that these KPIs may need to be refined and improved during future monitoring actions. Monitoring is intended through a combination of internal and external audits based on the following considerations:
- Internal audits.
  - Creation of an audit grid and development of the procedure for communicating audit results internally and to stakeholders.
  - Designate member(s) of the PIU (independent of BMP implementation) to plan and organize internal audits.
  - Conduct periodic internal audits (every 6 months during pre-construction and construction phases and every 2 years during operation) to measure the progress of actions and results, establish corrective action plans and performance objectives.
- External audits
  - Appoint an appropriate external auditor to assess implementation of the BMP
  - Respond to non-conformities in a timely manner and implement corrective actions recommended by the auditor at the conclusion of the audit.
  - Construction phase: 4 external audits. Operation phase one external audit each 5 years.

Table 10: Key Performance Indicators for Monitoring Implementation of this BMP

BMP Activities	Key Performance Indicators	Responsible
1. Establish a Biodiversity Unit as a component of the PIU	• A BU is established as part of the PIU, staffed with experienced ecologists with defined responsibilities. • An Organizational Chart for the PIU includes the role of the BU and its reporting structure.	PIU

BMP Activities	Key Performance Indicators	Responsible
2. Implement a Natural Resource Management Policy with Biodiversity Protection and Staff Code of Conduct	• A DGPC endorsed Sustainable Development Policy that includes reference to the BMP and management of workers is readily available.	PIU
3. Incorporate Biodiversity Protection Requirements into Tender Documents	• Documents issued to announce and describe the content of tenders include requirements to protect biodiversity and reference the BMP.	PIU
4. Raise Awareness of Biodiversity Protection among Project Staff, Contractors, Subcontractors and Local People	• Several outreach sessions conducted For Staff & Contractors each year, also following important incidents or non-conformities. • Events are well attended by the target audience. • A program of "Raising awareness of local populations to the protection of biodiversity" is available and meeting the needs and requirements of quality. Several awareness events carried in year and in different villages/appropriate locations and well attended by the target audience.	PIU
5. Equipment and Capacity Building for the Biodiversity Unit	• An initial capacity building plan is available based on an analysis of the required skills of the BU. • Evidence of implementation of the capacity building plan with participation of Project ecologists is available. • Appropriate equipment procured and used for biodiversity monitoring purposes.	PIU
6. Implement Biodiversity Friendly Approaches in conjunction with the Social Influx Management Plan	• Participation of Project Ecologists in appropriate actions to address biodiversity issues associated with the Social Influx Management Plan.	PIU
7. Consider Additional Biodiversity Protection Measures to enhance ESMP Management Plans	• Measures to protect and enhance biodiversity associated with the Project site are incorporated into management plans developed by contractors as required by the ESMP.	Contractor
8. Preconstruction surveys for birds and bird nesting activity	• Evidence of preconstruction avifaunal surveys to nesting behaviour of important bird species. • Evidence of appropriate measures to address results of the preconstruction surveys to minimises impacts to affected birds. • Procurement of appropriate equipment for bird surveys • Acoustic data is analysed and species occurrence report generated.	PIU
9. Preconstruction surveys for *Hoya bhutanica,* orchids and other epiphytes	• Evidence of thorough implementation of preconstruction surveys to determine the presence of *Hoya bhutanica* plants within areas of the Project footprint where habitat will be lost. Surveys are conducted during the flowering season of these plants. • Evidence is provided of appropriate measures to address results of the Hoya preconstruction surveys in a manner that safeguards the survival of located plants.	PIU

BMP Activities	Key Performance Indicators	Responsible
10. Control Invasive Alien Species in Construction Sites	• Evidence of assessment of supply sites is available together with measures taken to prevent the unintentional introduction of IAS. • Measures to control the spread of IAS within the project site are implemented.	Contractor
11. Avoid Animal Mortality during Construction Works	• Evidence of surveys of wildlife presence in the project area, with a focus on potentially dangerous wildlife. • Record of vehicle-wildlife collisions, occurrence of injured animals and near-miss situations • Evidence of implementation of results to protect workers and avoid harm to wildlife, such as road signage, protection of trenches and other measures. • PIU provides guidance on appropriate response procedures if dangerous animals are encountered.	Contractor
12. Prevent Animal Mortality during Operations	• Technical solutions compliance report provides details of measures to avoid and reduce mortality of fish through the hydropower systems, and electrocution of birds and monkeys on transmission lines. • Other causes of mortality are identified and appropriately addressed.	PIU
13. Rescue Trapped and Injured Animals in Construction Sites and their Vicinity	• A response procedure is available for responding to encounters with wildlife in distress.	PIU
14. Incorporate Safe Wildlife Crossings along New Roads	• Design of the new road to divert around the reservoir includes safe wildlife crossings compliant with guidelines for SAR.	PIU
15. Ensure Implementation of the EFlow Management Plan	• The EFLow Management Plan is implemented effectively	PIU
16. Implement a Migratory Fish Catch and Release Program	• Diversity and approximate abundance of migratory fish is demonstrated in the Kurichhu River • Records are maintained of migratory fish capture and release upstream and downstream the dam site.	PIU

6 BIODIVERSITY NET GAIN STRATEGY

The objective of this BMP is to meet the requirements of ESS6 with emphasis on (i) achievement of Net Gain in response to impacts to natural habitat, (ii) to achieve net gains for the biodiversity features for which critical habitat is designated, and (iii) to promote and enhance the conservation aims and effective management of affected protected areas.

This Biodiversity Net Gain Strategy (NGS) is developed to meet the BMP objectives, which are achieved through the following six components:

1. Support for protected areas and conservation initiatives
2. Conservation measures for endangered birds
3. Afforestation to compensate the Project induced loss of habitat
4. Propagation of *Hoya bhutanica* and translocation of orchids and other epiphytes
5. Establishment and operate a fish hatchery to boost fish populations
6. Further assessment of range restricted fish species.

6.1 Support to Protected Areas and Conservation Initiatives

The third subobjective of this BMP is to meet the ESS6 requirement to promote and enhance the conservation aims and effective management of affected protected areas. The DoFPS is responsible for the management of protected areas, and this BMP objective is interpreted as providing financial and technical support to DoFPS to enhance their capacity the manage the protected areas affected by the Project. Support can be extended to various conservation initiatives that are operational in the area, but are not strictly associated with protected areas, such as establishment of a Key Biodiversity Area (KBA) for Pallas's Fish Eagle, and protection efforts for White-bellied Heron. This action is also required to demonstrate net gain benefits for critical habitat mammals.

The Divisional Forest Office, Mongar has developed a conservation plan to guide the management of the BC-7, with a budget of Nu 38.4 million (approx. USD 445,000). The management plan has been submitted for approval by the Chief Forestry Officer, Mongar, forwarded for approval by the Chief Forestry Officer, NCD, recommended for approval by the Director, DoFPS, and approved by the Secretary, MoENR. The vision, mission, goal and objectives of this management plan are presented in Table 11. Some of the actions of the BC-7 conservation management plan overlap other components of this Net Gain Strategy, for example Activity 3 of Objective 01 is to document the orchid diversity of the BC-7, which overlaps with the net gain for *Hoya bhutanica* and epiphytic orchids (Section 6.4).

Table 11: Vision, mission, goal and objectives of the Biological Corridor #7 Conservation Mgmt Plan

Vision:	A structurally functional corridor for wildlife movement and genetic dispersal between protected areas of Bhutan
Mission:	To secure functional habitat contiguity between three protected areas of PNP, WCNP and BWS through enhanced climate smart management of biodiversity and engagement of communities.
Goal:	Secure the BC-7 as a core habitat for migration of species between the above three major protected areas by 2032. • To contribute towards participatory landscape conservation and ensure the functionality of BC-7 in pursuit of the above mission and vision. • To provide baseline information and guidance in implementing the proposed activities through a timeframe of 10-year management plan period.
Objectives:	
Objective 01:	To maintain viable populations of flora and fauna (with 3 strategies and 11 actions)
Objective 02:	To ensure sustainable utilization of forest resources (3 strategies and 7 actions)

Objective 03:	To enhance socio-economic wellbeing of the communities (2 strategies & 4 actions)
Objective 04:	To enhance institutional capacity to deliver effective service (3 strategies and 9 actions)
Objective 05:	To strengthen environment education and interpretation of biodiversity conservation and waste management (1 strategy and 2 actions)

The Project will provide support to the DoFPS to implement actions outlined in the approved BC-7 conservation management plan, approved conservation management plans for the Phrumsengla National Park and Bumdeling Wildlife Sanctuary, or any approved revisions or updates of these plans. An action plan is available for a KBA proposed for Pallas's Fish Eagle (Section 6.2) is eligible for support, but approval of the plan needs to be clarified.

The Chief Forestry Officer, Mongar, will request support through submitting proposals via the BU to the PIU. The proposal will include an action plan, implementation schedule, timeframe, reporting structure and budget.

The Project is required to achieve net gain outcomes for critical habitat mammals (Tiger, Wild Dog, Red Panda and other large mammals) proportional to the manner in which they are impacted. Management actions that can demonstrate benefits to these species should therefore be prioritized for support.

The extent to which large mammals can cross the Kuri Chhu in its current state is uncertain. Also, the severity of the impact caused by development of the reservoir is difficult to assess. The Chief Forestry Officer has proposed conducting a Corridor Functionality Study to assess its effectiveness for the movement of wildlife. The BC-7 conservation management plan includes actions to study the population dynamics, habitat use and distribution of wildlife, and a Corridor Functionality Study can be therefore supported under this Net Gain component. The study should be initiated in the early construction phase prior to inundation of the reservoir, and continued until a period after inundation to assess changes in wildlife abundance and movement patterns. The study could use a combination of habitat mapping, camera trapping and fitting tracking devices to individual animals, although the objective, appropriate method, details for implementation and budget needs to be compiled with guidance from the NCD and relevant specialists.

Costs of a Corridor Functionality Study have not been estimated, instead a lumpsum budget is provided for the Net Gain Component.

Activities to support Protected Areas and Conservation Initiatives

Type of mitigation: Net Gain	**Target biodiversity: Birds**	**Responsibility: PIU BU, DoFPS**
• Financial support to selected activities of conservation management plans and conservation initiatives • Monitoring the conservation effectiveness of supported activities • Corridor Functionality Study for the BC-7		

6.2 Conservation measures for Endangered Birds

Pallas's Fish Eagle and White-bellied Heron are recognized as critical habitat species for the Project. Pallas's Fish Eagle is known to forage for fish over the KHP reservoir, which is also the site where White-bellied Heron is occasionally observed. These birds could be affected by altered flow of the Kuri Chhu, but will likely benefit from development of the reservoir stocked with fish, and the extent to which they will be impacted is uncertain. No residual impacts are expected and net gain measures are not obligatory (Table 5).

A Key Biodiversity Area (KBA) has been proposed on the Kuri Chhu to recognize the importance of the area for Pallas's Fish Eagle. A KBA is not a legally gazetted protected area but draws attention to the

biodiversity importance of sites. An action plan has been compiled by the Chief Forestry Officer, Mongar for this KBA which presents a budget for Nu 25.5 million (approx. USD 300,000) but shows no direct benefits (net gains) for conservation of Pallas's Fish Eagle.

The White-bellied Heron Conservation Centre, funded by RSPN has been established in Changchey, Tsirang District to take extraordinary measures to conserve the few remaining White-bellied Herons in Bhutan. This conservation centre is active throughout Bhutan.

Both birds nest in large trees, and the availability of suitable nesting sites is anticipated to be a limiting factor for these birds. Tree-nesting birds are vulnerable to nest predation by Macaque Monkeys, which has been documented as a threat for White-bellied Heron.

Great success has been achieved in the conservation of Osprey through providing nesting platforms (Figure 5), and populations have improved in many parts of the world. Nesting platforms are now widely used as an alternative to discourage these birds from nesting on transmission line towers. Provision of nesting platforms provides an opportunity for improved conservation of Pallas's Fish Eagle and White-bellied Heron, as well as other large tree-nesting birds that occur in the area, such as Osprey, Great Cormorant and others.

Figure 5: Examples of Osprey using nesting platforms

The important attributes of nesting platforms are appropriate site selection, and placement of an approx. 1m x 1m platform on a pole that extends above the height of the tree canopy. Sufficient platforms should be erected to prevent competition between different bird species and should be appropriately spaced to accommodate the territorial behaviour of most raptors. Sites should be away from areas of regular human activity as the excreta of most fish-eating birds is repugnant. Poles should be fitted with primate-deterrent structures (such as a slippery metal sleeve) to prevent predation. Abundant websites and online videos are available providing guidance on site selection and designs for nesting platforms. If cameras are installed, the video and images achieved are a great resource for encouraging awareness and support for conservation.

Construction costs will be relatively low while equipment and materials are available for Hydropower construction. Twelve (12) nesting platforms are considered sufficient and are budgeted at USD 5,000 each.

Activities for Conservation of Pallas's Fish Eagle and White-bellied Heron

Type of mitigation: Net Gain	Target biodiversity: Birds	Responsibility: PIU BU
• Construction of nesting platforms in suitable locations along the Kuri Chhu • Monitoring bird nesting activity		

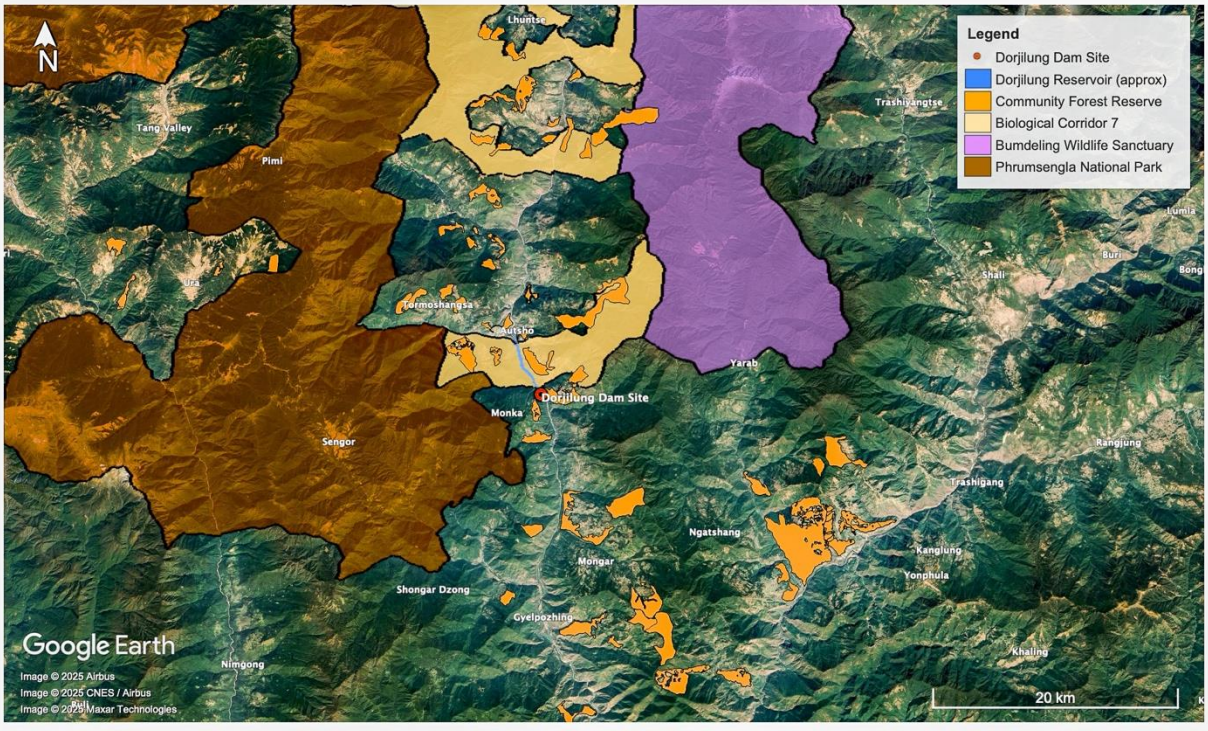
6.3 Afforestation to compensate the loss of Natural Habitat

Development of the Project will result in the loss of 606 ha of natural habitat (Section 4.2.1). The objectives of this BMP align with the ESS6 requirement to implement measures to achieve No Net Loss, and where feasible, preferably a net gain of biodiversity in response to impacts to natural habitat.

Net gain will be achieved through an afforestation program to plant trees within degraded landscapes in the Mongar and Lhuentse Dzongkhags. Afforestation areas will match the impact area on a 1:1 ratio with trees planted in densities appropriate to the local conditions, with the budget based on 1,500 seedlings planted per hectare. Green Bhutan Corporation Ltd. have extensive tree planting experience and will implement the afforestation program under the supervision of DoFPS. Many community forest reserves are established (Figure 6) and will be targeted for afforestation as communities in such areas will be supportive of the program leading to improved long-term survival for trees.

Natural grasslands will be avoided, but degraded forest habitats will be planted with a variety of locally indigenous trees appropriate to the selected sites. Preference will be placed on trees that promote the ecology, such as indigenous fruit trees that attract hornbills and primates. Local communities will be involved to the extent possible and appropriately compensated in the propagation of seedlings, planting activities and subsequent care of trees.

Figure 6: Layout of community Forest Reserves in the vicinity of the Project



An estimated afforestation budget is provided in Table 12 presents an overview of the expected cost, however there are many variables that influence the final cost. An important variable is the accessibility of

afforestation sites. Remote areas with steep terrain require considerably more time to access which increases costs. Variation between communities and their availability to provide labour is another important variable. Costs are therefore estimated with an upper and lower limit. No fencing has been included in the budget as this is deemed not essential. The higher estimate of cost is included in the BMP due to complex terrain in the greater area.

Afforestation Activities

Type of mitigation: Net Gain	Target biodiversity: Afforestation	Responsibility: PIU BU
• Selection of degraded forest sites for afforestation • Tree propagation and growth of seedlings • Tree planting • Tree care and replacement planting of dead trees • Fire suppression • Monitoring and evaluation		

Table 12: Budget Estimation for afforestation of 606 hectares (1,497 acres)

Activity	Rate calculation	Estimated cost (USD)	
		Lower estimate	Upper estimate
Site preparation (clearing invasive species, debris and soil preparation)	50 - 150/ha	$ 30,300	$ 90,900
Seedling nursery establishment and production	0.1 - 0.3 per seedling	$ 90,900	$ 272,700
Planting costs (up to 1,500 seedlings / ha)	100 - 200/ha	$ 60,600	$ 121,200
Maintenance and protection (3 years of weeding, replacement planting)	20 - 50/ha/year	$ 60,600	$ 151,500
Fire suppression & management for 5 yrs	5 - 15/ha/year	$ 15,150	$ 45,450
Monitoring and evaluation for 5 years	2 - 5/ha/year	$ 6,060	$ 15,150
Administrative and training costs		$ 15,000	$ 30,000
Contingency budget (~10%)		$ 27,390	$ 73,100
Total Costs (USD)		$ **306,000**	$ **800,000**

6.4 Propagation of *Hoya bhutanica* and Translocation of Orchids and other Epiphytes

Hoya bhutanica is an endangered epiphyte growing within sites that will be lost to the project footprint. Many *Hoya* species are propagated as ornamental plants, and *Hoya bhutanica* is expected to be suitable for propagation. The Project will establish facilities to propagate and multiply these plants, which will then be incorporated into the afforestation program, used in landscaping of project facilities and shared with communities.

The reservoir created by the hydropower dam will flood the riparian vegetation along the Kuri Chhu, which supports a diversity of orchids and other epiphytes. Orchids are cultured and feature prominently in the Buddhist monasteries and religious sites such as the many stupas in the Project vicinity. The Project will collaborate with DoFPS officers managing the BC-7, monastery folk and communities to save as many of the orchids and epiphytic plants as possible from the future reservoir area. The monks, members and followers of the religious community will be encouraged to culture these orchids in places where they can be appreciated by the community. Orchids kept in outdoor pots will disperse their seeds into the environment and will contribute towards sustaining these plants in their natural habitat outside of the reservoir footprint, and participation of the monasteries presents a significant opportunity towards the conservation of these species.

The BC-7 Management Plan includes an activity within Objective 01 to document the diversity of orchids in the area. The future reservoir is within the BC-7, and orchid specimens will be submitted to local herbaria for identification and findings shared with the Chief Forest Officer, Mongar.

Costs are not estimated for each activity, instead a lumpsum budget is provided for the Net Gain Component.

***Hoya bhutanica* propagation and Orchid Conservation Activities**

Type of mitigation: Net Gain	Target biodiversity: Epiphytes	Responsibility: PIU BU
• Procurement of equipment and facilities for propagating *Hoya bhutanica,* such as a bark chipper and horticultural supplies. • Inclusion of *Hoya bhutanica* into afforestation and project landscaping activities. • Collaboration with DoFPS, monasteries, and community members to carefully remove orchids and other epiphytes from the reservoir inundation footprint • Collaboration with monasteries, religious leaders and interested members of the community to culture orchids and share lessons learnt • Species identification of orchids through local herbaria.		

6.5 Establish and operate a Fish Hatchery

A cascade of hydropower schemes on the Kuri Chhu will deplete fish populations, with some species expected to be more affected than others. Fish are essential for sustaining the ecological balance of aquatic ecosystems, as they control invertebrates, are a key food source for many birds, and support a range of ecosystem services.

A fish hatchery has been proposed to culture various fish species that are being adversely affected for release into the Kuri Chhu to sustain natural populations. A fish hatchery can focus initially on promoting fish within the Kuri Chhu catchment, but hydropower projects are being developed in different catchments across Bhutan and there is potential to expand the service to support other catchments.

There are ecological and ethical risks associated with fish hatcheries, which include:

- Altered genetic diversity through moving fish between catchments and across natural barriers and subsequent hybridization between natural and hatchery bred fish.
- Reduced genetic diversity through intensive culture from limited fish breeding stock.
- Altered population dynamics, sexual balance and impaired reproductive success of natural fish populations.
- Disruption of the natural balance between fish populations and altered competition for available natural resources, which could affect endangered and range restricted species.
- Disruptions of the predatory balance (ecological function) on macroinvertebrates and species higher on the food chain that depend on fish as a food source.
- Potential for introduction and multiplication of parasites, disease and fungal infections leading to reduced resistance of natural fish populations.
- Water contamination, particularly with antibiotics, growth hormones and other pharmaceutical products.
- Perceived domestication of fish, particularly the larger species such Golden and Chocolate Mahseer which could affect the ethics of a developing sport fishing industry.

The above risks can be managed through adopting a set of conservation principles that respects the diversity between catchments, promotes genetic diversity within the population, release only of fingerlings, supports aquatic habitat restoration and management, continued support to sustain fish migrations, and careful health screening and other forms of monitoring natural fish populations. A conservation manifesto to guide the fish hatchery management needs to be developed through specialist engagement and stakeholder consultation.

Risks can also be managed through learning from professional fish management practices elsewhere in the world, and the following box presents a case study from Canada. A tour for project staff, DoFPS and NRDCRLF officials to meet specialists of the Freshwater Fisheries Society of British Columbia is included in the budget, costs are presented in Table 13, although visa availabilities will need to be clarified.

The province of British Columbia, Canada, is home to some of the finest freshwater fish resources in North America, and supported by a robust and highly professional fisheries management system. A prime example of this is the Freshwater Fisheries Society of British Columbia (FFSBC), which serves as a suitable case study in large-scale fish hatchery management.

Established in 2003 as a non-profit organization, the FFSBC plays a critical role in sustaining fish populations and supporting the angling community. The Society operates six major hatcheries that annually stock five million fish into 650 lakes across the province. Its funding comes primarily from the sale of fishing licenses, ensuring that its operations are both community-driven and self-sustaining. The FFSBC also works closely with BC Hydro, the province's power generation utility, to align its conservation goals with broader environmental stewardship initiatives.

The FFSBC focuses on the cultivation of three key fish species:

- Rainbow Trout (*Oncorhynchus mykiss*)
- Brook Char (*Salvelinus fontinalis*)
- Kokanee (*Oncorhynchus nerka*).

In addition to its hatchery operations, the Society is deeply committed to conservation, particularly through recovery programs for endangered species like the White Sturgeon (*Acipenser transmontanus*), a vital part of British Columbia's aquatic heritage.

To ensure transparency and strategic growth, the FFSBC has published a five-year strategic plan (2023–2028), outlining its long-term goals and objectives. Furthermore, the FFSBC 2024 Annual Report highlights annual expenditures of approximately CAD 16,000 (USD 11,100). However, this figure does not reflect the full operational budget for the Society's hatcheries, which is likely to be significantly higher, given the scale and scope of its activities.

This integrated approach to fish stocking, conservation, and community engagement underscores the FFSBC's critical role in maintaining British Columbia's reputation as a premier destination for freshwater fishing and ecological stewardship.

Table 13: Cost estimation for a Fisheries Study Tour to British Columbia, Canada

Cost Item	Amount
International Air fare (Druk Air for Bhutanese citizen, via Bangkok)	$ 2,500
Internal Travel - Canada	$ 1,000
Accommodation & Subsistence	$ 6,500
Total estimate per participant	**$ 10,000**
Total for 10 participants	**$ 100,000**

Sever aquatic impacts happen once the dam is constructed and the reservoir filling occurs, which is towards the end of the construction phase and through the operational phase of the Project. Establishment of a fish hatchery should therefore be scheduled to operational towards the end of the construction phase (Year 7), although planning for its development should start earlier. The hatchery can be established in redundant construction space with no land acquisition required. The hatchery should initially focus on the culture of

Snowtrout and expand the number of cultured species as the capacity of the hatchery develops. Monitoring of natural fish populations will also guide the direction for expansion of the hatchery.

Activities for Fish hatchery establishment and operation

Type of mitigation: Net Gain	Target biodiversity: Fish	Responsibility: PIU BU
• Development of conservation principles to guide management of the fish hatchery • Capital expenditure costs and 10 years of operational costs • Research and development budget • Partnerships with NRDCRLF • Tour of professional fish hatcheries in BC, Canada		

Table 14 presents a breakdown of expected costs for establishment and operation of a large-scale fish hatchery for budgeting purposes but will need to be refined through a detailed planning process.

Table 14: Estimated capital and annual operational costs for a large-scale fish hatchery

Cost Centre	Cost Items	Cost Estimate (USD)
1. Capital Costs		
a. Land Acquisition		Not budgeted
b. Hatchery Infrastructure	Hatchery building construction/renovation	$ 300,000
	Tanks, raceways and ponds	$ 350,000
	Water intake systems (pumps, filtration)	$ 400,000
	Water recirculation/aeration systems	$ 300,000
	Backup power system (generators)	$ 70,000
	Storage facilities and workshops	$ 50,000
	Office spaces	$ 50,000
c. Equipment	Fish transport vehicles	$ 70,000
	Lab equipment (water testing, health monitoring)	$ 80,000
	Hatchery tools and supplies	$ 100,000
	Monitoring systems (cameras, software, sensors)	$ 30,000
Total Capital Cost (USD)		$ **1,800,000**
2. Annual Operational Costs		
a. Salaries	Hatchery manager	$ 45,000
	Biologists (2)	$ 65,000
	Hatchery technicians (3)	$ 65,000
	Administrative/support staff	$ 25,000
b. Fish Stock and Feed	Eggs or broodstock acquisition	$ 65,000
	Fish feed (varies by species and number of fish)	$ 60,000
c. Utilities and Maintenance	Electricity and water	Not budgeted
	Routine maintenance	$ 50,000
	Equipment repairs and replacements	$ 30,000
d. Miscellaneous Costs	Testing and certifications	$ 20,000
	Transportation costs	$ 50,000
Total Operational Costs (per year)		$ **475,000**
Total Operational Costs (10-year period) USD		$ **4,750,000**

Activities for Fish hatchery establishment and operation

Type of mitigation: Net Gain	Target biodiversity: Fish	Responsibility: PIU BU
• Development of conservation principles to guide management of the fish hatchery • Capital expenditure costs and 10 years of operational costs • Research and development budget • Partnerships with NRDCRLF		

- Tour of professional fish hatcheries in BC, Canada

6.6 Further Assessment of Range Restricted Fish Species

Field surveys of fish in the Kuri Chhu and its tributaries have identified the presence of three range-restricted fish species (Table 5). However, it remains unclear whether these species are classified as range-restricted due to limited data on their distribution or because they genuinely occupy a very narrow geographic range. Also notably, the Indian Mottled Eel (*Anguilla bengalensis*) was detected through eDNA analysis, although no physical specimens were observed. Further evidence of a viable population is required to justify any mitigation actions. Given the migratory nature of the Indian Mottled Eel, which moves between oceanic and freshwater habitats, its occurrence in the area was anticipated.

To address these knowledge gaps, a comprehensive study is proposed to extend the investigation of fish distribution beyond the area sampled during baseline surveys. eDNA sampling will be conducted throughout the Kuri Chhu catchment, encompassing the main river stem and key tributaries. The study's findings will allow for a reassessment of the critical habitat status of the identified fish species and inform the adaptation of mitigation measures as necessary.

A lump sum budget is allocated to support this initiative, covering Sampling equipment and materials, Laboratory analysis of eDNA samples, Travel and field logistics, Per diem for field personnel, and Report preparation and dissemination.

This study will provide a more accurate understanding of fish distribution and habitat needs, ensuring that conservation measures are both evidence-based and effective.

6.7 Implementation Framework for the Biodiversity Net Gain Strategy

NG Strategy Component	Supported Actions	Implementation Schedule	Indicators and Means of Verification	Responsible Parties
Conservation support for protected areas and conservation initiatives	• Financial support to selected activities of conservation management plans and conservation initiatives • Monitoring the conservation effectiveness of supported activities • Corridor Functionality Study for the BC-7	Construction and Operations Phases	- Proposals submitted requesting support - Independent ecological assessment of conservation effectiveness of support provided. - Audit reports of funds provided - Corridor Functionality Study final report with recommendations for improved management of the BC-7	DoFPS, NCD PIU BU
Conservation measures for Pallas's Fish Eagle and other birds	• Construction of nesting platforms in suitable locations along the Kuri Chhu • Monitoring bird nesting activity	Platforms by Construction Year 3	- Construction plans for nesting platforms - Monitoring results of use of nesting platforms by large birds.	PIU BU
Afforestation to compensate the Project induced loss of habitat	• Selection of degraded forest sites for afforestation • Tree propagation and growth of seedlings • Tree planting • Tree care and replacement planting of dead trees • Fire suppression • Monitoring and evaluation	Construction Phase Year 3 to Year 5	- Afforestation plans addressing site selection, involvement of communities, action plan, timeframe and budget. - Monitoring reports of tree survival - Audit reports of funds provided	Green Bhutan DoFPS PIU BU
Propagation of *Hoya bhutanica* and translocation of	• Equipment and facilities for propagating *Hoya bhutanica,* such as a bark chipper and horticultural equipment and supplies. • Inclusion of *Hoya bhutanica* into afforestation and project landscaping activities.	Construction Phase	- Evidence of Hoya propagation facilities - Operational reports of Hoya cultivation and distribution	PIU BU DoFPS

NG Strategy Component	Supported Actions	Implementation Schedule	Indicators and Means of Verification	Responsible Parties
orchids and other epiphytes	• Collaboration with DoFPS, monasteries, and community members to carefully remove orchids and other epiphytes from the reservoir inundation footprint • Collaboration with monasteries, religious leaders and interested members of the community to culture orchids and share lessons learnt • Species identification of orchids through local herbaria.	Year 2 to Year 4	- Ecologist reports for search and collection of orchids - MoU with monasteries to cultivate orchids - Herbaria identification reports for orchid samples from the Project.	Religious institutions
Establishment and operate a fish hatchery to boost fish populations	• Development of conservation principles to guide management of the fish hatchery • Capital expenditure costs and 10 years of operational costs • Research and development budget • Partnerships with NRDCRLF • Tour of professional fish hatcheries in BC, Canada	Hatchery establishment started by Construction Year 7. Hatchery operational through the Operations Phase	- Manifesto of conservation principles for hatchery management. - Planning and construction reports for fish hatchery development. - MoU with NRDCRLF regarding management of the fish hatchery. - Evidence of fish fingerlings released into aquatic ecosystems. - Monitoring reports of the status of natural fish populations, with recommendations for fish hatchery management.	PIU BU NRDCRLF
Further assessment of range restricted fish species	• eDNA sampling conducted across the Kuri Chhu catchment	Final report by Construction Year 7	- Inception report for an eDNA study across of the Kuri Chhu catchment. - Final report on the status of fish species listed in this BMP as restricted range species, with adaptive management actions for their protection.	PIU BU NRDCRLF

6.8 Analysis of Net Gain Achievements

The objectives of this BMP (Chapter 3) require the Project to implement measures to achieve the following three outcomes: (i) demonstrate Net Gain to compensate for the loss of natural habitats; (ii) achieve net gains for the biodiversity features for which critical habitat is designated; and (iii) enhance the conservation aims and effective management of affected protected areas.

This section presents an analysis of the confidence of achieving these Net Gain objectives.

6.8.1 Net Gain achievement for Natural Habitats

Section 4.2.1 estimates that the project will result in the loss of approximately 606 hectares of natural habitat, of which 70% is forest habitat and 30% is aquatic habitat. To offset this impact, an afforestation program is proposed to restore tree cover over an area equivalent to the habitat affected. The program will focus on degraded landscapes within community forest reserves, including areas within the BC-7. This initiative is expected to benefit not only forest habitats but also adjacent aquatic ecosystems, as restored tree cover will improve overall habitat quality. Additionally, aquatic habitats will be further supported through the professional management of a hatchery aimed at maintaining fish diversity and abundance across the Kuri Chhu catchment, as detailed below.

A 1:1 ratio of impacted area to afforestation extent is deemed sufficient to achieve net gains, based on the following considerations:

- Protected Status: Afforested areas will be incorporated into community forest reserves, ensuring long-term protection and management.
- Expert Implementation: The program will be executed by the Green Bhutan Corporation Ltd., a trusted organization with extensive experience in tree planting across Bhutan.
- Community Involvement: Local communities, with a vested interest in the program's success, and will play an active role in ensuring the long-term survival of the trees. Healthy seedlings will be carefully planted, increasing confidence in the program's overall effectiveness.

As a result, net gains for both forest and aquatic habitats are considered achievable, contributing to the restoration of ecosystem services and biodiversity in the region.

Net Gain for Fish

A dam in the Kuri Chhu will fragment the river, compounded by the transformation of fast-flowing riverine habitat into a deep, standing-water reservoir. This shift will have significant ecological consequences for fish populations, and the cumulative impacts of a cascade of hydropower projects along the river are expected to result in a general decline in fish abundance and diversity.

To mitigate these impacts, the project will construct and operate a large-scale hatchery to culture various fish species for release into different parts of the Kuri Chhu. The hatchery will be designed with the capacity to produce sufficient fish fingerlings to support populations across the entire Kuri Chhu catchment, with potential to expand its influence to other river systems in Bhutan. A manifesto of conservation principles will be developed to guide hatchery operations, focusing on topics such as:

- Protecting genetic diversity of fish stocks.
- Preventing the spread of parasites and diseases.
- Enhancing natural fish habitats to support sustainable populations.

Operation of a large-scale fish hatchery will provide a significant boost to the achievement of net gain for aquatic habitats.

Currently, three fish species are provisionally identified as critical habitat species due to their restricted ranges. However, this classification may reflect a lack of comprehensive distribution data rather than a truly narrow range of occurrence. To address this uncertainty, an eDNA study will be undertaken across the Kuri Chhu catchment. This study will assess the distribution of these species, re-evaluate their critical habitat status, and determine whether additional conservation or management actions are required for their protection.

6.8.2 Enhanced Conservation Aims and Effective Management of Protected Areas

The construction of the project reservoir will disrupt the BC-7 wildlife corridor, though the full significance of this impact remains challenging to assess. While a conservation management plan for the BC-7 has recently been developed, divisional DoFPS staff have indicated that their current financial resources are insufficient to implement the plan effectively, leaving management of the BC-7 constrained. However, the DoFPS remains committed to enhancing the management of the BC-7. With the financial support budgeted in this BMP, significant improvements in the corridor's management effectiveness are expected. Additionally, these resources will extend to nearby protected areas and conservation initiatives, enabling better integration of BC-7 with the surrounding network of protected areas.

To further inform and enhance management efforts, the Chief Forest Officer of Mongar has proposed a Corridor Functionality Study for the BC-7. This study will involve the Ugyen Wangchuck Institute for Forestry Research & Training (UWIFoRT) or the Nature Conservation Division (NCD), leveraging their expertise in camera trapping and wildlife tracking, as demonstrated in the elephant tracking initiative under the ACCESS Bhutan Project. With the UWIFoRT's or NCD's professional capacity, there is high confidence that the Corridor Functionality Study will be successfully implemented, providing critical guidance for the long-term management and conservation of the BC-7.

By addressing resource limitations and incorporating advanced wildlife monitoring techniques, the project will not only mitigate the impacts of reservoir development but also strengthen the ecological integrity of the BC-7 and its connectivity with adjacent protected areas.

6.8.3 Net Gain Outcomes for Critical habitat-designated Species

Table 5 lists six species for which critical habitat is designated and may be impacted by the Project. Net gain is achievable for each of these species as discussed below for mammals, birds and plants.

Net Gain for Large Mammals

Large mammals designated as critical habitat species include the Bengal Tiger (*Panthera tigris*), Dhole (*Cuon alpinus*), and Red Panda (*Ailurus fulgens*). The BC-7 and surrounding protected areas support important populations of these species, but the primary impact of the project is expected to be the fragmentation of this wildlife corridor.

Enhanced management of the BC-7, as outlined above, will provide better protection for these mammals. The above proposed Corridor Functionality Study will play a key role by investigating the movement patterns of these animals and their prey populations. The study will identify alternative movement corridors that may naturally emerge over time. Findings from the study will guide the adaptation and improvement

of management strategies for the BC-7 and adjacent protected areas, ensuring continued connectivity and ecological functionality.

With the implementation of this approach, Net Gains in biodiversity conservation are considered achievable, as the improved management of the BC-7 will enhance habitat protection, mitigate fragmentation, and support the long-term survival of critical habitat species.

Net Gain for Large Birds

The Pallas's Fish Eagle and White-bellied Heron may experience some impacts from altered hydrology caused by the project. However, both species have demonstrated adaptability by foraging in the nearby KHP reservoir. Similarly, these birds are expected to benefit from the creation of the project reservoir, which will be stocked with fish, providing an ample food source. As a result, no significant residual adverse impacts are anticipated.

To further support these species, the installation of nesting platforms in safe, strategic locations is proposed. These platforms will enhance nesting success and encourage the birds to fully utilize the foraging opportunities provided by the future reservoir. With these measures in place, there is high confidence that Net Gains can be achieved for these species, contributing to their conservation and long-term habitat suitability in the area.

Net gain for Plants

Hoya bhutanica, an endangered epiphyte, is found in areas that will be impacted by project activities. Fortunately, Hoya species are easily propagated, making it possible to multiply this plant in large numbers. Propagated plants can be distributed for use in the afforestation program, incorporated into project landscaping, and gifted to local monasteries, where they can be nurtured and appreciated. This approach offers a substantial opportunity for achieving Net Gain for the species.

Similarly, many different epiphytic orchids grow on trees along the Kuri Chhu, which will be lost to inundation by the reservoir. Although these orchids are not currently recognized as critical habitat species due to challenges in identifying them, their unknown endemism and conservation status, their ecological and cultural significance is undeniable. Orchids are popular for cultivation in local monasteries and religious sites, where they can be appreciated by the community.

To conserve these plants, the project will collaborate with monasteries and the DoFPS to collect orchids and other epiphytes from the reservoir impact area. These plants will be cultivated in monasteries, where dedicated care will enhance understanding of their requirements and life cycles. Over time, orchid seeds will disperse into the natural environment, supporting their regeneration and promoting broader ecological benefits.

Most importantly, integrating biodiversity conservation into the local culture creates a powerful multiplier effect for the Net Gain Strategy. By involving local communities and fostering cultural appreciation for biodiversity, this approach not only ensures the survival of species like *Hoya bhutanica* and orchids but also strengthens the connection between people and their natural environment, yielding lasting ecological and cultural benefits.

7 IMPLEMENTATION SCHEDULES

An Implementation schedule is presented in Table 15 to guide mitigation to address Project impacts. The schedule covers the Preconstruction, Construction and Operations phases, based on two-year, 6.5 year and extended periods respectively. The pattern of the Implementation schedule considers the summer and winter seasons as many biodiversity-related activities are seasonally dependent, for example:

Table 16 presents an implementation schedule for the Biodiversity Net Gain Strategy following the same Preconstruction, Construction and Operations phases.

These implementation schedules are indicative of the expected optimal periods for proposed activities but will need to be fine-tuned during implementation of the BMP.

Table 15: Implementation Schedule for Activities to Address Project Impacts

Activities	Pre-construction Phase								Construction Phase																				Operations Phase										
	Year 1		Year 2				Year 3		Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10				Year 11	Year 12	Remain. Operations
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
MITIGATION REQUIREMENTS TO ADDRESS PROJECT IMPACTS																																							
1. Establish a BU as a component of the PIU																																							
2. Incorporate Biodiversity Protection & Staff Code of Conduct into Nat. Res. Mgmt Policy																																							
3. Incorporate Biodiversity Protection Requirements into Tender Documents																																							
4. Raise Awareness of Biodiversity among Staff, Contractors, Subcontractors & Locals																																							
5. Equipment and Capacity Building for the BU																																							
6. Implement Biodiversity Friendly Approaches with the Social Influx MP																																							
7. Consider Additional Biodiversity Protection to enhance ESMP Plans																																							
8. Surveys forBirds and Bird Nesting Activity																																							
9. Preconstruction surveys for *Hoya bhutanica* , orchids and other epiphytes																																							
10. Control IAS in Construction Sites																																							
11. Prevent Animal Mortality during Construction Works																																							
12. Prevent Animal Mortality during Operations																																							
13. Rescue Trapped and Injured Animals in Construction Sites and their Vicinity																																							
14. Incorporate safe wildlife crossings along new roads																																							
15. Ensure Implementation of the EFlow MP																																							
16. Implement a Migratory Fish Catch-&-Release Protocol																																							
17. Monitor the Effectiveness of BMP Implementation																																							

Explanation of colours used above: Proposed timing of activities; Summer season (focus period for biodiversity activities); Winter season

Table 16: Implementation Schedule for the Biodiversity Net Gain Strategy

Net Gain Components	Pre-construction Phase								Construction Phase																				Operations Phase										
	Year 1		Year 2				Year 3		Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10				Year 11	Year 12	Remain. Operations
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
BIODIVERSITY NET GAIN STRATEGY																																							
1. Conservation support to protected areas and conservation initiatives																																							
2. Conservation measures for Endangered birds																																							
3. Afforrestation to compensate natural habitat loss																																							
4. Propagation of Hoya bhutanica and saving orchids																																							
5. Establish and operate a fish hatchery																																							
6. Distribution study of range restricted fish																																							

Explanation of colours used: Proposed timing of activities; Summer season (focus period for many biodiversity activities); Winter season

8 INSTITUTIONAL RESPONSIBILITIES

This BMP is a component of Project ESMP and therefore replicates some content of the ESMP where a focus is required on biodiversity.

Roles and responsibilities need to be clearly defined for effective establishment, implementation and improvement of the ESMP. Apart from a few key areas, most of the risk and impact mitigation measures discussed in the Chapter for Project Mitigation are the responsibility of the Contractor and its subcontractors. However, the PIU remains accountable for ensuring adequate implementation takes place. The PIU must monitor the Contractor and its subcontractors and be prepared to intervene and require corrective actions be applied where necessary.

The Net Gain Strategy will not involve the Contractor, instead this will be implemented by the Biodiversity Unit established within the PIU, in collaboration with DoFPS and NRDCRLF staff.

The Project roles relevant to this BMP are:

- PIU under the supervision of DGPC.
  - The Biodiversity Unit (BU) will be established as a component of the PIU
- Construction Contractor – not yet assigned.
- Lenders Environmental and Social Management Consultant - not yet assigned.
- DoFPS and NRDCRLF in collaboration with the BU for implementation of the Biodiversity Net Gain Strategy.

8.1.1 Role of the Project Implementation Unit (PIU)

The PIU is responsible for implementing all programs related to land acquisition (in collaboration with local authorities), Influx management, Traffic management and monitoring contractors and subcontractors to fulfil their impact mitigation responsibilities.

Throughout Project activities, many individuals will have an influence on the environmental and social performance of the Project and all, must have or have access to appropriate training to ensure successful implementation of the BMP.

DGPC, their representatives and technical assistance, and contractors must make available the necessary resources including human resources and specialized skills, organizational infrastructure, technology and financial resources to achieve successful BMP performance. DGPC management will define the roles, responsibilities and authorities for all parties to ensure that:

- The BMP is fully established, implemented and maintained properly to ensure that all Project-related activities are carried out in compliance with the lenders E&S requirements and Bhutanese regulations.
- The Contractor and its subcontractors have management plans in line with DGPCs ESMP.
- Performance of this BMP is reviewed on a regular schedule and reports are prepared including recommendations for improvement for consideration by DGPC Management.
- Regularly inform the community & the larger public of project activities and impacts and address issues raised by the community.

8.1.2 Role of the Construction Contractor(s)

In the context of the construction, the Project, the Engineering-Procurement-Construction (EPC), the CC commits to respect the following principles during the whole period of the construction activities:

- To manage construction activities with diligence and with the awareness that an important objective is to protect the environment and to minimize construction impacts, by employing the best E&S management measures within the limits of their economic feasibility.
- Ensure water and air quality is maintained through effective pollution control, minimized destruction of productive land, preserve local economic activity, respect communities and culture, safe and healthy working environment and measures for forest and biodiversity conservation.
- To comply with the PIU's environmental requirements and to self-monitor compliance.
- To respect internationally recognized good practices in the fields of concern.
- Strive for continual improvement through the implementation of the principles of Environmental Management System as defined by ISO 14001.
- To provide training and awareness programs to construction staff to achieve continual improvement in environmental protection performance.
- To efficiently implement measures outlined in this BMP, regularly monitor and inspect relevant activities and results and measure E&S performance through regular audits.

To minimize negative impacts on the environment, society, health and safety during the construction phase, the Contractor commits to comply with legal regulations, implement mitigation measures as required in the contract, and commits to comply with the relevant regulations. The CC further commits to engage qualified professionals; to comply with E&S requirements and to comply with the conditions specified in the contract.

The EPC Contractor will develop a Construction ESMP and associated sub-plans (including BMP). DGPC will review and approve the documents prior to site activities starting.

8.1.3 Role of the Lenders E&S Management Consultant

The Lenders E&S Management Consultant will be contracted by the lender to carry out a role of an independent E&S monitoring consultant typically involved in documentation review and audits during the Project implementation.

8.1.4 Role of the Authorities and Government Agencies

The authorities (DoECC; Department of Water; DoFPS, Department of Livestock, Department of Culture and Dzongkha Development; MoIT; Dzongkhag Administration in Mongar and Lhuentse) will contribute to the finalisation of the BMP through verification of the content and involvement during the implementation stage.

The institutional arrangements and roles of government agencies are described in detail in the ESIA. Key activities undertaken by government agencies include:

- Implementation of offsetting program such as reforestation and taxon management program in existing protected area and if necessary, in protected area to be created
- Monitoring and verifying the implementation of this BMP and operational BMP and other E&S commitments.
- Monitoring and verifying the conformity of the Project and its activities against relevant regulations such as water and air quality, etc.

9 COST ESTIMATES

This section presents a forecast of the budget required for mitigation to address project impacts, and additional measures encompassed within the Biodiversity Net Gain Strategy. Table 17 presents a summary of the total BMP budget for over USD 16.5 million, and is supported by more detailed budgets provided in Table 18 and Table 18.

Table 17: Total Budget to implement this BMP

Cost Estimate	Amount (USD)
Mitigation to address project Impacts	$ 4,236,445
Biodiversity Net Gain Strategy	$ 12,415,000
Total Budget for this BMP	**$ 16,651,445**

Table 18 presents an indicative summary budget for mitigation to address project impacts, as presented in Chapter 5 of this BMP, with references provided to sub-budgets included within Chapter 5. This budget is developed for the preconstruction and construction phase, and the operational phase. In accordance with the Implementation schedule (Section 6.8), the preconstruction and construction phases are collectively budgeted for a 8.5-year period, while the Operations Phase is budgeted for a 10-year period. The Operational phase will extend over a longer period but will require ongoing refinement of activities and budgets. Costs are estimated based on the ESIA and knowledge of the Bhutanese context and supported by various notes associated with mitigation descriptions.

Table 19 presents a summary budget for the Biodiversity Net Gain Strategy based on the activities provided in Chapter 6. Many sub-budgets included within Chapter 6 to support the calculation of this budget. Many of the activities will not be influenced by project phases and this budget is not separated into project phases.

Table 18: Cost Estimate for activities to address project impacts

Activities to address Project Impacts	Preconstruction & Construction	Operations (10 years)	Total (USD)
Establish a Biodiversity Unit (BU) and logistics (*refer to Table 8 for breakdown of costs*)	$ 1,330,000	$ 730,000	$ 2,060,000
2. Incorporate Biodiversity Protection and Code of Conduct into the Natural Resource Mgmt. Policy	PIU operational costs are not budgeted here		
3. Incorporate Biodiversity Protection Requirements into Tender Documents			
4. Raise Awareness of Biodiversity among Staff, Contractors & Local People	$ 68,000	$ 58,000	$ 126,000
5. Equipment and capacity building for the Biodiversity Unit (*refer to Table 9 for costs*)	$ 460,000	$ 270,000	$ 730,000
6. Implement Biodiversity Friendly Approaches with the Social Influx MP	$ 150,000	$ 100,000	$ 250,000
7. Consider Additional Biodiversity Protection to enhance ESMP Plans	$ 150,000	$ 100,000	$ 250,000
8. Surveys for Birds and Nesting Activity	$ 50,000	$ 60,000	$ 110,000
9. Preconstruction surveys for *Hoya bhutanica*, Orchids and other Epiphytes	$ 80,000		$ 80,000
10. Control IAS in Construction Sites	Costs are included in EPC budgets, Biodiversity Unit costs are included above		
11. Avoid Animal Mortality during Construction			
12. Avoid Animal Mortality during Operations			
13. Rescue Trapped and Injured Animals in Construction Sites and their Vicinity	$ 80,000	$ 40,000	$ 120,000
14. Incorporate Safe Wildlife Crossings along New Roads (survey and monitoring costs)	$ 70,000	$ 20,000	$ 90,000
15. Ensure Implementation of the EFlow Management Plan	Costs estimated in the EFlow Management Plan		
16. Implement a Migratory Fish Catch-&- Release Protocol	$ 40,000	$ 100,000	$ 140,000
17. Monitoring BMP implementation	$ 200,000	$ 80,445	$ 280,445
Total (USD)	**$ 2,678,000**	**$ 1,558,445**	**$ 4,236,445**

Table 19: Cost Estimation for the Biodiversity Net Gain Strategy

Net Gain Component	Rate Calculation	Amount
1. Support to protected areas, conservation initiatives and Corridor Functionality Study	Lumpsum	$ 3,500,000
2. Conservation measures for Endangered birds	12 platforms @ $ 5,000	$ 60,000
3. Afforestation to compensate natural habitat loss	Refer to Table 12	$ 800,000
4. Propagation of *Hoya bhutanica* and saving orchids	Lumpsum	$ 180,000
5. Establish and operate a fish hatchery		
Fish Hatchery capital and operational costs	Refer to Table 14	$ 6,550,000
Fisheries Study Tour	Refer to **Error! Reference source not found.**	$ 100,000
Fish culture research and development for	Lumpsum	$ 600,000
Partnerships with NRDCRLF, specialists and stakeholders	Lumpsum	$ 500,000
Fishery Conservation guidelines	Lumpsum	$ 60,000
6. Distribution study of range restricted fish	Lumpsum	$ 65,000
Total budget for Net Gain Strategy		**$ 12,415,000**

10 IMPORTANT REFERENCES

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