Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS) Project, Bhutan

Gelephu-Tareythang Road

Department of Surface Transport (DoST),
Ministry of Infrastructure and Transport,
Royal Government of Bhutan (RGoB)

DATE
March 2025

BIODIVERSITY MANAGEMENT PLAN (BMP)

Draft version

BMP CONTENTS

LIST OF TABLES

ACRONYMS USED IN THE REPORT

Acronym	Description
ACCESS	Accelerating Transport and Trade Connectivity in Eastern South Asia
ADB	Asia Development Bank
AoA	Area of Analysis
BMP	Biodiversity Management Plan
CHA	Critical Habitat Assessment
CR	Critically Endangered with extinction
DoFPS	Department of Forests and Park Services
DoST	Department of Surface Transport
E&S	Environmental and Social
ECABP	Elephant Conservation Action Plan for Bhutan 2018-2028
EN	Endangered with extinction
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Standards
FNCA	Forest and Nature Conservation Act
GMC	Gelephu Mindfulness City
GPN	World Bank Good Practice Note
HEC	Human Elephant Conflict
HSE	Health, Safety and Environment
IAS	Invasive Alien Species
MIKE	Monitoring Illegal Killing of Elephants
NCD	Nature Conservation Division of DoFPS
PWS	Phibsoo Wildlife Sanctuary
QRT	Quick Response Teams
RMNP	Royal Manas National Park
ROW	Right-of-Way

1 EXECUTIVE SUMMARY

PROJECT OVERVIEW

The Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS Bhutan) Project is a multi-phased project with financial support from the World Bank. The project aims to improve regional connectivity while ensuring the sustainable management of biodiversity along the project corridor. This Biodiversity Management Plan (BMP) for the Gelephu-Tareythang Road (GT Road) in Bhutan is an essential environmental and social safeguard instrument of the ACCESS Bhutan project.

The GT Road, a subcomponent of the ACCESS Bhutan project, is a Green, Resilient, and Sustainable Road Connectivity initiative implemented by the Department of Surface Transport (DoST). The project seeks to provide a more resilient and safer alternative to existing infrastructure that is prone to flooding and landslides. The proposed road development includes environmental measures to mitigate biodiversity loss and ensure compliance with the World Bank's Environment and Social Framework (ESF) which provides the Environmental and Social Standard 6 (ESS6) on biodiversity conservation.

BIODIVERSITY SENSITIVITIES, IMPACTS AND MITIGATION REQUIREMENTS

The project area has been identified as ecologically significant, with extensive natural habitats that connect legally gazetted protected areas of Bhutan, namely the Phibsoo Wildlife Sanctuary and Royal Manas National Park. The Environmental and Social Impact Assessment (ESIA) estimates a direct impact to approximately 0.07 km² of natural habitat, that triggers the ESS6 requirement to achieve no net loss and, where feasible, preferably a net gain of biodiversity over the long term.

The project area is home to endangered species, including the Asian Elephant (*Elephas maximus*) and Gee's Golden Langur (*Trachypithecus geei*), which qualify as critical habitat species. The project footprint intersects their critical habitats and will impact their movement patterns, which necessitates a rigorous mitigation strategy that yields net gain outcomes for these species.

MITIGATION MEASURES

This BMP follows a structured approach to mitigating biodiversity impacts in accordance with the mitigation hierarchy:

1. **Avoidance Measures** – The GT Road design has been structured to include wildlife underpasses for elephants, canopy bridges for golden langurs, and culverts for smaller faunal species.
2. **Minimization Measures** – Measures such as speed limits, strategic fencing, reduced night-time construction, and habitat rehabilitation will be implemented to limit project-induced biodiversity disturbances.
3. **Biodiversity Net Gain Strategy** – The Net Gain Strategy aligns with Bhutan's national conservation strategies, such as the Elephant Conservation Action Plan for Bhutan (2018-2028) and will be implemented by the Department of Forests and Park Services (DoFPS). The net gain strategy outlines several initiatives, including:
    - Habitat Enrichment Programs to restore degraded grasslands to achieve net gain for natural habitats.

- Safeguarding elephant movement corridors to ensure their safe passage.
- Strategies to promote Human-Wildlife Coexistence, including improved fencing of community assets and Quick Response Teams (QRT) for conflict mitigation.
- Research on wildlife movement to guide adaptive management.
- Strengthening partnerships and institutional capacities.

This BMP has been prepared considering the cumulative impacts of the GT Road and other projects to elephants, but excludes cumulative impacts associated with the GMC (Gelephu Mindfulness City) as limited data is available.

IMPLEMENTATION AND MONITORING

A structured implementation framework is provided for the project mitigation and the net gain strategy with description of activities, target indicators and allocation of responsibilities. Monitoring mechanisms include camera trapping, field surveys, and citizen science initiatives to track mitigation effectiveness.

BUDGET

An indicative budget is estimated at USD 4,400,000 to mitigate project impacts (15% of budget) and implement the Biodiversity Net Gain Strategy (85% of budget). An additional USD 600,000 is budgeted for supervision, partnerships and capacity building, which will be supported under Component 3 of the Project financing. This BMP budget excludes road design costs, contractor costs and social development costs.

NEXT STEPS TO FINALIZE THIS BMP

This BMP is provided in draft format. It provides a provisional analysis which suggests that mitigation measures are technically, financially and politically feasible to mitigate the GT Road's direct and indirect impacts and its contribution to cumulative impacts, to achieve net gains for natural and critical habitat features. However net gains need to be measured based on metrics that need to be developed. A specialist workshop led by the Nature Conservation Division (NCD) of DoFPS is proposed prior to Project Effectiveness to plan the implementation of research studies on wildlife movement and guide the development of net gain metrics.

This BMP requires consultation with internal RGoB stakeholders and external stakeholders, led by DoST with DoFPS involvement to guide the finalization of this BMP within 60 days post Project Effectiveness.

CONCLUSION

The BMP serves as a guiding document to ensure biodiversity conservation in tandem with infrastructure development. It provides a roadmap for achieving net gain outcomes for sensitive biodiversity through scientifically backed conservation strategies and community engagement. While the BMP effectively addresses project-related impacts, broader cumulative and transboundary biodiversity challenges will require continued collaboration and long-term commitment beyond the project's scope.

2 INTRODUCTION

The Royal Government of Bhutan (RGoB) is implementing the Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS Bhutan) to strengthen regional trade and connectivity through a multi-phased project with financial support from the World Bank.

The Gelephu-Tareythang Road on the Southern East-West Highway, Sarpang, Bhutan (hereafter the "GT Road") represents Subcomponent 2.1 of the ACCESS Bhutan Project. Subcomponent 2.1 covers development of Green, Resilient, and Sustainable Road Connectivity - Gelephu-Tareythang Road and Bridges. This subcomponent is implemented by the Department of Surface Transport (DoST), Ministry of Infrastructure and Transport and the RGoB.

Subcomponent 2.1 will adopt a resilient and nature-positive approach to road and bridge construction to fill one of the missing links along the Southern East West Highway. It includes the preparation of the detailed design, construction, and works supervision, including environmental and social supervision. The new link will be a shorter, more resilient, and safer alternative to the existing 45 km dzongkhag (district) road connecting Gelephu and Tareythang, which experiences considerable damage and road closures annually due to flooding and landslide events, making it a non-viable option for upgrading. At its western end, the greenfield road will connect with the planned Gelephu multimodal transport and logistics hub and the international airport. It will also serve as the main arterial road for the planned Gelephu Mindfulness City (GMC). The incremental cost for the resilience measures against climate exacerbated hazards, including extreme heat, flooding, and landslides, are estimated at 25% of the subcomponent costs. The road construction will include accessibility and safety measures such as sidewalks, safe crossings, and non-motorized transport facilities.

An Environmental and Social Impact Assessment (ESIA) has been developed on behalf of DoST and in accordance with the World Bank Environmental and Social Framework (ESF). The ESIA identifies natural and critical habitat and several important biodiversity impacts necessitating the development of this Biodiversity Management Plan (BMP) to outline mitigation and monitoring measures for the GT Road.

3 BMP OBJECTIVES

This BMP is the primary E&S instrument for addressing the requirements of ESS6, the ESF standard 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.

This BMP outlines management measures to mitigate project impacts to biodiversity following the mitigation hierarchy 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. (Note 1)
- To present a mitigation strategy to achieve Net Gain for the biodiversity features for which critical habitat is designated through an approach that is proportional to the GT Road impacts.
- Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of affected protected areas.

Note 1: ESS6 encourages setting a mitigation target to achieve Net Gain rather than No Net Loss of biodiversity. This BMP outlines mitigation measures for habitat enrichment that exceeds the loss of natural habitat, and the BMP is therefore able to achieve the preferred Net Gain of biodiversity for natural habitats. These measures, together with Net Gain measures for critical habitat features are presented in the Net Gain Strategy.

3.1 STRUCTURE OF THIS BIODIVERSITY MANAGEMENT PLAN

This BMP is structured to align with the Indicative Content of a BMP provided in the ESS6 Guidance Notes (GN Appendix A), which requires a separation of mitigation to address project impacts and mitigation to address ESS6 No Net Loss and Net Gain requirements, for Natural and Critical Habitats, respectively.

This version of the BMP serves as a draft document that requires development of metrics for monitoring Net Gain measures. It also requires consultation with RGoB, internal and external stakeholders and their input. The next steps to finalize this BMP are provided in Section 10.

4 BACKGROUND INFORMATION

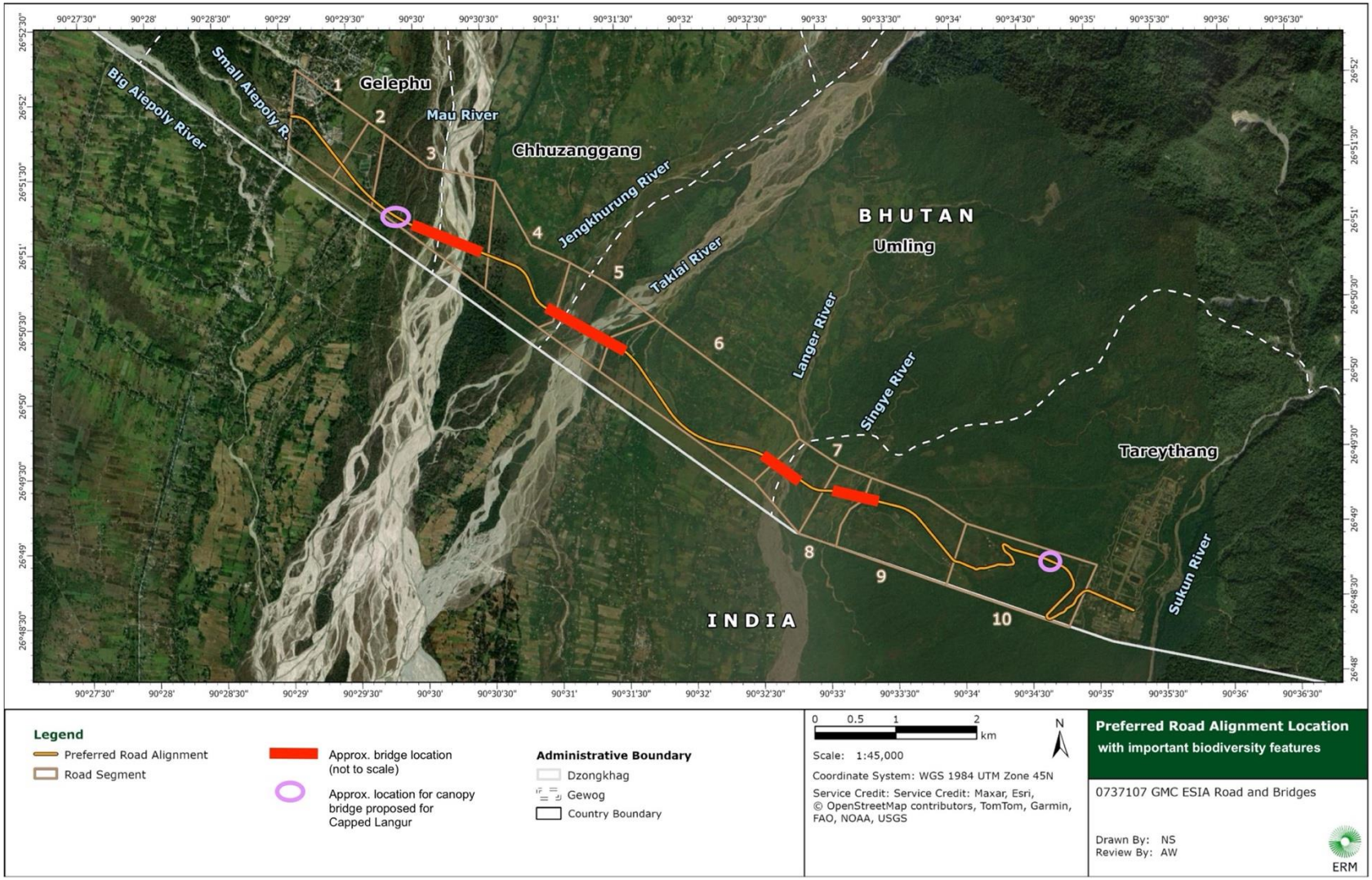
4.1 PROJECT DESCRIPTION

The GT Road (Figure 1) comprises at-grade roads (built at the same level as the natural terrain), interchanges, and bridge crossings. At-grade roads will be constructed on top of embankments in low-lying areas, the approaches to bridge crossings and areas requiring changes in elevation. Other civil works include retaining walls and drainage provisions. The road design includes the following:

- **Road**: about 3.8 km of the proposed road will be dual two-lane highway with double carriageway (15 m wide) and 9.8 km will be single carriageway highway (7.5 m wide) with one lane in each direction, with the suitable geometry to be classified as a Primary National Highway. The preliminary design reveals approximately 10.2 km will comprise a new greenfield highway and a 3.4 km stretch of widening the existing highway near Tareythang.

  The Right-of-Way (ROW) corridor will include a buffer zone on either side to allow potential future expansion. The typical dual carriageway portions with two lanes in each direction will have a 40 m wide ROW. The typical single carriageway portions will have a 30 m wide ROW.
- **Bridges**: Approx. 2.6 km of bridge structures are divided over four bridges across the Mau River, Jengkhurung and Taklai Rivers, Langer River and Singye River. Various culverts will be installed.
- **River Training Works**: To control erosion on the riverbanks and limit the extent of flooding, gabion basket walls are proposed upstream and downstream of the highway at the bridges crossing the Mau River, Jengkhurung and Taklai Rivers, and the Langer River.
- **Embankments (with Box Culverts)**: To transition from the at-grade road to the bridge structures. Box culverts will be perpendicular to the highway at regular intervals along the embankment section to allow potential flood water to flow underneath the highway, preventing flooding of the highway.
- **Retaining Structures**: Reinforced concrete retaining walls are adopted to minimize the extent of slope works and width of embankment construction as the height of the embankment increases, or the terrain is unfavorable for embankment construction i.e. steeply inclined.
- **Quarry Sites and Borrow Pits**: Construction materials, such as sand, stones, aggregates and fill material will be sourced from the existing government approved and licensed quarry/crushing plants located near Gelephu. The locations are given in the ESIA Project description (Section 2.5.1).
- **Work Areas**: Two sites, at each end of the GT Road, will be used for storage of materials, workshops and construction support. Contractors will use the work areas for offices, supervision staff offices, equipment storage, machine storage and repair workshop. Two work areas are planned considering the geographical extent of the Project. The final location and layout of construction ancillary facilities, including crushing and batching plants will need to be confirmed and updated as part of detailed construction planning, following engagement of the design and construction contractor.
- **Worker camps**: Camps will be located at each of the work areas and developed in compliance with the ESS-2 including but not limited to IFC-EBRD Guidance on Works Accommodations: Processes and Standards (2009).

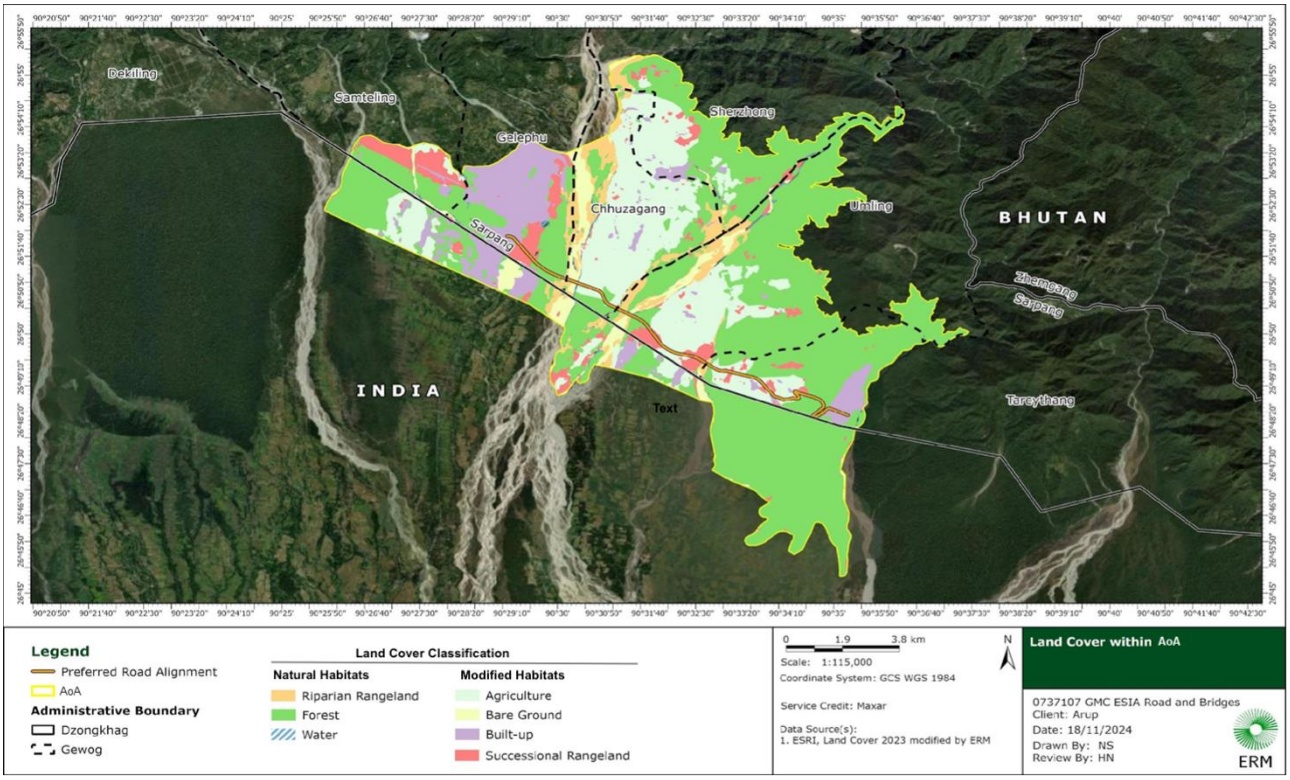
FIGURE 1 LAYOUT OF THE GELEPHU-TAREYTHANG ROAD ADAPTED TO SHOW IMPORTANT BIODIVERSITY FEATURES



4.2 BIODIVERSITY SENSITIVITIES

The Area of Analysis (AoA) for biodiversity assessment of the GT Road Area is presented in Figure 2. This AoA includes areas where cumulative impacts to biodiversity are envisaged to be significant, typically beyond the Project's Area of Impact, and is commensurate with the scale of relevant practical conservation management activities.

FIGURE 2 AREA OF ANALYSIS AND LAND COVER USED IN BIODIVERSITY ASSESSMENT



4.2.1 Surveys Conducted

Terrestrial and aquatic field surveys were conducted by ERM in July/August 2024 for baseline development, with summaries provided in the CHA of the ESIA. These surveys have been supplemented by the following studies:

- Dry season camera trapping conducted by DoFPS from August to October 2024
- Analysis of elephant behavior and distribution based on camera trapping by Nature Conservation Division of DoFPS (NCD) from July to November 2024.
- Study of the perceptions of Human and Elephant Conflict (HEC) and conservation attitudes of affected communities in Sarpang, Bhutan by NCD in 2024

4.2.2 Natural Habitat

Habitats are classified within the ESIA as either natural or modified in accordance with ESS6 definitions, with mapping based on land cover (Figure 2 Area of Analysis and Land Cover used in biodiversity assessment

and Appendix B). Overlay of the GT Road footprint reveals that development of the GT-road components will result in direct loss of 0.07 km^2 natural habitat. Additionally, the Camp and Work areas will result in the loss of 0.01 km^2 of natural habitat and 0.11 km^2 of modified habitat which will be rehabilitated once works are concluded. Loss of natural habitat, potentially hosting critical habitat features, triggers No Net Loss and preferably Net Gain requirements in accordance with ESS6 (as discussed in Chapter 3 BMP Objectives). This aspect is addressed in Chapter 6 of this BMP.

4.2.3 Critical Habitat Assessment

Critical habitat has been assessed using ESS6 paragraph 23 criteria. The five criteria are:

(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; and

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

Interpretation of the above criteria has been guided using a method developed in South Asia, that is applied to the AoA and involves the following stages: Step 1 to generate a list of species; Step 2 to screen species based on likelihood of occurrence; Step 3 to evaluate species and features against the ESS6 criteria; and Step 4 to assess the requirements and feasibility for Net Gain for critical habitat features that will be impacted.

Results of the CHA are presented in ESIA Appendix J and summarized in Appendix A of this BMP. The CHA has identified mammal, bird, reptile, fish and plant species to be recognized as sensitive biodiversity features. This list includes one Critically Endangered (CR) and 11 Endangered (EN) species, but the GT Road AoA has significant importance for four species which are considered to qualify as critical habitat features per criteria (a) and (b), namely Asian Elephant, Gee's Golden Langur, Bengal Tiger (*Panthera tigris*), and *Hoya bhutanica* (an epiphytic plant). The AoA is central within the range of elephants in Bhutan and is considered essential to maintain the viability of elephant populations in Phibsoo Wildlife Sanctuary and Royal Manas National Park. The AoA therefore potentially triggers criteria (e).

The final analysis of the CHA (Step 4) has revealed that only Asian Elephant (*Elephus maximus*) and Gee's Golden Langur (*Trachypithecus geei*) are critical habitat-qualifying species with potential to be significantly impacted by the GT Road. Reasons for recognizing Asian Elephant and Gee's Golden Langur as critical habitat species is summarized in Table 1.

TABLE 1 REASONS FOR RECOGNIZING CRITICAL HABITAT SPECIES

Species	Reasons for recognizing Critical Habitat species
Asian Elephant (*Elephus maximus*)	Presence of Asian Elephant in the Project AoA was confirmed by DoFPS who estimate over 100 individuals are present. This implies the Project AoA supports over 6% of the National elephant population, which is significant. A desktop review of movement data for two elephants indicated that the AoA is important for the movement of elephants and to connect elephant populations in adjacent protected areas, namely PWS and RMNP. The loss of habitat due to development of GT Road and GMC area and its vicinity would adversely affect the elephant population over a wider area.
Gee's Golden Langur (*Trachypithecus geei*)	Gee's Golden Langur were recorded in the sub-tropical region within the AoA, with an estimated population of 23 to 93 individuals of Golden Langur. This represents up to 1.55% of the global population and 1.7% of the National population. The Project AoA therefore supports a significant population of this Endangered and restricted-range species. Genetic diversity and structural issues among isolated populations of the Gee's Golden Langur in Assam, India have been recorded, indicating that gene isolation is a consequence of population fragmentation, which can lead to local extinction. Habitat fragmentation from the project can adversely affect this species.

This BMP indicates that mitigation measures are technically, financially and politically feasible, to successfully mitigate the GT Road's direct and indirect impacts and its contribution to cumulative impacts, and to achieve Net Gain for both Natural Habitat and Critical Habitat features (elaborated in Chapter 6 and summarized in Section 6.8 of this BMP).

4.2.4 Ecosystem Services

The ecosystem services currently derived by the local communities within the Project's Impact Area include:

- Subsistence and small-scale sale fishing activities upstream of the road alignment;
- Small scale aquaculture;
- Agriculture/ Cultivation of rice, paddy, ginger, oranges, cardamom, fruit plants, lychee, mangoes and Betel nut;
- Foraging for forest produce (e.g. Berries and mushrooms) for local consumption;
- Livestock rearing;
- Foraging for teak and sandalwood as building materials and for small-scale commercial sale;
- Extraction of surface water for daily activities (for e.g. sanitation, agricultural irrigation, aquaculture, livestock rearing, etc.); and
- Cultural values of natural space and sacred trees.

5 MITIGATION TO ADDRESS PROJECT IMPACTS

This BMP presents mitigation to address impacts to biodiversity. This chapter presents mitigation to address direct project impacts, while Chapter 6 presents mitigation to achieve Net Gain for natural and critical habitat features.

The mitigation in this chapter is separated into (1) mitigation incorporated into the project design (Section 5.1) which does not require additional actions to implemented (except monitoring actions); and (2) mitigation to minimize project impacts (Section 5.2), which do require an implementation schedule.

5.1 DESIGN (AVOIDANCE) MEASURES FOR WILDLIFE CROSSINGS

The ESIA identified potential impacts associated with increased risk of wildlife mortality and human-wildlife conflicts due to the presence of the GT Road. To mitigate this impact, the GT Road development will install appropriate wildlife crossings, namely:

- Bridges underpasses for Asian elephant and other terrestrial mammals
- Canopy bridges for golden langur
- Culverts for small mammals and reptiles, e.g. Tricarinate Hill Turtle

Wildlife crossings will be incorporated into the detailed design of the GT Road, and this Chapter provides the minimum design requirements.

5.1.1 Underpass Structures

Though elephants have been recorded utilizing underpasses less than 5 m high in Bhutan, underpasses heights of 6.5 to 7 meters are recommended by South Asia wildlife infrastructure guidelines (including ADB, Wildlife Institute of India, and Asian Elephant Transport Working Group).

Underpasses' openness affects how much light enters and how wildlife perceives the opposite side of the structure, and the distance across a structure has a significant impact on the cross-sectional size of an opening. Openness helps ungulates overcome their fear of enclosed places that provide a predation risk.

However, every species of wildlife has its preference for passage structure design, dimensions, and size. While this indicator is intuitive and can be easily calculated, it is discouraged to be used as the single factor for the technical design of the passage and instead local conditions and target species should be considered.

Yet some species groups or taxa exhibit general similarities in preference for passage structure size. Table 2 provides general recommended dimensions for four underpass size categories for Asian wildlife species ranging from small to very large. Wildlife's ability to navigate underpasses and overpasses is an important aspect for successful structure use. The utilization of even the best-designed structure may be limited or even prohibited if approaches are not adequately implemented. Ensure clear line-of-sight visibility and allow wildlife to view daylight through underpasses from opposite sides when approaching. For nocturnal species, light allowance structure is not necessary as the nighttime activities do not require bright light conditions.

TABLE 2 WILDLIFE SIZE CLASSES, UNDERPASS TYPES AND RECOMMENDED DIMENSIONS (ADB, 2019)

Wildlife Size Class and Focal Groups	Type of Underpass Structure				Min. Dimensions (m)			
	Concrete box culverts	Metal culverts	Arch culvert	Bridge	≤20 m length		35 m length	
Small: Reptiles, amphibians, small carnivores	Yes	Yes	Yes	Yes	2.0	2.0	3.0	2.5
Medium: Small ungulates, small carnivores, bears		Yes	Yes	Yes	6.0	3.0	8.0	3.0
Large: Large ungulates, bovids, large felids, large canids			Yes	Yes	10.0	4.0	15.0	4.5
Very large: Asian elephant			Yes	Yes	12.0	5.5	15.0	6.5

Bridges as Wildlife Crossings

Major bridge underpasses, ranging from 30 to 120 m in width, are typically designed as multi-span structures. In cases where Asian elephant passage is prioritized, bridges have been constructed either solely for this purpose or as cost-effective dual-use structures that also accommodate streams and smaller rivers.

Since all major bridge underpasses are sufficiently wide to facilitate Asian elephant passage, application of the Asian Elephant Transport Working Group guidelines focuses on underpass height. Given that major bridges are unlikely to be associated with narrow linear transport infrastructures values of <10 m, typically seen in minor bridge underpasses, the guidelines address two underpass length categories (bridge width): <20 m and >20 m.

The Asian Elephant Transport Working Group recommends that viaducts and bridges be designed with 10–12 m wide, flat, and obstruction-free passage lanes adjacent to bridge abutments to facilitate safe elephant movement. Additionally, minimum clearance heights are critical for bridge underpasses and should follow the minimum clearance indicated in Table 3**.**

TABLE 3 GUIDELINES FOR UNDERPASS DESIGN (ASIAN ELEPHANT TRANSPORT WORKING GROUP, 2024)

Underpass Length	Minimum Underpass Dimension	
	Width	Height
<20 m	30	6.5
>20 m	30	7.0

Spacing for Asian Elephant Crossings

Spacing guidelines ranged from 1.3 km for small ungulates (e.g., barking deer) to 13.6 km for Asian elephants. Table 4 presents these passage structure spacing recommendations (minimum) for a range of wildlife taxa and species, small to large, based solely on mean home range sizes reported by Bissonette and Adair (2008) and modified to include representative Asian species.

TABLE 4 RECOMMENDED SPACING OF PASSAGE STRUCTURES FOR ASIAN WILDLIFE

Species Group	Mean Home Range (km^2)	Spacing (km)	Passage Structure Size	Relevant Asian Wildlife
Small ungulates	1.7	1.3	Medium	Barking deer
Small carnivores	2.0	1.4	Small	Civets, marten
Small felids	7.8	2.8	Medium	Leopard cat, Asiatic golden cat
Large ungulates	12.2	3.5	Large	Sambar
Bears	13.7	3.7	Medium	Asiatic black bear, sloth bear
Large bovids	27.0	5.2	Large	Asian water buffalo, gaur
Large felids	60.8	7.8	Large	Common leopard, tiger
Large canids	116.6	10.8	Large	Dhole
Elephants	184.0	13.6	Very large	Asian elephant

The spacing and location of elephant crossings along the GT Road should be evaluated in the context of the current landscape and future urban development plans, including the GMC.

The GT Road design (**Error! Reference source not found.**) will meet the requirements of the a bovementioned SAR wildlife infrastructure guidelines for elephant crossings. The road will provide four designated elephant crossings within an 11 km stretch, with the maximum distance between crossings being approximately 4 km (from Singye Bridge to east of Tareythang). The following considerations inform the detailed highway design:

- From Gelephu to west bank of Mau River: This area is frequently used by elephants to access households and gardens in the Gelephu old town (Bhutan Elephant Corridor Project). However, as the GMC plans to intensify urban development in this area, measures should be taken to minimize elephant crossings. No additional crossing structures are recommended in this Chapter.
- Mau River Bridge: The current bridge design incorporates an elephant corridor on the east bank of the Mau River. This corridor is approximately 500 m wide, with a bridge clearance height of 8–10 m, providing sufficient space for elephants to move along the river and access foraging areas north of Gelephu town.

- Mau River east bank to Taklai River west bank: Local communities report that elephants frequently use this area to enter Bhutan from India, often foraging on agricultural land and causing human-elephant conflict. The GMC plans to develop this area for residential use between 2046 and 2065. To encourage elephants to avoid this region and shift to alternative food sources, no crossing structures should be installed here.
- Jengkhurung River and Taklai River Bridge: The current bridge design includes a clearance height of 8–10 m to accommodate elephant passage.
- Taklai River west bank to Langer River east bank: Evidence of elephant movement in this Chapter has been linked to human-elephant conflicts with local farmers, as noted by the Bhutan Elephant Corridor Project. The GMC envisions residential development in this area between 2066 and 2125. Like the Mau-Taklai Road section, no crossing structures should be provided to encourage elephants to transition to alternative foraging routes.
- Langer River bridge: The bridge design includes a clearance height of 10–15 m, facilitating safe movement of elephants underneath.
- Singye River bridge: The design incorporates a clearance height of 5–10 m for elephant passage.
- Singye River to Tareythang: This section of the highway will follow the existing two-lane road. While the segment near the Singye River is relatively flat and occasionally crossed by elephants, the portion near Tareythang has steep slopes that limit crossings. The GMC plans to intensify residential development in this area between 2066 and 2125. No additional crossings are planned along this segment. An alternative elephant corridor is under initial design, rerouting elephant movement north of the residential area to connect with the Royal Manas National Park. Additionally, a secondary passage exists beyond Tareythang, allowing elephants to enter from India into the national park.

Culverts

Box culverts will be introduced perpendicular to the highway at regular intervals along the embankment section to allow potential flood water to flow underneath the highway preventing flooding of the highway. Culvert internal dimensions are 2.5 m x 2.5 m x 0.4 m thick slabs and walls.

The design of the culverts complies with the Asian Development Bank Guidelines presented in Though elephants have been recorded utilizing underpasses less than 5 m high in Bhutan, underpasses heights of 6.5 to 7 meters are recommended by South Asia wildlife infrastructure guidelines (including ADB, Wildlife Institute of India, and Asian Elephant Transport Working Group).

Underpasses' openness affects how much light enters and how wildlife perceives the opposite side of the structure, and the distance across a structure has a significant impact on the cross-sectional size of an opening. Openness helps ungulates overcome their fear of enclosed places that provide a predation risk.

However, every species of wildlife has its preference for passage structure design, dimensions, and size. While this indicator is intuitive and can be easily calculated, it is discouraged to be used as the single factor for the technical design of the passage and instead local conditions and target species should be considered.

Yet some species groups or taxa exhibit general similarities in preference for passage structure size. Table 2 provides general recommended dimensions for four underpass size categories for Asian wildlife species ranging from small to very large. Wildlife's ability to navigate underpasses and overpasses is an important aspect for successful structure use. The utilization of even the best-designed structure may be limited or even prohibited if approaches are not adequately implemented. Ensure clear line-of-sight visibility and allow wildlife to view daylight through underpasses from opposite sides when approaching. For nocturnal species, light allowance structure is not necessary as the nighttime activities do not require bright light conditions.

Table 2 Wildlife Size Classes, Underpass Types and Recommended Dimensions (ADB, 2019) and will allow the passage of small sized animals.

The recommended spacing for the culverts by the ADB Guidelines is 1.4 km based on an estimated home range of small mammals of 2 km^2. Therefore, considering that small animals can also use the bridge crossings, it is estimated that three culvers should be sufficient: one culvert between Gelephu and Mau River, one between Taklai River and Langer River and one between Singye River and Tareythang.

Fencing and Funneling

Installation of fences is recommended to increase traffic safety and improve usage of underpasses by elephants and large mammals.

Fences should be installed at the following locations:

- From Gelephu to the west bank of Mau River: as the GMC plans to intensify urban development in this area, including the creation of a permanent wetland, measures should be taken to prevent elephants crossing the road. Fences should be installed along the southern boundary of the road alignment.
- Mau River east bank to Taklai River west bank: the GMC plans to develop this area for residential use between 2046 and 2065. To encourage elephants to avoid this area and use the dedicated elephant corridor on the east bank of Mau River, elephant-proof fencing should be installed along the southern boundary of the road.
- Taklai River west bank to Langer River east bank: The GMC envisions residential development in this area between 2066 and 2125. Elephant-proof fencing should be installed along the southern boundary of the road.
- Singye River to Tareythang: While the segment near the Singye River is relatively flat and occasionally crossed by elephants, the portion near Tareythang has steep slopes that limit elephant crossings. No additional fencing is recommended in this area, but support should be provided to farmers to install electric fences to protect their crops.

Fencing along the road should be installed in alignment with the guidelines of the Asian Elephant Transport Working Group and ADB Green Infrastructure Design for Transport Projects.

For the road sections from Gelephu to west bank of Mau River and for the Mau River east bank to Taklai River west bank it is recommended to install a combination of:

- Railway Track fences with four horizontal trackbar with separation less than 0.5 m to prevent elephants from getting trapped between the bars.
- Steel cable fences consisting of horizontal steel cable fence with multiple strands sustained by concrete or metal poles higher than 3m. Tension can be increased by adding small wooden poles.

For the road section from Taklai River west bank to Langer River east bank it is suggested:

- Horizontal electric fence.

The design of the fences will be completed at the detailed design stage and be adjusted to ensure compliance with national regulations on road safety. Road fencing costs are to be included in the design costs. The DoFPS have tested various fence designs for effectiveness as elephant barriers for local conditions, and findings will be incorporated into road fencing design.

5.1.2 Canopy Bridges (Arboreal Crossings)

Golden Langur are Endangered, and a critical habitat feature for the GT Road, and special provision is made for the installation of canopy bridges (also referred to as arboreal crossings).

The distance between the tree canopy on each side of the road will exceed the scope for development of natural canopy connectivity. Artificial canopy bridge structures are sufficiently solid to provide a sense of stability and are partially enclosed to prevent claustrophobia but provide protection from predators and humans while crossing. Jha *et al.* (2023) and Yap *et al.* (2022) provide guidance of canopy bridge designs based on studies in India and Malaysia respectively. Such structures are low cost and installed once heavy construction activities have completed. Appropriate signage must be installed, including emergency contact signage for the public to contact if any bridge-related accidents occur on the site.

During the baseline survey, Golden Langur were observed at the following two locations with mature trees that can provide connectivity through the canopy along the GT Road (ESIA Chapter 7.5.2):

- In proximity of the wastewater treatment plant (26°51'26.77"N, 90°30'11.30"E), and
- Close to Tareythang along the existing road (26°48'51.23"N, 90°34'38.67"E).

Canopy bridges are required in these two locations where Golden Langur were observed (**Error! Reference s ource not found.**). Up to three additional locations must be selected where Golden Langur occur in suitable habitat. A survey of Golden Langur occurrence is presented in Chapter 6.5 of this BMP.

Detailed locations will be established through field survey after the main road construction activities are completed. Factors like density of forests, stability and suitability of trees and known patterns of movement of langur will be used to identify the crossing locations.

5.1.3 Monitoring Wildlife Crossings

Responsibility of monitoring activities is under DoFPS. Video surveillance using motion-sensitive cameras will be installed at each road bridge, canopy bridge crossing and selected culverts to assess use by target species. Monitoring duration should cover construction and several years of operation or until statistically significant evidence of successful net gain in connectivity is demonstrated.

Citizen science can provide an effective and cost-efficient method of monitoring, and development of mechanism for the public to contribute data is encouraged, such as sightings of wildlife use of crossings, wildlife on the road, and the presence of road kills.

Section 6.5 presents requirements for wildlife movement research as part of the BMP Net Gain Strategy. Monitoring the use of crossings and data analysis will be integrated into those studies.

5.2 MINIMIZATION MEASURES TO ADDRESS PROJECT IMPACTS

This section presents the mitigation required to minimize project impacts, which excludes design features to avoid project impacts (Section 5.1). Mitigation to achieve net gain for natural and critical habitat features, as required by the BMP Objectives is provided in Chapter 6.

Mitigation measures related to biodiversity management are presented in Table 5, which are based on impact assessment provided by the ESIA. These mitigation measures have been listed according to the construction and operation phases and structured as follows:

- Planned activities as part of the GT Road development and associated impacts.
- Embedded controls and additional mitigation measures to mitigate the identified impacts.
- Targets and Indicators for each action to allow monitoring of efficacy.
- Responsible party for implementation of each action, including the monitoring of efficacy.

As biodiversity is typically a multi-disciplinary subject, the roles and responsibilities of the BMP involves different teams and expertise such as E&S, Biodiversity and Environmental.

The overall responsibility for each role is presented in Table 11.

TABLE 5 FRAMEWORK OF MITIGATION MEASURES TO ADDRESS PROJECT IMPACTS

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
	Preconstruction Activities - Terrestrial Biodiversity				
1	Loss of habitat Wildlife mortality	Conduct site walks prior to start of works to confirm no species of conservation significance are present within the working areas. If any are present and they are at risk of being harmed, then translocate these species to predetermined areas of suitable habitat. The PMU, NCD and senior DoFPS are to be notified if any priority species (Appendix A) are detected during site walk throughs.	No important conservation species lost during land preparation work	Evidence of predetermined sites for translocation. Construction reports	DoFPS Biodiversity Officer Construction supervision cost
2	Loss of habitat Wildlife mortality	Train all staff and contractors on the recognition of species of conservation significance and measures within the Wildlife Shepherding Protocol (Appendix C). Before tree cutting, a visual inspection should be conducted to identify wildlife, nests, or any species of conservation interest.	No species of conservation significance are killed during land preparation work	Training Plan, Construction reports	DoFPS Biodiversity Officer Training cost
3	Loss of habitat	Demarcate areas to be cleared in advance to avoid inadvertent/ accidental clearing. Monitor habitat clearance closely during construction to minimize this risk.	Zero area cleared over the planned footprint as established in the Site Plan	Work Protocol, Visual Inspection	Contractor HSE Manager Contractor costs
4	Loss of habitat	Prohibit clearing vegetation outside of designated areas by all Project staff, workers, all contractors, and personnel engaged in/or associated with the GT Road.	Prohibition of vegetation clearance outside designated area is included in the Worker's Code of Conduct	Work Protocol, visual inspection	Contractor HSE Manager Contractor costs

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
5	Loss of natural resources	Implement a worker and sub-contractor education program to inform personnel about the prohibition of collecting timber and non-timber forest products and the importance of natural habitat for the species of conservation significance.	100% of project personnel have received training	Training Plan, Work Protocol, Records and Reports	Contractor HSE Manager Contractor costs
6	Loss of natural resources	Checkpoints should be used to manage access and inspect vehicles for wood and timber products taken from areas of natural habitat within the GT Road impact area.	Checkpoint at the entrance of access roads is established and operating	Work Protocol, Records and Reports	Contractor HSE Manager Contractor costs
	Preconstruction Activities – Aquatic Biodiversity				
7	Aquatic species loss	Review of gabion design to ensure suitability for local landscapes and conditions.	Design reviewed and approved	Project Design	DoST E&S Manager Design cost
8	Aquatic species loss	Ensure drainage designs includes capacity for extreme, climate change-driven weather (e.g. 1:500 or 1:1000-year flood)	Design reviewed and approved	Project Design	DoST E&S Manager Design cost
9	Decreased fish migratory route	Assess and reduce risk factors to fish movement and survival in headwaters spawning and rearing areas.	Assessment is completed and additional mitigation measures identified, if required	Records and Reports, Visual Inspection	DoFPS Biodiversity Officer Construction supervision cost
	Construction Activities - Terrestrial Biodiversity				
10	Loss of terrestrial habitat Risk of Invasive Alien Species (IAS) spread	Before tree cutting, a visual inspection should be conducted by the DoFPS Biodiversity Officer to identify wildlife, nests, or any species of conservation interest. Machine operators involved	Revegetation of temporary disturbed areas	Construction reports	DoFPS Biodiversity Officer Contractor HSE Manager

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
		in vegetation clearing are to be under control of a supervision engineer. Rehabilitation/ reforestation of project disturbed sites using indigenous plant species to the extent possible.			Contractor costs
11	Increased risk of wildlife mortality	Check for the presence of fauna along the tracks, routes, or other working areas prior to starting any type of work in the area to minimize the likelihood of vehicular collision with these species, especially those that move slowly.	No species of conservation significance are killed	Records and Reports, Work Protocol	DoST E&S Field Officer Construction supervision cost
12	Increased risk of wildlife mortality	Install and maintain appropriate information signages at strategic wildlife crossings. The monitoring program proposed in the BMP will inform the location with high wildlife movement areas. It is suggested to use high-visibility, reflective materials for signage, ensuring they are easily seen in low-light conditions	Signage installation	Records and Reports, Work Protocol	DoST E&S Field Officer Design cost
13	Increased risk of wildlife mortality	Secure the eastern bank of the Mau River as natural passage to facilitate the movement of Asian Elephants. See also development of corridors in the Biodiversity Net Gain Strategy (Chapter 6).	Area identified, delimited and management in place	Project Design	DoST E&S Manager and DoFPS Biodiversity Officer NG Strategy cost
14	Increased risk of wildlife mortality	Install and maintain appropriate fencing where adjacent habitats support wildlife, especially the eastern and western part of the GT Road.	Establishment of wildlife fencing	BMP	DoST E&S Field Officer Design cost

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
15	Habitat degradation	Use fencing where minor project infrastructure (such as buildings) is adjacent to natural habitat patches.	Fences are installed	Project Design, Records and Reports	DoST E&S Manager Design cost
16	Dust emissions and IAS spread.	Implement a wheel wash system during construction to minimize dust dispersion and movement of organic materials	Wheel washes are installed and operative	Work Protocol	Contractor HSE Manager Contractor Cost
17	Dust emissions	Include water spraying of disturbed areas to minimize fugitive dust dispersion.	Protocol; for water spraying is established	Work Protocol	Contractor HSE Manager Contractor Cost
18	Risk of Illegal Wildlife Harvest & Trade	Educate the staff and stakeholders about Illegal Felling and Extraction of Trees and Illegal Extraction and Harvest of Non-Wood Forest Product regulated as per the Forest and Nature Conservation Rules and Regulations, 2023.	100% of project personnel have received training	Training Plan	Contractor HSE Manager Contractor Cost
19	Increased risk of IAS spread	Develop and implement an IAS Control Plan to restrict IAS introduction, proliferation and transmission. The IAS Management Plan will include monitoring, associated timeline, and the recommendation for invasive removal.	Invasive Alien Species Management Plan is established	Work Protocol, Records and Reports	DoST E&S Manager IAS control cost
20	Noise disturbance	Ensure that noise levels are minimized during nocturnal operations by using quieter equipment and scheduling noisy activities for daytime hours, to the extent possible. Seasonal movement patterns of wildlife must be considered for minimizing nocturnal noise levels.	No high noise generating activities performed during nighttime	Work Protocol	DoST E&S Manager Construction supervision cost

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
21	Lighting disturbance	Use timers for permanent and temporary lighting where possible to avoid unnecessary light at night-time. Cowls to deflect light towards the intended target, matt screens and directional lighting will be used to minimize artificial lighting of natural habitat areas.	Equipment installed as per plan	Work Protocol	Contractor HSE Manager Contractor Cost
22	Lighting disturbance	For artificial lighting at night, avoid excessive use and ensure light sources are directed only to the site management area, using matt screens to prevent light spillage into external areas.	Work Protocol	DoST E&S Manager	DoST E&S Manager Construction supervision cost
23	Wildlife disturbance	Train all staff and contractors on the threatened species that may be encountered during construction and operation, including measures related to fauna rescue outlined within the Wildlife Shepherding Protocol (Appendix C).	100% staff training recorded	Work Protocol	DoST E&S Field Officer and DoFPS Biodiversity Officer Training costs
24	Wildlife disturbance	Check for fauna along the tracks, routes, or other working areas before starting any type of work in the area to minimize wildlife road kills.	Monitoring log	Work Protocol, visual inspection	DoST E&S Field Officer Construction supervision cost
25	Wildlife disturbance	Minimize nighttime construction activities	Minimized wildlife disturbance	Work Protocol, Project Design	DoST E&S Manager Construction supervision cost
26	Wildlife disturbance	Implement speed limits during construction (30 km per hour) for vehicles to reduce wildlife road kills.	Speed limit implemented	Work Protocol, Project Design	DoST E&S Manager Construction supervision cost

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
27	Wildlife disturbance	Construct animal passages (crossing paths/ underpasses) at important animal crossings sites along the roads. (Electric) fences are recommended by the communities.	Animal passages and electric fences established	Project Design	DoST E&S Manager Design cost
28	Wildlife disturbance	Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.	Blockages cleared	Work Protocol and Site Inspection	DoST E&S Field Officer Construction supervision cost
29	Wildlife disturbance	Avoid construction activities at night to the extent possible, particularly in areas near known wildlife movement routes, to reduce encounters with nocturnal wildlife. If nightwork is necessary, ensure there is on-call support for any potential wildlife conflicts, especially in bridge construction zones	Protocol for night works.	HWC records	DoST E&S Manager Construction supervision cost
	Construction Activities – Aquatic Biodiversity				
30	Aquatic habitat degradation	As far as practicable, limit in-river activities (such as earthworks and material extraction) to the dry seasons and allow sufficient time for stabilization of any disturbed areas along new road segments and at bridge crossings before the wet season.	Work schedule reviewed and approved by DoST	Work Protocol, Project Design	DoST E&S Manager Construction supervision cost
31	Aquatic species loss	Stabilize areas disturbed by road and bridge construction by appropriate compaction, use of geotextile/erosion blankets, silt fencing, and reclamation using native species of grasses, shrubs and trees to establish ground cover vegetation and stabilization	100% of disturbed land is rehabilitated	Project Design, Records and Reports	DoST E&S Field Officer Construction supervision cost

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
32	Aquatic species loss	Ensure gabion basket walls allow for continuous flow and accessibility to migratory species.	No blockage of migratory fish during construction	Project Design	DoST E&S Manager Construction supervision cost
33	Aquatic species loss	Timing of intensive bridge construction should avoid peak spawning seasons of Golden Mahseer (monsoon) to the extent possible.	Work Protocol	Construction reports	DoST E&S Manager Construction supervision cost
	Construction Activities - Ecosystem Services				
34	Water abstraction	Limit sourcing water from nearby rivers and streams used by local villages for potable water (particularly near the Tareythang area).	No water that is used by local villages as potable water is used or degraded	Work Protocol	DoST E&S Manager Construction supervision cost
35	Sedimentation	Ensure proper erosion and sediment control measures are implemented.	Mitigation measures implemented as per ESMP	Project Design, Records and Reports	DoST E&S Manager Construction supervision cost
36	Water abstraction	Provide safe potable water to households relying on water sources downstream of construction activities, via extending of the GT Road water system, well installation or piping water from upstream locations.	No water that is used by local villages as potable water is used or degraded	Work Protocol	DoST E&S Manager Social development costs
	Operations Activities - Terrestrial Biodiversity				
37	Increased risk of wildlife mortality	Install and maintain appropriate signage at strategic wildlife crossings to provide continued education of road users and communities.	Road signage	Project Design, visual inspection	DoST E&S Field Officer Road maintenance cost

ID	Impact	Project Minimization Measures	Targets/Indicators	Verification	Responsibility Budget type
38	Increased risk of wildlife mortality	Monitor use of bridge underpass by elephants, use of canopy bridges by Gee's Golden Langur, and culvert usage by lesser wildlife including Tricarinate Hill Turtles. Implement monitoring regime and implement actions to address concerns	Monitoring reports	Monitoring campaign, records and reports	DoST E&S Manager and DoFPS NG Strategy cost
39	Habitat fragmentation	Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.	Any blockage is removed	Work Protocol	DoST E&S Manager Road maintenance cost
40	Increased risk of wildlife mortality	Collect and record carcasses due to roadkill.	Work Protocol	Roadkill records	DoST E&S Field Officer and DoFPS Biodiversity Officer Operations supervision cost

6 BIODIVERSITY NET GAIN STRATEGY

6.1 NET GAIN REQUIREMENTS

Based on the Critical Habitat Assessment (CHA) and Environmental and Social Impact Assessment (ESIA), it was ascertained that:

- The GT Road development would result in a loss of 0.19 km2 of terrestrial habitat for the construction of segments 1-9 and the widening of segment 10, excluding the area of the existing segment. This will result in loss of 0.07 km² of natural habitat plus an additional 0.01 km² loss from construction camps and work area. Net Gain outcomes will need to be demonstrated as compensation.
- The CHA has identified Asian Elephant, the Gee's Golden Langur and connectivity of their habitats / corridors as critical habitat features to be considered for Net Gain outcomes.

The DoFPS has developed the Elephant Conservation Action Plan for Bhutan 2018-2028 (ECAPB), which provides guidance on management of issues involving elephants. The ECAPB serves as a guiding document for development of the Net Gain Strategy within this BMP, and Table 6 presents an outline of the ECAPB as an introduction to this chapter.

TABLE 6 VISION, GOALS, OBJECTIVES AND APPROACHES OF THE ELEPHANT CONSERVATION ACTION PLAN FOR BHUTAN 2018-2028

Outline of the Elephant Conservation Action Plan for Bhutan 2018-2028, developed by NCD of the DoFPS, Ministry of Agriculture and Forests, RGoB

VISION: A viable population of elephants in coexistence with the people in the landscape.

GOAL: To maintain a viable population of elephants in an improved habitat with reduced human-elephant conflict.

OBJECTIVES AND APPROACHES:

1. To prevent habitat loss and improve the existing habitat condition

Achieved through zonation to reduce loss from land use change, degraded critical habitats will be restored and managed. Elephant migratory routes will be mapped, delineated and managed to ensure habitat connectivity.

2. Reduce human elephant conflict through adoption of science based and community driven approaches

Achieved through adoption of science and community-based approaches. Successful preventive and mitigation measures will be upscaled and community protection groups will be strengthened. Ex-gratia schemes and incentives will be provided to increase tolerance of communities to elephants and the possibility of translocating the problem animals will be explored.

3. Increase knowledge base on elephant and its habitat

Achieved through ecological and behavioral studies to understand, including population survey, radiotelemetry and vulnerability to climate change.

4. Improve coordination among stakeholders including trans-boundary partners

Achieved through transboundary engagement, exchange programs, synchronized patrolling and species monitoring works. Collaboration with other stakeholders involved in policy and planning to grassroots and other line agencies will be enhanced.

5. Strengthen institutional capacity and human resource development

Achieved through strengthening institutional and human capacity, national elephant conservation programs will be instituted both at national and field level. A cadre of professionals will be trained in various aspects of elephant conservation and management.

6. Identify and address the current and emerging disease

Disease outbreak and transmission will be prevented and controlled through adoption of international guidelines and protocols including enlisting of potential diseases, staff training and disease surveillance.

7. Prevent poaching and illegal trade of elephant parts and products

Poaching and illegal trade will be prevented through implementing a zero poaching strategy and MIKE (Monitoring Illegal Killing of Elephants) program in protected areas and forest divisions. The provision on elephants in the National Forest Policy and Forest and Nature Conservation Act of Bhutan 1995 will be harmonized.

8. Improved management of captive elephants

Applicable to a small group of captive elephants, but their health will be monitored regularly following standard protocols. Proper housing and diet for the elephants and training and welfare of the mahouts will be accounted for.

This Biodiversity Net Gain Strategy focuses on the following components:

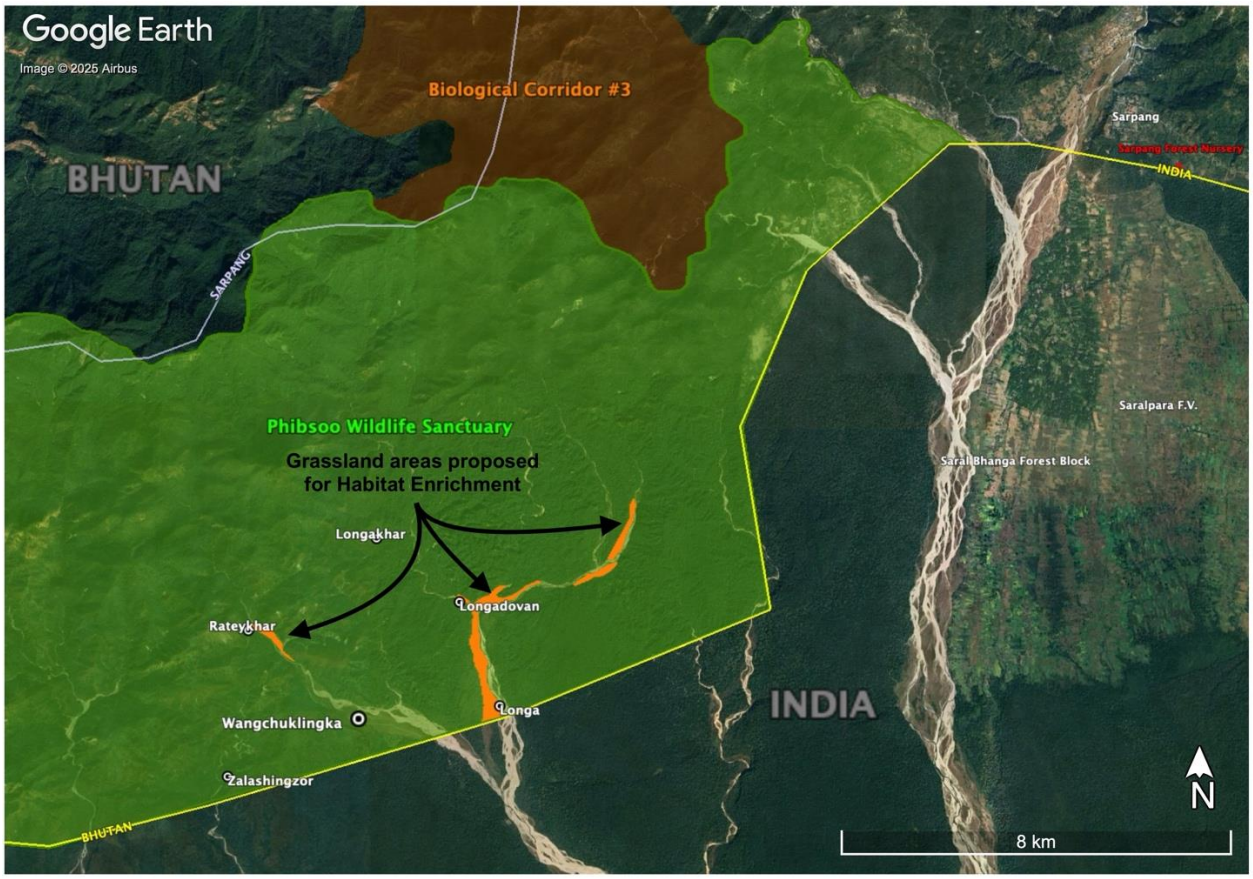
1. Habitat enrichment program
2. Safeguarding future elephant movement corridors
3. Promoting human wildlife coexistence
4. Wildlife movement research
5. Partnerships and capacity building

6.2 HABITAT ENRICHMENT PROGRAM

Large areas have become infested with Invasive Alien Species (IAS, comprising *Chromolaena odorata*, *Lantana camara*, *Achyranthes aspera*, *Ageratum conyzoides* and other invasive plants) leading to land degradation and a severe drop in the biological diversity of habitats. Severe IAS infestations exist within legally protected areas of Phibsoo Wildlife Sanctuary (PWS) and Royal Manas National Park (RMNP), and particularly within grassland habitats which formerly provided important seasonal forage for Asian elephant and other large herbivores and wildlife populations have diminished. Herbivores are the primary food source for predators, and the ecology of the protected areas are affected. DoFPS officials have stated the decline in land productivity outside of protected areas could be leading to elephants seeking alternative food sources such as cultivated crops, resulting to increased Human-Elephant Conflict (HEC). This concept was raised during public consultation conducted for the PWS ESMP (2021).

A pilot habitat enrichment program, referred to as "Improvement of Lowland Grassland" is being implemented in the PWS with support from Bhutan for Life with a budget of Nu. 1,000,000 (USD 14,700) as outlined in the PWS ESMP (2021). This program involves mowing the vegetation in grassland habitat to suppress shrub-growing IAS. The protected areas lack good roads and bridges and are inaccessible by vehicle during the rainy (monsoon) season which means some vegetation cutting needs to be done manually. Areas supporting healthy stands of tall growing *Themeda* grass are protected from grazing so that the grasses can mature, and seed can be harvested in large quantities. This fresh grass seed is distributed over the areas of cut vegetation to reinforce the growth of palatable grasses and improve the habitat. This program is repeated every year for five years, over which time the grassland is expected to be sufficiently reinforced to naturally suppress IAS infestation. This habitat enrichment program will be expanded within the PWS, RMNP and within elephant movement corridors associated with the GT Road.

FIGURE 3 GRASSLANDS WITHIN PHIBSOO WILDLIFE SANCTUARY AVAILABLE FOR HABITAT ENRICHMENT



This habitat enrichment is labor intensive. DoFPS have proposed an area of 150 ha for habitat enrichment based on available capacity and anticipated budget availability. Habitat enrichment will be conducted in grassland habitats within PWS (Figure 3) and RMNP, and in Riparian Rangeland (Figure 2; with areas provided in Appendix B) within elephant corridors outside the protected areas. The available habitat exceeds the proposed 150 ha (Figure 3 identifies 195 acres of available grassland within PWS).

Rehabilitation of mineral licks and waterholes is proposed within the protected areas to improve the attractiveness of enriched habitats to wildlife during the dry season. Minor road works may also be necessary.

The habitat enrichment program presents both benefits and risks, as summarized in Table 7, but offers a suitable approach to support the conservation aims and effective management of protected areas, also to achieve Net Gain outcomes above and beyond the loss of natural habitat associated with construction of the GT Road. However, the program should not be interpreted as a solution to resolving HEC. The DoFPS have the capacity to implement their current program, but support will be needed to upscale activities to a level that sufficiently compensates for the loss of natural habitat.

TABLE 7 BENEFITS AND POTENTIAL RISKS OF THE HABITAT ENRICHMENT PROGRAM

Benefits	**Potential Risks**
• Habitat enrichment activities are cost effective and easily implemented • Measures are considered effective for improving habitat quality for herbivores, which will boost predator populations and improve multiple ecological functions in these areas. • Controlling IAS in protected areas is a suitable Net Gain action to meet ESS6 requirements to address loss of natural habitat. • Abundant IAS degraded grassland is available for habitat enrichment.	• It is a pilot program, activities have started but there is no complete worked example. • A rebound of IAS is possible after completion of the proposed 5-year program. Successful IAS suppression may require ongoing support. The ACCESS funding is linked to the road construction and a once-off 5-year habitat enrichment program is envisaged. • The program might seasonally attract elephants but is unlikely to change elephant distribution patterns and is not expected to significantly draw elephants away from areas of human-elephant conflict. This mitigation does not address that impact.

Activities for Habitat Enrichment

- Labor costs for manual vegetation clearing, harvesting grass seed and additional IAS suppression.
- Purchase of equipment and relevant PPE for vegetation clearing.
- Equipment hires and operating costs for mechanized vegetation clearing.
- Driver training and necessary capacity building.
- Rehabilitation of waterholes for wildlife in the protected areas.
- Supervision and monitoring of activities.

6.3 SAFEGUARDING FUTURE ELEPHANT MOVEMENT CORRIDORS

The Gelephu and surrounding gewogs are located between two protected areas that support significant populations of elephants within Bhutan. There is a legally gazetted wildlife corridor (Biological Corridor #3) connecting protected areas but the terrain through which it passes is too mountainous to sustain

elephant movement. Results of elephant tracking have revealed they avoid Biological Corridor #3. The project AoA is therefore important for sustaining elephant movement between these protected areas. Construction of the GT Road will disrupt the movement of elephants within the Gelephu area, and several large bridges have been designed to accommodate elephant movement beneath the GT Road. These bridges could create bottlenecks creating local hotspots for elephant activity potentially with agitated behavior and increased levels of HEC. A cumulative impact associated with development of the GMC (Gelephu Mindfulness City) could limit the movement of elephants beyond the GT Road which would exacerbate the effect of the bottlenecks of elephant activity. A network of future movement corridors needs to be established to safeguard and facilitate elephant movements beyond the road alignment to encourage them to disperse and resume their normal behavior.

Safeguarding movement corridors needs to integrate with the development plan of the GMC which is still in development and planning of a greater corridor network cannot be achieved at present. The Sarpang, Tsirang, and Zhemgang Dzongkhags Regional Development Plan have issued a report of the Bhutan Elephant Corridor Project, that provides a draft map of elephant movement corridors and overlaps the western side of the GT Road area. Some corridor development can be planned and implemented near the road alignment to facilitate elephant movements through the proposed bridge crossings, for example the East Bank of the Mau River. Securing future elephant movement corridors (under this BMP) will focus on the area within an approximately 1 km buffer of the road network, but the extent of securing such areas needs to be determined for each crossing facility relative to the surrounding landscape and exacerbation potential for HEC. No formula exists to determine this extent, and the experience of DoFPS staff is needed to assess each situation on a case-by-case basis in consultation with communities, DoST, and prevailing GMC planning initiatives. Agriculture and human settlement in the vicinity of these elephant movement corridors will need to be secured to protect them from adverse effects of HEC.

Activities for safeguarding future elephant movement corridors

- Local land use planning to retain natural habitat.
- Fencing to protect established settlements and associated agriculture (excludes elephant-proof fencing and signage of the GT Road included in the road design).
- Community engagement and awareness raising.
- Engagement and workshopping between DoST, DoFPS and town planners.

6.4 PROMOTING HUMAN WILDLIFE COEXISTENCE

Many people live within Gelephu and surrounding areas/gewogs with established agricultural fields and orchards. There are also many Asian elephants sharing this space. ERM surveys observed two herds totaling 37 elephants, but DoFPS staff estimate there are over 100 elephants residing there. The presence of people and elephants leads to conflict as the elephants regularly raid herbaceous and tree crops, destroy reticulation systems to access water, damage to houses has been recorded and approximately three human fatalities occur each year caused by elephants. The Nature Conservation Division of DoFPS provides an analysis of damage (NCD, 2024). Analysis is also provided by Tshering et al. (2024). Other wildlife, such as wild boars and peacocks also present lesser sources of conflict.

Fencing is widely used to keep elephants away from houses, crops and fruit trees. DoFPS have experimented with various fencing designs and established that combined electrified and chain link fencing with high, middle and low electrified wires is an effective barrier to elephants. Fences require a solid base beneath the wires to prevent animals from passing underneath. Wooden fence posts are not long lasting in the high rainfall environment, while metal fence posts cause leakage of electrical current. Good insulators are therefore needed, and wires need to be kept clear of vegetation. This installation and maintenance of effective fences is costly, and beyond the means of most residents in Gelephu and surrounding gewogs. Unfortunately, many inadequate fences were observed in the area, which elephants easily overcome, and which encourage the elephants to not respect fences. Many people light small fires at night around their fields to deter elephants but do not effectively exclude them.

DoFPS have established a command center and Quick Response Teams (QRT) to respond to active elephant raiding incidents. The QRT chase the elephants away and investigate incidents. Elephants are most active after dark, and most HEC incidents happen at night (supported by Tshering et al. 2024). Vegetation is dense in the area and elephants are not easily seen at night which easily results in them being unintentionally approached too closely. Elephants can be aggressive at night and most human fatalities occur during the hours of darkness. QRT tasks present a serious safety risk to DoFPS staff and community members involved. QRT activities therefore require trained and disciplined staff with a clear mandate of what their task involves. QRT need to be well equipped with appropriate tools, reliable vehicles, strong torches, uniforms that include waterproof gear and night visibility clothing, and effective communication within the team and the central command post. Enough trained staff are required to sustain a rotational schedule of night duties. QRT activities are the responsibility of DoFPS but require a good collaboration with communities, police, military and judicial services in the GT Road area and surroundings.

The ECAPB acknowledges, within its second objective to reduce HEC, the possibility of translocating the problem animals needs to be explored. Such actions cannot be supported under this BMP, however elephants involved in repeated and/or severe HEC incidents need to be identified. The use of recreational paintball guns has been tested in Africa as a harmless method to provide temporary markings on elephants at night so that they can be more easily identified the next day. Caution is needed to avoid increasing the aggressive behavior of elephants.

Construction of the GT Road could exacerbate HEC and QRT capacity needs to be scaled up and supported in the Gelephu area. QRT actions address the symptoms of HEC and do not resolve the underlying causes of the problem. A budget is presented for upscaling and a 5-year operational period, however the need for QRT activities will continue and discussion is required between DoST, DoFPS and other stakeholders.

Address Risks of Poaching and Illegal Wildlife Trade

The ECAPB includes an objective to ‘Prevent poaching and illegal trade of elephant parts and products’ but also states that poaching incidents and retaliatory killing of elephants in Bhutan is insignificant. However, foreign workers involved in construction activities may increase the poaching risk and potential illegal wildlife trade (IWT). The World Bank Good Practice Note (GPN) on “Reducing Illegal Trade of Biodiversity & Living Natural Resources” provides practical guidance to projects to address the effects of

IWT. The Project Management Unit (PMU) is required to be familiar with this GPN and to implement its recommendations as appropriate to the GT Road area. Some of the key actions include:

- A project code of conduct needs to be implemented that prohibits all workers from hunting, wildlife harvest or any form of trade in wildlife products from the area.
- Conduct appropriate risk assessments to determine the potential for illegal trade/wildlife crime and apply measures to detect and monitor the existence of such risks.
- Report and track incidences of illegal trade, project grievances, independent monitoring and informal discussions with Government authorities and civil society organizations.
- Provide anonymous and safe reporting mechanisms that are accessible to all (staff, contract workers, authorities and communities), and promote awareness of these mechanisms.
- Ensure that actions against illegal trade are appropriately communicated to project workers, communities and other stakeholders as this encourages further reports of illegal activity.
- The PMU needs to partner with DoFPS and local conservation organizations so that activities are coordinated with conservation efforts and initiatives in the nearby protected areas.

Challenges to addressing Human-Elephant Conflict

There are many challenges associated with addressing HEC and resolving the issue is beyond the scope of this BMP. Some of the challenges include:

- There is inadequate data on the dynamics of the population of elephants. Elephants exist in the GT Road area as part of a large transboundary population that extends into India, with the larger portion of the population in India. The tall dense forest in which they occur is a challenging habitat for counting elephants. As a result, the size, geographic extent and an increasing or decreasing population trend is not known but is essential for planning future interventions to manage elephants and HEC. A single elephant census for Bhutan was conducted in 2015, but multiple coordinated census counts are required across the transboundary population to understand the population trends.
- There is inadequate transboundary coordination between Bhutan and India, as noted in the ECAPB. The Bhutan-India border is patrolled by the military and currently there is no collaboration between DoFPS and the equivalent conservation authority in India.
- The approaches to addressing HEC in Bhutan and India are different. The Buddhist culture of Bhutan is tolerant towards animals and elephants feature prominently in the culture. DoFPS staff suspect there is an influx of elephants into Bhutan from India to escape the reportedly violent approaches they are exposed to there in response to HEC.
- HEC could be exacerbated by development of the GMC and other developments within the extent of the transboundary population. HEC is therefore a cumulative effect that needs a coordinated approach.
- Many projects in other parts of the world have experienced challenges in addressing HEC, for example Botswana which supports a large population of African Elephants. Elephants are intelligent animals with strong social bonds that last a lifetime. Elephants are long lived with a

longevity like humans, and disruptions to their social bonds lead to long-term problems, as with humans. Elephants deserve the empathy they get from many people and feature strongly in many cultural traditions, as is the case in Buddhism and Hinduism in Bhutan. Problems pertaining to HEC are not easily solved in the short term.

The GT Road Project can address the indirect impacts associated with HEC but resolving the causes of HEC and achieving a harmonious Human-Elephant Coexistence is beyond the scope of this BMP.

Actions to address Human-Elephant Conflict

- Provision of QRT equipment and operational support, including a limited number of appropriate vehicles.
- Upscaling of command center facilities and communication equipment to provide an early warning system.
- Collaboration and facilitation with police, military, and judicial services.
- Increased community engagement relating to HEC.
- Establish an anonymous reporting mechanism regarding illegal activities against elephants or any forms of illegal wildlife trade.
- Support towards fencing of fields and settlements near HEC hotspots caused by project construction.
- Limited compensation for HEC incidents that can be attributed to project construction.
- Develop community guidelines on safe practices to avoid dangerous incidents with elephants.
- Develop community guidance on effective fencing designs, explore potential sources of funding and encourage upgrading of fences in the GT Road area.
- Engage relevant authorities to motivate for the establishment of crop insurance schemes for farmers. Although supporting crop insurance is beyond the scope of this BMP.
- Participate in a cumulative impact assessment to investigate solutions to address HEC.

6.5 WILDLIFE MOVEMENT RESEARCH

There is a shortage of data on local wildlife populations and their movements, but it is needed to guide decisions, future planning and to monitor the effectiveness of mitigation. Studies are proposed to investigate the movements of Asian elephants and Golden Langur.

An understanding of elephant movements will provide insight into their population dynamics and address some of the knowledge gaps described in the ECAPB. GPS tracking of two elephants started in October 2024 supported under the ACCESS PPA. The DoFPS proposal is to fit tracking collars to at least 10 elephants and maintain these for a five-year period (depending on available battery capacity). Adult elephants representative of both sexes, different social groups and present in different parts of Gelephu and surrounding gewogs will be selected for collaring. India conservation authorities need to be engaged in the design, implementation and subsequent analysis, as collared animals are expected to venture across

the extent of the transboundary population. The camera trapping study by NCD and Divisional Forestry Office (2024) has revealed the importance of detailed elephant tracking data. The study design needs to be optimized prior to implementation to maximize the benefit from results. Motion-sensitive cameras will be mounted on bridges with capacity for elephant underpasses that will support the analysis of elephant and other wildlife movements.

Golden Langur are unlikely to venture long distances, and transboundary movements are not expected to be significant. Capturing and handling Golden Langur to fit collars or implants presents a health and safety risk to these endangered primates and should be avoided. Instead, groups of these monkeys are easily observed with binoculars and plotting visual observations along with counts of group size and composition will indicate their home range and extent of movement. Motion-sensitive cameras fitted to overpass structures designed to allow Langur crossings will contribute towards the study of Langur movement and assess the effectiveness of crossing facilities.

Wildlife movement research needs to integrate with monitoring the use of wildlife crossings (Section 5.1.3). Section 6.9 proposes that this research contributes towards measurement of Net Gain and Chapter 10 outlines next steps for a specialist workshop prior to July 2025 to plan the implementation of these studies.

Activities for Wildlife Research

- Specialist workshop to plan studies prior to Project Effectiveness
- Collaring of elephants with veterinary and logistical support.
- Operational support to monitoring and maintaining collars on elephants.
- Involvement of the relevant India wildlife conservation authorities.
- Observational monitoring of Golden Langur movement.
- Data analysis and reporting.

6.6 PARTNERSHIPS AND CAPACITY BUILDING

Implementation of this Net Gain Strategy will require partnership between DoST and DoFPS staff, with collaboration from communities, police, military, judicial services, GMC planning teams, and conservation NGOs. Capacity building and upscaling of relevant office facilities will be required. Cross border collaboration is also needed, which will require facilitation by higher government authorities.

Partnership and Capacity Building Activities

- Capacity building and training of DoST and DoFPS officers, also key community members.
- Provision of office and IT equipment
- Facilitation support such as workshops and cross-border travel

6.7 IMPLEMENTATION OF THE NET GAIN STRATEGY

Table 8 presents an implementation framework for the Net Gain Strategy and identifies the actions, implementation schedule and responsible parties. Indicators and means of verification are provided to guide the monitoring of actions.

TABLE 8 IMPLEMENTATION FRAMEWORK FOR THE NET GAIN STRATEGY

NG Strategy Component	Supported Actions	Implementation Schedule	Indicators and Means of Verification	Responsible Parties
1. Habitat Enrichment Program	• Labor costs for vegetation clearing, harvesting grass seed and additional IAS suppression. • Equipment and PPE procurement for vegetation clearing. • Equipment hires and operating costs for mechanized vegetation clearing. • Driver training and necessary capacity building. • Supervision and monitoring of activities.	Implemented annually over 5-year period.	• Establishment of palatable *Themeda* grass, verified by field survey. • Monitor use of habitat enriched areas by elephant. • Dominance of IAS in enriched habitat, verified by field survey. • Field reports submitted by supervising officers.	DoFPS
2. Safeguarding Future Elephant Movement Corridors	• Local land use planning to retain natural habitat. • Fencing to protect established settlements and associated agriculture (excludes fencing and signage included in the road design). • Community engagement and awareness raising. • Engagement and workshopping between DoST, DoFPS, GMC and town planners.	Implemented on an ongoing basis over 5-year period.	• Land use plans with approval by affected community members. • Minutes of meetings and workshop proceedings.	GMC DoST DoFPS
3. Promoting Human Wildlife Coexistence	• Provision of QRT equipment and operational support, including a limited number of appropriate vehicles. • Upscaling of command center facilities and communication equipment to provide an early warning system. • Collaboration and facilitation with police, military and judicial services. • Increased community engagement relating to HEC by DoST and DoFPS. • Establish an anonymous reporting mechanism regarding illegal activities against elephants or any illegal wildlife trade.	Implemented on an ongoing basis over 5-year period.	• QRT operational reports • Procurement reports approved by PMU • IWT anonymous reporting mechanism. • Fencing plans and evidence of implementation • Compensation claims and evidence of payment. • Community accessible guidelines on safe practices when encountering wildlife.	DoFPS

NG Strategy Component	Supported Actions	Implementation Schedule	Indicators and Means of Verification	Responsible Parties
	• Support towards fencing near HEC hotspots caused by project construction. • Develop community guidelines on safe practices to avoid dangerous incidents with elephants and other wildlife. • Develop community guidance on effective fencing designs, explore potential sources of funding and encourage upgrading of fences. • Training and capacity building for long-term fence maintenance support • Engage relevant authorities to motivate for crop insurance schemes for farmers. • Participate in a cumulative impact assessment to investigate solutions to address HEC.		• Community accessible guidance on fencing.	
4. Wildlife Movement Research	• Specialist workshop to plan the required studies prior to Project Effectiveness. • Collaring at least 10 elephants with veterinary and logistical support • Operational support to monitoring and maintaining collars on elephants • Involvement of the relevant India wildlife conservation authorities • Observational monitoring of Golden Langur movement • Data analysis and reporting	Implemented over 5-year period.	Scientific research reports on wildlife movement, including: • PMU approved ToR for researchers, • Inception reports and regular progress reports, • Analysis results and recommendations for wildlife management	NCD of the DoFPS
5. Partnerships and Capacity Building	Capacity building and training of DoST and DoFPS officers Office and IT equipment procurement Facilitation support, workshops and cross-border travel	Implemented over 5-year period.	• Evidence of staff training • PMU approved procurement reports • Meeting & workshop proceedings	DoST DoFPS

6.8 PROVISIONAL ANALYSIS OF NET GAIN ACHIEVEMENT

6.8.1 Net Gain for Loss of Natural Habitat

ESS6 requires mitigation measures that demonstrate Net Gain for loss of natural habitat and Net Gain for critical habitat features impacted by the GT Road.

The Impact assessment (ESIA Chapter 10.1.2) estimates that 0.08 km² of natural habitat will be lost through construction of the GT Road and support facilities. The habitat enrichment program applied by DoFPS will enhance 150 ha (1.5 km²) of heavily IAS infested grassland within the PWS, RMNP, and within provisional corridors. The habitat enrichment program thus exceeds the area of impact by a ratio of 1:7.5 and is considered sufficient to achieve Net Gain outcomes that compensate for the loss of natural habitat.

The habitat enrichment program will also contribute towards enhancing the conservation aims and effective management of the respective protected areas, as required by ESS6.

6.8.2 Net Gain for Asian Elephant

Asian Elephants are a critical habitat feature, and their movement patterns will be impacted by development of the GT Road. Several bridges will provide underpass facilities enabling elephant movements and the road will be fenced to keep elephants safe from road kills (also to protect road users), and no direct loss of elephants is expected. Indirect impacts could occur as disrupted movement patterns may create bottlenecks for elephant movement, resulting in hotspots of elephant density which creates an unavoidable risk of increased HEC incidents. Measures are proposed to address this risk through safeguarding future movement corridors, fencing settlements and crops and improved QRT capacity, but quantifying the indirect residual impact on elephants is not possible. The affected elephants will benefit from habitat enrichment within the provisional corridors, and the greater elephant population will benefit from enrichment of habitats in the adjacent protected areas. A Net Gain benefit for elephants is therefore expected to be achieved. Project mitigation will contribute towards six objectives of the ECAPB (Table 9) which further supports the achievement of Net Gain.

TABLE 9 ALIGNMENT BETWEEN PROJECT MITIGATION AND OBJECTIVES OF THE ELEPHANT CONSERVATION ACTION PLAN FOR BHUTAN 2018-2028 (ECAPB)

ECAPB Objectives	**Relevant Mitigation in this BMP**
To prevent habitat loss and improve the existing habitat condition.	• Bridge designs to accommodate elephant movement • Habitat enrichment program in PWS, RMNP and future corridors
Reduce human elephant conflict through adoption of science based and community driven approaches.	• Improved QRT capacity • Fencing of settlements and crops
Increase knowledge base on elephant and its habitat.	• Elephant movement study

ECAPB Objectives	Relevant Mitigation in this BMP
Improve coordination among stakeholders including trans-boundary partners.	• Support for transboundary collaboration
Strengthen institutional capacity and human resource development.	• Support towards partnerships and capacity building
Identify and address the current and emerging disease	Not relevant
Prevent poaching and illegal trade of elephant parts and products.	• Activities to combat illegal wildlife trade
Improved management of captive elephants.	Not relevant

Mitigation is presented to address the HEC impact associated with development of the GT Road. However, this conflict is a widespread problem within the Gelephu area and has a transboundary component. Addressing HEC effectively over the greater landscape is beyond the scope of the ACCESS Bhutan Project. The following suggestions are proposed for addressing HEC under a different financing instrument:

- Previous consultation on community perceptions towards coexistence with elephants should be expanded, with an emphasis on cultural perceptions and acceptance of available mitigation measures.
- Develop a better understanding of elephant movements are their areas of occupancy in Gelephu and surrounding gewogs.
- Wider consultation is required with elephant experts.
- Review of elephant management practices in India.
- Transboundary workshops for elephant population monitoring and development of a transboundary elephant conservation management plan.
- Testing of HWC approaches applied elsewhere (such as improved fencing techniques, use of chili deterrents, review of supply chains).
- Review and expansion of land use planning for corridor development.
- Consider fencing of protected areas near settlement areas.
- Elephant population control (likely too controversial to be accepted).
- Capacity building of conservation authorities.
- Conduct a strategic and environmental assessment of the GMC Master Plan to deal with cumulative and transboundary impact that require higher levels of collaboration and cooperation.

6.8.3 Net Gain for Golden Langur

Golden Langur will be impacted through fragmentation of their habitat, which will be mitigated through installation of overhead canopy crossings at relatively low cost. No significant residual impact is expected

which avoids the need to demonstrate Net Gain measures, although the effectiveness of crossings will need to be monitored. The proposed study on Golden Langur will assess their movement patterns and determine the effectiveness of crossings. Adaptive management measures to address design changes or installation of additional crossing structures must be applied if there is insufficient evidence of installed crossings by the Golden Langur.

6.9 MEASUREMENT OF NET GAIN

The provisional analysis provided in Section 6.8 suggests that Net Gain is feasible for natural and critical habitat features. However, the expected benefits must be measured and analyzed to demonstrate the achievement of Net Gain. Measurement of Net Gain benefits must be based on metrics that need to be formulated relevant to the respective natural and critical habitat feature.

This BMP remains a draft, and formulation of Net Gain metrics needs to be developed through consultation and workshopping with biodiversity specialists familiar with the project situation (see Chapter 10).

Section 6.5 outlines the requirement for wildlife movement research focused on Asian Elephant and Golden Langur, and Section 5.1.3 requires the monitoring the usage of wildlife crossings to be integrated into this research. These studies can be designed to generate data that can serve as suitable Net Gain metrics. Table 10 proposes three approaches for establishment of net gain metrics but require further development if accepted by relevant biodiversity specialists.

TABLE 10 PROPOSED APPROACHES TO ESTABLISHING NET GAIN METRICS

Biodiversity Component	**Proposed Approach to Net Gain Metrics**
Net Gain for natural habitats	Net Gain needs to be achieved for the habitat, which encompasses all forms of biodiversity supported there. This BMP outlines a habitat enrichment program to achieve Net Gain. Healthy ecosystems support multiple intricate food chains, and the presence of the upper trophic levels of food chains (predators) suggests the presence of a functional ecosystem at the lower trophic levels and provide a good indicator of ecosystem functionality. Predators tend to be vocal creatures, and their presence can be determined acoustically. Low-cost methods are established for monitoring bird calls and can also be applied to mammalian predators. Acoustic devices can be installed in the vicinity of habitat enrichment programs to monitor the increased diversity of predators in response to the program. Monitoring of large herbivore use of enrichment areas should also be monitored, which can be conducted using transects to measure evidence of their presence (i.e. tracks and feces).

Biodiversity Component	Proposed Approach to Net Gain Metrics
	Monitoring needs to start prior to implementing the habitat enrichment program to measure the baseline state to be able to assess the level of change.
Net Gain for Asian Elephant	The elephant population size within the AoA is unknown due to the dense forests they inhabit and their transboundary population. Change in elephant population size is therefore not a practical Net Gain metric. The primary impact to elephants caused by the GT Road is fragmentation of their movement patterns. There is also a cumulative impact associated with HEC and the GMC. Net Gain metrics should therefore measure changes in movement patterns and/or area of occupation, and changes in levels of HEC.
Net Gain for Golden Langur	There are challenges associated with estimating the population size of Golden Langur. As with elephants, the primary impact to Golden Langur is fragmentation of their movement patterns. It is proposed that Net Gain metrics are developed to measure their areas of occupation, which will require identification of Golden Langur groups and establish their current areas of occupation, and to measure any change.

7 MONITORING AND ADAPTIVE MANAGEMENT

Given the importance of biodiversity associated with the GT Road development as part of the overall GMC, the BMP shall adopt an adaptive management approach. As part of this, the BMP shall also be implemented as part of the overall Environmental and Social Management Plan and other supporting plans to be developed as part of the Project's Environmental and Social Management System (ESMS).

7.1 SUPPORTING METHOD STATEMENTS

A Wildlife Shepherding Protocol is developed (Appendix C), considering the ecological sensitivities and known migration routes intersecting with the GT Road footprint.

As and when required, several other method statements may need to be developed such as:

- Vegetation clearance method statement.
- Flora translocation method statement.
- Fauna translocation method statement.
- Vegetation re-instatement method statement.

As per the roles and responsibilities described in Chapter 5, these method statements, when required, shall be developed by the DoST E&S Field Officer.

As the implementation of the BMP would involve multiple parties, DoST shall establish a schedule for audits or inspections involving the Contractors to ensure that the conditions stipulated in this BMP, its applicable standards, procedures and guidelines are complied with. Where possible, DoFPS shall be engaged and consulted to ensure efficacy of the BMP.

Inspections, monitoring and audits will be documented, and any corrective actions will be assigned owners and timescales for implementation. An action tracking database will be used to coordinate the close out of any corrective actions promptly.

Inspection, monitoring and audit findings, along with their respective improvement programs, will be regularly reported to the DoST E&S Manager. Inspection requirements for mitigation are provided in Table 5 and Table 8.

7.2 RECORD KEEPING AND AUDITING

All records will be stored safely and be readily accessible for auditing. The DoST E&S Manager and PMU Biodiversity Specialist are responsible for maintaining all environmental management documents as current at the point of use. Types of records relevant to this BMP include:

- Monitoring, inspection and compliance reports/records;
- Registers of fauna disturbance, vegetation clearance and vehicle clean down;
- Correspondence with public authorities;
- Induction and training records;
- Reports on environmental incidents, other environmental incidents non- conformances;
- Records of complaints and follow-up action.

7.3 CUMULATIVE IMPACTS

This BMP has been prepared considering the cumulative impacts of the GT Road, which has considered cumulative impacts of this and other projects to be high to elephants. Although the cumulative impacts of future development of the GMC have not been considered in this BMP and will have to be addressed in a further appraisal as more information becomes available.

7.4 UPDATING THIS BMP

This BMP is a living document that will be reviewed and updated as additional information becomes available. Thus, the BMP will be updated when detailed design and schedules for additional infrastructures become available (such as during the pre-construction phase) to ensure that procedures and arrangements are compatible with the updated designs. The BMP will also be updated once information from monitoring has been reviewed and evaluated, at a minimum once a year.

7.5 MANAGEMENT OF CHANGE

The process in place to manage changes impacting Environmental and Social aspects of the project should be integrated in the Project Environmental and Social Management System.

In relation to biodiversity impacts, of particular importance are the following potential triggers for changes:

- Design refinement or detailed design outcomes that affect biodiversity receptors;
- Changes in construction methodologies that may change effects on biodiversity receptors;
- Field obstacles or wildlife encounters during construction;
- Results of further field surveys and monitoring;
- Comments/concerns submitted by public/stakeholders/lenders; and
- Changes in regulations or requirements by regulatory bodies.

Different Tiers of change will require different levels of approval by the Project Lenders. The Tiers should be defined by the impact severity prior to the implementation of mitigation, which will be determined using the methodology presented in the GT Road ESIA.

- **Tier 1 Changes** – Changes where the potential impact of the change prior to mitigation will be no more than **Moderate**.
- **Tier 2 Changes** – Changes where the potential impact of the change prior to mitigation will be **Substantial**. DoST will inform lenders of plans to implement change
- **Tier 3 Changes** – Change where the potential impact of the change prior to mitigation will be **High** – DoST seeks lenders approval for the change prior to implementing.

Some examples of Tier 3 Changes include (1) changes to the GT Road design, footprint or activity that may result in a potential new High impact, or elevate an impact already assessed to a potential High impact; and (2) changes to avoidance or mitigation commitments to impacts that may result in a potential new High impact.

8 INSTITUTIONAL RESPONSIBILITIES

Key roles and responsibilities for implementing the BMP are outlined in Table 11. The DoST Environmental and Social (E&S) Manager will be the main person responsible for the management of this plan.

TABLE 11 ROLES AND RESPONSIBILITIES

Role	Responsibilities
DoST Director	• Has overall accountability for implementation of this BMP and compliance with the commitments set out within and within Corrective Action Plans resulting from Lender's monitoring missions and other formal oversight of the project. • Provide sign-off and regular revision sign-off. • Allocate financial and human resources and decision-making support required for plan implementation.
DoST E&S Manager	• Has overall accountability for ensuring the implementation of the plan and Project compliance with the commitments set out within it. • Leads annual reviews and revisions/updates of the management plans. • Revises the BMP regularly and whenever corrective actions require an update. • Manages monitoring activities during operation phase. • Ensures the communication of actions arising from incompliances identified by the Lenders are adequately communicated through the CONTRACTOR to subcontractors and receipt of the communication has been acknowledged. • Technical review surveys and audits related to environmental aspects of the Project
DoST E&S Field Officer	• Performs regular site audits. • Notifies DoST E&S Manager immediately of any occurrence of a Significant Safety or Social Reporting Event/Incident.
DoFPS Director	• Has overall responsibility to lead implementation of the Biodiversity Net Gain Strategy and ensuring technical soundness of general BMP implementation. • Leads bi-annual reviews of the BMP efficacy and liaise with the DoST Director and E&S Manager to determine if any revisions/updates are required.
DoFPS Biodiversity Officer, deputed from DoFPS to DoST PMU	• Implements/Supports site survey • Implements/Supports monitoring activities • Notify DoST E&S Field Officer immediately of any occurrence of a Significant Safeguards and Social Reporting Event. • Provides technical monitoring of the control invasive species during the rehabilitation and restoration. • Technical review of rehabilitation plan to ensure selected species meets the requirements set out in the Management Plan. • Responsible for developing the adaptive management method statements.
Contractor's HSE Manager	• Follows the BMP and implements the relative mitigation measures • Follows the Pre-Clearance Procedure • Reports results of the Pre-Clearance Survey to DoST E&S Manager

9 COST ESTIMATES

An indicative budget is presented below to support the economic/financial modelling and planning of the GT Road based on the mitigation measures described in Chapters 5.2 and 6.

Activities for addressing project impacts (Table 12) are allocated to budget cost groups. Only supervision costs, training and IAS control costs are budgeted here. Design costs, contractor costs and social development costs are budgeted elsewhere.

TABLE 12 INDICATIVE BUDGET FOR BMP IMPLEMENTATION

Activity	**Project Timing**	**Budget Amount (USD)**
Wildlife Crossings Infrastructure (Avoidance Measures)		
Elephant underpasses (Bridges)	Construction Phase	Integrated into Design Costs
Small animal underpasses (Culverts)		
Golden Langur canopy bridge crossings (up to 5)		
Mitigation to address Project Impacts (Minimization Measures)		
Supervision and monitoring of construction	Construction Phase	$ 300,000
Training		$ 80,000
Invasive Alien Species (IAS) control		$ 300,000
Biodiversity Net Gain Strategy		
Habitat enrichment program	5-year period	$ 1,600,000
Safeguarding elephant movement corridors	Late construction	$ 200,000
Promoting human wildlife coexistence	5-year period	$ 1,800,000
Wildlife movement research	Initiated prior to Project Effectiveness	$ 120,000
Additional Items Note (a)		
Supervision and monitoring of operations	Construction and Operations	$ 200,000
Partnerships and capacity building		$ 400,000
Total Budget		**$ 5,000,000**

Note (a): The Additional Items ($ 600,000) of this BMP budget will be financed separately, under Component 3 of Project financing.

10 NEXT STEPS TO FINALIZE THIS BMP

Metrics need to be developed for measurement of Net Gain. Section 6.5 outlines requirements for research into wildlife movement that integrates with monitoring of wildlife crossings (Section 5.1.3). This research needs to be planned in a manner that results will yield data that can serve as appropriate Net Gain metrics (Section 6.9). Data needs to reflect the current baseline status of key biodiversity features and measure the change as a result of Project interventions. A specialist workshop is proposed to plan the required studies and establish appropriate Net Gain metrics. This workshop will be led by the NCD, who will determine the proceedings and required participants. This workshop needs to be conducted prior to Project Effectiveness.

This BMP also requires consultation with internal RGoB stakeholders and external stakeholders including academics, conservation NGOs and relevant interest groups. Consultation will be led by DoST with DoFPS involvement. The consultation will guide the finalization of this BMP within 60 days post Project Effectiveness and is therefore not budgeted under this BMP.

11 IMPORTANT REFERENCES

Asian Development Bank, 2019. Green Infrastructure Design for Transport Projects. A Road Map to Protecting Asia's Wildlife Biodiversity. ISBN 978-92-9261-991-6 (print), 978-92-9261-992-3 (electronic). DOI: http://dx.doi.org/10.22617/TCS189222.

Bhutan Elephant Corridor Project (22-11-2023). Unpublished draft report issued by the Project for Formulation of Southern Central Regional Plan, Ministry of Works and Human Settlement (MoWHS) and Japan International Cooperation Agency (JICA).

Bhutan for Life. 2021. Environmental and Social Management Plan for Phibsoo Wildlife Sanctuary. Available in pdf format at:
https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/5pafm9h8ak_PWS_ESMP_2021.pdf

Bissonette, J. A., & Adair, W. 2008. Restoring habitat permeability to roaded landscapes with isometrically-scaled wildlife crossings. Biological conservation, 141(2), 482-488.

Asian Elephant Transport Working Group: Dodd, N., Butynski, M., Ament, R., Chen, S., Jayasinghe, N., Lim, J.C., Saaban, S., Tiwari, S. K., van der Ree, R., Wang, Y., & Wong, E. P. 2024. Handbook to Mitigate the Impacts of Roads and Railways on Asian Elephants. IUCN WCPA Connectivity Conservation Specialist Group/IUCN SSC Asian Elephant Specialist Group. https://doi.org/10.53847/PZNC3560

Jha, R.R.S., Zangmo, S., and G.V. Gopi. 2023. Artificial Canopy Bridge Design to facilitate Western Hoolock Gibbon (Hoolock hoolock) crossing over Mariani Dibrugarh broad-gauge single-track Railway Line in Hollongapar Gibbon Sanctuary, Assam. Wildlife Institute of India, Dehradun. TR No/2023/07. Pp. 30. Available at:
https://wii.gov.in/images/images/documents/publications/rr_2023_canopy-bridge_design-guidelines.pdf

NCD and Divisional Forest Office, Sarpang, 2024. Understanding Elephant Behavior and Distribution to Unveil Movement Corridors and Enhance Wildlife Connectivity in Sarpang, Bhutan. Department of Forest and Park Services, Ministry of Energy and Natural Resources, Thimphu. Bhutan.

NCD, 2024. Perception of Human Elephant Conflict and conservation attitudes of affected communities in Sarpang, Bhutan. Nature Conservation Division, Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu, Bhutan.

Tshering, U., Thakur, R., Ghosh, S., Nath, A. 2024. Addressing Human-Elephant Conflict in Sarpang, Bhutan: Challenges and Practices. Journal of Wildlife Science, 1 (2), 96-101. https://doi.org/10.63033/JWLS.FTLB3638

World Bank Group. Environmental and Social Framework (2016). Available in PDF format at: https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

World Bank Good Practice Note (undated). Reducing Illegal Trade of Biodiversity & Living Natural Resources.

Wildlife Institute of India. 2016. Ecofriendly measures to mitigate impacts of Linear Infrastructure on Wildlife. Wildlife Institute of India, Dahradun. Available at:
https://www.researchgate.net/publication/351613571_Ecofriendly_Measure_to_Mitigate_impact_of_linear_infrastructure_on_Wildlife

Yap, J. L., Rosely, N. F. N., Mahadzir, M., Benedict, M. L., Muniandy, V., & Ruppert, N. 2022. "Ah Lai's Crossing"–Malaysia's first artificial road canopy bridge to facilitate safer arboreal wildlife crossings. Folia Primatologica, 93(3-6), 255-269. Available at:
https://ruffordorg.s3.amazonaws.com/media/project_reports/Folia_Primatologica_0_2022_1-15.pdf

APPENDIX A: PRIORITY SPECIES

Common and Scientific Name	IUCN Red List	National Regulation	CITES Appendix	Potential Occurrence within Project Surroundings
Mammals				
Asian Elephant Elephas maximus	EN	FNCA, FNCR	I	Confirmed via survey.
Gee's Golden Langur *Trachypithecus geei*	EN	FNCA, FNCR	I	Confirmed via survey
Red Panda *Ailurus fulgens*	EN	FNCA, FNCR	I	Potential occurrence indicated by expert consultation.
Dhole *Cuon alpinus*	EN	-	-	Confirmed via baseline survey.
Hispid Hare *Caprolagus hispidus*	EN	FNCR	-	Potential occurrence indicated by expert consultation.
Tiger *Panthera tigris*	EN	FNCA, FNCR	I	Confirmed via baseline survey.
Chinese Pangolin *Manis pentadactyla*	CR			Potential occurrence indicated by expert consultation.
Pygmy Hog *Porcula salvania*	EN			Potential occurrence indicated by expert consultation.
Bengal Slow Loris *Nycticebus bengalensis*	EN	FNCR	I	Potential occurrence indicated by expert consultation.
Capped Langur *Trachypithecus pileatus ssp. tenebricus*	EN			Potential occurrence indicated by expert consultation.
Hog Deer *Axis porcinus*	EN		I, III	Confirmed via survey.
Gaur *Bos gaurus*	VU	FNCA, FNCR	I	Confirmed via survey.
Leopard *Panthera pardus*	VU	FNCA, FNCR	I	Confirmed via survey.
Sambar *Rusa unicolor*	VU	FNCR		Confirmed via survey.
Birds and Reptiles				
Great Hornbill *Buceros bicornis*	VU		I	Confirmed via survey.
White-bellied Heron *Ardea insignis*	CR			Potential occurrence indicated by expert consultation.
Tricarinate Hill Turtle *Melanochelys tricarinata*	EN		I	Confirmed via survey.
Elongated Tortoise *Indotestudo elongata*	CR			Potential occurrence indicated by expert consultation.
King Cobra *Ophiophagus hannah*	VU			Confirmed via survey.
Burmese Python *Python bivittatus*	VU			Confirmed via survey.
Fish				
Golden Mahseer *Tor putitora*	EN			Uncertain occurrence
Plants				
Hoya bhutanica	EN			IUCN Red List
Tectona grandis	EN			Confirmed via survey.

Common and Scientific Name	IUCN Red List	National Regulation	CITES Appendix	Potential Occurrence within Project Surroundings
Aporosa cardiosperma	VU			Confirmed via survey.
Litchi chinensis	VU			Confirmed via survey.

Note:
CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, and LC = Least Concern
FNCA - The Forest and Nature Conservation Act (FNCA) 1995
FNCRR - The Forest and Nature Conservation Rules and Regulation (FNCRR) 2017
Those highlighted in turquoise indicate critical habitat trigger species.

APPENDIX B: LAND COVER AND NATURAL HABITAT EXTENT

Table presenting land cover and calculation natural and modified habitat on next page.

LAND COVER AND CALCULATION OF NATURAL AND MODIFIED HABITAT

Land Cover	**Area (km²)**					
	Project footprint (carriageway)	**Work and Camp Area 1**	**Work and Camp Area 2**	**Project Impact Area (550 m from the alignment)**	**Terrestrial AOA**	**Aquatic AOA**
Modified habitat	0.12	0.03	0.08	8.79	52.80	-
Agriculture	0.06	-	0.02	4.28	27.42	Not applicable
Bare Ground	0.01	-	-	0.53	4.86	Not applicable
Built-up	0.02	-	-	1.89	12.99	Not applicable
Successional Rangeland	0.03	0.03	0.06	2.08	7.53	Not applicable
Natural habitat	0.07	-	0.01	6.74	76.80	
Forest	0.06	-	0.01	5.77	70.24	Not applicable
Riparian Rangeland	0.01	-	-	0.82	6.56	Not applicable as partially counted in the terrestrial AOA
Water	Not applicable	-	-	0.15	Not applicable	71.4
Total	**0.19**	**0.03**	**0.09**	**15.53**	**129.60**	**71.4**

APPENDIX C: WILDLIFE SHEPHERDING PROTOCOL

Wildlife Shepherding Team Requirements

All personnel involved will be briefed on the details of this plan and their respective roles before field activities begin. Personnel will also be equipped with mobile communication devices on the field to ensure that lines of communication are maintained during field activities and that the appropriate persons (e.g. veterinarians, wildlife handlers) are able to respond to exigencies in a timely manner.

Step	Activity Description
General approach to wildlife shepherding (scheduled during daylight hours only i.e. 8am to 6pm)	
1	Installation of barriers (if required), which will function as a drift fence to guide target terrestrial fauna in the intended direction of movement and as a barrier to prevent wildlife displacement onto adjacent roads.
2	Systematic pattern of walking through the site, starting from the area furthest from and then gradually moving towards the identified refuge area, to shepherd wildlife in an intended direction of movement towards adjacent refuge habitats.
3	In conjunction with (2), the site will be carefully surveyed to check for the presence of target fauna species and any active dens.
4	Site inspection by an ecologist to ensure that no target fauna and active dens remain.
5	Closing of gaps in the barriers (if required) as soon as practicable to prevent target terrestrial fauna from returning to the site.
*To note	Steps (2) and (3) to be carried out repeatedly over a course of up to three weeks for a site no larger than twenty hectares.
General approach for target fauna encounters	
Highly mobile fauna for which a passive shepherding approach is expected to be effective.	
6a	Personnel to remain in place to allow fauna to move of their own accord. The generation of mild human noise disturbance (e.g. talking loudly) may be used to encourage fauna movement. However, no attempt should be made to capture or handle these species, unless the animal is visibly injured in which case experienced wildlife handlers will carefully capture the animal for immediate veterinary attention. If any individual fauna does not move on its own after sufficient time (i.e. up to one hour) has passed, the area where the individual is located should be GPS-marked and left overnight to provide additional opportunity for the individual to move on its own accord. Personnel shall return to the GPS-marked location on the following day to inspect the area. This process will be repeated until the individual has moved.
Fauna for which a passive shepherding approach is expected to be unsafe and/or ineffective in guiding the individual fauna to move in an intended direction.	
6b	A capture-and-release approach will be needed to ensure safe relocation of these fauna from the site prior to construction. Experienced wildlife handlers will carefully capture the animal for subsequent assessment and microchipping (where safe and possible) by a veterinarian. Where sensitive fauna (i.e. Chinese Pangolin) and venomous snakes from are concerned, their capture shall

	only be carried out by designated wildlife handlers who have been trained in the appropriate handling techniques.
Arboreal and aerial species	
Able to continue utilizing remnant habitats on the site during construction and will not be excluded by the installed hoarding.	
7	An ecologist shall inspect the tree for the presence of fauna, inhabited tree hollows, and nests.
8	If the presence of arboreal mammals and herpetofauna, birds and/or bats are detected on the tree, tree felling or transplanting must be postponed until the animal has left the tree of its own accord.
9	If an inhabited tree hollow is identified, tree felling or transplanting must be postponed until the animal has left the hollow of its own accord and the entrance to the hollow has been sealed to prevent re-entry.
10	Tree felling or transplanting shall not occur during the prime breeding season for local avifauna. In any case, if active nests are detected on the tree, nests shall be left undisturbed until nesting activities have been completed (i.e. the young have left the nest). In addition, inactive nests shall be removed to minimize the possibility of a new nesting attempt. Tree felling or transplanting shall occur only when no active nests are present on the tree.
11	Notwithstanding the steps, after tree felling has occurred, an ecologist shall thoroughly search the fallen tree for any injured or trapped fauna that may have gone undetected. If injured or trapped fauna are found, immediate veterinary attention shall be administered.