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

Gelephu-Tareythang Road

Environment and Social Impact Assessment (ESIA) for Disclosure and Consultation

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

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Disclaimer:

This Environmental and Social Impact Assessment (ESIA) for the Gelephu-Tareythang Road forms part of the environmental and social (E&S) due diligence for the Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS) Bhutan Project. The ESIA was prepared by the Department of Surface Transport (DOST), Ministry of Infrastructure and Transport, Royal Government of Bhutan, and follows Good International Industry Practices (GIIP) and the Bank's Environmental and Social Framework (ESF).

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

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

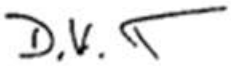
[Image on front page shows the Mau River in the project area]

SIGNATURE PAGE

Gelephu-Tareythang Road

Environmental and Social Impact Assessment (ESIA) for Disclosure and Consultation

0743906



Daniela Viveash
Partner

ERM Siam Co. Ltd.
179 Bangkok City Tower,
South Sathorn Road
Thungmahamek, Sathorn
Bangkok 10120

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ACRONYMS AND ABBREVIATIONS

Acronym	Description
$\mu g/m^3$	Microgram per cubic meter
AADT	Annual Average Daily Traffic
AoI	Area of Influence
AQ	Air Quality
AQS	Air Quality Standards
CALD	Culturally and Linguistically Diverse
CO	Carbon Monoxide

Acronym	Description
CO_2	Carbon Dioxide
CH4	Methane
DMRB	UK Highways Agency Design Manual for Roads and Bridges
DoST	Department of Surface Transport
EHS	Environmental, Health, and Safety
EPC	Engineering, Procurement, and Construction
ERM	Environmental Resource Management
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Standard
ESMO	Environmental and Social Management Officer
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GRM	Grievance Redressal Mechanism
ha	Hectare
IAQM	Institute of Air Quality Management
IFC	International Finance Corporation
KPI	Key Performance Indicator
km	Kilometer
LRP	Livelihood Restoration Program
m	Meter
M^2	Square meters
M^3	Cubic meter
MoIT	Ministry of Infrastructure and Transport
N2O	Nitrous Oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of Nitrogen
NTFP	Non-Timber Forest Product
PAH	Project Affected Household
PAP	Project Affected People
PM10	Particulate matter 10 micrometres or less in diameter
PM2.5	Particulate matter 2.5 micrometres or less in diameter
RAP	Resettlement Action Plan
SEP	Stakeholder Engagement Plan
SHG	Self-Help Group
SO_2	Sulphur Dioxide
TIA	Traffic Impact Assessment
USD	United States Dollar
UTM	Universal Transverse Mercator
WBG	World Bank Group
WHO	World Health Organization

GLOSSARY

Glossary	Description
Dzongkhag	District which is the first-order administrative unit
Gewog	A geographic administrative unit subordinate to the dzongkhag which is rural area
Thromde	Municipality/Town or Urban area which is the second-order administrative unit
Project Area	The Project footprint covered by the Project components. As the Project is currently under pre-development, the Project Area includes the road, bridges and ancillary facilities

9. IMPACTS TO PHYSICAL ENVIRONMENT

This chapter presents an assessment of impacts for the key environmental aspects and evaluates the Project's potential risks and impacts to the physical environment. The mitigation hierarchy will be applied to avoid and minimize risks and impacts to the extent possible, recommends mitigation and enhancement measures, and identifies the pre-mitigation and post-mitigation (residual) impact significance relative to impacts to the physical environment

The method for how the impact assessment was performed is described in ***Appendix B*** and ***Appendix J***.

9.1 AMBIENT AIR QUALITY

- The expansion of the road is expected to generate a range of ambient air quality impacts including:
  - Construction Phase:
    - Dust emissions from construction
    - Exhaust emissions from construction traffic
  - Operational Phase:
    - Exhaust emissions from operational traffic
- The Project will contribute to the release of various air pollutants, including particulate matter (PM (PM_{10} and $PM_{2.5}$) and nuisance dust), nitrogen oxides (NO_x) and by association nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) during both the construction and operational phases. These pollutants have the potential to affect air quality, posing health risks to nearby residents and sensitive receptors, such as schools, hospitals, and ecosystems. Air pollutant emissions during construction, particularly from heavy machinery, earthworks, and vehicular movement, can cause respiratory problems, aggravate pre-existing health conditions, and reduce overall air quality in the project area.
- The air quality impact assessment is undertaken in line with the requirements of the World Bank[1] which states that an assessment of environmental and social risks proportional to the proposed activities shall be undertaken. However, as the framework does not currently specify the required granularity and technical specification of the required air quality impact assessment, other national and international guidances have been adopted to inform the technical approach.

9.1.1 AVOIDANCE AND MINIMIZATION MEASURES

The Project has adopted the following measures to avoid or reduce impacts to air quality in accordance with the application of the mitigation hierarchy:

- **Dust Control Measures**: Regularly applying water or environmentally safe dust suppressants on construction sites, unpaved roads, and material storage areas to minimize fugitive dust emissions.
- **Covering Stockpiles:** Ensuring that material stockpiles, such as sand, gravel, and other fine materials, are covered to prevent wind erosion and dust generation.

[1] World Bank (2017) Environmental and Social Framework

Further project specific mitigation has also been identified, based upon the risk of significant impact identified from the assessment.

9.1.2 CONSTRUCTION PHASE IMPACT ASSESSMENT

9.1.2.1 CONSTRUCTION DUST IMPACT ASSESSMENT

During the construction phase, construction activities may result in combustion emissions from the use of vehicles, equipment, and engines (such as trucks, excavators, and generators etc.) to undertake earthworks, paving, material transport, and building construction activities.

The magnitude of dust generation was determined by the following:

- Earthworks, which will primarily involve excavating material, haulage, tipping, and stockpiling. This may also involve leveling the site and landscaping, the total area with potential for dust generation is thus expected to be significantly greater than the threshold of >110,000m^2 (estimated) for an emission magnitude of High, as this will include the stripping of existing roads and proper alignment to prepare the surface for tarring. The magnitude will thus be **high**[2];
- No demolition is currently expected to be necessary, therefore, therefore the magnitude of dust generation due to demolition will be **negligible**;
- Track out refers to the possibility of trucks transporting dust to offsite roads. Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology, and duration. Estimated number of vehicles on the internal paved roads is between 20-50 per day and the internal unpaved road length is greater than 100m, rendering the emission category as **substantial;**
- The airshed is considered not degraded for both PM_{10} and $PM_{2.5}$ in the wet season. At the time of writing, only the wet season data has been collected and analyzed. Monitoring of the dry season will be undertaken and will be incorporated into the ongoing assessment of air quality once available. Conservatively, as a worst-case scenario, the airshed should be considered degraded during the dry season.

On the basis of the above parameters the construction phase dust and PM_{10} and $PM_{2.5}$ generation is determined to be of **high** magnitude (having the potential to exceed $PM_{2.5}$ and PM_{10} AQS). Therefore, this impact is considered to be of ***Substantial*** significance. The receptor profile can be described as being of **substantial** sensitivity (general population).

Mitigation measures are outlined in ***Section 9.1.3.2*** With correct implementation of the required dust mitigation, the residual impacts could be ***Low risks***.

9.1.2.2 CONSTRUCTION TRAFFIC IMPACT ASSESSMENT

Traffic during the construction of the road will be undertaken using 66 machineries, which will be operated using diesel/petrol (***Table 9.1***). The closest sensitive receptors to the road construction site are approximately 100 meters away, and many of the roads utilized for the project are unpaved. Given the scope of the project, the sensitivity of the receptors to road construction is considered moderate in terms of human health. However, the impact magnitude is deemed negligible due to the relatively low project-related traffic volumes.

[2] The estimated values are based on the size of the Project area and guidance from IAQM (2024) Assessment of dust from demolition and construction, Institute of Air Quality Management.

Table 9.1 Construction Equipment

Construction Plant	Number per work front
Concrete lorry mixer, concrete mixer, concrete pump (lorry mounted)	8
Crane, mobile (diesel)	11
Drilling rig	1
Dump truck	3
Excavator/loader, wheeled/tracked	11
Lorry	11
Generator, silenced	10
Air compressor	5
Asphalt paver	2
Paint line marker	2
Roller, vibratory	2
Water pump, submersible	3
Bar bender and cutter (electric)	3
Poker, vibratory, hand-held	7
Grout mixer and grout pump	2
Breakers (handheld, and excavator mounted)	9
Circular saw	6
Compactor, vibratory	1
Piling, large diameter bored, grab and chisel	1
Travelling formwork / falsework	2

9.1.2.3 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The following activities can have impacts to ambient air quality during the **Construction** Phase of the Project:

- Construction of temporary ancillary facilities
- Procurement of material and operation of borrow pits
- Site preparation/Land clearing
- Earthworks (Cutting and Filling)
- Road construction & retaining walls

- Construction of bridges, including foundations, piers / abutments, and superstructures

Project air emission sources during construction will be from large diesel generators, aggregate crushing plants, concrete batch plants, small diesel generators, non-road construction equipment, construction vehicles, and fugitive dust. Mitigation measures, such as dust suppression (e.g., water spraying), proper maintenance of construction equipment to minimize emissions, and the use of cleaner or more efficient technologies, will be essential to reduce the potential impact of these emission sources during the construction phase.

Based on the above analysis, the project's potential impacts resulting from air emissions during construction will be direct, adverse, high in magnitude (taking into consideration the susceptibility of local residences to effects from air emissions), local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***.

9.1.2.4 PROPOSED MITIGATION MEASURES

Construction Dust

Without mitigation there is the potential for substantial dust emissions to arise from the Project activities, particularly from the construction phase. The measures required to mitigate dust during construction and operation phases are set out below. Alongside these mitigations, the Project boundary monitoring should be undertaken during the construction phase to allow dust emissions to be actively quantified and controlled.

The following mitigation measures to further reduce the magnitude of project impacts are listed below;

Site Planning:

- Plan Project layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dust causing activities are located away from receptors, as far as possible.
- Consider fences and enclosures around specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below:
    - Limit site runoff (of water or mud) to prevent egress of material to other areas which can create dust emissions when dried.
    - Keep site fencing, barriers and scaffolding clean using wet methods.
    - Cover, seed or fence stockpiles to prevent wind whipping.

Dust Management:

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in a logbook.

- Display the name and contact details of the person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Where construction compounds cannot be hardstanding, use lignin-based surface sealants or watering as required/available to suppress dust generation.
- Only use cutting, grinding, or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate. Use lignin-based surface sealants where possible to reduce water consumption.
- Minimize drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
- Avoid bonfires and burning of waste materials.

Mitigation specific to track out on Hardstanding Public Roads

- Use water-assisted dust sweeper(s) on hardstanding access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Where a construction site is fenced off, access gates to be located at least 10 m from sensitive receptors where possible.

General Monitoring Measures

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust and record inspection results.
- Carry out regular site inspections to monitor compliance with the Air Quality Management Procedure, record inspection results and identify any events that require further investigation or actions.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Undertake site boundary PM_{10} monitoring. Monitors should be positioned upwind and downwind of construction activities and relocated as construction works evolve.

Construction Traffic

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel- or petrol-powered vehicles practicable.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Impose and signpost a maximum-speed-limit of 30 kph on surfaced and 10 kph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided) and implement awareness training for drivers.

9.1.2.5 RESIDUAL SIGNIFICANCE

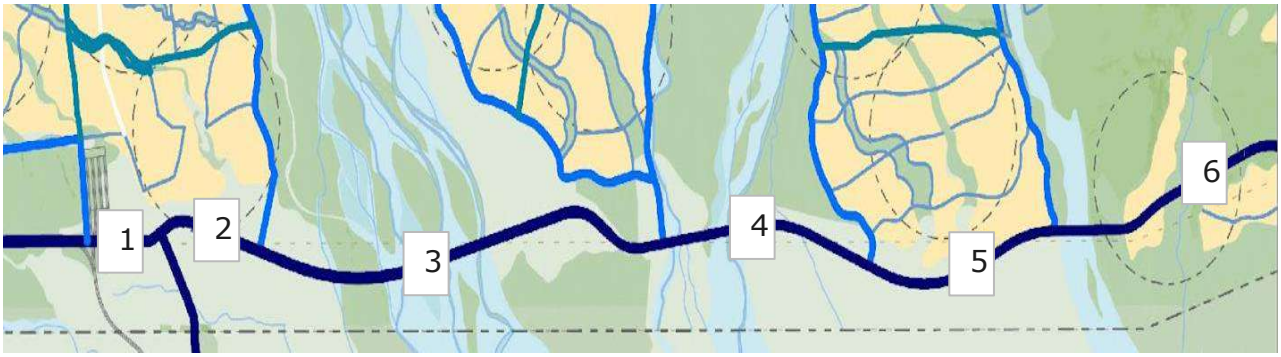
For the construction phase the proposed mitigation measures would reduce the magnitude of the impact from high to minor (taking into consideration the proposed compensation for any damage), so the project's potential impacts resulting from air quality during construction will be direct, adverse, high in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Negligible***, or at worst Minor.

9.1.3 OPERATIONAL PHASE IMPACT ASSESSMENT

9.1.3.1 TRAFFIC DURING OPERATION

Modeling of traffic flows has been conducted for the operation of the road, for 2035 and 2053. Of note is that in 2035 a substantial proportion of the vehicles are anticipated to be electric and therefore have no significant contribution to air pollution, and can be discounted. By 2053 all vehicles are assumed to be electric and therefore impacts to air quality will be negligible as there are zero exhaust emissions. The Annual Average Daily Traffic (AADT) for the project, minus the electric vehicles are presented below for the six (06) primary stretches of road (***Figure 9.1*** and ***Table 9.2)***

Figure 9.1 Project Segments used for Traffic Volume Projections



Source: ARUP 2024

Table 9.2 PROJECTED TRAFFIC CAPACITY AND VOLUMES

Road stretch	1	2	3	4	5	6
Total light vehicles (exc. Electric)* (24hr AADT in 2035)	2437	2730	3032	683	24	365
Total HGVs (exc. Electric)* (24hr AADT in 2035)	591	976	735	165	6	88

Source: ARUP 2024

*Note: *AADT taken from Arup modelling of traffic flows with an assumed 16% car mode.*

Following the infographic, the overall impacts associated with operational road traffic are therefore anticipated to be **negligible** for light vehicles. As the airshed is undegraded, the number of HGVs is also below the screening value and impacts are also considered to be **negligible**. Therefore, there is no need for air quality modelling of the operational traffic.

9.1.3.2 PROPOSED MITIGATION MEASURES

In light of the negligible impacts of operational traffic, no mitigation is required.

9.1.3.3 RESIDUAL SIGNIFICANCE

For the operational phase impacts without mitigation are considered to have a direct, adverse impact, however impacts are considered to be **negligible**.

9.1.4 CONCLUSION

The air quality impact assessment conducted for the construction and operational phases of the project highlights the primary pollutants of concern: particulate matter (PM_{10} and $PM_{2.5}$), Sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and nitrogen dioxide (NO_2). Semiquantitative methods were employed to assess dust emissions from construction activities, traffic-related emissions during the construction, and emissions from operational traffic.

By adhering to these methodologies and continuously reviewing the effectiveness of the mitigation measures, the project aims to achieve compliance with air quality regulations and maintain a high standard of environmental stewardship. The overall project impacts are concluded to be negligible, for construction phase and negligible for operational phase.

A summary of the significance of impacts on the air quality before and after mitigation measures, during the construction and operational stages, is given in the following table.

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Construction Phase Impacts and Risks		
Dust from earthworks and vehicular movement	Substantial	Low
Emissions from construction equipment and traffic	Substantial	Negligible
Operational Phase Impacts and Risks		

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Impact on air quality from traffic during operation	Negligible	Negligible

9.2 NOISE AND VIBRATION

Noise and vibration will be produced during both the construction and operation stages of the Project. Without appropriate management and mitigation, noise and vibration effects could result in nuisance, sleep disturbance, and other long-term adverse health conditions[3].

The noise impacts are likely to occur within a maximum distance of 550m from the Project footprint. Within this area of study, there are c.1,389 human receptors, of which 1,361 are understood to be residential and 28 are hospitals/educational buildings [4]. It should be noted that this number does not include wildlife, as effects on wildlife will be discussed separately in ***Chapter 10***.

Generally, the further the receptor is from the construction activities or the road operation, then the less adversely affected they would be as they would be exposed to less noise given the distance and the possible screening provided by the intervening buildings and natural topography. Therefore, the worst-case receptors are those closest to the Project footprint.

Activities during the construction phase inherently produce high levels of noise, and therefore some noise impacts from these activities cannot be avoided, although the impacts are often short-term and only last for the duration of the construction activity.

Operation of the Project will result in the creation of a new permanent road traffic noise source so the effect is long term. There will also be changes to the flow, speed and the composition of traffic on existing surrounding roads (including the section of existing road that will be widened as part of the Project). These changes will also affect the level of noise emitted. Changes in flow on existing roads outside of the main road ROW have not been considered quantitatively as data are not available at this stage and will be considered in the next phase of the ESIA. Traffic effects in future developments will be considered in the design of those developments to ensure appropriate noise levels for building occupants and fall outside the scope of this ESIA.

Vibration emissions are expected to be highest during the construction stages, however the effects are expected to be short-term. Typically, guidance documents[5] and previous experience suggest that vibration effects can occur up to 200 m from the closest construction activity.

Where there is sufficient soft ground between the vibration inducing activities and receptors, it is unlikely for ground-borne vibration due to standard construction methods to exceed the thresholds at which vibration effects could become significant, which is expected to be the scenario for most construction activities associated with this Project. Some areas may experience higher levels of vibration during major construction activities for large structures, such as bridges, that may warrant a more detailed vibration assessment as the construction strategy is

[3] Guidelines for Community Noise. World Health Organization. 1999
[4] Based on GIS data from the Open Building Databases form Google research.
[5] Design Manual for Roads and Bridges, LA111 Noise and Vibration. Highways England. 2020

developed further. This can be assessed as part of the next phase of the ESIA based on information available at the time.

9.2.1 AVOIDANCE AND MINIMIZATION MEASURES

The Project will implement an ESMP, which will include measures to avoid or reduce noise impacts during the construction stage in accordance with the application of the mitigation hierarchy. The measures listed below will be included in the ESMP and are based on good industry practices:

- Siting noisy activities and plant as far as possible from sensitive receptors.
- Configuring the construction traffic control system to minimize the need for mobile plant to reverse. Where reversing cannot be avoided, construction contractors will use alternatives to tonal reversing alarms, such as visual and/or broadband noise emitting models, that provide a safe system of work.
- Where possible, selecting quieter plant and vehicles, e.g., electric powered equipment instead of combustion engines, where possible.
- Switching off plant and vehicle engines when not in use.
- Lowering items in a controlled manner rather than dropping them from heights.
- Lining chutes and bins with damping material.
- Locating stationary equipment in acoustically treated enclosures, where practicable;
- Regularly maintaining equipment, plant and enclosures.
- Installing mufflers or silencers as per manufacturer recommendations.
- Avoiding vibration from activities over extended periods by implementing alternative techniques.
- Effective communication with the occupants of the nearby sensitive receptors that could be at risk of being exposed to higher (although temporary) noise emissions during significant stages of work.
- Ensuring that site personnel are aware of the recommendations listed above.

Based on the successful implementation of the noise control mitigation and management measures described above, it is envisaged that a reduction in the overall noise from construction plant teams of approximately 3 dB is achievable. These reductions have been included in the assessment of construction noise.

Temporary accommodation for the construction labor force will be suitably constructed to provide adequate internal noise levels for living and resting/sleeping. This is readily achievable by implementing the following principles to the design, where practicable:

- Constructing the accommodation in areas exposed to the least noise and vibration;
- Increasing the sound insulation of façade elements; and/or
- Providing alternative means of ventilation to reduce the need to open windows during the periods of high external noise.

The WB Toll Roads Guidance provides a list of noise control measures that can be applied to reduce the noise impact from the operation noise. The measures are summarized below:

- Construction of the road below the level of the surrounding land;

- Noise barriers along the border of the right-of-way (e.g. earthen mounds, walls, and vegetation);
- Insulation of nearby building structures (typically consisting of window replacements);
- Use of road surfaces that generate less tire noise such as stone-matrix asphalt. The typical reduction that can be achieved at speeds below 70 km/h is around 1 dB. This correction has been included in the calculations.

9.2.2 CONSTRUCTION PHASE IMPACT ASSESSMENT

9.2.2.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The following activities can have noise impacts on the surrounding receptors during the Construction Phase of the Project:

- **Road Construction Activities:**
  - Site preparation, land clearing and earthworks
  - Road surfacing, retaining walls
  - Construction of culverts, drainage and water management structures
  - Slope works for the widening of the existing road
- **Bridge Construction Activities:**
  - Foundations
  - Piling caps and piers
  - Superstructures
- **Miscellaneous Construction Activities:**
  - Construction of river training works
  - Landscape works
  - Tree felling
  - Construction of concrete batching plant
  - Procurement of material and operation of borrow pits
  - Construction of temporary ancillary facilities

Changes in road traffic noise during construction may arise as a result of construction activities such as the deliveries of materials. Noise changes of greater than 3 dB are considered to be the onset of a significant effect as a change in environmental noise of this magnitude corresponds to the limit of what can be perceived outside of laboratory conditions.

Construction traffic flow estimates for existing roads were not available at the time of the assessment, and therefore a quantitative assessment could not be carried out at this stage. A revised assessment will be carried out in due course as the information is made available.

Noise emissions from construction activities, as listed above, were predicted using the calculation methodology in accordance with BS 5228; a widely used British Standard that is considered best practice for the assessment of construction noise in the absence of specific national and WB guidance (as discussed in ***Section 9.2.1*** above). The calculations were based on preliminary construction schedules and equipment lists provided by the design team and sound power levels extracted from BS 5228. Full details of the data used to inform the calculations are provided in ***Appendix J2***, and are summarized below:

- Sound power level of the activities
- Percentage on time over the assessment period
- Whether the noise is propagating across soft of hard ground
- Distance between the source and receptor.

The calculated sound power levels of each of the construction activities have been summarized in ***Table 9.3*** below for convenience.

Table 9.3 Calculated Construction Activity Sound POwer Levels

S.N.	Activity [a]	Group	Expected locations	A-weighted sound power level
1	Site preparation, land clearing and earthworks	Roads	All areas within the Project footprint	106 dB
2	Road surfacing, retaining walls			111 dB
3	Construction of culverts, drainage and water management structures			114 dB
4	Slope works			114 dB
5	Foundations	Bridges	Areas of the project footprint where bridges will be constructed	110 dB
6	Piling caps and piers			117 dB
7	Superstructures			115 dB
8	River training works	Miscellaneous	TBC	105 dB
9	Landscape works		All areas within the Project footprint	105 dB
10	Tree felling			114 dB
11	Construction of concrete batching plant		TBC	109 dB

Note:

*[a] Full details of the construction teams are provided in **Appendix J2**.*

[b] Sound Power Levels include a -3 dB correction for the assumed successful implementation of the noise control and management measured discussed earlier in this chapter.

Details of equipment lists and construction schedules for some activities are not yet available and as such cannot be assessed at this stage. A revised assessment will therefore be carried out once information on the following construction activities are available:

- Procurement of material and operation of borrow pits
- Construction of temporary ancillary facilities

9.2.2.2 CONSTRUCTION NOISE IMPACT ASSESSMENT

The combination of construction activities will vary across the Project site and may occur at different times throughout the year. It is understood that this level of detail on construction schedules has not yet been produced, therefore, for the purpose of this assessment, three worst-

case scenarios have been generated based on the loudest construction activities that could be reasonably carried out in isolation, or in combination, at a given time and location within the construction phase. The scenarios are summarized as follows:

- **Scenario 1**: Loudest road construction activity – No. 3 from ***Table 9.3***
- **Scenario 2**: Loudest bridge construction activity – No. 6 from ***Table 9.3***
- **Scenario 3**: Combined loudest miscellaneous construction activities – No. 3, 8, 9 & 10 from ***Table 9.3***

Calculations were then carried out to determine how far from the activities a receptor would need to be for the construction noise to result in a negligible, low, medium and high magnitude of predicted impacts for each of the aforementioned scenarios. The results are presented in ***Table 9.4***.

Table 9.4 Calculated Construction Noise levels

Receptor description	Magnitude of predicted Impact	Noise level (dB, $L_{Aeq,12h}$)	Approximate distance from construction activity (m)		
			Scenario 1	Scenario 2	Scenario 3
Residential properties in rural, suburban and urban areas	High	≥75	0 - 50	0 - 60	0 - 70
	Medium	≥70 - <75	50 - 80	60 - 110	70 – 110
	Low	≥65 - <70	80 - 130	110 - 170	110 – 180
	Negligible	<65	>130	>170	>180
Hospitals and educational buildings	High	≥70	0 - 80	0 - 110	0 - 110
	Medium	≥65 - <70	80 - 130	110 - 170	110 - 180
	Low	≥60 - <65	130 - 220	170 - 280	180 – 300
	Negligible	<60	>220	>280	>300

Note:

[a] Noise emissions assumed to be propagating equally in all directions across flat ground with mixed absorption

Based on the above analysis, the project's potential impacts on residential receptors resulting from noise during construction (Scenario 3, which is worst case) will be direct, adverse, high-to-negligible in magnitude depending on the distance of the receptors from the construction activities, local in extent, and short-term in duration, with an overall pre-mitigation significance of:

- ***Substantial*** for receptors within 70m from the construction works (c.115 receptors, some of which are clustered around the outskirts of Gelephu and the existing road leading to and within Tareythang);
- ***Moderate*** for receptors between 70-110m (c.76 receptors);
- ***Low*** for receptors between 110-180m (c.156 receptors); and
- ***Negligible*** for receptors further than 180m.

For hospitals and educational buildings, the noise impact resulting from noise during construction will be direct, adverse, high-to-low in magnitude depending on the distance of the receptors

from the construction activities, local in extent, and short-term in duration, with an overall pre-mitigation significance of:

- ***Substantial*** for receptors within 110m from the construction works (eight (08) receptors, of which seven (07) are clustered in the same area[6]);
- ***Moderate*** for receptors between 110-180m (two (02) receptors);
- ***Low*** for receptors between 180-300m (total one (01) receptor); and
- ***Negligible*** for receptors further than 300m.

9.2.2.3 PROPOSED MITIGATION MEASURES

The mitigation measures set out in ***Section 9.2.1*** above represent the best practical means that are likely to be possible based on the current Project information. This takes account of the fact that much of the plant will be mobile and therefore the options for noise mitigation are limited. Further consideration of noise mitigation options will be considered in the detailed design of the construction methodology.

In cases where high levels of noise are likely to be generated over long periods of time at specific receptors it may be possible to consider the feasibility of offering upgraded glazing and ventilation to reduce noise levels inside properties. However, this may not be appropriate for all building constructions and so has not been included here. Temporary relocation of affected receptors would be possible where there are no additional mitigation measures, and it is noted that some properties that are included in the counts above may be relocated permanently for other reasons.

9.2.2.4 RESIDUAL SIGNIFICANCE

No additional mitigation measures have been identified and therefore the project's potential impacts on residential receptors resulting from noise during construction will remain direct, adverse, high-to-low in magnitude depending on the distance of the receptors from the construction activities, local in extent, and short-term in duration. However, on the basis that the worst-affected residential receptors will be temporarily relocated, (c.115 receptors that fall within the "Substantial" category above) during longer periods of high noise producing construction activities, the residual significance is considered to be:

- ***Moderate*** for receptors between 70-110m (c.76 receptors)
- ***Low*** for receptors between 110-180m (c.156 receptors)
- ***Negligible*** for receptors further than 180m

For hospitals and educational buildings, the noise impact resulting from noise during construction will remain direct, adverse, high-to-low in magnitude depending on the distance of the receptors from the construction activities, local in extent, and short-term in duration, However, on the basis that worst-affected receptors (up to eight (08) receptors) can also be temporarily relocated as required, then the residual significance is considered to be:

- ***Moderate*** for receptors between 110-180m (two (02) receptors)
- ***Low*** for receptors between 180-300m (one (01) receptor)
- ***Negligible*** for receptors further than 300m

[6] Taraythang Temple – latitude: 26.8186, longitude:90.5585

9.2.3 OPERATIONAL PHASE IMPACT ASSESSMENT

9.2.3.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Operation of the Project is likely to result in changes in traffic volume, speed and composition along existing or widened roads, and will introduce new road sections that will pass receptors. These changes will affect existing noise receptors that are close to the route. Since the highway is being planned in an area which is under development, traffic levels on the Project and associated noise levels will increase over time as the population of the area increases. The three scenarios listed below have been considered, however, the conclusion of the noise assessment are based on the worst-case assessment which occurs at the maximum flow capacity in scenario 3.

1. Year 2035;
2. Year 2053; and
3. Road traffic at maximum capacity.

A new road surface would be laid as part of the Project, which would be smooth and free of significant irregularities, and the road surface will be regularly maintained (this could be included in the Environmental Management Plan). Road degradation has therefore not been considered as factor that would contribute to material increases in road traffic noise over time.

Road traffic noise prediction methodologies for major roads do not consider engine noise at typical highway speeds as noise emissions are dominated by the interaction of tyres with the road surface. Unlike other topics such as air quality, the introduction of electric vehicles is not likely to reduce noise levels significantly and has not been included in the assessment.

Operational noise was predicted using a 3D noise model – SoundPLAN v.9.1; an industry-standard software application that incorporates the calculation methodology set out in relevant standards and guidance documents[7,8,9].

The noise model was constructed based on layouts provided by the project GIS team and traffic flow data from the project transport engineers. ***Appendix J2*** presents the traffic data that were considered in the calculations, along with the calculation settings.

Given that the Project is still in the early design stages, detailed topography data were not available at the time of the assessment, and therefore the noise model assumes that road traffic noise will propagate across a flat ground surface with mixed ground absorption properties. It is noted that this approach will slightly overestimate the noise propagation across some areas where the natural topography would provide screening, and underestimate noise emissions generated from sections of road that would be on an incline[10]. An updated assessment that includes the effects of topography will be provided once this information becomes available.

The noise model was used to produce noise contours that show which areas fall within the absolute road traffic noise thresholds set out in in ***Appendix J2***.

[7] Calculation of Road Traffic Noise. Department of Health and Transport Welsh Office. 1988
[8] ISO 9613-2:2024, Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors. International Organization for Standardization. 2024
[9] Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping. PG Abbot & PM Nelson (TRL Limited)
[10] Road traffic noise emissions are typically slightly louder when vehicles are travelling uphill.

9.2.3.2 OPERATION NOISE IMPACT ASSESSMENT

The modelled noise levels were used to determine the predicted magnitude of impact across all receptors within the study area based on day and night-time thresholds. The results are presented in ***Table 9.5*** below, noting that some properties that are included in the counts may be relocated permanently for other reasons and, therefore, represents a worst case.

Table 9.5 Calculated Operation Noise Impact Magnitudes

Magnitude of predicted Impact	Daytime thresholds (dB, $L_{Aeq,16h}$)	Night-time thresholds (dB, $L_{Aeq,8hr}$)	Period	Number of receptors		
				Year 2035	Year 2053	Capacity
High	≥65	≥55	Day	1	15	57
			Night	4	18	76
Medium	≥60 to <65	≥50 to <55	Day	38	59	153
			Night	43	64	166
Low	>55 to <60	>45 to <50	Day	115	165	343
			Night	138	183	424
Negligible	≤55	≤45	Day	1	15	57
			Night	4	18	76

Note:

[a] Noise emission assumed to be propagating equally in all directions across flat ground with mixed absorption

[b] The above results also include receptors that would be relocated as part of establishing the right of way for the development

[c.] Based on a dataset of receptors within 550m from the road centerline

Out of the three scenarios, 'Capacity' contains the highest number of receptors that will be within the 'High' magnitude of predicted impact category, which is the worst-case scenario for the purpose of a robust assessment.

Many of the most affected receptors are within the outskirts of Gelephu; the most affected being 'R1309'[11] with predicted noise levels of up to:

- 65 dB $L_{Aeq,16h}$ during the day and 56 dB $L_{Aeq,8h}$ during the night (results rounded to the nearest decibel) for the '2035' scenario.
- 67 dB $L_{Aeq,16h}$ during the day and 58 dB $L_{Aeq,8h}$ during the night (results rounded to the nearest decibel) for the '2053' scenario.
- 70 dB $L_{Aeq,16h}$ during the day and 60 dB $L_{Aeq,8h}$ during the night (results rounded to the nearest decibel) for the 'Capacity' scenario.

Based on the above analysis, the Project's predicted impacts from road traffic noise during operation at Capacity will be direct, adverse, high in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***High***.

[11] Latitude 26.8635, longitude 90.487

9.2.3.3 PROPOSED MITIGATION MEASURES

Section 9.2.1 above sets out the practicable noise control strategies that can be implemented in the detailed acoustic design for the Project. No further practicable mitigation measures have been identified.

From the mitigation measures listed in ***Section 9.2.1,*** noise barriers will be considered to provide road traffic noise screening. It is noted however that given the early design stage of the Project, it is not yet possible to specify in detail where the barriers will be installed as this will depend on the final design of road elevations, proposed earthworks (i.e., cut and/or fill areas), and the topography of the surrounding area. Nevertheless, the typical sound reduction that can be expected from a barrier is between 5-10 dB, and for the purpose of the assessment, it is assumed that a barrier can be carefully designed to achieve a 7 dB reduction (i.e., a reasonable halfway point).

Effective barrier locations are anticipated to be areas that are densely populated, with the worst-affected receptors (i.e., those closest to the new road). Examples of these areas are the outskirts of Gelephu and within Tareythang. The locations of the barriers will be determined in due course, once further design details of the road elevations and proposed earthworks are available.

The engine type of the vehicle has also been considered. As discussed previously, the change of vehicle type to electric will not result in an appreciable improvement road traffic noise emissions at the proposed speeds due to noise emissions being dominated by the interaction of tires with the road surface, instead of the engine. The use of electric vehicles has therefore not been considered further.

9.2.3.4 RESIDUAL SIGNIFICANCE

Based on the assumed 7 dB reduction from the noise barrier and the 1 dB reduction from the low noise road surfacing already included in the modelling calculations, the residual magnitude of predicted impact may therefore be reduced to:

- 58 dB $L_{Aeq,16h}$ during the day and 49 dB $L_{Aeq,8h}$ during the night, which would also reduce the predicted magnitude from the onset of high to low for the 2035 scenario;
- 60 dB $L_{Aeq,16h}$ during the day and 51 dB $L_{Aeq,8h}$ during the night, which would also reduce the predicted magnitude from high to the onset of medium for the 2053 scenario; and
- 63 dB $L_{Aeq,16h}$ during the day and 53 dB $L_{Aeq,8h}$ during the night, which would also reduce the predicted magnitude from high to medium during the Capacity scenario.

The Project's potential impacts resulting from noise during operation will therefore be direct, adverse, up to medium in magnitude when the road is operating at capacity, local in context, and long-term in duration.

Based on the above description of the impact, the residual impact should be classed as Moderate to Substantial depending on the scenario. Whilst this method is appropriate for assessing the significance of the impact when the new road has just been constructed (i.e., Year 2035 in this instance), this approach is likely to overestimate the significance of the worst-case scenario impact (Capacity) without considering the context of the noise effect, as discussed in ***Chapter 5 Methodology*** (***Appendix B***). As such the following contextual considerations discussed below have also been used to determine the residual significance.

In this instance, the impact magnitude of road traffic noise is expected to be initially 'low' when considering the mitigation treatment detailed above. The magnitude of the impact is then only expected to reach the onset of 'medium' impact after ~18 years, by which time it is reasonable to assume that existing receptors would consider the road as part of the existing noise environment. The changes in noise levels due to the gradual increase in road traffic flows are expected to be perceived as changes to an existing noise source that are less intrusive[12] than if an entirely new noise source was introduced. With the potential 7 dB reduction, the impact magnitude is not expected to exceed the medium threshold.

It is also noted that the general method used in the ESIA to convert between magnitude and significance is highly stringent for noise. Whilst it is appropriate to mitigate medium magnitude impacts as far as possible to reduce them, noise assessment practice in various countries would only require noise levels at the upper boundary of the medium magnitude category to be avoided, for instance by offering noise insulation at receptors. Given the above, it is considered appropriate to downgrade the overall residual significance from Substantial to ***Moderate***.

A summary of the significance of impacts on the noise and vibration before and after mitigation measures, during the construction and operational stages, is given in the following table.

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Construction Phase Impacts and Risks		
Noise and vibration from construction	Substantial	Moderate
Operational Phase Impacts and Risks		
Impact on air quality from traffic during operation	Negligible	Negligible
Noise and vibration from traffic during operation	High	Moderate

9.3 SURFACE WATER QUALITY AND HYDROLOGY

This section evaluates the project's effects on surface water quality and hydrology including the flow, springs, rivers, and streams because of project construction and operation. The hydrology of the project area is intricate, with extensive catchment areas.

As detailed in ***Section 6.2*** hydrological baseline, the discharge level during monsoon period (June to August) can get up to 1500 m^3/s to 3300 m^3/s while it can be diminished to few m^3/s during dry months. The Project area's fluctuating hydrology will affect floodplain dynamics, erosion, sedimentation, water quality, and related issues detailed in this section.

From a hydraulic perspective, the river flows are characterized by significant sediment deposition as material is transported from the mountains. A mix of sediment and debris will increase hydraulic loads on bridge structures and river training areas, leading to erosion during floods in

[12] A 3 dB change is sound pressure level is regarded as the minimum threshold for detecting a difference in environmental noise outside of laboratory conditions.

the monsoon season of June to August, where water frequently overflows onto the surrounding wide floodplains.

At the time of the Draft ESIA preparation, a HEC-HMS (Hydrologic Engineering Center's Hydrologic Modelling System) was used to simulate the hydrological cycle and estimate runoff across various catchments in the Project area to predict the impacts to the hydrological environment. By setting parameters like basin shape, size, and slope, HEC-HMS simulates water flow through the catchment, producing discharge estimates for various storm events or hydrological conditions. This preliminary modelling for the GMC was used for the assessment, however during the Feasibility Study a more comprehensive model will be undertaken to verify the road and bridge design. The detailed hydrology study will be utilized to update the assessment in the future once available.

The construction of the project access road, bridge foundation, river training works and highway all have the potential to impact hydrology and water quality. The potential impacts to hydrology include the following:

- Alteration of river flow and discharge including flooding /debris risk
- Increase erosion and sedimentation
- Surface water quality contamination from drainage and wastewater

Given the absence of specific regulations on surface water quality in the WBG General EHS Guidelines, the applicable thresholds should be referenced to national water quality standards regulated under the National Environment Commission Royal Government of Bhutan, June 2020.

The water quality environmental impact assessment methodology follows the method as detailed in ***Chapter 5 (Appendix B)***.

9.3.1 AVOIDANCE AND MINIMIZATION MEASURES

Project road and bridge design and construction and operations will include the following embedded controls that correspond to GIIP for transportation infrastructure including:

- Road design follows the Bhutan Standard "ICS:93.080.10, Draft Bhutan Standard on Road Geometric Design and Alignment Requirements, Bhutan Standards Bureau", with enhancements based on international standards to ensure water drainage requirements are met.
- The Bridge Design and Drainage design in the Feasibility Study will be based on a Detailed Hydrological Modelling for the watershed.

9.3.2 CONSTRUCTION PHASE IMPACT ASSESSMENT

The following activities can have impacts to surface water quality and hydrology during the Construction Phase of the Project:

- Site preparation/Land clearing
- Earthworks (Cutting and Filling)
- Construction of river training works
- Construction of bridges, including foundations, piers / abutments, and superstructures
- Construction of culverts / drainage and water management structures

The potential impacts to surface water are detailed in the following sections.

9.3.2.1 ALTERATION OF NATURAL WATER FLOW

9.3.2.2 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Construction of piers and foundations in the rivers can lead to disruption of the riverbed, increasing the risk of soil erosion and sediment runoff. The increase in sediment load may result in sediment runoff into nearby water bodies and disrupt the habitats. Construction across floodplains can interfere with their ability to absorb floodwaters, which may lead to flooding in the downstream areas. The disruption of the piers and foundation and construction of the bridges and construction of the river training may narrow the river's flow channels, which may increase flood risks.

To assess and predict impacts from the runoff across various catchments within project impact area, the analysis and results from the HEC-HMS and Rational Method are used.

(1) River Discharge Analysis

Based on the Hydrological Development of the GMC Project, the catchments' discharges are modeled using HEC-HMS and rational method has been applied for smaller catchments. The GMC region contains numerous catchments and sub-catchments, most of which have dry riverbeds for the majority of the year and only carry water during peak rainfall events. These smaller sub-catchments are typically very steep with a narrow shape, leading to a high runoff coefficient and peak discharge rates.

1. HEC-HMS

Hyetographs are used to represent 24-hour rainfall events, and the analysis has been conducted on 16 different catchments, focusing on estimating the peak discharge rates. The peak

discharges indicate the potential flood hazard's magnitude, allowing for adjustments to the boundaries of planned new developments accordingly.

The peak discharges for the catchments from a 5-year to 200-year return period are shown in ***Table 9.6***. The GMC project is expected to be impacted by the Sarpang, Bhur, Mau and Taklai Rivers.

Table 9.6 PEAK Discharges derived by the HEC-HMS model

			Q_p, m^3/s					
#	Name	Area [km^2]	RP5	RP10	RP20	RP50	RP100	RP200
1	Sarpang	135	2014	2461	2794	3305	3590	3954
2	Bhur	76	1276	1451	1748	2013	2200	2380
3	Mau	752	3740	4185	4762	5042	5874	6275
4	Taklai	90	1226	1302	1658	1921	2107	2285

Source: Hydrological Development of the Gelephu Mindfulness City Project, Bhutan, 2024

As shown in the baseline chapter, the maximum discharges occur during the monsoon period (June-August) at the Mau River, with peak average daily discharges at 3,300 m³/s for a 50-year return period. The peak discharge will be increased to 5,042 m³/s with the GMC project.

With the increased daily peak discharge can lead to significant flooding risks at the downstream area at the low-lying areas. The increased discharge can destabilize riverbanks, leading to erosion and channel widening. This can alter the rivers course over time and affect the local ecosystem. With the increased peak discharge rate, the sedimentation is expected to be larger, which can cause an increase in turbidity and affect surface water quality.

2. Rational Method

For smaller catchments, the peak discharge is estimated using the rational method. Assuming a direct relationship between rainfall intensity, catchment area and runoff, using the following formula:

$$Q = CiA$$

Where
Q = Peak discharge
C = Runoff coefficient, representing the land's ability to shed water
i = Rainfall intensity or a specific return period
A = Catchment Area

As the GMC area mainly consists of steep slopes, a high runoff coefficient ($C = 0.6$) is used for the Rational Method.

Peak discharges for various sub-catchments in the developable areas based on catchment size have been calculated using the Rational Method and shown in ***Table 9.7***. Tc(avg) refers to the average time of concentration, which is the time it takes for runoff from the most distant point in a catchment area to reach the outlet. It's a key parameter in determining how quickly rainfall translates into peak flow at the outlet.

Table 9.7 Peak Discharges derived with rational method

			Q_p, m^3/s							
Catchment Size [km^2]	Run-off Coefficient	Tc (avg)	RP2	RP5	RP10	RP20	RP50	RP100	RP200	RP500
0.25	0.6	0.2	4	6	7	8	9	10	11	12
0.5	0.6	0.3	9	12	14	16	18	20	22	24
1	0.6	0.3	18	23	27	31	36	40	43	48
2	0.6	0.4	35	47	55	62	72	79	86	96
5	0.6	0.6	88	117	136	155	179	198	216	240
8	0.6	0.8	118	187	218	248	287	316	346	383
10	0.6	0.9	137	234	236	269	312	344	376	419
12	0.6	1.0	177	241	283	323	374	413	452	503
15	0.6	1.2	221	301	354	403	468	516	565	628
20	0.6	1.5	295	402	471	538	624	689	753	838
30	0.6	2.1	347	478	563	429	750	828	907	1011

(2) Combined Flood and Debris Flow Hazard

The Taklai River flows through Zamlingthang village in the Umling Gewog, which is adjacent to Sershong Gewog. The Taklai River, while providing water for irrigation to the gewog, is also known for causing floods, erosion and sedimentation in the area. The combined flood and debris flow hazard map is shown in ***Figure 9.2***. The flood hazard map with 5-year and 100-year return period are shown in ***Figure 9.3***, indicating the region near Mau River is the most susceptible to flood impacts.

Flood hazard indicator map form CDR[13] highlights areas prone to flooding and related hazards, such as debris flows. It shows that the Project Area falls into high to very high flood risk levels due to its proximity to multiple rivers, especially the Mau River, which poses a significant flood threat across the project site, as shown in ***Figure 9.4***.

Based on the above analysis, the project's potential impacts resulting from construction will be direct, adverse, high in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Substantial***.

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FIGURE 9.2 PROJECT COMBINED FLOOD AND DEBRIS FLOW HAZARD MAP

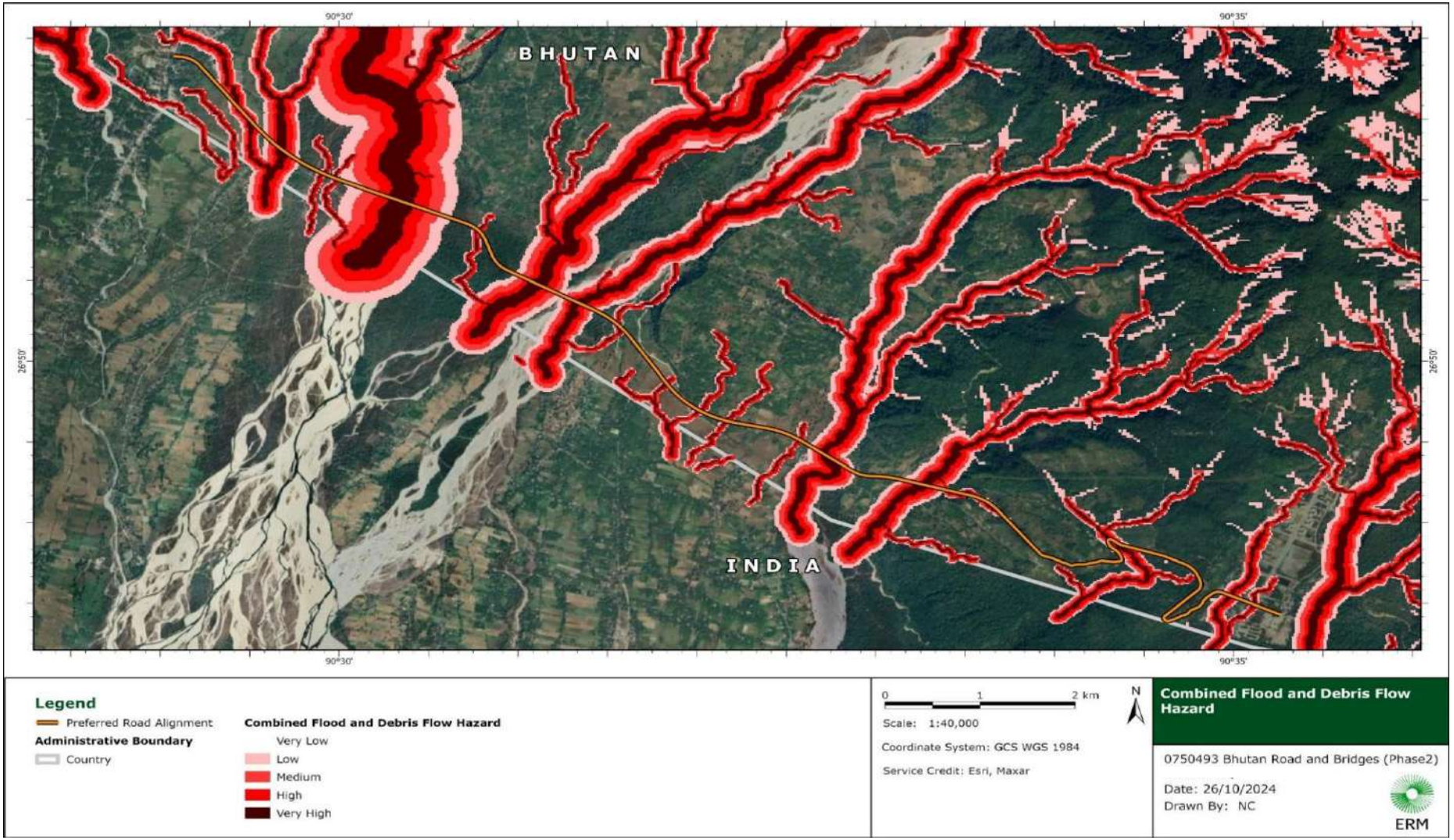
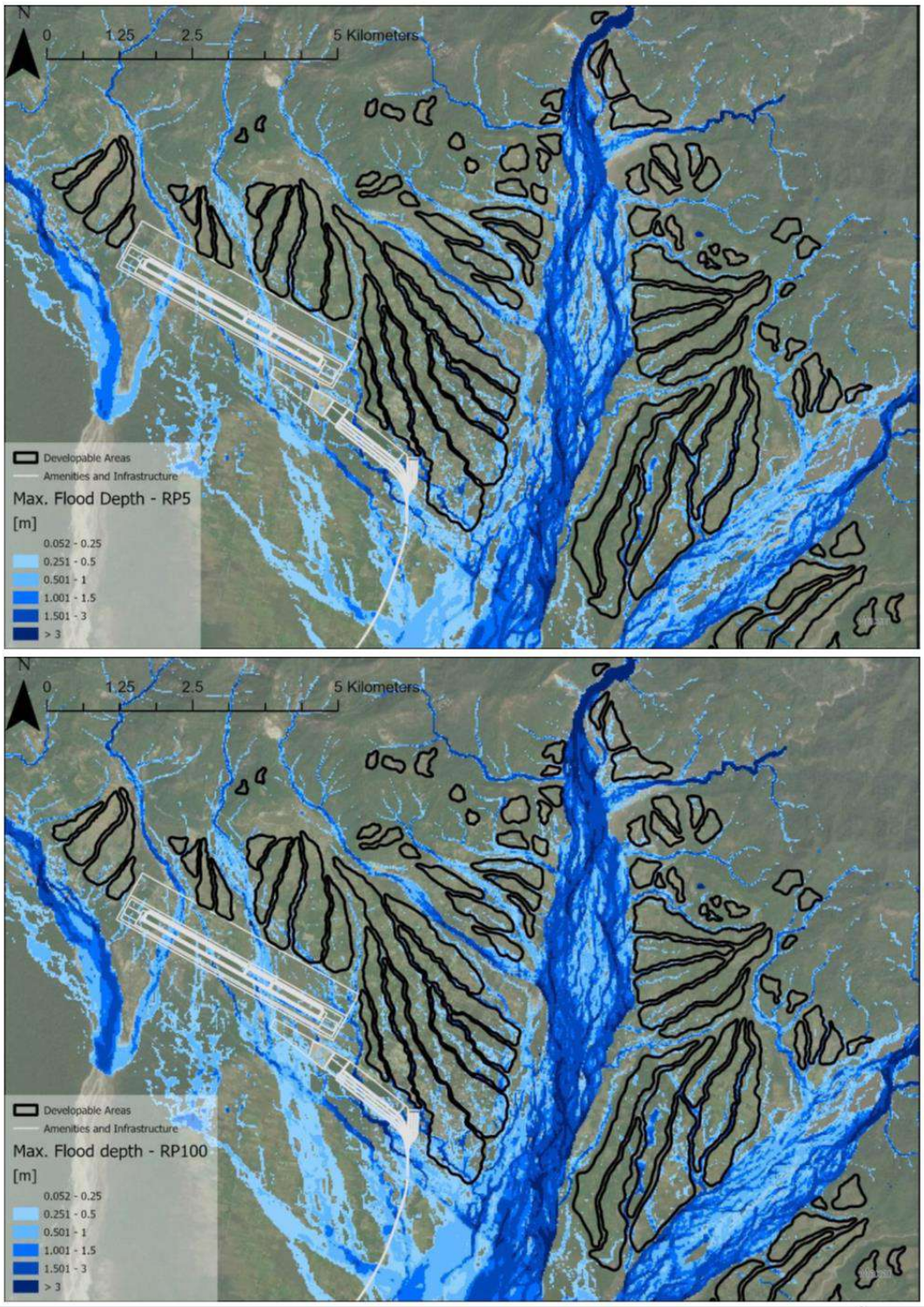


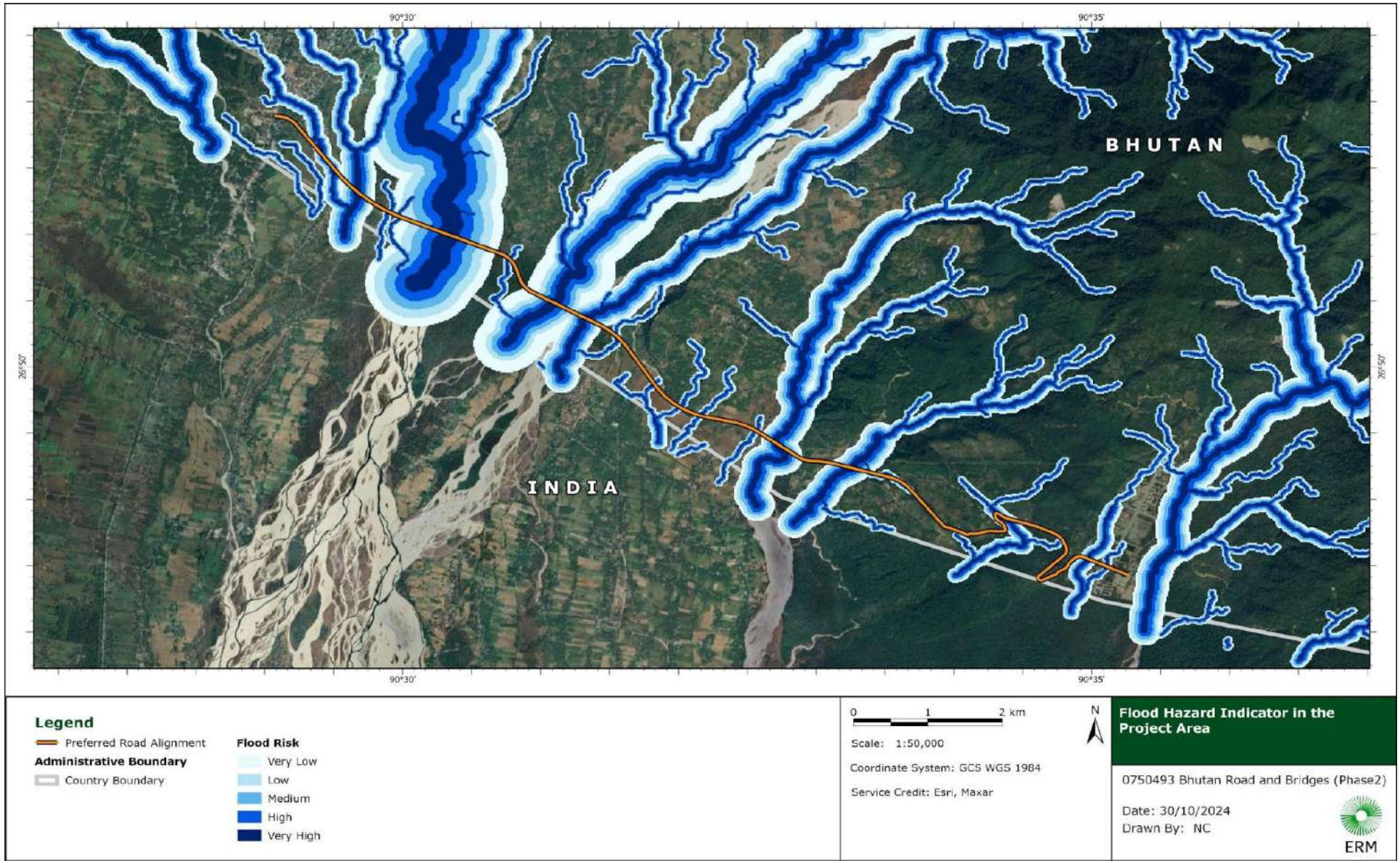
Figure 9.3 Maximum water depths for an event with a 5-year and 100-year return period in Gelephu



Maximum water depths for an event with a 5-year and 100-year return period	
0750493 Gelephu-Tareythang Road Project	
Photo Credit: CDR (2024)	Date: October 2024

ERM

Figure 9.4 Flood Hazard Indicator Map



9.3.2.3 PROPOSED MITIGATION MEASURES

Any manmade structure may induce alteration to natural water flow, including the bridge piers and road surfaces. Bridge designs in the Project have adopted limited numbers of piers in the river channels, as reflected in the alternatives ***Chapter 4***. The design of the culverts also plays a significant role in hydrology by influencing water flow and drainage patterns.

The foundation and sub-structure will comprise single or twin column integral pile cap on pile group. The piles will be cast in-situ reinforced concrete bored piles. The pier columns will be either solid or hollow rectangular cast in-situ reinforced concrete. The embankments will be used to transition from the at-grade road to the bridge structures. 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. At the time of the Draft ESIA preparation, the Culvert internal dimensions were 2.5m x 2.5m. 400mm thick slabs and walls.

The Mau bridge will carry two (02) lanes of traffic in each direction with provision for pedestrians on both and will utilize a traditional concrete box girder deck, with 80m spans over the river and typically 50 m spans on each side has been developed. The Jengkhurung and Taklai Rivers, Langer River and Singye River bridges will all utilize a concrete box girder with typical spans of 60 m in length. For the small streams and dips in the ground level some minor bridges and culverts will be required. The proposed form of these minor bridges will be concrete beam and slab with typical spans of up to 40 m in length.

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.

The other additional mitigation measures are recommended:

- Sufficient drainage capacity to withstand the design rainfall of RP100.
- The highway is designed to have 2% slope for drainage purposes. 2% slope is typically used to improve drainage by guiding rainwater off the road surface to culverts along the sides of the highway.
- Ensure a comprehensive hydrological and hydraulic study is completed to ensure engineering design each bridge location is met to ensure strong climate resilience for the future discharge rates due to climate change impacts (approximate potential 20% increase in flow)
- Detailed design to include bioengineering and slope protection work, established engineering structures. Some of the nature-based solutions are listed here:
    - Riparian Buffer Zones: Establishing vegetated buffer strips with native shrubs, grasses, and trees along the riverbanks helps stabilize soil, reduce erosion, and filter runoff. This enhances biodiversity, reduces sedimentation in the river, and minimizes the impact of construction.
    - Bio-swales**:** Bio-swales are shallow, vegetated channels designed to slow, capture, and filter runoff. For bridge construction, bio-swales can be located near roads or entry points to the construction site to capture runoff before it reaches the river.

They are typically planted with native grasses, shrubs, and deep-rooted plants that filter pollutants, encourage infiltration, and support groundwater recharge.

- Bioengineering Techniques: Techniques like live staking, where cuttings from native plants are planted in the bank to take root, help reinforce soil and reduce erosion. Other options include using live fascines (bundles of branches) and coir rolls, which are biodegradable and support plant growth, adding structure to riverbanks.
- Floodplain Restoration and Reconnection: Reconnecting floodplains and restoring them allows water to spread naturally, reducing flood risk near bridge crossings. This slows down water flow, mitigates flood risks downstream, and enhances groundwater recharge.
- Revetments with Natural Materials: Constructing revetments using logs, tree roots, and rocks (versus hard concrete) creates stable bank structures that blend with the natural environment. Such revetments protect against erosion and create habitats for aquatic species.
- Green Terraces or Stepped Banks: Incorporating terraced or stepped banks with native vegetation reduces erosion and provides habitats for various species. These terraces can be designed to absorb floodwaters, reducing pressure on banks and bridge foundations.
- Wetland and Aquatic Vegetation Planting: Planting aquatic plants like bulrushes, cattails, and sedges near bridge abutments or shallow river sections can reduce water flow speeds, trap sediment, and protect banks from erosion. Wetlands also act as natural water filters, enhancing water quality.
- Sediment Control with Vegetated Buffer Mats: Using vegetated mats or sediment traps in construction zones can reduce downstream sedimentation during bridge construction. These mats can be strategically placed to slow water flow and filter sediments.

- Defined legal sites for excavation of sand, gravel and aggregates.
  - Limit the material extraction from the river only in the deposited areas and no excavations in the active river channels.
  - Use materials only from legal sites and plants with licenses on extraction of construction materials. This will be spelled out in the bidding documents, in work contracts and will be verified in the C-ESMP prepared by the Contractors
  - Obtain a permit from local authorities for opening and/or use of borrow areas and quarries
  - Extraction of sand and gravel will be spread over the longest length possible from seasonal rivers so that no section of river bed is excessively disturbed
  - Source the material from the dry river beds and the non-perennial streams.
  - After the completion of extraction, the site will be properly fenced and closed, landscaped
- Borrow sites will be restored after completion of the works

9.3.2.4 RESIDUAL SIGNIFICANCE

The proposed mitigation measures would reduce the magnitude of the impact from High to Moderate (taking into consideration the proposed compensation for any damage), so the project's potential impacts on river flow during construction will be direct, adverse, medium in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Moderate***.

9.3.3 EROSION AND SEDIMENTATION

9.3.3.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

During the construction stage, earthworks, excavation and disposal of spoil could damage the mountain slopes and cause slope instabilities. Soil erosion may happen due to heavy rainfall during monsoon season, causing adverse impacts on the environment. Instream river works and material extraction from rivers can also cause changes to erosion and sedimentation. The sedimentation of downstream water bodies may cause damage to aquatic habitat and agricultural lands. The impact will be trans-boundary in nature as all the rivers and rivulets from the project area flow towards the plains of Indian state of Assam.

Construction activities contribute to soil loss from areas exposed to rain and runoff, leading to increased sediment entering rivers and streams. Slope erosion is particularly common during rainy periods in susceptible areas.

Based on the above analysis, the project's potential impacts resulting from erosion and sedimentation will be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Moderate.***

9.3.3.2 PROPOSED MITIGATION MEASURES

To minimize or avoid the induced impacts, the recommended designs and structures proposed under the detailed design will be implemented during the construction stage.

Long term mitigation involves application of civil and bioengineering techniques such as seeding and stabilizing slopes, in order to reduce sediment loss and minimize the induce impact. Land clearing and excavation will be halted on rainy days, and construction will generally be conducted during the dry season, specifically from October to May, where much lower rainfall would be expected.

The Project will implement the following mitigation measures to reduce the risk of erosion and sedimentation during construction:

- Prohibit the Contractor from clearing or disturbing any land beyond those approved by the Authorities.
- Require the Contractor to prepare a detailed Erosion and Sediment Control Plan, with special provisions for controlling all disturbed areas during the monsoon season.
- Implement the grievance mechanism, which will allow local stakeholders to inform Authorities and the Contractor of any erosion and sedimentation issues. Install approved sediment control measures before initiating land disturbing activities such that drainage from all disturbed areas is directed to a sediment control facility (e.g., silt fence, sediment trap, sediment pond).

- Preserve as much natural vegetation as possible especially near streams, floodplains, wetlands, steep slopes, and residential areas.
- Remove, store, and seed or cover topsoil, along with associated leaf litter and organic matter, for post-construction land stabilization.
- Manage excavated material by providing silt fencing / straw bales / berms around all topsoil / soil stockpiles and spoil disposal sites prior to commencement of earthworks.
- Prohibit the Contractor from side-casting or discharge to streams of any excavated material.
- All excavated material must either be re-used as fill material or hauled and properly disposed of at an approved spoil disposal site;
- Provide proper drainage controls to manage water flow through disturbed areas and to direct surface water away from steep slopes or other erodible areas to natural drainage ways;
- Protect exposed slopes by installing cut-off drains above and toe-drains below high cuts and provide terracing as needed so as to avoid the potential concentration of stormwater runoff across disturbed soil;
- Conduct grading, excavation, and slope stabilization in a progressive manner across the site to minimize soil exposure both in terms of area and duration;
- Stabilize disturbed areas as soon as possible in a progressive manner;
- Provide properly designed gabions/retaining walls for all spoil disposal sites;
- Ensure all erosion and sediment control measures are in place and functioning properly before the advent of the monsoon season;
- Provide regular (at least monthly) inspection of all erosion and sediment control structures to ensure they are working properly;
- Provide gravel or concrete pathways along routes expected to receive heavy pedestrian traffic to reduce the risk of erosion;
- Apply the stockpiled topsoil to help stabilize disturbed areas and promote the re-establishment of local native vegetation;
- Use native grass seed and species to vegetatively stabilize disturbed areas. Use of invasive or foreign species is expressly prohibited;
- Restrict vehicular traffic and pedestrian movement over vegetatively stabilized areas;
- Maintain, and repair as needed, the erosion and sediment control facilities until vegetation is successfully established and the disturbed areas are effectively stabilized;
- Provide special sediment control measures to minimize the increase of sediment entering the micro-hydropower plant intakes to avoid affecting the turbines, or provide electricity to the local villages;
- Limit the material extraction from rivers to deposit areas only and prohibit excavations in active river channels; and
- Include an experienced sediment and erosion control inspector.

9.3.3.3 RESIDUAL SIGNIFICANCE

The proposed mitigation measures would reduce the magnitude of the impact from Medium to Low, so the project's potential impacts on erosion and sedimentation during construction will be direct, adverse, low in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Low***.

9.3.4 SURFACE WATER QUALITY DEGRADATION

9.3.4.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Drainage

The Project will generate stormwater runoff from various facilities, including project roads, worker camps, maintenance yards and spoil disposal areas. This stormwater can carry various contaminants, including oil, grease, and metals, which can degrade water quality. Although they should still be suitable for irrigation purposes, these streams should not be used for any potable uses, at least without appropriate treatment.

Chemical & Fuel Storage

In addition to sediment erosion, construction activities often involve the use of chemicals / fuel. Mishandling these materials may contaminate surface waters, resulting in reduced water quality, harming the aquatic life and affecting drinking water sources for the locals.

Spoil management

During the land clearing, the removal of existing land will result in temporarily increase of runoff; consequently, leading to sediment erosion from the land and an increase in riverine flow and subsequent reduction in the quality of water due to influx of TSS resulting in low DO.

Wastewater

Improper management of wastewater generated by workforce activities during land clearing can lead to the contamination of surface water. This wastewater, especially when discharged uncontrolled, typically has high levels of acidity (pH), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), oil and grease, nutrients (such as ammonia), and Total Coliform.

Moreover, heavy rainfall can cause overflow or rapid movement of effluent to surface water before it is fully treated in septic tanks. Raw sewage can significantly affect surface water quality by introducing pathogens that may be harmful to both humans and ecological systems. Sanitary wastewater is often characterized by high concentrations of solids (both suspended and dissolved), BOD, COD, nutrients (including nitrogen and ammonia), and Faecal Coliform counts. The organic materials (such as hydrocarbons and proteins) decompose in water, which can lead to a reduction in dissolved oxygen levels due to the decomposition of organic matter.

Based on the above analysis, the project's potential impacts resulting from construction will be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Moderate***.

9.3.4.2 PROPOSED MITIGATION MEASURES

At a minimum, the Contractor will be required to implement the following mitigation measures to avoid or minimize potential water quality risks from stormwater runoff:

- The Contractor will be required to prepare a Stormwater Management Plan describing in details the methods it will use to minimize impacts to water quality.
- Ensure all drainage from these facilities including worker camps is directed to one or more stormwater basin to allow settling of suspended solids prior to discharge.
- Limit the material extraction from the river only in the deposited areas and no excavations in the active river channels.
- Construction-use cement shall be bagged and store on an impervious surface in a covered area to prevent exposure to water sources. The drainage from the cement storage area shall be directed to the stormwater basin for suspended solid settling prior discharge.
- Redirect surface drainage around the spoil disposal areas to minimize runoff.
- The stormwater basins will be regularly maintained to maintain its storage volume and the pH tested on a regular basis as the runoff can be highly alkaline (i.e., high pH). Treat water in the basin for high pH with a neutralizing acid (e.g., muriatic acid) as needed before discharge to a receiving stream.

For areas with chemical use including fuel depot, maintenance shops and fabrication shops:

- Provide an impervious surface and covered area for all workspaces.
- Use a drip tray to collect oil and grease during vehicle maintenance.
- Repair any leaking vehicles or equipment immediately
- Direct all drainage potentially exposed to oil and grease to an oil/water separator.
- Ensure all drainage is directed to one or more stormwater basins to allow settling of suspended solids prior to discharge

For Spoil Disposal Areas:

- Redirect surface drainage around the spoil disposal areas.
- Provide a settling basin for drainage from the spoil disposal areas
- Test the pH of the water in the settling basins and add neutralizing material (e.g., lime) if any evidence of acidic conditions, which can promote the mobilization of metals.

The Project will implement the following measures consistent with international good practice on reducing impacts on wastewater disposal:

- Prohibit the discharge of any untreated wastewater to any receiving water;
- Prohibit open defecation by project workers;
- Provide an enhanced septic system with a bioreactor or similar design or a package wastewater treatment facility for each of the project access road worker camps. The wastewater treatment system selected must be designed to meet the Bhutan national water quality standards and the WBG EHS guidelines, whichever is stricter, and avoid any contamination of local potable water sources;
- Provide a wastewater treatment facility (e.g., a package wastewater treatment plant) at worker camps to treat domestic wastewater prior to discharge to a receiving water.

- The wastewater treatment facility will provide secondary treatment and ensure, through regular/frequent monitoring that the effluent meets the Bhutan national water quality standards and the WBG EHS guidelines, whichever is stricter;
- Ensure the effluent discharge locations for all wastewater treatment plants are downstream of all sites used by local residents for potable water;
- Provide separate portable toilets for men and women at each of the project work areas. These toilets will be emptied on a regular basis by sewage trucks. These trucks will transport and discharge the wastewater into the wastewater treatment facility influent for treatment prior to discharge to a receiving water; and
- Maintain the wastewater treatment facilities in accordance with manufacturer specifications and conduct daily monitoring of effluent water quality.

Provide safe potable water to households relying on water sources downstream of construction activities. Provision of safe water could include extending the project's water system, installing a well, or piping water from locations upstream of any project facilities.

9.3.4.3 RESIDUAL SIGNIFICANCE

The proposed mitigation measures would reduce the magnitude of the impact from Moderate to Low, so the project's potential impacts on water quality during construction will be direct, adverse, low in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Low***.

9.3.5 OPERATION PHASE IMPACT ASSESSMENT

The following activities can have impacts to surface water quality and hydrology during the operation Phase of the Project:

- Road Operation and Maintenance

The potential impacts to surface water are detailed in the following sections.

9.3.5.1 DRAINAGE

9.3.5.2 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The alteration of the natural water flow in the rivers will mostly be completed during the construction and the impacts have been covered in ***Section 9.3.2.1***.

During operations the drainage system is required to manage the surface runoff from the road and bridges. These systems frequently divert water from natural channels, altering hydrological patterns and potentially causing downstream flooding if not properly designed. Stormwater runoff from the Project has the potential to marginally degrade downstream water quality should any contaminants be released onto the road surface.

Based on the above analysis, the project's potential impacts resulting from operations will be direct, adverse, low in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***Moderate***.

9.3.5.3 PROPOSED MITIGATION MEASURES

The Project will implement the following mitigation measures to reduce from drainage during operations:

- Regular inspection and maintenance of drainage and culverts to ensure no blockage and also perform routine surveys of the area to make sure the slopes are maintained during the operation of the road.
- Strictly prohibit disposal of solid wastes by local people
- Avoid disposal of any excess material in natural drainage paths
- If temporarily disposed, clear drainage path prior to start of rainy season
- Sufficient drainage capacity to withstand the design rainfall of RP100.
- Regularly monitor areas prone to erosion and rehabilitate with native vegetation to enhance stability.
- Engage with the Bhutan Meteorological Department on early warning systems and future forecasting of rainfall events (e.g. implement real-time hydrological monitoring stations to assess changes in water levels, flow rates, and quality, particularly during monsoon seasons) so that potential risks can be addressed promptly and activate pre-storm monitoring and maintenance activities.
- Install oil-water separators in areas with heavy traffic or rest stops to capture vehicle pollutants and prevent contamination of nearby water sources.
- Conduct regular water quality monitoring at runoff discharge points to detect pollutants and initiate corrective actions if contamination is detected.
- Provide adequate facilities for spill containment and quick response measures to minimize impact on water resources in case of hazardous spills.
- Engage local communities in maintaining vegetated areas around highways and in awareness campaigns on the importance of protecting water resources.
- Develop a feedback mechanism for residents to report road or drainage issues that could impact water resources, enhancing responsiveness to environmental risks.
- Preserve and maintain natural vegetation buffers along riverbanks near the highway to filter runoff, stabilize banks, and provide habitat for aquatic species.
- Encourage riparian restoration by planting native vegetation to control erosion and filter sediments, helping maintain water quality in streams and rivers.
- Establish a regular monitoring program to assess the health of riparian buffers, checking for signs of erosion, plant health, and water quality.

9.3.5.4 RESIDUAL SIGNIFICANCE

The proposed mitigation measures would reduce the magnitude of the impact from Medium to Low, so the project's potential impacts on erosion and sedimentation during construction will be direct, adverse, low in magnitude, site-specific in context, and long-term in duration, with an overall residual significance of ***Low***.

9.3.6 SURFACE WATER QUALITY IMPACT ASSESSMENT SUMMARY

Table 9.8 summarizes the surface water quality impact assessment.

Table 9.8 SURAFACE WATER QUALITY Impact Assessment Summary

		Magnitude	Extent	Duration	Overall
Alteration of natural water flow (construction)	Pre-mitigation	High	Local	Long-term	Substantial
	Residual	Medium	Local	Long-term	Moderate
Erosion And Sedimentation	Pre-mitigation	Medium	Local	Medium-term	Moderate
	Residual	Low	Local	Medium-term	Low
Water quality degradation from drainage and wastewater disposal	Pre-mitigation	Medium	Local	Medium-term	Moderate
	Residual	Low	Local	Medium-term	Low
Alteration of natural water flow (operations)	Pre-mitigation	Medium	Local	Long-term	Moderate
	Residual	Low	Site-Specific	Long-term	Low

9.4 SOIL & GROUNDWATER QUALITY

In the project area, where the terrain ranges from moderate to steep slopes, topsoil is a highly valued resource due to slow soil development and a high risk of erosion. High-quality topsoil is typically found only in a few locations with gentle to moderate slopes. Impacts on the soil environment occur from a number of causes during the detailed design and construction of the roadways. The following activities can have impacts to soil quality during the Construction Phase of the Project:

- Site preparation/Land clearing
- Earthworks (Cutting and Filling)
- Road construction & retaining walls
- Construction of river training works
- Construction of bridges, including foundations, piers / abutments, and superstructures
- Construction of culverts / drainage and water management structures

The operational phase will have limited impacts on soil and groundwater quality and is thus scoped out.

9.4.1 METHOD OF ASSESSMENT

Given the absence of specific regulations soil and groundwater quality in the WBG General EHS Guidelines and under the National Environment Commission Royal Government of Bhutan, June 2020 the applicable standards for soil are the Dutch and USEPA and for Groundwater is the WHO.

The water quality environmental impact assessment methodology follows the method as detailed in ***Chapter 5 (Appendix B)***.

9.4.2 AVOIDANCE AND MINIMIZATION MEASURES

The Project has adopted the following measures to avoid and minimize impacts to soils in accordance with the application of the mitigation hierarchy:

- Minimize disturbance of steep slopes, which are especially susceptible to erosion.

9.4.3 CONSTRUCTION PHASE IMPACT ASSESSMENT

The risks posed to soils from Project construction primarily relate to damage to soils (e.g., compaction) such that the soils are not suitable for reuse. Also, project activities will pose a risk for contamination to both soil and groundwater. Each of these potential impacts are described below.

9.4.3.1 SOIL COMPACTION AND DAMAGE

1 Pre-mitigation Impact Assessment and Significance

Project construction could damage soils, primarily as a result of soil compaction from the construction of buildings or the use of heavy equipment. This damage could affect the ability to return agricultural and other lands back to their original use and productivity after completion of construction.

With any Site preparation, land clearing, earthworks and construction works, the loss of topsoil can affect the soil fertility as top soil is often rich in organic matter and nutrients. The damaged soils can make it challenging for vegetation to re-establish, which will often lead to soil restoration.

Based on the above analysis, the project's potential impacts resulting from soil compaction will be direct, adverse, medium in magnitude, site-specific in extent, and long-term in duration, with an overall pre-mitigation significance of ***Moderate.***

2 Proposed mitigation measures

The Project will implement the following measures to conserve soil resources at the site:

- Prohibit the Contractor from clearing or disturbing any land beyond those approved by the Authorities.
- Install and maintain approved erosion control measures before initiating land disturbing activities to protect soil resources.
- Remove, store, and cover topsoil, along with associated leaf litter and organic matter, for postconstruction land stabilization.
- Apply the stockpiled topsoil to help stabilize disturbed areas and promote the re-establishment of local native vegetation.
- Aerate compacted soils and provide soil amendments (e.g., fertilizer) as needed to restore the productivity of agricultural soils.

3 Residual significance

Implementation of these measures will reduce the magnitude of the impact to low. Therefore, the project's potential impact on soil compaction during construction will be direct, adverse, low in magnitude, site-specific in extent, long-term in duration, with an overall residual significance of ***Low***.

9.4.3.2 CONTAMINATION OF SOIL & GROUNDWATER

1 Pre-mitigation Impact Assessment and Significance

The soil cover in Gelephu is mainly alluvial type at the lower part, which promotes a high rate of infiltration as the material is coarse. Soil contamination is likely due to the possible leakage of fuel/chemicals and dumping of construction wastes during construction stage with the topsoil damaged.

Construction material such as concrete and cement contains a wide range of compounds which can turn soil alkaline when it comes to contact with water. As the pH of the soil from baseline survey ranged from 5 to 7. An increase in pH may affect soil fertility and have potential impacts on agriculture. Organic waste like wood scraps from construction can decompose and alter soil nutrient balance. Herbicides may be used in construction for land clearing, it can retain in soil and it can affect the microorganisms at the soil and affect local vegetation.

The groundwater exploration in Gelephu, Sarpang, indicates that the hydrogeologic features primarily support unconfined aquifers near the surface. The water table depth varies between wet and dry seasons, with groundwater flow directed towards the Mau River basin, assisted by the region's material composition and inclined topography, resulting in relatively high flow velocity. Aquifer depths generally range from 40 m to over 100 m.

The use of construction material such as oil, paints, solvents and heavy metals may find way to permeate soil, leading to the possibilities of contaminating groundwater. As groundwater is a source of drinking water of the locals, possible contamination may impact the livelihood of the locals.

Based on the above analysis, the project's potential impacts from contamination of soil will be direct, adverse, high in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***High***.

2 Proposed mitigation measures

At various construction sites, the vehicles and equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refueling sites are kept away from drainage channels and water bodies. Refer to ***Section 9.3.4*** for measures to minimize drainage/spillage of chemicals and unwanted material.

3 Residual significance

Implementation of these measures will reduce the magnitude of the impact to low and reduce the extent of the impact. Therefore, the project's potential impact from contamination of soil during construction will be direct, adverse, medium in magnitude, local in extent, long-term in duration, with an overall residual significance of ***Moderate***.

9.4.4 SOIL & GROUNDWATER IMPACT ASSESSMENT SUMMARY

Table 9.9 summarizes the soil and groundwater impact assessment from ***Section 9.4***.

Table 9.9 Soil Impact Assessment Summary

		Magnitude	Extent	Duration	Overall
Soil Compaction and Damage	Pre-mitigation	Medium	Site-Specific	Long-term	Moderate
	Residual	Low	Site-Specific	Long-term	Low

		Magnitude	Extent	Duration	Overall
Contamination of Soil & Groundwater	Pre-mitigation	High	Local	Long-term	High
	Residual	Medium	Local	Long-term	Moderate

9.5 WASTE MANAGEMENT

The Project will generate a variety of solid wastes, primarily domestic solid waste and construction debris. Waste materials have the potential to cause adverse environmental impacts during generation, storage, transport and disposal. The principal adverse effects relate to dust, water quality, general health and safety and visual impacts.

The following activities can cause waste impacts during the Construction Phase of the Project:

- Worker mobilization/influx
- Procurement of material and operation of borrow pits
- Site preparation/Land clearing
- Earthworks (Cutting and Filling)

The estimated solid waste to be produced from the Project's construction includes:

Table 9.10 Type and Quantity of Waste Generated during Construction

Waste type	Quantity	Source/Activities
Domestic solid waste	1,250 kg/day	Waste generated from the activities of officials, workers, including organic waste, surplus food, plastics, paper, glass
Construction solid waste	1,000 kg/day	Waste generated from the construction site area, including concrete, broken bricks, damaged construction materials
Hazardous waste	5.8 kg/day	Oil-soaked rags and grease waste containers
	4.35 L/day	Liquid hazardous waste
	11.9 kg/day	Non-oil and grease-related hazardous waste

Source: ARUP, 2024

9.5.1 METHOD OF ASSESSMENT

The waste management impact assessment methodology follows the method as detailed in ***Chapter 5 (Appendix B)***.

9.5.2 AVOIDANCE AND MINIMIZATION MEASURES

The Project has adopted the following measures to avoid or reduce impacts to air quality in accordance with the application of the mitigation hierarchy:

- Avoiding and/or minimizing waste generation where practical by improvements or changes in the project design or site procedures.
- Reusing / recycling / recovering materials where possible and thereby negating / minimizing disposal requirements (e.g. by waste segregation according to type,

separation of recyclable materials such as metal, reuse of wood from site hoarding/concrete formwork, utilization of excavated material for filling or landscaping).

- Ensuring that all treatment and disposal options comply with best practice and all relevant guidelines and legislation.
- Coordinate with local authorities for waste disposal and ensure that waste management aligns with local standards and practices, including the identification of disposal sites and obtaining relevant permits

9.5.3 CONSTRUCTION PHASE IMPACT ASSESSMENT

9.5.3.1 WORKER MOBILIZATION / INFLUX

1 Pre-mitigation Impact Assessment and Significance

The large-scale development will lead to a significant influx of workers into the area, resulting in a substantial increase in municipal and sanitary waste generation. Without proper waste management, this could pose risks to air quality and public health.

Currently, the area has limited waste treatment capacity within the region with 1 landfill located 12 km from core town. The landfill is lined with leachate pits and is management by the Gelephu Environmental Division. This landfill can accept general domestic waste, but not hazardous waste. Hazardous waste to be transported to the existing waste incinerator in Thimphu.

Based on the above analysis, the project's potential impact from improper solid waste disposal during the construction will be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Substantial***.

2 Proposed Mitigation Measures

The Contractor will be required to prepare a detailed Solid Waste Management Plan describing in detail the methods it will use to manage wastes in accordance with international good practice. At a minimum, the Contractor will be required to implement the following mitigation measures to avoid improper solid waste disposal:

- DoST to Support the Gelephu Environmental Division to expand the existing land fill in Gelephu to be able to manage the increase in domestic hazardous wastes.
- EPC contractor to Develop Waste Management Plan for various specific waste streams prior to commencing of construction and submit to DoST for approval. Minimum requirements include:
    - Provide appropriate waste storage areas and waste segregation practices
    - Separate domestic waste from construction waste;
    - Food waste collected and composted or transported to vermicompost treatment area
    - Transport all non-recyclable domestic waste by the Gelephu Environmental Division waste collector or the EPC construction contractor will be responsible to ensuring the safe transport of solid waste in covered trucks/containers to an approved solid waste landfill at least once a week for disposal. Domestic solid waste transported and disposed at the Gelephu landfill with approval from Gelephu Environmental Division.
    - Store solid waste temporarily on site in designated areas. The storage area shall include a covered concrete pad to avoid direct contact with precipitation and surface

runoff and be fenced to prevent wind-blown litter. Waste storage containers shall be covered, tip-proof, weatherproof, and scavenger proof;

- Transport all other construction debris offsite for disposal at Gelephu landfill with approval from Gelephu Environmental Division;
- Remove all construction-related debris from the site both during construction and at the completion of construction.
- Separate our hazardous waste containers (oil, gas and chemical containers) and return back to vendor for proper disposal. No hazardous materials can be disposed in the area. Hazardous waste must be stored and safely managed. .

- Maintain all facilities in a neat and tidy condition and keep all construction sites free of litter;
- Random disposal of solid waste shall be strictly prohibited;
- Provide easily identifiable and marked litter bins/garbage receptacles at convenient locations within the worker camps and work areas to reduce the potential for litter and discourage negligent behavior;
- Train workers in the principle of the 3R's (reduce, reuse, and recycle) and apply this to the extent possible:
  - Segregate recyclables and perishables at the worker camps and provide separate clearly marked containers.
  - Collect, recycle, reuse, or make available to local scrap dealers all metal, empty cement bags, various containers, glass, wood, plastics, packaging material, wooden pallets, spent batteries, and rejected materials.
- Training and waste management for health and safety to be included in contractors contract document;
- The burning and burial of domestic wases within fill or backfill areas will be prohibited;
- Inert construction debris (e.g., waste concrete), can be disposed of within the spoil disposal areas.

Implementation of these measures will reduce risk and magnitude of impacts associated with improper waste disposal.

3 Residual Significance

Implementation of these measures will reduce the magnitude of the impact to low. Therefore, the project's potential impact from improper solid waste disposal during the construction will be direct, adverse, low in magnitude, local in extent, medium-term in duration, with an overall residual significance of ***Low***.

9.5.3.2 WASTES GENERATED FROM SITE CLEARANCE, EXCAVATIONS LAND CLEARING

1 Pre-mitigation Impact Assessment and Significance

Solid wastes generated by construction activities including site clearance and excavations may generate large quantities of waste materials, which need to be managed efficiently to minimize environmental impact such as air and water quality.

Soil erosion and sedimentation are potential environmental impacts if the excavated materials are not properly handled. Sedimentation and run-off from work sites may lead to contamination of soil and groundwater.

Based on the above analysis, the project's potential impacts resulting from site clearance and excavations will be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Substantial***.

2 Proposed mitigation measures

All materials should be re-used or transported off site as soon as possible to minimize the potential of adverse environmental impacts. It is recognized that some stockpiling of materials will be required in some instances although these should be segregated in terms of material type as far as practical to facilitate material re-use (i.e. topsoil for landscaping, suitable fill for engineering works).

All excavated material should be handled in a manner that minimizes the release of fugitive dust (especially during hot and dry weather) and where possible the movement of material should be kept to a minimum. Within the stockpile area, the following measures should be in place to control potential impacts.

- Covering material during heavy rainfall;
- Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin);
- Controlling the excessive use of water during spraying to prevent the generation of runoff contaminated with elevated levels of suspended solids;
- Segregation of the surface water system for the stockpile area and the fitting of silt traps where appropriate;
- Locating stockpiles to minimize potential visual impacts;
- Minimizing land intake of stockpile areas as far as possible;
- Provide fencing within designated areas to separate sensitive habitats and prevent stockpiling in unsuitable locations; and designate appropriate haulage roads;
- Minimizing excavation requirements as far as possible;
- Balancing cut and fill requirements;
- Evaluating the potential for maximizing the re-use of excavated materials for example, within landscape mounds;
- Considering treatments for unsuitable excavated materials e.g. upgrading of subsoils to topsoil by mixing with compost;
- Providing an area within the construction site to allow for sorting and segregation of materials;
- Segregating waste materials according to type in order to facilitate re-use and recycling;
- Co-ordinate material deliveries to site in order to minimize storage time on site and the likelihood of causing damage;
- Consider on site mulching of vegetation to reduce bulk and review opportunities for possible use within landscaping areas;

- Training site staff in waste minimization practices.

A reduction in the total volume of excavated materials requiring offsite disposal will be achieved as far as possible by optimizing the re-use of suitable material on-site.

In accordance with good practice, accurate site records should be maintained throughout the construction works detailing the quantities of materials; a) generated on site; b) reused on site; and c) disposed off-site, together with disposal routes/locations.

3 Residual Significance

Implementation of these measures will reduce the magnitude of the impact to low and reduce the extent of the impact. Therefore, the project's potential impact from site clearance and excavations will be direct, adverse, low in magnitude, site specific in extent, short-term in duration, with an overall residual significance of ***Low***.

9.5.3.3 HAZARDOUS MATERIAL WASTE MANAGEMENT

1 Pre-mitigation Impact Assessment and Significance

Project construction will require the transport, storage and use of low amounts of various hazardous materials including oils, lubricants, paints, concrete additives and other materials. The generate hazardous wastes from these materials, which could pose risks to water quality and public health if not properly managed.

Based on the above analysis, the project's potential impact on water quality from hazardous materials and waste during construction would be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Substantial***.

2 Proposed Mitigation Measures

At a minimum, the Contractor will be required to implement the following mitigation measures:

- Prohibit the disposal of any hazardous material or waste on-site;
- Identify a suitable disposal location for the hazardous wastes;
- Provide training for staff using hazardous materials regarding proper care, handling, storage, transport, and disposal of hazardous materials and wastes. Only trained and authorized personnel shall handle hazardous materials and waste;
- Maintain an inventory of all hazardous materials (e.g. diesel fuel, oils, solvents, paints);
- Store all hazardous materials/wastes in designated and controlled (i.e., fenced with restricted entry) locations in suitable containers as prescribed by the manufacturer;
- Locate hazardous material/waste storage facilities at least 100 m from any perennial or intermittent stream channel;
- Identify all hazardous materials with hazard signage and have appropriate Material Safety Data Sheets posted at the storage facility, and kept on file at the site office;
- Provide an impervious floor and secondary containment with capacity of at least 110% of the largest container for all hazardous liquids, including access road, hydropower facility, and transmission line components;

- Provide spill kits at all work areas where hazardous materials are used and in all vehicles transporting hazardous materials, and ensure staff are trained in their effective use;
- Check storage tanks and vehicles for leaks on at least a weekly basis;
- Practice good housekeeping to store the hazardous materials in accordance with their hazard category;
- Prohibit the storage of empty fuel or oil drums;
- Dispose of hazardous waste at an approved waste disposal site or recycling company in accordance with Bhutan regulations and international good practice. Hazardous waste must be safety stored and managed.
- Include in the construction contractors bid documents a requirement that in the event there are no approved disposal facilities for hazardous and/or special wastes, the contractor is responsible for properly transporting and disposing of such waste;
- Include in the contract a requirement for contractors to obtain transport and disposal certificates for hazardous waste, ensuring a documented chain of custody for hazardous materials

3 Residual Significance

Implementation of these measures will reduce the magnitude of the impact to low and reduce the extent of the impact. Therefore, the project's potential impact on water quality from hazardous materials and waste during construction will be direct, adverse, low in magnitude, local in extent, medium-term in duration, with an overall residual significance of ***Low.***

9.5.4 WASTE IMPACT ASSESSMENT SUMMARY

Table 9.11 summarizes the waste impact assessment from ***Section 9.5***.

Table 9.11 Waste Impact Assessment Summary

		Magnitude	Extent	Duration	Overall
Worker Mobilization / Influx	Pre-mitigation	Medium	Local	Medium-term	Substantial
	Residual	Low	Local	Medium-term	Low
Wastes Generated from Site Clearance, Excavations Land Clearing	Pre-mitigation	Medium	Local	Medium-term	Substantial
	Residual	Low	Site-Specific	Medium-term	Low
Hazardous Material Waste Management	Pre-mitigation	Medium	Local	Medium-term	Substantial
	Residual	Low	Local	Medium-term	Low

9.6 TRAFFIC IMPACT ASSESSMENT

The Traffic Impact Assessment (TIA) assesses the potential impacts of traffic generated by the Project's development and implementation on the surrounding transportation system. The TIA includes the scope of assessment, the baseline condition of the existing transportation system, and the identification of potential impacts. The TIA also describes improvement and mitigation measures introduced to address the Project's impacts.

The detailed objectives of the TIA are as follows:

- Assess the current status of the transportation system related to the Project's development and implementation;
- Identify the sources of traffic impacts from the Project's development and implementation;
- Identify the traffic sensitive receptors;
- Identify and assess the potential impacts of the Project's development and (to a lesser degree) implementation on the transportation network in general and traffic sensitive receptors in particular within the scope of the assessment; and
- Propose mitigation measures to promote the efficient and safe operation of the transportation network.

9.6.1 SCOPE OF THE ASSESSMENT

The TIA covers road transportation during the Project's construction and operation phases. The study extent of the TIA is the geographical area surrounding the Project site from which the Project is likely to draw a high percentage of its trips, which generally includes Gelephu, Tareythang, and the intervening river valleys currently connected by the Sarpang-Gelephu-Trongsa Highway.

During construction, the Project would contribute to increased road traffic through the transportation of equipment and materials to and from the Project area and daily trips made by workers in the vicinity. All equipment and materials will be transported by land. As a result, only road traffic (motorized and nonmotorized vehicles and non-vehicle users) has been evaluated. Construction materials, such as cement, asphalt, aggregates, etc., will be locally sourced from government-recognized cement manufacturing, batching, asphalt, and quarry plants along the Project alignment. Some materials will be imported from India via the existing border crossing in Gelephu.

The activities that have been scoped into the assessment for the construction phase are: worker mobilization/influx; procurement of material and operation of borrow pits; site preparation/land clearing; earthworks (cutting and filling); road construction and retaining walls; construction of river training works, construction of bridges, including foundations, piers/abutments, and superstructures; and construction of culverts / drainage and water management structures.

The operational phase would generate substantial traffic volume, because the Project is intended to facilitate regional trade, connectivity, improved resilience, and associated reduction in travel time from Gelephu to Tareythang. The operational assessment considers the expected changes to travel patterns. This assessment assumes that the Project (i.e., the road) has been designed to accommodate projected traffic volumes while preserving acceptable traffic levels of service.

The impacts on the air quality and noise generated by increased traffic are assessed in the Air Quality and Noise Assessment chapters (see ***Section 9.1 and 9.2***) in this ESIA. The Unplanned Events Risk Assessment assesses the safety risk from increased traffic and transportation of heavy equipment and hazardous waste (see ***Section 9.7***).

9.6.2 IMPACT ASSESSMENT

9.6.2.1 DESCRIPTION OF POTENTIAL IMPACTS

The Project would impact road traffic as a result of the factors listed below.

- **Construction**
  - Traffic delays and congestion resulting from additional vehicle travel on roads used for travel to construction area, including vehicle travel related to delivery of materials and supplies, movement of construction vehicles and equipment, and employee travel;
  - Active worksites on and adjacent to existing roads, resulting in temporary lane or road closures.
- **Operations**
  - New vehicular and pedestrian travel patterns resulting from the new primary highway;
  - Increased regional traffic volumes resulting from the new primary highway;
  - Improved road infrastructure.

These Project activities would impact traffic congestion, road safety, and the condition of road surfaces.

9.6.2.2 EMBEDDED CONTROLS

Project construction and operations will include the following embedded controls that correspond to GIIP for transportation infrastructure including:

- Road design follows the Bhutan Standard "ICS:93.080.10, Draft Bhutan Standard on Road Geometric Design and Alignment Requirements, Bhutan Standards Bureau", with enhancements based on international standards to improve safety.

9.6.2.3 IMPACT SIGNIFICANCE

Construction Phase

Project construction would generate an average weekday traffic volume of 205 vehicles between the hours of 07:00 and 18:00, distributed among vehicle types as shown in ***Figure 9.5***.

Figure 9.5 Project Construction Traffic

Time period	Passenger vehicles	Heavy Vehicles	Total
07:00-09:00	38	7	45
09:00-11:00	10	20	30
11:00-13:00	14	22	36
13:00-15:00	17	22	39

Time period	Passenger vehicles	Heavy Vehicles	Total
15:00-17:00	29	3	32
17:00-19:00	23	0	23
Total	131	74	205

Source: ARUP Initial Option Study, 2024

As indicated in ***Figure 9.6***, the Project will obtain fill materials from sources close to the Project worksites, bitumen and cement will be sourced locally. Other materials will be transported from India. Materials and equipment will be transported by road to the Project via the national road through Gelephu and the network of district and local roads. In-water sand mining will not be permitted; sand and gravel extraction will be confined solely to the floodplain areas outside the wetted river channel.

Figure 9.6 Construction Material Quantities and Sources

Raw Materials	Source
General Fill	Extracted from river floodplains (outside of the wetted river channel) close to Project sites
Boulders/Rock Fill	Dredged from rivers close to Project sites
Bitumen	Local
Cement	Local
Sand	India
Aggregates	Extracted from river floodplains (outside of the wetted river channel) close to Project sites
Steel Reinforcement	India
Pre-stressing Steel	India
Steel Wire	India

Source: ARUP

The Project includes two major work areas with adjacent worker camps. The western work area and camp is adjacent to the preferred alignment near the Project's western terminus in Gelephu, accessed via Gatshel Lam SE, an existing, paved road that intersects S Ngedrup Zhung Lam, provides road access to numerous residential and commercial land uses, and terminates at a Sewerage Plant southeast of Gelephu. Gatshel Lam SE has two lanes with 8 m pavement width at its western end, narrowing to a 5 m width for most of its length. Many of the structures along the road are close or immediately adjacent to the road travelway. The eastern work area and camp is close to the Project's eastern terminus in Tareythang. Access to the work area/camp, and from the work area/camp to the Project preferred alignment is available via a paved roadway through central Tareythang that has multiple lanes and a 25 m paved width.

Several district and local roads intersect the preferred alignment and could provide road access points during Project construction. Temporary access roads from existing roads to worksites along the Project alignment may be needed as well.

The following Project impacts during construction are anticipated.

Road Congestion and Delays

The Project will add about 200 daily vehicle trips to the current traffic volume on roads within the project direct and indirect area and in the region. Assuming that deliveries would be spread out over the day, and that some or all daily worker commutes would be from worker camps at or near Project worksites, Project construction traffic volumes are unlikely to generate new congestion or exacerbate existing congestion. Slow-moving supply and equipment deliveries are

likely to result in temporary traffic delays on roads near the Project. Additionally, existing local roads that intersect the Project may be subject to road closures or lane closures during work on segments of the Project near those existing roads. Lane closures would result in traffic delays. Detours required as a result of temporary road closures would disrupt and lengthen the routes that local residents use to travel to work and other destinations.

Road Safety

The Project-related increase in vehicular traffic, particularly heavy haul vehicles, would increase the risk of motor vehicle accidents and incidents. The traffic counts available for the National Road north of Gelephu indicate that 87 percent of existing traffic were cars or similar light vehicles. This indicates that residents of the Project area are not fully accustomed to heavy vehicle traffic, and that they may not respond with appropriate precaution in the presence of these vehicles. The limited understanding of traffic safety risks can increase the likelihood of an accident.

Additionally, the Project-related increase in heavy vehicle traffic on Gatshel Lam SE, a narrow road with structures immediately adjacent to the carriageway, would increase safety risks for pedestrians, outdoor areas of residences, and businesses. The road includes three hotels, several homes, and other businesses, all of which could be impacted by the increased presence of heavy vehicles and associated safety concerns.

Road Condition

Increased traffic, and in particular heavy vehicle movements, would increase the rate of road surface deterioration. Without monitoring and frequent repair of road surfaces used for construction traffic, road surfaces would develop cracks, pitting and ruts faster than under current conditions. The deterioration would occur more quickly for unpaved roads but would affect paved roads as well.

Impact Evaluation

Road transportation impacts during Project construction would be direct and limited to the construction period, and therefore would be of short-term duration. Project construction would have high magnitude impacts on the local road network within the direct and indirect project impact area. Without mitigation, users of existing roads are likely to experience increased travel delays, new safety risks, and increased wear and deterioration of road infrastructure. The Project would also generate low magnitude impacts on the regional road network due to increased traffic volume. Accordingly, Project construction would have a ***Substantial*** impact on road travel.

Operation Phase

The Project would be designed as described in ***Section 2***, in compliance with the standards for Primary National Highways.[14] About 3.8 km of the proposed road, from its intersection with S Ngedrup Zhung Lam to Chhuzanggang, would have two (02) lanes in each direction. The remaining 9.8 km from Chhuzanggang to Tareythang would have one lane in each direction. The road design standards include the following features:

- 7.5 m wide carriageway for 2-lane road segments;

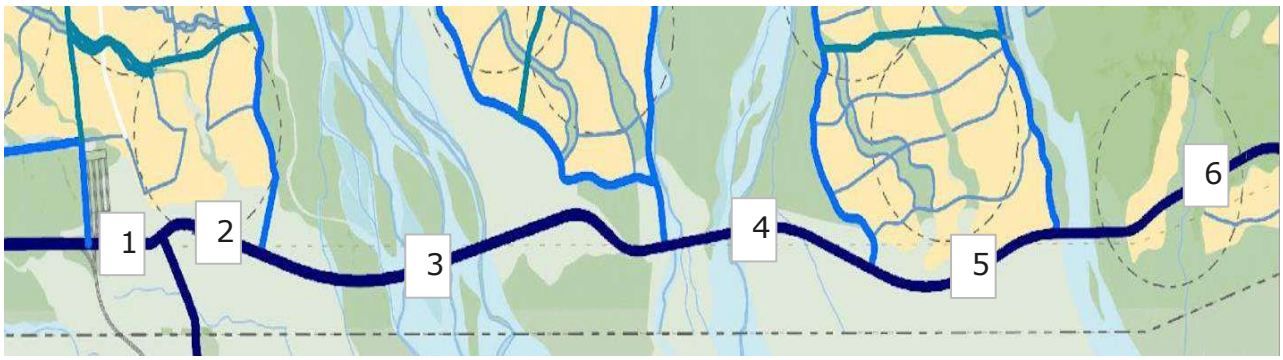
[14] Ministry of Works and Human Settlement, Department of Roads. 2017. *Road Classification System in Bhutan.* Available from: https://www.moit.gov.bt/wp-content/uploads/2014/03/Road-Classification-System-in-Bhutan-Final.pdf.

- 2 x 7.5 m wide carriageway for 4-lane segments, with a typical 2 m wide central median;
- Shoulders and drainage along road edges;
- Pedestrian footpaths on all bridges; and,
- Design speeds from 30 to 60 kph depending upon terrain.

While specific design elements depend on conditions, typical segments would have either 5 m shoulders on both sides of the road or a 10 m shoulder on one side of the road, exceeding the road design standards for Primary National Highways.

Projected road travel demand based on the vision for the region's future development have been estimated for six (06) segments of the Project as shown in ***Figure 9.7***. The projected future traffic volumes and carrying capacity of the Project are summarized in ***Table 9.12.***

Figure 9.7 Project Segments used for Traffic Volume Projections



Source: ARUP 2024

Table 9.12 Projected Traffic Capacity and Volumes

Road Segment	Project Traffic Capacity [a]	2035 Projected Traffic Volume [a]	2053 Projected Traffic Volume [a]
1	63,000	25,554	39,796
2	63,000	29,251	43,493
3	63,000	31,789	49,506
4	31,500	7,157	11,146
5	31,500	255	397
6	31,500	3,827	5,960

Source: ARUP 2024

Note: [a] Traffic capacity and projected volumes are expressed as 24 hour Annual Average Daily Traffic (AADT).

As shown ***Table 9.12***, projected annual average daily traffic (AADT) volumes on the Project would be substantially smaller than daily capacity. In addition, the hourly traffic-carrying capacity of the Project would be approximately 6,000 vehicles for the 4-lane segments (100 vehicles per minute), and approximately 3,000 vehicles for the 2-lane segments (50 vehicles per minute). Year 2053 traffic projections for peak hours of the day (0700-0900 and 1600-1800) would not exceed 4,900 vehicles per hour on the proposed 4-lane segments and would not exceed 1,100 vehicles per hour on the 2-lane segments. Based on these projections, the Project

would provide adequate capacity for anticipated traffic, resulting in little traffic congestion during typical operations.

Operation of the Project would reduce existing travel times and trip mileage (especially between Gelephu and Tareythang) and would slow the deterioration of existing local roads. The Project would increase road safety for all users, including drivers and pedestrians, by providing an alternative to the existing mountainous road between Gelephu and Tareythang, reducing traffic volumes on the local roads, providing a road designed and built-in compliance with the national road design standards, and providing pedestrian facilities and shoulders that exceed national standards.

Accordingly, Project operations would have a ***Beneficial*** impact on operations phase traffic conditions.

9.6.2.4 RECOMMENDED MITIGATIONS

Because the impact during operations is anticipated to be beneficial, no mitigations are recommended, beyond application of Bhutan's existing laws and policies related to roads and related to roads and vehicle travel. This section describes mitigation and management measures recommended to address the Project's transportation impacts during the construction phase.

- Establish and implement a Traffic Management Plan during construction, including:
    - A detailed schedule and route plan for the transportation of materials and equipment compatible with construction activities;
    - Coordination of worker transportation from worker camps to job sites and from local communities to the worker camps;
    - Maps of commuting routes and modes (pedestrian or vehicular) and worker access points to parking areas for Project work sites;
    - Plans for ridesharing or bus transportation for workers;
    - Strategy for minimizing effects on local residents associated with temporary road closures and detours; and
    - Plans for scheduling worker shifts to minimize congestion.
- Prior to construction, work with the local authorities to fund and expand, complete repairs to, or provide durable surfaces for all local roads that would be used to access Project worksites.
- Review the suitability of Gatshel Lam SE, including its road surface, width and alignment, to carry heavy vehicles; provide surface improvements resulting in width and durability suitable for anticipated loads; establish procedures to address safety risks associated with truck traffic in close proximity to structures; install safety measures (such as temporary concrete road edge barriers) to protect footpaths, outdoor use areas, and existing residences and commercial buildings along the road.
- Upon completion of construction, work with local authorities to repair road surfaces damaged during construction (including providing funding for and/or completing repairs to address such damage).
- Work with local authorities to support the implementation of necessary safety measures for pedestrians, bicyclists, and drivers, including:
    - Implement safe corridors and crossings for pedestrians and bicyclists along construction vehicle routes, especially on roads with anticipated high traffic

volumes, large vehicles, and areas with a high concentration of amenities (schools, markets, etc.);
    - Provide adequate and visible traffic signs and speed controls, especially in areas with high population density or high concentration of amenities;
    - Design solutions for sensitive areas where congestion could occur (bottlenecks and intersections);
    - Enhance traffic safety awareness among the local community.
- Integrate the construction traffic aspect into the Community Grievance Mechanism and Employee Grievance Mechanism during construction.
- Identify and enforce driver qualification and training requirements for all drivers, whether employees or contractors. Include requirements in applicable contracts.
- Establish and enforce consistent safe driving practices for all drivers, whether employees or contractors:
    - Require rest and break standards that comply with industry and national standards;
    - Structure contracts with truck contractors to avoid incentives for speeding or insufficient fatigue breaks;
    - To the degree permissible by law, require daily or periodic drug and alcohol testing for all drivers;
    - Equip trucks with speed governors or on-board GPS, and/or monitor vehicle speed and location;
    - To the degree allowed by law, enforce driver quality through loss of jobs or contracts for individual drivers for drug or alcohol offenses, chronic or egregious speeding, or other notable or repeated unsafe behaviors;
    - Require scheduled, preventative vehicle maintenance according to manufacturers' recommendations for all Project vehicles, whether owned by Project or a contractor;
    - Require completion of a vehicle safety checklist daily prior to vehicle operation on public roads;
    - Provide uniform in-vehicle communications systems that enable contact with truck traffic controllers and other drivers.

9.6.2.5 RESIDUAL IMPACTS

Upon implementation of the mitigation and management measures, the road transportation impacts from Project construction would be reduced to "Medium" magnitude within the direct and indirect impact area and would continue to have a "Low" magnitude regionally, resulting in an overall impact significance of ***Moderate*** during the construction period.

9.7 UNPLANNED EVENTS

9.7.1 INTRODUCTION

During Project construction and operation, a variety of emergencies may occur involving natural disasters and accidents, which could affect community safety. Natural disasters include earthquakes and fire. Flooding and Landslides are further covered in the Climate Change Risk

Assessment (***Appendix K***). Project-related accidents may include construction accidents, explosions, drownings, and construction and operational phase traffic accidents.

The following Chapter presents the assessment of impacts resulting from unplanned or non-routine events and those that result from accidents. These are different to impacts from effects that would reasonably be predicted to occur in the normal course of activities during construction.

9.7.2 CONSTRUCTION AND OPERATIONAL PHASES

Several of the natural disaster and accident risk scenarios could occur during construction and operation phases, so are discussed in an integrated manner below.

9.7.2.1 SEISMIC HAZARDS

Bhutan is located on the collision boundary of the Eurasian and Indian tectonic plates, which governs the seismicity in the region. The geographical positioning of Bhutan makes the country susceptible to seismic hazards. Bhutan has experienced several large and damaging earthquakes in the past. Severe earthquakes with magnitude higher than 6 are typically found in the Eastern Bhutan while smaller earthquakes typically occur around the central and southern parts of the country.

Earthquake ground motions are amplified by surficial materials (soils), this can often make the difference between minor and major damage during an earthquake. Softer deposits (soils and alluvium) result in higher levels of ground shaking than harder deposits or rock conditions. Data from the Gelephu Flood Protection Project indicate that the soil characteristics in the Project Area align with the definition of Fluvisol (FAO/UNESCO 1977). This young soil, commonly found in alluvial deposits, features weakly developed horizons with a distinct topsoil.

Liquefaction is an important secondary hazard related to earthquake ground shaking. Young alluvial deposits are susceptible to liquefaction if the ground is saturated or has a shallow water table. Aquifer depths within and surrounding the Project site generally range from 40 m to over 100 m. At this depth liquefaction is very unlikely in spite of the alluvial deposits.

Project construction is unlikely to trigger any earthquakes, and the Project is designed to high standards in order to withstand seismic activity. Earthquakes may damage local infrastructure, community resources, Project resources and may cause delays to programme.

Construction of the project may lead to an influx of workers and project staff to the area, which, as outlined above is prone to earthquakes and potentially high levels of ground shaking. In addition, the Project is designed to allow greater movement and access between Gelephu and Tareythang and therefore people travelling in the area of seismic activity. Injuries and fatalities may occur in the event of an earthquake.

During construction and operation phases it is considered that the Project's earthquake risks, and therefore impacts to the Project staff and users could be direct, adverse, high in magnitude, though likely local in extent. The duration of an earthquake may be short, however the potential impacts to people and infrastructure would take a long time to recover from. Overall, the pre-mitigation significance is ***High***.

Mitigation Measures and Residual Significance

Carefully monitor seismic activity during the construction phase and avoid working in higher risk areas (e.g. steep slopes that must be disturbed), during periods of high activity.

The Project Contractor and Operator will develop and implement an Emergency Preparedness and Response Plan describing in detail the procedures the Contractor will put in place in the event of a natural disaster. This plan, which will be prepared by the Contractor, will describe emergency procedures and communication protocols in the event of an earthquake.

Design facilities (e.g., bridges) to withstand earthquakes. Any new infrastructure shall at least follow the requirements of new proposed draft Indian seismic code (IS 1893:2023).

Implementation of these measures will reduce the magnitude of the impact to medium. Therefore, the potential risk from earthquakes will be direct, adverse, medium in magnitude, local in extent, long term in duration, with an overall residual significance of ***Substantial***.

9.7.2.2 FOREST FIRE

Forest fires are one of the prominent causes of forest degradation in Bhutan, and they can be caused by natural or man-made activities. While most fires in Bhutan are caused by human activities such as the burning of agriculture debris, development of pastures, reckless behaviours of picnickers and smokers, the source of fire is not ascertained in 80% of the incidences. Natural forest fires are primarily from lightning strikes during dry seasons from March to May. Forest fire risk is prominent during the dry season, which can create conditions conducive to forest fires. The rugged terrain and mountainous landscapes with dense vegetation contribute to higher fire risk.

Forest fires during construction and operation may damage local infrastructure, community resources and Project resources and have the potential to cause injuries and fatalities to Project workers, users, and the surrounding community.

Therefore, the Project's forest fire risks during the construction and operation phases could be direct, adverse, high in magnitude, local in extent, and impacts would take a long time to recover from, resulting in an overall pre-mitigation significance of ***High***.

Mitigation Measures and Residual Significance

- The Project Contractor and Operator will develop and implement measures to reduce the risk of man-made fires occurring, including:
  - Prohibit worker smoking outside of designated areas within the Worker Camps during construction;
  - Prohibit smoking outside of designated areas during the operational phase;
  - Storage of highly flammable and combustible materials in designated locations with appropriate firefighting equipment available (e.g. fire blanket, extinguishers); and
  - As part of the preparation of the Emergency Preparedness and Response Plan, liaise with relevant third party bodies to develop specific local plans for responses and use of the emergency services in the event of a fire.
- Provide fire-safety training
  - The Contractor shall ensure that all staff receive fire safety training, including for designated fire wardens trained in the use of relevant firefighting equipment, and that all staff are clearly informed regarding the fire safety risks; and
  - Ensure all Project personnel are aware of fire emergency response procedures (including accident/incident reporting requirements and disciplinary actions)

Taking into consideration these mitigation measures, the Project's forest fire risks during the construction and operation phases could be direct, adverse, implementation of these measures will reduce the magnitude of the impact to medium, local in extent, with an overall residual significance of ***Substantial***.

9.7.2.3 TRAFFIC ACCIDENTS FROM CONSTRUCTION TRAFFIC

Traffic generated during construction of the road will arise as a result of the following construction activities:

- Delivery of construction materials and equipment to the construction sites; and
- Worker movements to the sites, including potential mobilization from outside of the Project area and local movements from construction sites.

Construction traffic will use the existing local road network to access the Project site. The additional traffic movements increase the potential for road accidents between vehicles or between vehicles and pedestrians. Accidents involving pedestrians are more likely away from the populated towns where people will be less used to movement of large vehicles, and may have taken risks when crossing the road. This risk is increased when the pedestrians are young children, who may have limited road safety awareness. Furthermore, there is also a risk of both intentional and unintentional trespass into construction sites which may lead to injuries or fatalities.

Therefore, the risks of traffic accidents during the construction phase could be direct, adverse, high in magnitude, local in extent, and short term in duration, resulting in an overall pre-mitigation significance of ***High***.

Mitigation Measures and Residual Significance

Traffic Impact Assessment of this ESIA describes mitigation and management measures recommended to address the Project's transportation impacts during the construction phase.

Implementation of these measures will reduce the magnitude of the impact to medium. Therefore, the potential risk from vehicular traffic will be direct, adverse, medium in magnitude, local in extent, long term in duration, with an overall residual significance of ***Substantial***.

9.7.2.4 TRAFFIC ACCIDENTS FROM OPERATIONAL TRAFFIC

During operation there is potential for road traffic accidents along the road, especially due to the increased traffic volumes and increasing speeds which will be achievable due to the design of the road. Such accidents have the potential to result in injuries and fatalities and are more common if drivers are not following basic road safety.

Further details on traffic related accidents and road safety, as well as mitigation measures, is covered in ***Section 9.6***, Traffic Impact Assessment.

9.7.2.5 ACCIDENTAL OIL, CHEMICAL, HAZARDOUS MATERIAL SPILLS

Various hazardous materials will be used in the course of carrying out Project activities, the main ones being hydrocarbon fuels (diesel), lubricating oils, and chemicals. There is the potential for accidental release in the course of storage and handling of these fuels.

During construction, there is the potential for spills of fuels and oils during fueling and maintenance of machinery and vehicles. Spills could occur in a number of locations around the site including areas used for maintenance, material and equipment laydown, parking, fuel

storage, and fueling. Spills could also occur along the roads adjacent to the Project site and along the route for construction traffic. Spills on the site have the potential to affect the terrestrial environment.

Spills from the storage areas due to major spills would affect the terrestrial environments and result in potential deterioration of the quality of groundwater, surface water, and soil. This would in turn have adverse effects on flora and fauna and local water users.

Therefore, the risks of spills during the operational phase could be direct, adverse, high in magnitude, local in extent, and long term in duration, resulting in an overall pre-mitigation significance of ***High***.

Mitigation Measures and Residual Significance

The following mitigation measures will be implemented to reduce and minimize the potential impacts associated with accidental oil and chemical spills:

- Adhere to best practice principles;
- Equipment should be up to industry standard and serviced regularly to prevent oil spills;
- A spill response plan should be in place and construction workers should be trained accordingly;
- On-site storage areas for hydrocarbons and other chemicals should be constructed in a way that potential tank failures can be contained including bunds and surface hardstanding;
- Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release. Bunds should be sized to hold 110% of the maximum capacity of the largest tank or drum;
- Refueling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local business partner. Drip trays must be used when refueling and servicing vehicles or equipment, where it is not on a hardstanding surface;
- Leaking equipment must be repaired immediately or be removed from site to facilitate repair;
- The Project will develop a detailed hazardous material spill response plan, which includes community sensitization/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Project. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated and post remediation verification will be carried out;
- Appropriately sized spill kit kept onsite relevant to the scale of the activity taking place must be available; and
- Maintain an incidents and complaints register in which all incidents or complaints involving the public are logged.

Implementation of these measures will reduce the magnitude of the impact to low. Therefore, the potential risk of spills will be direct, adverse, low in magnitude, local in extent, long term in duration, with an overall residual significance of ***Moderate***.

9.7.2.6 OCCUPATIONAL HEALTH AND SAFETY DURING CONSTRUCTION

Activities of the Project site's personnel will involve risks due to mobile equipment and working at height, working with hazardous materials, driving, earthworks, and other construction activities. Accidents resulting in injuries or fatalities remain a possibility. The rate of accidents will be dependent on the consciousness and cautiousness of personnel regarding the specific hazards of the work in which they are involved. These risks may be managed with adequate training in accordance with good management approaches and international construction site practices, avoiding problems with the worker-employer relations and significant occupational health and safety risks.

A number of chemicals/ hazardous materials will also be used, stored and handled during the construction phase, such as diesel oil, hydraulic fluid, and paint. If handled and stored inappropriately, these chemicals can cause serious injuries.

Therefore, the Project's health and safety risks during the construction phase could be direct, adverse, high in magnitude, local in extent, and, the resultant impacts would take a long time to recover from, resulting in an overall pre-mitigation significance of ***High***.

Mitigation Measures and Residual Significance

The Project should ensure that design plans fully integrate the minimization of occupational health and safety risks at an early stage. Furthermore, the Project Contractor should develop and implement an Occupational Health and Safety (OHS) Management Plan and should hire suitable staff for implementation of the plan. This management plan should be enforced throughout the Project's life cycle and cover all the Project's personnel (including direct hire employees, advisors and consultants, contractors and sub-contractor personnel). It will include aspects such as regular training and monitoring, reviews of construction plans and method statements by the contractors, job hazard analysis of all construction sites, monitoring, and reporting, as well as daily inspections and audits.

- Within the OHS management plan, the following measures should be included:
    - Hazard identification and assessment;
    - Identification and provision of personal protective equipment (PPE) to all concerned workers;
    - Pre-employment screening protocols for all employees including contractors and sub-contractors which will include medical checks appropriate to World Health Organisation's (WHO) recommendations, the individual's country of origin and vaccinations;
    - Workers will be provided with primary health care (including access to a General Practitioner (GP) if required) and basic first aid at all worksites;
    - Regular medical check-ups and centralised medical treatment for all workers of the Project (including contractors and sub-contractors) will be provided; and
    - Workforce, including contractors and sub-contractors, will be provided with health awareness training (and refreshers), including hazardous works, a significant briefing of hygiene practices (such as hand washing), implementation of educational outreach to increase awareness of major communicable disease and how to protect against infection and about transmission routes and the symptoms of the communicable diseases of concerns (including STIs).

- Contractors' contracts and the associated management plan(s) will specify that monitoring be undertaken by contractors and suppliers and will establish the right for the Project to monitor and audit the performance of all contractors and sub-contractors. Contractors' contracts will also specify that the same standards will be met by their sub-contractors and suppliers. As part of the contractor and supplier selection process, the Project will take into consideration performance of prospective contractors with regard to workers' health and safety as outlined in national law, international standards and internal policies and procedures.

- The Project should also develop and implement its own Emergency Preparedness and Response Plan (EPRP) and require all appointed contractors establish their own EPRP or adopt the Project's.

Implementation of these measures will reduce the magnitude of the impact to low. Therefore, the potential risk from Project activities on health and safety will be direct, adverse, low in magnitude, local in extent, long term in duration, with an overall residual significance of ***Moderate***.

9.8 CLIMATE CHANGE RISK

There are hazards directly linked to climate change within the specific context of the Project and it is therefore necessary to evaluate Project-specific vulnerabilities and exposure related to the hazard and to assess and identify climate risks and their materiality to the Project. A full climate risk assessment is presented in ***Appendix C8***.

9.8.1 WATER AVAILABILITY

The project's exposure to water availability issues will primarily occur during the construction phase, as water is essential for activities like dust control and material mixing. Therefore, as the construction phase will last only for 3.5 years, the climate change related risks are unlikely to occur. During operation the water use is limited to potential cleaning during the dry season and watering of the roadside greenery (likely to be limited to the Mau River Bridge) both likely to require a negligible amount of water. As such no significant impacts have been identified.

9.8.2 FLOOD

The road and bridges will be located in areas prone to flooding. The bridges will be particularly exposed to the high flow of the rivers during the wet season.

Floodwaters can erode bridge supports by washing away protective soil and destabilizing pylons, leading to weakened structural integrity and potential collapse.

For roadways, intense flooding can penetrate and undermine foundations, causing asphalt and concrete layers to crack, buckle, or wash away entirely, rendering the surfaces impassable and dangerous. Additionally, fast-moving floodwaters can strip away protective embankments and side slopes, creating further erosion along the road's edges and destabilizing adjacent land.

Key potential impacts include:

- Structural damage for both road and bridges weakening structural integrity and, in the worst case, resulting in the collapse of the bridge structure;
- Surface erosion generating cracks in the pavement of the road;

- Floods can erode embankments, slopes, and shoulders, making roads vulnerable to further collapse and reducing road stability;
- Isolation of communities; and
- Economic losses associated to reparation cost and disruption on local supply chain.

9.8.3 LANDSLIDES

The Project is potentially susceptible to landslides, which could lead to impacts, including interruptions to traffic flow and accessibility along the route. In more extreme instances, landslides could inflict structural damage on the road infrastructure, requiring repairs and potentially compromising the safety and functionality of the corridor.

However, due to the area's topography, only the 500-m segment of road near Tareythang is at risk.

Key potential impacts include:

- Pavement damage or, in extreme cases, structural damage for road;
- Isolation of communities; and
- Economic losses associated to reparation cost and disruption on local supply chain.

9.8.4 EXTREME HEAT

Roads take in a large amount of solar heat throughout the day, causing their surface temperatures to rise significantly. Based on the information found, asphalt may begin to soften when the temperature surpasses 48 degrees Celsius[15].

Hence, roads are vulnerable to heat because thermal expansion can lead to cracks, potholes, or uneven surfaces, which reduces their lifespan and increases maintenance costs.

Key potential impacts include:

- Reduces the overall lifespan of roads
- High temperatures cause cracks and potholes or uneven surfaces
- Workers are at risk of heat exhaustion during maintenance.

9.8.5 CYCLONE AND HURRICANE

The project area is generally not directly affected by cyclones or hurricanes, however, there could be a risk to safety of workers during construction and maintenance.

9.8.6 WIND SPEED

Generally, road projects are not highly exposed or vulnerable to wind speed. However, extreme wind events can impact construction activities, increasing risks for workers and equipment, and potentially delaying progress.

9.8.7 LIGHTNING

The road and bridge structures have limited exposure to lightning, as strikes are more likely to discharge onto taller structures, such as trees and utility poles.

[15] Texas Roads Could Melt as Potentially Record-Breaking Heat Wave Hits. May 03, 2024. Access via https://www.newsweek.com/texas-roads-could-melt-potentially-record-breaking-heat-wave-1897050

In the unlikely event of a lightning strike directly on the road surface, only minor surface damage is expected. Thunderstorms, however, could pose safety risks to personnel conducting maintenance activities.

9.8.8 MITIGATION MEASURES AND RESIDUAL CLIMATE RISK

The below table summarizes the risk level and mitigation measures identified for the Project.

Table 9.13 Summary of Risk Level for the Project

Hazard	Risk Level			Mitigation Measures	Residual Risk Level
	Baselin	RCP 8.5			
		2030	2050		
Water Availability	Low	Low	Low	• If possible, recycle water used for road cleaning to water the roadside greenery.	Low
Flood	High	High	High	• DoST to complete the flood modelling for the entire length of the Gelephu Tareythang road through collaboration with the engineering team • DoST to maintain coordination with the parties responsible for the design of upstream infrastructure associated to the Gelephu Mindfulness City. The coordination will ensure that the water retention structures that are installed within the Gelephu Mindfulness City will reduce the water/debris flow and risk of flooding along the road • Integrate the results on the full model to the detailed engineering design of the road and bridges and include at least the risk associated with a 100 year return period	Low
Landslides	Low	Low	Low	• Integrate slope stabilization structures (e.g. retaining walls, gravity walls, etc.) in the detailed design of the road • Reduce soil erosion by maintaining existing vegetation or revegetating ground movement areas through geotextiles or similar techniques along the 500 m road segment near Tareythang • Ensure correct drainage of rain and groundwater to avoid building up pressure on soil structure • Stabilize the slope by including supporting structures (e.g. retaining walls, gravity walls, etc.) or by stabilizing the soil structure • Regular inspection to identify potential structure failure (e.g. cracking, soil movements, water breaks from ground surface, etc.)	Low
Extreme Heat	Medium	Medium	Medium	• Schedule heavy labor work during cooler parts of the day • Set up cooling areas and provide heat protection for worker.	Low
Cyclone and Hurricane	Low	Low	Low	• Implement safety procedures during severe weather. • Monitor real-time weather conditions to be prepared for potential severe weather events.	Low
Wind Speed	Low	Low	Low	• Not required	Low

Hazard	Risk Level			Mitigation Measures	Residual Risk Level
	Baselin	RCP 8.5			
		2030	2050		
Lightning	Low	Low	Low	• Not required	Low

9.9 GREENHOUSE GAS EMISSIONS

Greenhouse Gas emissions associated with road projects are generally considered in two phases. Key activities to consider include:

- **Construction Phase**:
  - Construction of temporary ancillary facilities: Emissions from building temporary offices, storage areas, and worker accommodations.
  - Procurement of material and operation of borrow pits: Emissions from extracting, processing, and transporting construction materials, as well as operating borrow pits.
  - Site preparation / Land clearing: Emissions from clearing vegetation and preparing the site using heavy machinery.
  - Earthworks (Cutting and Filling): Emissions from excavation, transportation, and compaction of soil.
  - Road construction & retaining walls: Emissions from producing and transporting construction materials and using construction equipment.
  - Construction of bridges, including foundations, piers / abutments, and superstructures: Emissions from building bridge foundations, piers/abutments, and superstructures.
- **Operation Phase**:
  - Road Operation and Maintenance: Emissions from vehicle traffic, maintenance activities, and operation of road infrastructure such as lighting and signage.

9.9.1 GREENHOUSE GAS EMISSION

The project will emit greenhouse gases (GHGs) such as CO_2, CH_4, and N_2O. These emissions can occur during both the construction and operation phases. While they may not have an immediate impact, they contribute to climate change over time, leading to consequences such as floods, droughts, and extreme weather events. Therefore, it is crucial to monitor and manage these emissions to mitigate their long-term effects on the environment.

- The summary of GHG types includes the following:
- Carbon Dioxide (CO_2): The most common GHG emitted from fuel combustion in vehicles and machinery, and from the production of construction materials like cement and asphalt.
- Methane (CH_4): Emitted during material extraction and from vehicle exhausts.
- Nitrous Oxide (N_2O): Emitted from vehicle exhausts and certain construction processes.

9.9.2 AVOIDANCE AND MINIMIZATION MEASURES

No built-in avoidance or minimization measures related to GHG emissions were identified. However, mitigation measures are discussed in detail in ***Section 9.9.3*** (Construction Phase Impact Assessment) and ***Section 9.9.4*** (Operation Phase Impact Assessment).

9.9.3 CONSTRUCTION PHASE IMPACT ASSESSMENT

9.9.3.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The following activities can have impacts to ambient air quality during the Construction Phase of the Project:

- Construction of temporary ancillary facilities
- Procurement of material and operation of borrow pits
- Site preparation/Land clearing
- Earthworks (Cutting and Filling)
- Road construction & retaining walls
- Construction of bridges, including foundations, piers / abutments, and superstructures

Project GHG emission sources during construction will be from construction equipment that uses diesel fuel and electricity, which are classified as GHG emissions according to the GHG Protocol. Fuel consumption in construction equipment is categorized as GHG Scope 1 emissions, while electricity purchased from the grid is classified as GHG Scope 2 emissions. The details of the sources of greenhouse gases emission in construction phase are specified in ***Table 9.14***.

Table 9.14 Identified GHG emission sources in construction phase

Activity	Emission Category	Emission source	Scope
Construction phase			
Fuel consumption in construction equipment	Energy – Mobile combustions	Use of fuel for construction equipment	Scope 1
Electricity consumption in construction equipment	Purchased Electricity	Use of grid electricity	Scope 2

9.9.3.2 APPROACH AND RESULT

For the Scope 1 emissions, calculations will be based on the GHG Protocol for construction. Reporting of Scope 1 GHG emissions must consider the amount of fuel used in construction and other activities. In this project, greenhouse gas emissions will result from the fuel consumption of construction equipment. The data used for calculating GHG emissions Scope 1 will be categorized as Tier 3, as defined by the IPCC, since the emission factors used are the default values specified in the IPCC Guidelines. Total Scope 1 emissions from construction phase is 17,671.35 ton CO_2e from different fuel consumption.

For the calculation of Scope 2 GHG emissions, we will estimate the electricity purchased for use in construction, specifically the electricity used by construction equipment. This approach aligns with the GHG Protocol's recommendations for situations where power is sourced from the

national grid without any specific renewable energy purchase agreements. The data used for calculating Scope 1 GHG emissions will be categorized as Tier 2, as defined by the IPCC, since the emission factor used from the national electricity grid is 23 gCO_2 per kWh, based on the 2022 Energy Profile of Bhutan by the International Renewable Energy Agency (IRENA)[16]. Total Scope 2 emissions from construction phase is 720.36 ton CO_2e from electricity demand during the construction phase from construction equipment totals 32,631.77 kWh.

The operation period for each piece of equipment is aligned with the timeline of the respective construction activities, as outlined during this assessment. It assumes 24-hour shifts daily, with the total construction period spanning 3.5 years. As a result, the total GHG emissions from the construction phase of this new Gelephu-Tareythang route is expected to be approximately 18,000 tCO_2e.

Table 9.15 shows the GHG emission estimation result from construction phase. Applied emission factors and the calculation details can be found in ***Appendix L3*** and ***Appendix L4***, respectively.

[16] Energy Profile Bhutan, Available in; Bhutan_Asia_RE_SP.pdf (irena.org)

Table 9.15 Estimate Project Emission in Construction Phase

	Emission Category	Emission source	GHG emission			
			CO_2 ton CO_2e	CH_4 ton CO_2e	N_2O ton CO_2e	Total ton CO_2e
Scope 1						
Fuel consumption in construction equipment	Energy – Mobile combustions	Use of fuel for construction	17,328.36	47.85	264.97	17,671.35
Scope 2						
Electricity consumption in construction equipment	Purchased Electricity	Use of grid electricity	720.36	-	-	720.36
Total			18,048.72	47.85	264.97	18,391.71

9.9.3.3 PROPOSED MITIGATION MEASURES

The assessment of greenhouse gas (GHG) emissions during the construction phase reveals that most emissions stem from the fuel consumption of construction equipment. To mitigate these emissions, it is advisable to replace traditional equipment with more fuel-efficient alternatives, electric machinery, or hybrid solutions. Additionally, implementing a system to monitor fuel usage and equipment operation can help optimize activities, enhancing efficiency and further reducing GHG emissions.

Additionally, although this report does not calculate Scope 3 GHG emissions during the construction phase, we can reduce these emissions by using low-carbon construction materials, such as low-emission cement. This would help decrease GHG emissions in Scope 3, Category 1: Purchased Goods and Services. Alternatively, using electric vehicles (EVs) for transporting construction materials can reduce GHG emissions in Scope 3, Category 3: Upstream Transportation and Distribution.

9.9.3.4 RESIDUAL SIGNIFICANCE

Before the implementation of the proposed mitigation measures, the potential GHG emissions from the construction activities were expected to be ***Moderate***. Traditional construction equipment, which typically relies on fossil fuels, would have contributed substantially to the project's overall carbon footprint. The high emission factors associated with these conventional methods would have resulted in considerable environmental impacts, highlighting the necessity for effective mitigation strategies.

The proposed mitigation measures, particularly the replacement of traditional construction equipment with electric machinery or the use of hybrid solutions where available, would significantly reduce GHG emissions from construction activities. Given the relatively low emission factor of the country's electricity, electrifying onsite construction equipment is a promising strategy for reducing GHG emissions associated with the Project. Consequently, the project's potential GHG impacts from constructing the new route will be reduced, potentially resulting in an overall residual significance of ***Low***, depending on the extent of implementation.

9.9.4 OPERATIONAL PHASE IMPACT ASSESSMENT

9.9.4.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The following activity can have impacts to ambient air quality during the Operation Phase of the Project:

- Road Operation and Maintenance

The project GHG emission sources during operation will primarily come from road usage, calculated based on the energy consumed by vehicles traveling on the constructed roads. Although road maintenance activities do contribute to GHG emissions, these emissions are relatively minor compared to the overall Scope 3 emissions from road usage. Consequently, the emissions from maintenance activities can be considered negligible, as they represent only a small fraction of the overall emissions from this phase.

For the calculation of Scope 3 emissions, two scenarios will be considered:

- Scenario 1: If no new road is constructed, all vehicles will continue to travel on the existing road over years 2029-2053 (25 years).

- Scenario 2: If a new road is constructed, all vehicles will travel on the new road over years 2029-2053 (25 years).

Note that the assessment has been conducted given similar vehicle types, fuel usage, and vehicle growth rates over the same period of time when comparing GHG emissions for two different road operations. In calculating Scope 3 GHG emissions from the operation phase, we have made assumptions based on actual vehicle usage data and growth rates, referencing ARUP's model projection. For more information about these assumptions, please refer to ***Appendix L2***. However, this calculation of Scope 3 emissions is only a preliminary assessment, and due to limited data, the results may change. The details of the sources of greenhouse gases are specified in ***Table 9.16***.

Table 9.16 Identified GHG emission sources in construction phase

Activity	Emission Category	Emission source	Scope
Operation phase			
Fuel consumption from vehicle that use Road	Energy – Mobile combustions	Use of fuel of vehicle that use road	Scope 3

Approach and Result

The proposed new road between Gelephu and Tareythang represents a strategic initiative aimed at significantly reducing greenhouse gas (GHG) emissions. By optimizing travel distances, enhancing fuel efficiency, and alleviating traffic congestion, this project promises to lower CO_2 and other GHG emissions. The improved road design and infrastructure will facilitate smoother traffic flow and potentially increase public transport usage, further reducing reliance on private vehicles. Additionally, regular maintenance and the use of sustainable practices will ensure the road remains in optimal condition, contributing to lower emissions over its lifecycle. This initiative aligns with Bhutan's commitment to sustainable development and its vision for a greener future.

For the calculation of Scope 3 GHG emissions, we align with the GHG Protocol's Scope 3 guidelines. The Scope 3 GHG emissions for this project will cover emissions from the fuel consumption of vehicles using the road. The calculation is based on the proportion of vehicles traveling from Gelephu-Tareythang, which includes cars, LGVs, and HGVs, multiplied by their fuel consumption rates. Additionally, the growth rate of vehicle usage in Bhutan is considered to estimate the total number of vehicles using the road over its 25-year lifespan and fuel consumption based on the ADB's Vehicle Emission Control Strategy for Bhutan. The calculation covers GHG emissions in both scenarios: Scenario 1, if no new road is constructed, all vehicles will continue to travel on the existing road, and Scenario 2, if a new road is constructed, all vehicles will travel on the new road.

The result of Scope 3 GHG emissions in Scenario 1 is 3,509,383 tons CO_{2e}, and in Scenario 2 is 1,091,707 tons CO_{2e}. For more details on greenhouse gas emissions, refer to ***Table 9.17.*** However, this Scope 3 GHG emissions calculation is based on current data and assumptions, so the results may have some discrepancies. Refer to ***Appendix L3*** for emission factors and ***Appendix L5*** for the specific values of the activity data and the calculation results of both scenarios.

Table 9.17 Estimate Project Emission in Operation phase

	Emission Category	Emission source	GHG emission			
			CO_2 Ton CO_2-e	CH_4 Ton CO_2-e	N_2O Ton CO_2-e	Total Ton CO_2-e
Scenario 1, if no new road is constructed, all vehicles will continue to travel on the existing road						
	Energy – Mobile Combustion (Scope 3 Category 11 use of Sold Product)	Fuel consumption from vehicle use road (No project implement)	3,379,221	19,125	111,037	3,509,383
Scenario 2, if a new road is constructed, vehicles will travel on both the old and new roads						
	Energy – Mobile Combustion (Scope 3 Category 11 use of Sold Product)	Fuel consumption from vehicle use on existing road and new road (Project implement)	1,051,279	5,916	34,512	1,091,707

9.9.4.2 PROPOSED MITIGATION MEASURES

Additional Mitigation, Management, and Monitoring

From the assessment of greenhouse gas emissions during the operation phase, GHG emissions come from road vehicle usage. To mitigate the impact, it is essential to develop a monitoring and evaluation system for road usage, including the number and types of vehicles. This data can be used to calculate GHG emissions and set criteria for vehicles allowed on the roads, as well as to help develop policies for the low-emission transport sector in Bhutan.

Based on Bhutan's *Low Emission Development Strategy (LEDS) for Surface Transport* (2021), several GHG mitigation measures have been identified. Among these, the promotion of electric vehicles (EVs) and the improvement of public transport are particularly effective in reducing the number of private vehicles on the road and lowering emissions from fuel combustion.

Moreover, the "Gelephu Mindfulness City (GMC)" project, which aims to develop a "15-minute" city with walkable neighborhoods, well-connected public transportation, and low private car usage, serves as a strategy to encourage reduced use of personal vehicles and increased reliance on public transportation. This initiative is expected to directly impact greenhouse gas reduction by lowering fuel consumption from vehicles along the Gelephu-Tareythang route.

9.9.4.3 RESIDUAL SIGNIFICANCE

The Gelephu-Tareythang Road is a crucial part of the route from Gelephu to Tareythang, facilitating access to the airport, dry port, and multimodal transport hub in Gelephu, as well as

the strategically important Samtse to Samdrupjongkhar Highway, which runs from east to west across the country.

While road travel inherently produces GHG emissions due to fuel use, the project itself may also generate emissions from vehicles traveling along the route, particularly if they use fossil fuels. Initially, the potential GHG emissions from the road operation phase were expected to be ***Moderate***. To effectively reduce the significance of GHG emissions from surface transportation, the government plan to promote electric vehicles (EVs) and the improvement of public transport are key strategies to reduce GHG emissions from surface transportation. By encouraging the adoption of EVs, not only that Bhutan could decrease reliance on fossil fuels, but also significantly lower emissions from fuel combustion, especially given the country's low grid emission factor. Additionally, enhancing the efficiency and coverage of public transportation systems can reduce the number of private vehicles and freight on the road, further cutting down emissions. Together, these measures can play a crucial role in mitigating GHG emissions and promoting sustainable transport in Bhutan, with an overall residual significance of ***Low***.

10. IMPACTS TO BIOLOGICAL ENVIRONMENT

10.1 TERRESTRIAL HABITAT LOSS

10.1.1 AVOIDANCE AND MINIMISATION MEASURES

The initial Feasibility Study (FS) assessed the three (03) alignment options considering (i) minimization of high-quality forested area clearance, (ii) enhancement of wildlife connectivity, and (iii) disturbance of river and associated riparian habitats. Specifically, the preferred alignment aimed at minimizing the impact to existing wildlife habitats by allowing for sufficient passageway for wildlife, in particular Asian Elephant. This consideration contributed to minimizing the direct habitat loss.

10.1.2 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The preferred alignment consists of 10.2 km of new highway right-of-way and 3.4 km of widening to the existing highway right-of-way. Vegetation clearance area has been estimated within 100 m from each side of centerline for each alignment. The typical dual carriageway portions with 2 lanes in each direction will have a 40 m wide ROW. The typical single carriageway portions will have a 30 m wide ROW. There were 2 wild flora species of conservation interest found within less than 500 m of the proposed alignment centerline the Project area and its proximity, i.e., Teak (*Tectona grandis*, IUCN EN), and "Lindley'sor Deccan Aporosa" *Aporosa cardiosperma* (IUCN VU). Teak is exploited for its high-quality wood while *A. cardiosperma* is used in traditional medicines. Vegetation clearance in the project area may lead to the loss of these important species.

The direct habitat loss consists of **0.07 km²** natural habitat and **0.12 km²** modified habitat (***Table 10.1***). A total of **0.07 km²** of natural terrestrial habitat will be lost during land clearance for the construction of segments 1-9 and the widening of segment 10, excluding the area of the existing segment. Additionally, the Camp and Work areas will result in 0.01 km² natural habitat loss and 0.11 km² of modified habitat loss. These losses are considered temporary and rehabilitation can address this impact.

The direct loss of Project footprint (carriageway) accounts for **0.05%** of the terrestrial EAAA. This loss is considered permanent loss. It is noted that this quantified loss is considered for the Natural/Modified habitat, but Critical Habitat. Additional surveys and assessments should be in place to quantify Critical Habitat loss.

Table 10.1 land cover and NAtural/ Modified habitat calculation

Land Cover	Project footprint (carriageway) (km²)	Work and Camp Area 1 (km²)	Work and Camp Area 2 (km²)	Project Impact Area Area (550 m from the alignment) (km²)	Terrestrial EAAA (km²)	Aquatic EAAA (km²)
Modified habitat	0.12	0.03	0.08	8.79	52.80	-

Land Cover	Project footprint (carriageway) (km^2)	Work and Camp Area 1 (km^2)	Work and Camp Area 2 (km^2)	Project Impact Area Area (550 m from the alignment) (km^2)	Terrestrial EAAA (km^2)	Aquatic EAAA (km^2)
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 EAAA
Water	Not applicable	-	-	0.15	Not applicable	71.4
Total	0.19	0.03	0.09	15.53	129.60	71.4

While the majority area of the EAAA is Modified Habitat, investigations to date indicate habitats within the study area are likely to still support several species of conservation concern, specifically:

- Asian Elephant (*Elephas maximus*, IUCN EN),
- Gee's Golden Langur (*Trachypithecus geei*, IUCN EN),
- Dhole (*Cuon alpinus*, IUCN EN),
- Bengal Tiger (*Panthera tigris,* IUCN EN),
- Hog Deer (*Axis porcinus*, IUCN EN), Gaur (*Bos gaurus*, IUCN VU),
- Leopard (*Panthera pardus,* IUCN VU),

- Sambar (*Rusa unicolor,* IUCN VU); and
- Tricarinate Hill Turtle (*Melanochelys tricarinata*, IUCN EN).

A full list is provided in ***Chapter 7***, Biodiversity Baseline.

Most species found within the project area and its vicinity are generalists and are adapted to use a wide range of Natural and Modified Habitats. Additionally, the project area is contiguous with warm broadleaf forests to the north and subtropical forests to the south, potentially providing alternative habitats for species previously inhabiting the project site, provided vacant niches or territories are present and that the current alternative habitats described are maintained and/ or enhanced on either side of the road and provisions are maintained to facilitate wildlife crossing and habitat connectivity, and animal-vehicle collision, allowing for risk minimization and minimization of functional habitat loss.

Direct habitat loss is permanent and ongoing for all major infrastructure components following construction, with some rehabilitation of cleared areas around infrastructure components when construction finishes. These areas include workers camps, lay down areas, temporary roads and temporary infrastructure.

Overall, the impact magnitude is **Medium**, extent is **Site-specific**, and the duration is **Long-term**. Thus, the impact significance is ***Moderate***.

10.1.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

- The Project will appoint an Ecological Clerk of Works (ECoW) in the PIU to oversee and implement ecological mitigation measures[17].
- Prior to construction activities, the Ecological Clerk of Works conduct a site walk through to confirm no species of conservation significance are present within the working areas.
- 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 *Fauna Shepherding Protocol* included in the Biodiversity Management Plan (BMP). In short, before any tree cutting, a visual inspection by the Project staff and Department of Forests and Park Services of Bhutan (DoFPS) officer should be conducted to identify the presence of wildlife, nests, or any species of conservation concern. If animals are found, especially species of conservation interest, ecologists or DoFPS officer should be contacted to safely relocate the animals.
- Demarcate areas to be cleared in advance with tape or fencing, to avoid inadvertent additional clearing. The ECoW to monitor habitat clearance closely during construction to minimize risk of inadvertent additional clearing.
- Prohibit clearing vegetation outside of designated areas by all Project staff, workers, all contractors and personnel engaged in/or associated with the Project.
- 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 conservation of significant species.
- Checkpoints should be used to manage access and inspect vehicles for wood and timber products taken from areas of natural habitat within the project area.

[17] Consider secondee from DoFPS with understanding of biodiversity management"

- Rehabilitate/ reforest the temporary laydown areas and workers' camps to pre-construction conditions once construction is complete.
- Rehabilitation/ reforestation will be implemented to compensate for residual impacts and achieve a no net loss of terrestrial Natural habitat. The Site Rehabilitation Plan outlined in the Biodiversity Management Plan details the procedures for site rehabilitation. The specific rehabilitation locations will be identified in consultation with the DoFPS. The calculation of the required rehabilitation area will take into account:
    - Any overlap with Critical Habitat areas
    - The quality of the loss of habitat
    - The current habitat quality of the proposed rehabilitation site. If on-site rehabilitation is determined to be unfeasible, actions to enhance existing habitats will be considered as compensatory measures for the habitat loss.

In general, these measures will reduce the magnitude impact to **Low**, the impact extent is **Site-Specific,** and the duration is **Long-term.** Therefore, the overall significance is ***Low***.

10.2 HABITAT FRAGMENTATION

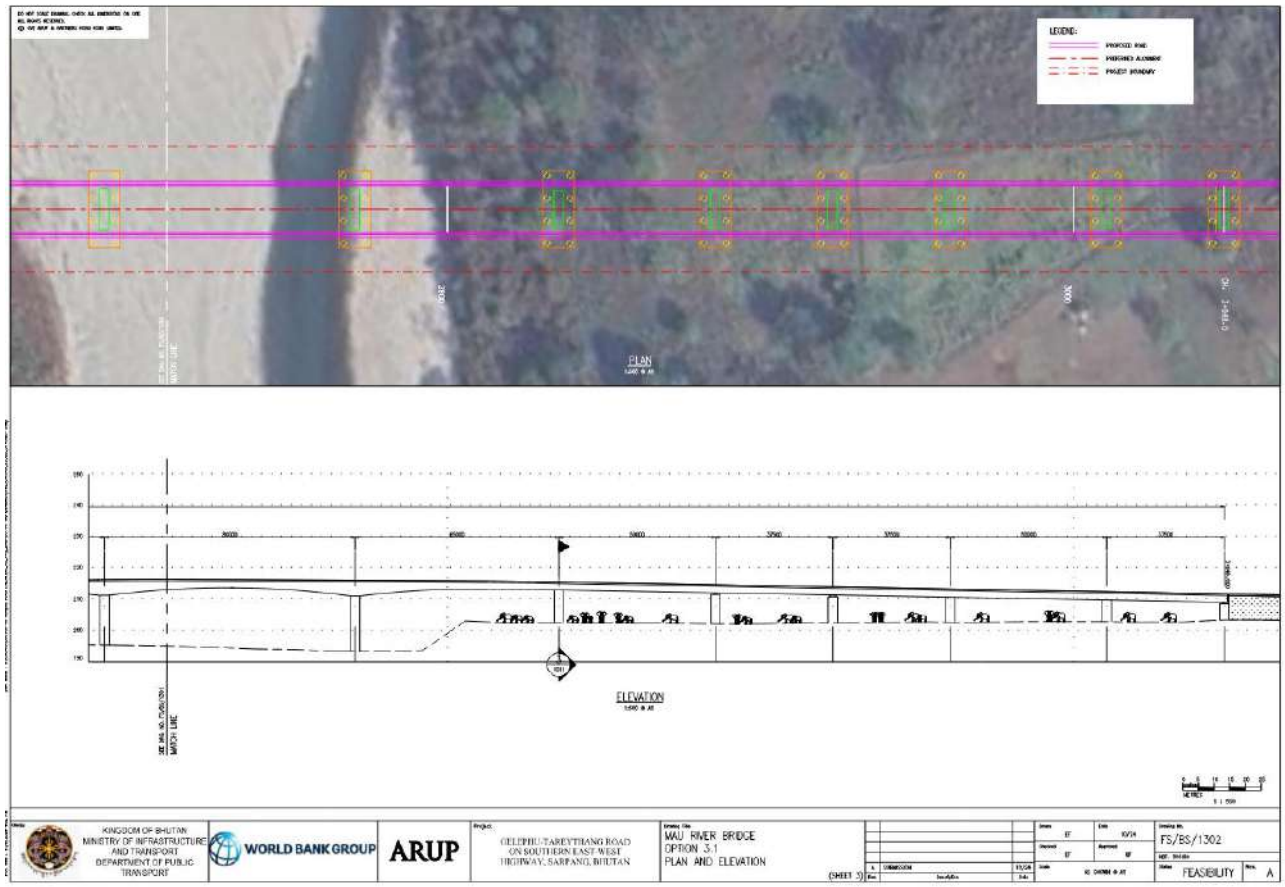
10.2.1 AVOIDANCE AND MINIMISATION MEASURES

The initial Feasibility Study (FS) assessed the three (03) alignment options also considering the maintenance of existing wildlife connectivity. The width of available elephant corridor is considered as part of the evaluation along the different sections of the road. Moreover, the plan for the elephant corridor establishment is under prepared and reviewed to address the loss of habitat connectivity supporting the Asian Elephant. This consideration contributed to minimizing the fragmentation impact.

The bridge is extended on the eastern side to allow for passage of elephant's underneath. The elephants use the riverways for passage, therefore, to maintain this passage during the wet season, the initial design has incorporated a minimum of 250 m wide elephant corridor on eastern riverbank has been incorporated, with an average vertical clearance of 8.15 m, and a minimum clearance of 5.80 m at the East abutment in line with Good International Industry Practice (GIIP). The majority of the corridor is elevated and remains dry throughout the year, including during the wet season. Based on the results of the flooding risk with 100 years return period, a minor portion of the corridor may be flooded[18]. However, given the permeability of the soil in the area, the flooding events are expected to be short terms (few hours to few days) and do not impede the overall movement of the elephants.

[18] CDR, 2024 Hydrological Assessment and Management Principles for Masterplan Area

Figure 10.1 Mau river – elephant passage



10.2.2 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

While the direct habitat loss will be restricted to the project footprint (including temporary areas), fragmentation of the overall EAAA habitat mosaic, edge effects and loss of habitat connectivity will extend beyond the immediate project footprint. These will result in (i)

- altered microclimates,
- altered predator-prey interactions and habitat selection,
- noise, air emissions,
- increased human and construction activities during the construction phase; and
- increased traffic and other human activity during the operation phase.

The result of this will be net habitat loss for several currently occurring species, and possibly some increase in occupancy by species more adapted to modified habitats and human activity (see ***Section 10.4*** for the disturbance impacts). To practically account for this indirect impact in a quantitative manner, a 550-m radius from the project site is considered impacted in terms of biological effects, to align with the noise modelling results (***Section 9.2***, Noise IA). However, special considerations applies to Asian elephant, whose movement range exceeds the 550 m. Those large mammals will experience habitat fragmentation at a different scale. For this reason, impacts are assessed considering a wider area and mitigation measures identified takes into account the connectivity with suitable habitat around the road, including the Royal Manas National Park.

The existing habitats within the EAAA help retain functional, southerly terrestrial ecological connections between Phibsoo Wildlife Sanctuary (PWS) and Royal Manas National Park as well as habitats immediately south of the Bhutanese-India border (especially India's Manas National Park). Functional terrestrial ecological connection between PWS and RMNP is also to lesser extent, supported by Natural Habitats in the North of the project along the Bhutanese Himalayan foothills that includes the formally recognized Biological Corridor 3 (also known as the "Northern Biodiversity Corridor") that roughly parallels the elevation contours from 329–2,647 masl[19]. Species less inclined to use steep, higher elevation terrain associated with Biological Corridor 3 (e.g. elephants) may be more adversely affected by the loss of connectivity.

Asian Elephant: The Project EAAA contains Critical Habitat supporting Asian Elephant. The Project and its adjacent areas are within the home range of the Asian Elephants. Field surveys recorded frequent occurrences of this species within the project vicinity, with two herds (totaling 37 individuals) observed. There is evidence that the elephants' dispersal route overlaps with the project site. Bhutan Elephant Corridor Project assessed the movement of an elephant code-named "Jetsun". 'Jetsun' was observed reaching the boundary of Umling Gewog, adjacent to Manas National Park, and travelling as far west as Phibsoo Wildlife Sanctuary. Jetsun visited this sanctuary in the first half of 2015 and again in the second quarter of 2016, indicating that she consistently remained in forested or shrubland areas. Based on the baseline field survey conducted for the Project, Asian Elephant's presence was recorded during camera traps and transect surveys (both direct observation and indirect evidence) along the road alignment, indicating that the elephants utilize these passageways to travel between the forested areas in India and the forested areas north of the road alignment and the Royal Manas National Park. They are more active during dawn and dusk showcasing crepuscular behavior. The loss of habitat in and around the Project area may force elephants to alter their traditional routes and expand their home ranges into new areas that is not previously used, due to decreased accessibility and barrier effects. While the expansion could reach more forested areas, it is also likely that elephants, particularly adult males, may extend their range into cropland, indirectly intensifying human-wildlife conflict (***Section 10.6***). Habitat loss, barrier and fragmentation effects have been assessed for Asian Elephant in various places[20], e.g., Nepal[21], India[22,23], China[24], Malaysia[25],

[19] Bhutan Biodiversity Portal. Available at: Biological Corridor 3 (biodiversity.bt) Accessed date: Oct 10, 2024

[20] Leimgruber, P., Gagnon, J. B., Wemmer, C., Kelly, D. S., Songer, M. A., & Selig, E. R. (2003). Fragmentation of Asia's remaining wildlands: implications for Asian elephant conservation. *Animal conservation*, *6*(4), 347-359.

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[22] Padalia, H., Ghosh, S., Reddy, C. S., Nandy, S., Singh, S., & Kumar, A. S. (2019). Assessment of historical forest cover loss and fragmentation in Asian elephant ranges in India. *Environmental Monitoring and Assessment*, *191*, 1-13.

[23] Kumar, M. A. (2006). Effect of habitat fragmentation on Asian elephant (Elephas maximus) ecology and behaviour patterns in a conflict-prone plantation landscape of the Anamalai hills, Western Ghats, India. *Rufford Maurice Laing Foundation, UK*, *29*.

[24] Liu, S., Dong, Y., Cheng, F., Zhang, Y., Hou, X., Dong, S., & Coxixo, A. (2017). Effects of road network on Asian elephant habitat and connectivity between the nature reserves in Xishuangbanna, Southwest China. *Journal for Nature Conservation*, *38*, 11-20.

[25] Mohd Taher, T., Lihan, T., Tajul Arifin, N. A., Khodri, N. F., Ahmad Mustapha, M., Abdul Patah, P., ... & Mohd Nor, S. (2021). Characteristic of habitat suitability for the Asian elephant in the fragmented Ulu Jelai Forest Reserve, Peninsular Malaysia. *Tropical Ecology*, *62*, 347-358.

Thailand[26]. There are currently no records of elephants using Biological Corridor 3 and research indicates a negative correlation between elephant abundance, elevation[27] and slope[28]. As part of the road alignment and design, plans to establish an elephant corridor including the design of under passages wide enough to facilitate elephant movement are under review. During the final design, the eastern bank of Mau River will be maintained to keep natural passage for Asian Elephant. Additional data collection will inform the final design of elephant corridor. If designed and implemented effectively, these passageways/ corridors will potentially mitigate some habitat fragmentation impacts to the Asian Elephant populations, by retaining connectivity between the forested patches on the south and north of the road alignment. Elephants migrate primarily to access seasonal resources such as food and water, avoid human conflict, and maintain traditional social and ecological behaviors. The dispersal of the male elephant is critical for its reproduction[28]. Specifically, this helps in avoiding inbreeding and is critical for gene flow through the population. Without the proposed elephant corridor, the movement of Asian elephants may be severely restricted, which could have long-term negative impacts on the population. The fragmentation impacts on the Asian elephant without the measure of the proposed elephant corridor is high. The fragmentation impact on the Asian elephant is considered medium, taking into consideration the ongoing corridor design and associated efficacy studies/research.

Gee's Golden Langur: The Project EAAA contains Critical Habitat supporting Gee's Golden Langur. Gee's Golden Langur is in danger facing the fragmentation effect in the border of Bhutan-India[29]. The fragmented populations have low possibility of long-term survival[30]. There are genetic diversity and structural issues among isolated populations of the Gee's Golden Langur in Assam, India[31] . Gene isolation can be the most extreme consequence among population fragments, which leads to local extinction[32].The field survey recorded four groups of golden langurs, (i) the first group had 13 individuals, (ii) the second had 7, (iii) the third had 13 to the west of the Mau River, and (iv) the fourth had 9 to the east of the Mau River. This species' occurrence was associated with presence of the sub-tropical forest and dense canopy that allow their movement. Supplemental data from iNaturalist shows the species occurring in the Phibsoo Wildlife Sanctuary, Royal Manas National Park, and scattered across Biological Corridor 3. Groups of Gee's Golden Langur can share a home range and disperse for foraging. While it is unlikely that the species would cross rivers to move between the sanctuaries, they could utilize Biological Corridor 3, which provides suitable habitat. Considering the existing fragmentation threats to the species in the area, the impact on this species is expected to be medium. In addition to

[26] Suksavate, W., Duengkae, P., & Chaiyes, A. (2019). Quantifying landscape connectivity for wild Asian elephant populations among fragmented habitats in Thailand. *Global Ecology and Conservation*, *19*, e00685.

[27] National Elephant Survey Report (2018). Bhutan Trust Fund. Available at: 1705405524National-Elephant-Survey-Report-DoFPS.pdf (bhutantrustfund.bt) Accessed date: Oct 1, 2024

[28] Liu, P., Wen, H., Lin, L., Liu, J., & Zhang, L. (2016). Habitat evaluation for Asian elephants (Elephas maximus) in Lincang: Conservation planning for an extremely small population of elephants in China. *Biological Conservation*, *198*, 113-121.

[29] Choudhury, A. (2002). Golden langur Trachypithecus geei threatened by habitat fragmentation. *ZOOS'PRINT JOURNAL*, *17*(2), 699-703.

[30] Choudhury, A. (2002). Golden langur Trachypithecus geei threatened by habitat fragmentation. *ZOOS'PRINT JOURNAL*, *17*(2), 699-703.

[31] Ram, M. S., Kittur, S. M., Biswas, J., Nag, S., Shil, J., & Umapathy, G. (2016). Genetic diversity and structure among isolated populations of the endangered gees golden langur in Assam, India. *PLoS One*, *11*(8), e0161866.

[32] Templeton, A. R., Shaw, K., Routman, E., & Davis, S. K. (1990). The genetic consequences of habitat fragmentation. *Annals of the Missouri Botanical Garden*, 13-27.

fragmentation, crossing the road can pose mortality risk to Gee's Golden Langur due to roadkills[33].

Dhole: The Dhole, a habitat generalist, was observed in the subtropical forest in southern Project area. Its population is often associated with wild pig populations, and camera traps confirmed its presence. Research indicates that Dholes are scattered throughout Bhutan in various habitats[34]. Dholes are also estimated to require five times more land area than large-bodied carnivores, mainly because of the social structure of populations living in exclusive territories[35]. Thus, maintaining the connectivity among habitat is essential for Dhole. While there is loss of Project area, Dhole can utilize the Biological Corridor 3 to move among habitats. The loss of habitat connectivity through the Project is projected to pose low-medium impacts on this species.

Tiger: Based on existing studies, road construction resulting in habitat fragmentation can create "tiger islands" where the populations become increasingly isolated[36,37,38,39]. Tigers, were detected in the forest near Tareythang, less than 1 km to the project site such as in the Royal Manas National Park. While tigers may pass through the project area, increased human activity during the construction and operations phase may reduce the attractiveness of the area for them during certain times of day and or during certain seasons of elevated traffic and overall human activity.[40] Available records indicated that tigers could be using the forested areas between the Royal Manas National Park, Phibsoo Wildlife Sanctuary and the Ripu and Chirang Reserve Forests in India[41,42]. Additionally, previous records indicated that Tiger could be using wildlife corridors[43], e.g., to disperse from Royal Manas National Park[44]. Thus, the loss of habitat connectivity through the Project is projected to pose insignificant impacts on this species.

[33] Available at: Golden langurs killed by people, roads and power lines in Bhutan | Dialogue Earth Accessed date: November 01, 2024

[34] Thinley, P., Rajaratnam, R., Kamler, J. F., & Wangmo, C. (2021). Conserving an endangered canid: assessing distribution, habitat protection, and connectivity for the dhole (Cuon alpinus) in Bhutan. Frontiers in Conservation Science, 2, 654976

[35] Thinley, P., Rajaratnam, R., Kamler, J. F., & Wangmo, C. (2021). Conserving an endangered canid: assessing distribution, habitat protection, and connectivity for the dhole (Cuon alpinus) in Bhutan. *Frontiers in Conservation Science*, *2*, 654976.

[36] Barber-Meyer, S. M., Jnawali, S. R., Karki, J. B., Khanal, P., Lohani, S., Long, B., ... & Wikramanayake, E. (2013). Influence of prey depletion and human disturbance on tiger occupancy in N epal. *Journal of Zoology*, *289*(1), 10-18.

[37] Joshi, A., Vaidyanathan, S., Mondol, S., Edgaonkar, A., & Ramakrishnan, U. (2013). Connectivity of tiger (Panthera tigris) populations in the human-influenced forest mosaic of central India. *PloS one*, *8*(11), e77980.

[38] https://www.wildlifeconservationtrust.org/wp-content/uploads/2018/11/Vol-1-Policy-Framework-CI-and-EG-Landscape-Low-Res-.pdf

[39] Carter, N., Killion, A., Easter, T., Brandt, J., & Ford, A. (2020). Road development in Asia: Assessing the range-wide risks to tigers. *Science Advances*, *6*(18), eaaz9619.

[40] WWF. Available at: WWF congratulates Bhutan for increase in wild tiger population | WWF Accessed date: Oct 10, 2024

[41] WWF. Available at: Bhutan: Where tigers are recovering in national parks big and small | WWF (panda.org) Accessed date: Oct 10, 2024

[42] WWF. Available at: Bhutan's biological corridors - Alive and kicking! | WWF (wwfbhutan.org.bt) Accessed date: Oct 10, 2024

[43] Thinley, P., Dendup, T., Rajaratnam, R., Vernes, K., Tempa, K., Chophel, T., & Norbu, L. (2020). Tiger reappearance in Bhutan's Bumdeling Wildlife Sanctuary: a case for maintaining effective corridors and metapopulations. *Animal Conservation*, *23*(6), 629-631.

[44] WWF. Available at: Bhutan: Where tigers are recovering in national parks big and small | WWF Accessed date: Nov 01, 2024

Hog deer: Hog Deer is an important prey of Bengal Tiger[45]. The species was recorded in the southern project area, within grasslands, warm broadleaf forests, subtropical forests and some agricultural lands. The highest elevation where it has been recorded was 1,500 m asl in Nagaland[46]. They could potentially use Biological Corridor 3 if necessary. However, iNaturalist data indicates that the species is predominantly found in lowland areas in southern Bhutan, adjacent to India. As a result, the impact of habitat fragmentation on hog deer is considered medium.

Gaur: Gaur habitat is characterized by (i) large, relatively undisturbed forest tracts, (ii) hilly terrain below an altitude of 1,500-1,800 m asl, (iii) availability of water, and (iv) an abundance of forage in the form of coarse grasses (including bamboo), shrubs, and trees[47]. The field survey suggested the frequent occurrence of gaur in the sub-tropical forest to the south of the Project area, while desktop review suggests occurrences within the Himalayan subtropical broadleaf forest ecoregion. While they could utilize Biological Corridor 3, most of their recorded occurrences are in lowland areas of southern Bhutan. Camera trap data during the field survey indicated 950 sightings, largely concentrated along the lowland areas, closer to the proposed road alignment. Therefore, the impact of habitat connectivity loss on gaur is considered medium.

Leopard: Leopards are able to occupy an extremely wide range of habitats where there is adequate prey[48]. They are expected to currently frequent all areas of the EAAA and larger GMC planning area where there is available prey. During the field survey, leopard tracks were observed at one grid location, towards the eastern portion of the road alignment, where an existing road has been constructed. Therefore, any activities in this area are limited to expansion of the existing roadway. As such, any additional loss of connectivity from road expansion in this area relative to the broad range of productive habitats in the EAAA is expected to have a negligible impact on this species.

Sambar: Sambar were observed in the subtropical forests of the southern project area. This primarily nocturnal species rests in dense forest cover during the day and can live at elevations up to 3,900 m[49]. It possibly utilizes the biological corridor 3 if necessary for its movement. Given that the adjacent areas to the road alignment are largely modified, it is unlikely that the sambar rests within these areas during the day. As part of the field baseline survey, some observations of Sambar were made, with greater concentration towards the eastern portion of the road alignment, whereby tracking and feeding marks were observed, indicating usage of these areas.

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[45] Odden, M., Wegge, P., & Storaas, T. (2005, February). Hog deer Axis porcinus need threatened tallgrass floodplains: a study of habitat selection in lowland Nepal. In *Animal Conservation forum* (Vol. 8, No. 1, pp. 99-104). Cambridge University Press.

[46] Timmins, R., Duckworth , J.W., Samba Kumar, N., Anwarul Islam, M., Sagar Baral, H., Long, B. & Maxwell, A. 2015. *Axis porcinus*. *The IUCN Red List of Threatened Species* 2015: e.T41784A22157664. https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T41784A22157664.en. Accessed on 10 October 2024.

[47] Duckworth, J.W., Sankar, K., Williams, A.C., Samba Kumar, N. & Timmins, R.J. 2016. *Bos gaurus*. *The IUCN Red List of Threatened Species* 2016: e.T2891A46363646. https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2891A46363646.en. Accessed on 10 October 2024.

[48] Stein, A.B., Gerngross, P., Al Hikmani, H., Balme, G., Bertola, L., Drouilly, M., Farhadinia, M.S., Feng, L., Ghoddousi, A., Henschel, P., Jhala, Y., Khorozyan, I., Kittle, A., Laguardia, A., Luo, S.-J., Mann, G., Miquelle, D., Moheb, Z., Raza, H., Rostro-García, S., Shivakumar, S., Song, D. & Wibisono, H. 2024. *Panthera pardus*. *The IUCN Red List of Threatened Species* 2024: e.T15954A254576956. Accessed on 04 October 2024.

[49] Timmins, R., Kawanishi, K., Giman, B, Lynam, A., Chan, B., Steinmetz, R., Sagar Baral, H. & Samba Kumar, N. 2015. *Rusa unicolor* (errata version published in 2015). *The IUCN Red List of Threatened Species* 2015: e.T41790A85628124. https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T41790A22156247.en. Accessed on 10 October 2024.

Given the availability of alternative food sources (grass, foliage, fruits etc.) in the area, any impact of habitat connectivity loss on this species' movement is considered low.

Tricarinate Hill Turtle: The Tricarinate Hill Turtle, inhabits the grasslands of the Himalayan foothills and nearby wet evergreen forests at elevations up to 300 meters[50]. The species is semi-fossorial and active mainly during the wet season; it appears to prefer stream edge habitats[51]. The nearest suitable habitats identified during field surveys and subsequent analysis of remote sensing imagery, is approximately 2.5 km North of the proposed road alignment. There may be seasonal movements toward water during the monsoon season, though no specific research on this movement in southern Bhutan was found. There is research suggesting corridor establishment to address habitat loss and fragmentation affecting Tricarinate Hill Turtle implying that the destruction of habitat connectivity can adversely impacts this species[52]. However, the habitat loss due to the Project does not lead to fragmentation of the northern habitat outside the Project supporting this species. Therefore, the impact of habitat connectivity loss on this species' movement is considered low. Additionally, crossing the road can pose mortality risks to this species[53].

The loss of habitat connectivity from the project is expected to adversely affect certain species, particularly those sensitive to fragmentation. However, Biological Corridor 3, which connects Phibsoo Wildlife Sanctuary and Royal Manas National Park, offers an alternative route for many species. Overall, the magnitude of fragmentation is considered **Medium**.

In conclusion, the magnitude impact is high, the impact extent is regional and the duration is long-term. Thus, the impact significance is ***High***.

10.2.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

10.2.3.1 CONSTRUCTION PHASE

- 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.
- The Project, e.g., ECoW works with the DoFPS to install and frequently 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.
- Preserve the eastern bank of Mau River as natural passage to facilitate the movement of Asian Elephants until the elephant corridor is implemented. At the time of this assessment, this measure is being considered in the design of the elephant corridor and is included in The

[50] Horne, B.D., Praschag, P., Choudhury, B.C. & Singh, S. 2020. *Melanochelys tricarinata*. *The IUCN Red List of Threatened Species* 2020: e.T13038A511526. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T13038A511526.en. Accessed on 01 October 2024.
[51] Horne, B.D., Praschag, P., Choudhury, B.C. & Singh, S. 2020. *Melanochelys tricarinata*. *The IUCN Red List of Threatened Species* 2020: e.T13038A511526. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T13038A511526.en. Accessed on 10 October 2024.
[52] Mondal, I., Kumar, R. S., Habib, B., & Talukdar, G. (2016). Modelling fine scale movement corridors for the tricarinate hill turtle. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *41*, 719-725.
[53] Das, P., & Nair, V. S. (2021). Road mortality of an endangered Tricarinate Hill Turtle, Melanochelys tricarinata (Blyth 1856). *Reptiles & Amphibians*, *28*(3), 428-429.

Gelephu Mindfulness City Masterplan. A monitoring program to track use of the eastern bank of Mau River by Asian elephants should be commenced prior to construction activities.

- Install and maintain wildlife fencing in areas where habitats support a variety of species, especially the eastern and western part of the Project adjacent to the subtropical forest and warm broadleaf forest. The specific locations of the wildlife fencing are to be determined in the BMP.Implement speed limits (30 kph) for vehicles to reduce wildlife road kills.
- Allocate adequate budget to establish and maintain wildlife crossings that are designed based on industry best practices and recent academic research to maintain safe passageway of animals between the natural habitats surrounding the Project such as:
    - Elephant corridor, taking into account the minimum size required and alignment as close as possible to the existing pathways utilized. (Electric) fencing with trench can be applied to navigate elephant's movement. Trenches, however, are prone to filling with water during the rainy season, and their sides may collapse if the soil structure is unstable, reducing their effectiveness as barriers. The project (e.g., ECoW) should collaborate with the DoFPS to conduct annual maintenance of the trenches after the rainy season to ensure their continued functionality. The cost for establishment and maintenance of the elephant corridor is specified in the BMP. Install and maintain wildlife fencing in areas where habitats support a variety of species, especially the eastern and western part of the Project adjacent to the subtropical forest and warm broadleaf forest. The specific locations for the wildlife fencing will be confirmed in the BMP.
    - Vegetated canopy bridge/ feeder ropes/ glider poles for arboreal species, i.e., Gee's Golden Langur (refer to **Chapter 7 – Biodiversity Baseline** for locations where forest canopies intersect with the road alignment, e.g., western part of the Project). The specific locations for the canopy bridge will be confirmed in the BMP. An example of Golden Langur crossing canopy bridge can be found in ***Figure 10.2***.
    - Crossings, such as culvert for Trilaminate Hill Turtles can minimize the fragmentation impact on this species, e.g. possibly to the west of the Project where the species was found during the field survey[54]. The specific locations for the culverts will be confirmed in the BMP. ***Figure 10.3*** presents an example of turtle culvert used by a different turtle species.
- Habitat Quality Improvement: Enhancing resources within protected areas through grassland development, nursery establishment, and invasive species management.
- Prioritize the creation of a "Migration Corridor Pilot" consisting of an initial corridor development on available government land, with plans for potential expansion requiring additional funding.
- Resource Availability: Development of waterholes and mineral licks to support wildlife within protected zones, reducing the incentive to move into human-occupied areas.

10.2.3.2 OPERATION PHASE

- The Project, e.g., ECoW works with the DoFPS to install and frequently maintain appropriate information signages at strategic wildlife crossings. The monitoring program outlined in the BMP will help identify areas with high wildlife movement. It is suggested

[54] Mondal, I., Kumar, R. S., Habib, B., & Talukdar, G. (2016). Modelling fine scale movement corridors for the tricarinate hill turtle. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *41*, 719-725.

to use high-visibility, reflective materials for signage, ensuring they are easily seen in low-light conditions.

- The Project, i.e., ECoW collaborates with the DoFPS frequently monitor elephants' movement along the road and corridors usage by elephants to evaluate the success of the corridor.
- The Project, i.e., ECoW collaborates with the DoFPS to frequently monitor the canopy bridge usage by Gee's Golden Langur.
- The Project, i.e., ECoW collaborates with the DoFPS to frequently monitor the culvert usage by Tricarinate Hill Turtles.
- Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.
- Department of Surface Transport (DoST) is responsible for collecting carcass due to roadkill, the Project ECoW works with the DoFPS and DoT to monitor this data.

Cross-border collaboration is essential to support the movement of species, particularly the Asian Elephant. Efforts could include regular communication among the Project, the DoFPS, and the management boards of KBAs and PAs in Bhutan and India. However, it is important to note that the involvement of KBAs, PAs, and authorities in India is not yet secured.

Figure 10.2 A golden langur crossing roads using a canopy bridge in india[55]

[55] Available at: Artificial canopy bridge helps check death of prized golden langurs on Assam roads. Accessed date: November 01, 2024

Figure 10.3 A Midland Painted turtle enters one of the new culverts that were installed under the Causeway in the fall of 2014 to enable wildlife to pass safely under the busy road[56]

In general, these measures will reduce the magnitude impact to **Medium**, the impact extent is **Regional** and the duration is **Long-term.** Therefore, the overall significance is **High**.

10.3 HABITAT DEGRADATION

10.3.1 AVOIDANCE AND MINIMISATION MEASURE

The Project proposed to implement the measures to mitigate the impact caused by dust emissions from construction, exhaust emissions from construction and operation traffic operational that will occur along the entire length of the road as specified in **Section 9.1 - Air Impact Assessment**.

10.3.2 IMPACT EVALUATION AND SIGNIFICANCE

Beyond removal of ground cover vegetation and landform modification, road construction and operation also can alter and degrade habitat by the following means:

- edge effects as a result of opening up forest canopy;
- pollution of adjacent landscapes from dust, vehicle residues, road user litter;
- opportunistic human activity by work force or future road users (poaching or harassment of wildlife (by humans or their pets), plant collecting, firewood collection etc.;
- introduction of invasive species;
- alteration of surface and sub-surface drainage that would have otherwise maintained local soil-moisture conditions; and by

[56] Available at: More aquatic wildlife culverts for Long Point Causeway – Long Point Causeway Improvement Project Accessed date: November 01, 2024

- creation of risk of surface erosion and instabilities that result in generation of silt, slope unraveling, and slope failures resulting in collateral damage and degradation to habitat.

Impacts from Fugitive Dust

During the construction phase, land preparation activities have the potential to generate dust. Dust generated from the Project could settle on vegetation adjacent to the Project area. Excessive dust deposition on foliage may act to suppress growth by limiting photosynthesis, and dusted foliage and fruits may become unpalatable to foraging fauna[57]. Construction activities will be temporary and dust generation is likely to be localized to active work areas. This impact will typically be limited to October to May during the construction phase, as the monsoon rains from June to September will limit dust formation and wash any accumulated dust-off foliage.

Impacts from Invasive Species

Invasive species have the potential to be introduced or spread throughout the project area via increased movement of people, vehicles, machinery, vegetation and soil. An increase in the prevalence of invasive species has the potential to reduce the abundance of native species through competition. Invasive flora species can rapidly germinate in disturbed areas, which may affect the ability of native vegetation communities to re-establish[58] and change species composition; this may in turn affect the composition of the faunal array these communities' support.

The alignment expansion and construction will increase the likelihood of invasive flora introduction and proliferation. The alignment requires regular maintenance , and the frequent traffic and machines can act as a vector for invasive species. Furthermore, areas that are subject to significant disturbance (e.g. clearance) are more vulnerable to colonization by invasive alien species[59]. Invasive fauna may adversely impact native fauna and flora because of increased competition for resources, predation or habitat degradation. Nine flora invasive species listed in Biodiversity Bhutan User List was identified during the biodiversity baseline surveys in the nearby Project area, (see **Chapter 7 – Biodiversity Baseline**).

Impacts from Enhanced Access

Enhanced access to natural habitat patches due to access roads from construction may cause an increase in the collection of wood and timber products by workers, local people, and tourists/visitors. This may result in localized reductions in ground habitats (fallen logs) or the removal of certain tree species used for building or household purposes.

[57] Farmer, A.M., 1993. The effects of dust on vegetation—a review. Environmental pollution, 79(1), pp.63-75.
[58]Ramula, S., Knight, T.M., Burns, J.H. and Buckley, Y.M., 2008. General guidelines for invasive plant management based on
comparative demography of invasive and native plant populations. Journal of Applied Ecology, 45(4), pp.1124-1133.
[59] Lee, C.E., 2002. Evolutionary genetics of invasive species. Trends in ecology & evolution, 17(8), pp.386-391.

Poaching has been a serious threat in Bhutan[60,61], especially, Tigers[62] and Leopard [63].[64] Enhanced access increases the risk of wildlife poaching. The presence of access roads can facilitate entry into previously undisturbed habitats, making it easier for poachers to target wildlife species, particularly those of conservation interest. This can lead to a decline in populations of threatened and endangered species, disrupt local ecosystems, and exacerbate the vulnerability of already at-risk species.

A total of 127 tree species, 69 herbs species, and 37 epiphytes species were identified during the biodiversity surveys. Among these, there were two (02) species of conservation interest, e.g., Teak (*Tectona grandis*, IUCN EN), and *Aporosa cardiosperma* (IUCN VU).

Summary

Therefore, the Project's potential for degrading terrestrial habitat because of construction will be direct, adverse, medium in magnitude, local in extent, short term in duration, with an overall impact significance of Moderate, while the Project's potential impact during operations will be direct, adverse, low in magnitude, local in extent, and long term in duration, with an overall pre-mitigation significance of ***Moderate***.

10.3.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

- Use fencing and hoarding where minor project infrastructure (such as buildings) is adjacent to natural habitat patches.
- Implement a wheel wash system during construction to ensure minimize dust dispersion and movement of organic materials.
- Include water spraying of disturbed areas to minimize fugitive dust dispersion.
- Educate the staff and stakeholders about (i) Illegal Felling and Extraction of Trees, (ii) Harvest of Non-Wood Forest Product regulated as Forest and Nature Conservation Rules and Regulations, 2023,[65] and (iii) legal consequences of poaching and consuming bush meat.
- Poaching may occur when large-scale construction work is present. Workers will be trained and educated on biodiversity protection, and the worker's code of conduct for construction workers will mandate any hunting, and collecting of natural resources would result in employment termination.

Invasive Species

- Rehabilitate disturbed land that is not used with native species.
- Develop an Invasive Species Management Plan to manage invasive species within the Project area so that any introduction or proliferation does not impact natural habitats in

[60] WWF.Available at: Towards Zero Poaching in Bhutan | WWF Accessed date: November 15, 2024
[61] South Asia Monitor. Available at: 4,000 wildlife crimes in the last three years in Bhutan | South Asia Monitor Accessed date: November 15, 2024
[62] Bhutan Foundation. Available at: Addressing Tiger Poaching with Compassion - Bhutan Foundation Accessed date: November 15, 2024
[63] WWF. Available at: Big cat protection in Bhutan | WWF Accessed date: November 15, 2024
[64] Tenzin, K. (2023). Assessing Human-Common Leopard Negative Interaction: Mitigating Poaching and Illegal Trading of its Products in Eastern Himalaya. *Authorea Preprints*.
[65] Royal Government of Bhutan Ministry of Energy and Natural Resources Department of Forests and Park Services. Forest and Nature Conservation Rules and Regulations, 2023. Available at: FNCRR-2023.pdf (moenr.gov.bt)

the proximal areas. The measures to prevent the transmission of invasive species should be planed and implemented, e.g., the Project to install wheel wash bays to remove dirt and plant material from vehicle wheels before entering and leaving the Project area during the construction. The Invasive Species Management Plan will include the invasive monitoring program, associated timeline, and the recommendation for invasive removal, where appropriate.

- Removal of Lantana camara for habitat improvement: Lantana camara is an invasive exotic weed which is found spreading throughout the elephant's habitat under Sarpang Dzongkhag[66].

The initially allocated cost in 5 years for invasive management will be specified in the BMP.

Degradation of habitat and harm to terrestrial species due to air pollution

Implement mitigation measures regarding air pollution during construction phase reduction in this ESIA. These measures include:

- site planning using wet method;
- dust management;
- measures to track out on hardstanding public roads;
- managing construction traffic; and
- regular inspection of Air Quality.

For the construction phase, these measures will reduce the magnitude impact to Low, the impact extent is local, and the duration is short-term. Therefore, the overall significance is Low. During operation, these measures will reduce the magnitude impact to Low, the impact extent is Local, and the duration is long-term. Therefore, the overall significance is ***Low***.

10.4 DISTURBANCE TO TERRESTRIAL WILDLIFE

The Project has the potential to disturb and/ or displace fauna because of (i) light, noise, and vibration emissions during the construction, (ii) increased human activity due to increased accessibility during construction and operation, and (iii) increased traffic volumes/speed and associated human activities during the operation.

Examples of construction activities cause disturbance include:

- Activities at storage areas and any refueling and maintenance yards;
- operation of borrow pits, crushers (if any);
- Materials transport;
- Surveying and land clearing;
- Earthworks (blasting, excavation, compaction, grading);
- Construction of bridges, including foundations, piers / abutments, and superstructures; and
- Installation of any ancillary utilities (e.g. powerlines, waterlines etc.).

[66] Human-Elephant Conflict Management Report. 2017. Divisional Forest Office, Sarpang Department of Forests and Park Services Ministry of Agriculture and Forests 2017. Available at: Human-Elephant-Conflict-Management-Report-Divisional-Forest-Office-Sarpang-Bhutan.pdf Accessed date: November 01, 2024

10.4.1 INDIRECT IMPACT MINIMISATION MEASURES

The Project proposed to implement the measures to mitigate the impact caused by noise and air emissions as specified in ***Section 9.1*– Air IA and *Section 9.2* – Noise IA**.

10.4.2 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Terrestrial fauna within and adjacent to the Project area are expected to be subjected to increased light, noise, vibration, and human presence/activity, which have the potential to disturb natural breeding, roosting/loafing, and/ or foraging behavior of terrestrial fauna species[67] and/or cause temporary or permanent movement away from project facilities, during construction and to perhaps a lesser extent operation (when gradual habituation may occur)[68].

Influences of artificial night lighting on the behavior and community ecology of species[69,70]. Lighting associated with the Project has the potential to inhibit fauna movement patterns and behavior, particularly nocturnal species and carnivores[71].

It is expected that the Project will generate vibration impacts associated with blasting activities and the movement of heavy vehicles and machinery. Wildlife species can be more sensitive to vibrations than humans. Species that rely on vibration for prey/ predator detection (e.g. spider [72]) are likely to be negatively affected, which may in turn affect wildlife abundance and distribution[73].

Anthropogenic noise will be the primary disturbance for resident fauna, which will be closely associated with vegetation clearing, excavation, vehicle and equipment movement, and other typical construction activities. These activities will introduce noise sources that are not currently present in the EAAA. More specifically, noise can affect wildlife communication, which in turn can affect breeding potential, predator detection, and social interactions[74,75].

In general, observed species of conservation concern may avoid the Project area and its proximity. While in some settings, Asian elephant may actively avoid areas of high human activity[76,77] it appears that Asian elephant elephants within the EAAA have habituated to human disturbance and are prone to conflict with local farmers. Some studies have shown the Asian

[67] van der Ree, R., Smith, D.J. and Grilo, C., 2015. Handbook of Road Ecology. John Wiley & Sons.
[68] van der Ree, R., Smith, D.J. and Grilo, C., 2015. Handbook of Road Ecology. John Wiley & Sons.
[69] Longcore, T., & Rich, C. (2004). Ecological light pollution. *Frontiers in Ecology and the Environment*, *2*(4), 191-198.
[70] Raap, T., Pinxten, R., & Eens, M. (2015). Light pollution disrupts sleep in free-living animals. *Scientific reports*, *5*(1), 13557.
[71] Kavanau, J. L., & Ramos, J. (1975). Influences of light on activity and phasing of carnivores. *The American Naturalist*, *109*(968), 391-418.
[72] Wu, C. H., & Elias, D. O. (2014). Vibratory noise in anthropogenic habitats and its effect on prey detection in a web-building spider. *Animal Behaviour*, *90*, 47-56.
[73] Raboin, M., & Elias, D. O. (2019). Anthropogenic noise and the bioacoustics of terrestrial invertebrates. *Journal of Experimental Biology*, *222*(12), jeb178749.
[74] Shannon, G., McKenna, M. F., Angeloni, L. M., Crooks, K. R., Fristrup, K. M., Brown, E., ... & Wittemyer, G. (2016). A synthesis of two decades of research documenting the effects of noise on wildlife. *Biological Reviews*, *91*(4), 982-1005.
[75] Bowles, A. E. (1995). Responses of wildlife to noise. *Wildlife and Recreationists: Coexistence through Management and Research (RL Knight and KJ Gutzwiller, Eds.). Island Press, Washington, DC*, 109-156.
[76] Liu, S., Dong, Y., Cheng, F., Zhang, Y., Hou, X., Dong, S., & Coxixo, A. (2017). Effects of road network on Asian elephant habitat and connectivity between the nature reserves in Xishuangbanna, Southwest China. *Journal for Nature Conservation*, *38*, 11-20.
[77] Srinivasaiah, N. M., Anand, V. D., Vaidyanathan, S., & Sinha, A. (2012). Usual populations, unusual individuals: insights into the behavior and management of Asian elephants in fragmented landscapes.

Elephants exhibit greater sensitivity to larger vehicles and the motorists' behavior[78]. Specifically, although motorists in heavy vehicles caused the least disturbance, elephants were most affected by heavy vehicles (because of their size) and generally tolerated smaller vehicles, even those that created significant disturbance[79]. Furthermore, alternating the behavior observed is that Asian Elephant modulate their vocalizations as a response when disturbed.[80] In long-term, sustained human activity presents significant environmental challenges for elephant populations, either through displacement or through habituations where elephants are prone to conflict and or risk of intentional or unintentional injury, that may lead to population declines[81]. Herds comprising females, juveniles, and calves are particularly vulnerable to disturbances, such as large vehicles and sustained human activity, due to their protective and defensive behavior (Sumith personal communication).

There is no research regarding how Gee's Golden Langur responded to human disturbance. However, available research for other langur species indicated that to response to disturbance, primate may behave or show a threatened and avoidant position[82]. In areas where langurs appear to survive in disturbed habitats, the different response of bisexual and all male groups to disturbance may still result in serious disruption to the population structure[83].

Dholes avoided roads spatially, and avoided human activity temporally[84,85, 86]. Similarly, Tiger strongly preferred prey-abundant areas and strongly avoided the human-disturbed areas[87]. Human disturbance contributed to the reduced population of Hog Deer[88,89].

[78] Vidya, T. N. C., & Thuppil, V. (2010). Immediate behavioural responses of humans and Asian elephants in the context of road traffic in southern India. *Biological conservation*, *143*(8), 1891-1900.
[79] Vidya, T. N. C., & Thuppil, V. (2010). Immediate behavioural responses of humans and Asian elephants in the context of road traffic in southern India. *Biological conservation*, *143*(8), 1891-1900.
[80] Sharma, N., Kohshima, S., & Sukumar, R. (2020). Asian elephants modulate their vocalizations when disturbed. *Animal behaviour*, *160*, 99-111.
[81] Tang, R., Li, W., Zhu, D., Shang, X., Guo, X., & Zhang, L. (2020). Raging elephants: effects of human disturbance on physiological stress and reproductive potential in wild Asian elephants. *Conservation Physiology*, *8*(1), coz106.
[82] Avenzora, R., Rachmatullah, A., Munajat, M., Winarno, G. D., Oktovianus, Suprajanti, D. S., Putra, N. D., Putra, L. A., Kholil, R., & Al-Ghifari, M. (2024). Dynamic patterns of primate responses to human actions on ecotourism activities in Gunung Gede Pangrango National Park, Indonesia. *International Journal of Design & Nature and Ecodynamics*, *19*(4), 1425-1437. https://doi.org/10.18280/ijdne.190435
[83] Ross, C., & Srivastava, A. (1994). Factors influencing the population density of the Hanuman langur (Presbytis entellus) in Sariska Tiger Reserve. *Primates*, *35*, 361-367.
[84] Thinley, P., Rajaratnam, R., Kamler, J. F., & Wangmo, C. (2021). Conserving an endangered canid: assessing distribution, habitat protection, and connectivity for the dhole (Cuon alpinus) in Bhutan. *Frontiers in Conservation Science*, *2*, 654976.
[85] Nurvianto, S., Imron, M. A., & Herzog, S. (2015). The influence of anthropogenic activities and availability of prey on the distribution of dholes in a dry deciduous forest of East Java, Indonesia. *Asian Journal of Conservation Biology*, *4*(1), 26-36.
[86] Srivathsa, A., Karanth, K. K., Jathanna, D., Kumar, N. S., & Karanth, K. U. (2014). On a dhole trail: examining ecological and anthropogenic correlates of dhole habitat occupancy in the Western Ghats of India. *PloS one*, *9*(6), e98803.
[87] Bhattarai, B. P., & Kindlmann, P. (2018). Human disturbance is the major determinant of the habitat and prey preference of the Bengal tiger (Panthera tigris tigris) in the Chitwan National Park, Nepal. *European Journal of Ecology*, *4*(1), 13-21.
[88] Odden, M., Wegge, P., & Storaas, T. (2005, February). Hog deer Axis porcinus need threatened tallgrass floodplains: a study of habitat selection in lowland Nepal. In *Animal Conservation forum* (Vol. 8, No. 1, pp. 99-104). Cambridge University Press.
[89] Bhattarai, B. P., & Kindlmann, P. (2013). Effect of human disturbance on the prey of tiger in the Chitwan National Park–Implications for park management. *Journal of Environmental Management*, *131*, 343-350.

The duration of construction activities is expected to occur over several years and cover several breeding seasons. Similarly, it should be noted that the light, noise and vibration disturbances will be continuous for the construction phase. Light, noise and vibration disturbance are unlikely to occur at all locations simultaneously. The impacts associated with noise and vibration disturbance and displacement are likely to reduce considerably during operation, however lighting impacts will continue near many components of project infrastructure.

Therefore, the Project's potential to disturb or displace terrestrial wildlife during construction will be direct, adverse, medium in magnitude, local in extent, short term in duration, with an overall significance of Moderate. It is assumed that shunting and poaching from the road will not increase with road development and improvement during the operation. The impacts during operation will be direct, adverse, low in magnitude, site-specific in extent, long term in duration, with an overall significance of ***Low***.

10.4.2.1 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

In addition to the mitigation measures for noise reduction detailed in ***Section 9.2***, implement the following mitigation measures to minimise disturbance to wildlife from artificial light sources:

- Ensure that noise levels are minimized during nighttime operations by using quieter equipment and scheduling noisier activities for daytime hours where possible.
- 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.
- Control light spillage outside of the construction area using appropriate cowling and positioning of direct light onto the construction area and away from the surrounding habitats.
- Use timers for permanent and temporary lighting where possible to avoid unnecessary light at night-time. Cowls and directional lighting will be used to minimize lighting of natural habitat areas

These measures will reduce the magnitude of construction noise, light, and vibration impacts magnitude to Low during the construction, the duration is short-term, the extent is Low, thus the impact significance is Low. The impact significance during operation remains ***Low***.

10.5 AQUATIC HABITATS

10.5.1 AVOIDANCE AND MINIMISATION MEASURE

The mitigation measures related to management of hydro-ecological changes are described in ***Section 9.3***.

10.5.2 IMPACT EVALUATION AND SIGNIFICANCE

Based on the aquatic baseline survey conducted for this ESIA in August 2024, 29 species were recorded in the Mau River, while 24 species were recorded in the Taklai River. Of these, only two (02) species of conservation significance were observed in both rivers during the survey, i.e., Reticulated Loach (*Schistura reticulofasciata*) and Mrigal Carp (*Cirrhinus cirrhosus*). Both these species are defined as Vulnerable (VU) on the IUCN Red List and additionally, however, the Mrigal Carp is considered invasive in Bhutan. Note that while the Golden Mahseer (*Tor putitora*, IUCN EN) is known to inhabit these waters, but no individuals were observed during this survey. More information on the presence of the Golden Mahseer is included below.

The Mau River is highly dynamic and provides a variety of habitats for different floral and faunal species such as small perennial streams, sand bars, gravel bars and depositional areas (for cobble and boulder) during the dry period, which are high-flowing rivers during the approximate 2-3 months wet season. Based on further desktop review, it is understood that the Mau River also serves as a migratory pathway for the Golden Mahseer[90]. It was confirmed during the stakeholder engagements and site reconnaissance that the year-round occupied habitat and spawning ground of the Golden Mahseer are primarily located towards the headwater's elevations of the Mau River, within the deeper pockets approximately 5 km north of the road alignment. During the aquatic baseline survey conducted for this ESIA in August 2024, 535 samples of macroinvertebrates was recorded, belonging to 11 families under 9 orders, with high relative abundance of *Baetis sp.* and *Ambrysus sp.* Plot 3 and Plot 2 along the Taklai River, approximately 1 km north of the road alignment demonstrated ecologically diverse and resilient species composition. However, it should be noted that the main distribution of Golden Mahseer in Bhutan is in Amochhu, Wangchhu, Punatsangchhu/ Sunkosh, and Manas River[91].

Earthworks as part of construction activities will result in increased sedimentation and surface runoff to the downstream water bodies. Both the Mau River and Taklai River are low-lying flat land comprising wide flood plains. Based on a survey conducted by the Department of Agriculture in Bhutan, the flow Taklai River is easily impacted by increased sedimentation, resulting in muddy substrate throughout the water column, which is further exacerbated by an influx of rocks/stones/sands from surrounding bare lands during heavy rain and flood.[92] Any temporary increase in sedimentation into these water bodies may also result in reduction in the quality of water due to influx of total suspended solids (TSS), thereby impacting biochemical oxygen demand (BOD) and chemical oxygen demand (COD) and resulting in low dissolved oxygen (DO). These changes in the water quality can impair respiratory functions of aquatic fauna, as well as result in smothering effects on fish and aquatic invertebrates, including their larvae and eggs. During siltation events, decreased DO levels may result in temporary migration of fish species to more oxygenated areas (e.g., less turbid holding water, near surface), increased mortality of vulnerable species more susceptible to decreased DO levels and increased growth of anaerobic bacteria resulting in further alterations to the nutrient cycling process[93,94]. Species such as the Golden Mahseer are known to be particularly sensitive to DO changes, due to high metabolic rate closely associated with the species' physiological functions and needs; for e.g. the Golden Mahseer is an active swimmer and can typically travel up to greater than 50 km in a 48-hour

[90] Nature Conservation Division, Department of Forests and Park Services, Ministry of Agriculture and Forests, Royal Government of Bhutan, 2022. Golden Mahseer Conservation Action Plan for Bhutan (2022 – 2023)

[91] NCD 2022. Golden Mahseer Conservation Action Plan for Bhutan (2022-2032): Securing "Tigers of the Rivers." Nature Conservation Division, Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu, Bhutan.

[92] Department of Agriculture, 2017. Data Collection Survey on Irrigation Development in the Kingdom of Bhutan. Accessible at Microsoft Word - 20171213_【ブータン情報収集】FR_EN__Final.docx (jica.go.jp)

[93] Prakash, Sadguru. "Impact of Climate change on Aquatic Ecosystem and its Biodiversity: An overview." International Journal of Biological Innovations 3, no. 2 (2021).

[94] Tomar, Garima, D. S. Malik, Amit Kumar Sharma, Vishal Kamboj, and Vikas Kumar. "Assessment of water quality and biodiversity status of Alaknanda River at Garhwal, Uttarakhand: A case study." In Environmental Pollution and Natural Resource Management, pp. 121-136. Cham: Springer International Publishing, 2022.

period[95,96]. Similarly, some macroinvertebrates such as mayflies (*Baetis sp*) (observed along both the Mau and Taklai Rivers) can be very important components of the mahseer food chain and at the same time, intolerant species to pollution and decreased DO[97,98,99,100].

River training in the form of specially designed gabion basket walls will be implemented along the abutment area of the river bridges to help minimize erosion and limit the extent of flooding at the bridge crossings along the Mau, Jengkhurung, Taklai and Langer Rivers. While river training is known to support flood mitigation, it can also disrupt/ alter natural flow patterns, such as increased velocity in some portions of the river (due to narrowing of natural flow path at the bridge) and thereby resulting in increased erosion and sediment transport if not properly designed[101]. The narrowing of natural flow paths and increased velocity may alter fish migration patterns and increase water temperature, which can affect species that thrive in cooler environments such as the Golden Mahseer.[102] In some instances, the use of gabion basket walls may also promote sediment deposition upstream of the baskets, which may alter the morphology of the riverbed and therefore the aquatic habitat within these water bodies[103]. The installation of the gabion basket wells can also result in some loss of riparian habitat. Based on a conservative approach, the riparian habitat loss from the construction of the bridges is anticipated to be no greater than 0.125 km^2, which is approximately 0.175% of the aquatic EAAA (71.4 km^2). Furthermore, the riparian landscape of the bridge crossings comprise open areas covered in homogenous grasses with little to no taller vegetation. Therefore, any riparian habitat loss is not envisaged to be significant.

The impacts to aquatic habitats will be transboundary in nature as all the rivers and rivulets from the project area flow towards the plains of Indian state of Assam and based on satellite imagery analysis, the bridge crossings are all located within 800m north of the Indian border[104].

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[95] Wangchuk, Karma, and Sonam Wangmo. "Climate change and freshwater fish biodiversity in Bhutan: Standardized monitoring of a Flagship Species, Golden Mahseer (Cyprinidae: Tor putitora)." Bhutan Journal of Animal Science 6, no. 1 (2022): 131-144.

[96] Francesc Rubio-Gracia, Emili García-Berthou, Helena Guasch, Lluís Zamora, Anna Vila-Gispert, Size-related effects and the influence of metabolic traits and morphology on swimming performance in fish, Current Zoology, Volume 66, Issue 5, October 2020, Pages 493–503

[97] Alhejoj, I., Hiasat, T. H., Salameh, E., Hamad, A. A., & Al Kuisi, M. (2023). Use of the aquatic mayfly (Insecta: Ephemeroptera) as environmental bio-indicator in Jordan. *Int. J. Design Nat. Ecodyn*, *8*(1), 133-139.

[98] Kamble, Rohini, and Sanjay Shamrao Nanware. "Mayfly nymphs as water pollution bioindicator." (2021): 1-5.

[99]

[100] Vilenica, Marina, Mladen Kerovec, Ivana Pozojević, and Zlatko Mihaljević. "Mayfly response to different stress types in small and mid-sized lowland rivers." ZooKeys 980 (2020): 57.

[101] Ma, Yifei, Jeffrey Nicholas Knowles, and T. Matthew Evans. "Numerical Simulation of Gabion Rockfall Barrier Subjected to Extreme Loads." In *ARMA US Rock Mechanics/Geomechanics Symposium*, pp. ARMA-2020. ARMA, 2020.

[102] Yadav, Prabhaker, Ajit Kumar, Syed Ainul Hussain, and Sandeep Kumar Gupta. "Evaluation of the effect of longitudinal connectivity in population genetic structure of endangered golden mahseer, Tor putitora (Cyprinidae), in Himalayan rivers: Implications for its conservation." *Plos one* 15, no. 6 (2020): e0234377.

[103] Haring, C. P., Murray, A. S., & Luna, F. D. (2023). *Sustainable Bank and Channel Stabilization Techniques in Arid Southwest Streams*. [US Army Engineer Research and Development Center],[Coastal and Hydraulics Laboratory].

[104] Ahirwal, Surendra Kumar, Jaspreet Singh, Kamal Sarma, Tarkeshwar Kumar, Vivekanand Bharti, and Amrendra Kumar. "Morphometric Characteristics, Length-Weight Relationships, and Condition Factors of Five Indigenous Fish Species from the River Ganga in Bihar, India." *Journal of Applied Ichthyology* 2023, no. 1 (2023): 1329222.

Based on the above analysis, the project's potential impacts to the aquatic habitats and biodiversity resulting from earthworks and river training are envisaged to be direct, adverse, medium in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Moderate***. Note that while the impacts will be transboundary in nature due to the proximity of the Indian border and the waterflow towards the floodplains in Assam, the impacts are expected to dissipate with distance. Taking into consideration the proximity of the Indian border relative to the project area, the extent has been defined as "Local".

10.5.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

Key mitigation measures as presented in ***Section 9.3*** **– Surface Water Quality and Hydrology IA** are:

- Properly design gabion basket shore protection and any wing wall construction to avoid historic design failures.
- Ensure designs factor in an adequate margin of safety in light of potential for extreme, climate change-driven weather (e.g. 1:500 or 1:1000-year flood)
- Assess and reduce risk factors to fish movement and survival in headwaters spawning and rearing areas.
- As far as practicable, limit earthwork activities to the dry seasons and allow sufficient time for stabilization any disturbed areas along new road segments and at bridge crossing before wet season.
- Stabilize areas disturbed by road and bridge construction by combined use of proper compaction, use of geotextile/erosion blankets, silt fencing, and reclamation using and native species of grasses, shrubs and trees to establish ground cover vegetation and stabilization.
- Undertake before and after mark recapture and or telemetry studies of fish in affected watersheds to improve long-term understanding and management.
- The most intensive construction activities of the bridge, which can affect the water flow significantly, should be avoided during peak spawning seasons of Golden Mahseer (monsoon season).

The proposed mitigation measures, if implemented correctly would reduce the magnitude of the impact from Medium to Low, thereby impacts from construction will be direct, adverse, low in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Low***.

Note that if activities such as river training are implemented effectively, this can also potentially create new aquatic habitats via rough surfaces for algal growth and invertebrate colonization.

10.6 HUMAN-WILDLIFE CONFLICT

10.6.1 AVOIDANCE AND MINIMISATION MEASURE

The initial Feasibility Study (FS) assessed the three (03) alignment options considering (i) minimization of high-quality forested area clearance, (ii) enhancement of wildlife connectivity, and (iii) disturbance of river and associated riparian habitats. Specifically, the preferred alignment aimed at minimizing the impact to existing wildlife habitats and maximizing the space for safe passage of wildlife, in particular Asian Elephant. This consideration contributed to minimizing the direct habitat loss and therefore, minimizes any incremental human-wildlife

conflict envisaged. An elephant corridor design is also currently under evaluation to address the loss of habitat connectivity.

10.6.2 IMPACT EVALUATION AND SIGNIFICANCE

Human-Wildlife Conflict (HWC) in Bhutan is broadly classified into three main categories: damage to crops and property, livestock predation, and human casualties. HWC in Sarpang involves six wildlife categories, with elephants being the most common conflicting species, responsible for 37% of incidents. Wild pigs (30.8%), primates (9.5%), peafowl (approx.7%) and deer (5.1%) also contribute to the conflicts. Crop damage is the most significant issue, with cereals being the most impacted (61.83%), followed by areca nut trees (37%) and other fruit trees such as banana, mango, orange, and litchi (36%). Among the 10 surveyed gewogs in Sarpang, Shompangkha was the most affected, suffering the highest monetary losses (Nu. 4.595 million) due to elephants, followed by Chhuzanggang (Nu. 3.714 million). Additionally, Respondents reported an increase in conflicts during the summer (June, July, August) and autumn months (September, October, November) compared to other seasons. The detailed background information related to Human-Wildlife Conflict can be found in ***Section 7.9***.

HWC has been reported in the project vicinity, primarily involving Asian Elephants. The field baseline results indicate that the Asian Elephant is present throughout most sections of the road alignment and are particularly abundant in transects located around Gelephu City and Tareythang (***Chapter 7***). Two (02) herds totaling 37 individuals were observed, first herd of 12 individuals was primarily in Grid_15, located within sub-tropical forest near the Mau River and second herd of 25 individuals was in Grid_33, also within sub-tropical forest., and it was observed that the elephants' movement route overlaps with the project site. Based on consultations undertaken to date, it is understood that each Gewog has a dedicated response team, who work with the Department of Forests and Park Services. During peak periods, approximately 3 - 4 response events are undertaken each week. Conflict primarily includes trampling of crops and human mortality (approximately one death a year). Records from a publicized interview with a Gelephu forest range office indicate that more than 65 elephant-related incidents were reported from 19 July to 05 September 2023 in Gelephu and Samtenling. In the same interview, it was reported that there has been an increasing trend of human elephant conflict, with the elephants demonstrating increasing aggressive behavior. [105]

As a result of habitat loss and fragmentation, these Asian Elephants may be forced to alter their home range, thereby resulting in increased human-wildlife conflict incidences around the area, which may subsequently result in human casualties and injuries, as well as loss of crops and properties During operations, increased vehicle traffic along the new road alignment may increase the risk of vehicular-wildlife accidents.

Based on the above, the project's potential impacts to frequency and intensity of human-wildlife conflict resulting from habitat loss and fragmentation are envisaged to be direct, adverse, high in magnitude, regional in extent, and medium-term in duration, with an overall pre-mitigation significance of ***High***.

[105] Jigme, K., and Williams, A. C. (2012). Human-elephant conflict in Bhutan: Patterns and implications. Gajah, 35, 25-28. Available at: https://www.asesg.org/PDFfiles/2012/35-25-Jigme.pdf

10.6.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

- 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 *Fauna Shepherding Protocol* included in the Biodiversity Management Plan (BMP). Establish and implement the elephant corridor, considering the "least cost path analysis". Establish a communication channel with the responsible team of the Department of Forestry and Park Services to notify presence of Asian Elephant and ask intervention in case of risk of attack from Asian elephants.
- 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 minimise the likelihood of vehicular collision. Minimize nighttime construction activities.
- Implement speed limits during construction (30 km per hour) for vehicles to reduce wildlife road kills.
- Install appropriate information signages at strategic wildlife crossings.
- Construct animal passages (crossing paths/ underpasses) at important animal crossings sites along the roads. (Electric) fences (as mentioned in ***Section 10.2.3)*** are recommended by the communities.[106]
- Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.
- Encourage the community to plant crops less preferred by elephants, however, farmers must weigh the technical, economic, safety issues and practicality of switching to less elephant-preferred crops. The cultivated crops in the Sarpang Forest with the strongest positive correlation to conflict incidents include maize, paddy, mustard, and areca nut, while cardamom shows a negative correlation.[107]The survey in the area suggested that cereals (61.83%) were the most impacted crop, followed by the damage to areca nut trees (37%) and other fruit trees including banana, mango, orange, and litchi at 36% (***Section 7.9***). The cultivated crops in the Sarpang Forest with the strongest positive correlation to conflict incidents include maize, paddy, mustard, and areca nut, while cardamom shows a negative correlation.[108]
- It is suggested the DoFPS form a Quick Response Teams (QRTs) with local communities. The Project ECoW works with the DoFPS to establish the community engagement program that trains communities on reporting crop and wildlife depredation. It is reported that 36% respondents did not report crop depredation incidents to the agencies i) they were unaware of the reporting system, ii) the damage caused by elephants was minimal, and iii) they were tolerant towards such damage due to Buddhism [109]
- The Project ECoW should maintain regular communication with the DFO on a monthly basis regarding reported HWC cases. This data is essential for evaluating the

[106] Jigme, K., and Williams, A. C. (2012). Human-elephant conflict in Bhutan: Patterns and implications. Gajah, 35, 25-28. Available at: https://www.asesg.org/PDFfiles/2012/35-25-Jigme.pdf
[107]

[108] Tshering, U., Thakur, R., Ghosh, S., & Nath, A. (2024). Addressing Human-Elephant Conflict in Sarpang, Bhutan: Challenges and Practices. *Journal of Wildlife Science (JWLS)*, *1*(2), 96-101.
[109] Jigme, K., and Williams, A. C. (2012). Human-elephant conflict in Bhutan: Patterns and implications. Gajah, 35, 25-28. Available at: https://www.asesg.org/PDFfiles/2012/35-25-Jigme.pdf

effectiveness of the mitigation measures implemented to address HWC, helping to identify both successes and areas for improvement.

With implementation of the above, the project's potential impacts to frequency and intensity of human-wildlife conflict resulting from habitat loss and fragmentation are envisaged to be direct, adverse, low in magnitude, regional in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Moderate***.

10.7 ECOSYSTEM SERVICES

10.7.1 AVOIDANCE AND MINIMISATION MEASURE

The initial Feasibility Study (FS) assessed the three (03) alignment options considering (i) minimization of high-quality forested area clearance, (ii) enhancement of wildlife connectivity, and (iii) disturbance of river and associated riparian habitats. Specifically, the preferred alignment aimed at minimizing the impact to existing wildlife habitats and maximizing the space for safe passage of wildlife. Other mitigation measures related to management of hydrological changes are described in ***Sections 9.3*.**

10.7.2 IMPACT EVALUATION AND SIGNIFICANCE

The ecosystem services currently derived by the local communities within the social studyproject 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 (for 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, sacred trees and the Golden Mahseer.

Based on stakeholder engagement activities conducted, it was understood that as no municipal water system has been established within the rural areas, some local villagers still utilize freshwater from the rivers for daily activities such as sanitation, consumption, irrigation, aquaculture and livestock rearing. Water shortages have been reported during the summer periods, whereby the villagers harvest rainwater to supplement the limited freshwater supply. During construction stage, water will be required during civil work, dust suppression, and domestic use. At time of writing, it is envisaged that potable water will be sourced from the local municipality or purchased from a supplier. However, if this is insufficient, water may need to be sourced from nearby rivers or streams, this could potentially impact local communities' availability of water resources. Increased sedimentation load from surface runoff arising from earthwork can also impact the water quality such as increased TSS levels and nutrient runoff from any agricultural pesticides or fertilizers in the area, consequently impacting the quality of the water extracted by local communities downstream of the project.

As part of the project development, land clearing activities will be undertaken, with the land cover types and corresponding areas to be cleared described in ***Table 10.1***. It is envisaged that 0.16 km^2 of agricultural land and 0.02 km^2 of riparian rangeland will be cleared. Clearance of agricultural land is envisaged to result in loss of livelihood/ economic displacement; this is discussed further in ***Chapter 11*** while the clearing of riparian rangeland may result in increased risk of erosion and flooding. Gabion basket walls will be constructed for flood mitigation. While the local communities currently forage for forest produce, this is conducted largely for subsistence or small-scale sales and the land clearing activities are not anticipated to impact these foraging activities substantially.

Based on the consultations undertaken, some community forests contain sacred sites of cultural such as the 'Devithan', an open space in the Dungkarling Community Forest and a sacred tree within the Chhuzanggang Community Forest. However, these are not envisaged to be cleared as part of the project development. Note also that the Golden Mahseer is also viewed as culturally significant (a symbol of good luck) in Bhutan and therefore, is protected.

Based on the above analysis, the project's potential impacts to the ecosystem services are largely in relation to surface water usage and is envisaged to be direct, adverse, medium in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Moderate***.

10.7.3 PROPOSED MITIGATION AND RESIDUAL IMPACT SIGNIFICANCE

The following mitigation measures are recommended:

- Limit sourcing water from nearby rivers or streams that are used by local villages for potable water. Note that this is particularly pertinent near the Tareythang area;
- Ensure proper erosion and sediment control measures are implemented;
- Provide safe potable water to households relying on water sources downstream of construction activities, via extending of the project's water system, well installation or piping water from upstream locations;
- If surface water will be utilized for Project use, a water use/extraction plan will be developed at later stage. Any impact on water supply due to project activities should be compensated/replaced.

Other mitigation measures described in **Chapter 9.3** for river training/ gabion basket walls.

The proposed mitigation measures would reduce the magnitude of the impact from Medium to Low (taking into consideration the proposed compensation of alternate water sources), so the project's potential impacts will be direct, adverse, low in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Low***.

10.8 INDICATIVE BIODIVERSITY MANAGEMENT PLAN AND NET GAIN STRATEGIES

A BMP aiming to address potential project impacts and cumulative impacts on biodiversity is being developed and will be finalized upon completion of detailed design, with an aim of achieving net gain of critical habitat features. An important element of BMP is the offset/net gain strategies and actions to achieve no net loss/net gain in line with ESS6 requirements. Those strategies and actions have been incorporated into the project design as subcomponent 2.3. An indicative BMP with Core components of a Net Gain Framework is summarized below and will be presented in detail in the Project BMP:

Component 1: Habitat Enhancement and Corridor Development

- Habitat Quality Improvement: Enhancing resources within protected areas through grassland development, nursery establishment, and invasive species management.
- Migration Corridor Pilot: Initial corridor development on available government land, with plans for potential expansion requiring additional funding. The corridor will focus on two (2) key elements:
- Elephant corridor: The plan for the elephant corridor establishment is under preparation to address the loss of habitat connectivity supporting the Asian Elephant. The Mau River Bridge is extended on the eastern side to allow for the passage of elephants. The elephants use the riverways for passage, therefore, to maintain this passage during the wet season, the initial design has incorporated a minimum of 250 m wide elephant corridor on eastern riverbank, with an average vertical clearance of 8.15 m, and a minimum clearance of 5.80 m at the East abutment in line with Good International Industry Practice (GIIP). These passageways/ corridors will potentially mitigate some habitat fragmentation impacts to the Asian Elephant populations, by retaining connectivity between the forested patches on the south and north of the road alignment.

a. Langur crossing: Establish vegetated canopy bridge/ feeder ropes/ glider poles for arboreal species, i.e., Gee's Golden Langur to support the movement of species. Frequent monitoring should be undertaken on the usage of canopy bridges by Gee's Golden Langur.

- Resource Availability: Development of waterholes and mineral licks to support wildlife within protected zones, reducing the incentive to move into human-occupied areas.

Component 2: Human-Wildlife Conflict (HWC) and Co-Existence Strategy Development and Implementation

- HWC Strategy Development: Formulate a detailed strategy to guide HWC mitigation efforts, integrating community feedback and expertise from forest services.
- Community Hard Barriers: Install hard barriers to safeguard agricultural lands, property and lives.
- Quick Response Team (QRT) Support: Enhancing the capacity of QRTs to respond effectively to HWC incidents.
- Early Warning Systems: Deployment of systems for early detection of elephants to alert and prepare communities.
- Basic Infrastructure Rehabilitation: Support for repairing critical infrastructure frequently damaged during HWC events, such as water pipes and storage tanks.

Component 3: Partnerships and Capacity Building

- Training Programs: Conducting training sessions with the QRT and local communities on effective HWC management, based on the HWC strategy to be developed.
- Partnerships and Collaborations: Engage and collaborate with other organizations and agencies to address the transboundary elephant movement

The BMP will also include comprehensive measures for the management, mitigation and monitoring of habitats and species during construction and operation/maintenance of road and bridges. The measures to minimize impacts during construction include prohibiting clearing

vegetation outside of designated areas, translocate the species of conservation interest where the species are found within the designated clearance area, and training construction staff on threatened species that may be encountered and fauna rescue outlined within the *Fauna Shepherding Protocol.* During operation, measures include establishing wildlife crossings and canopy bridges, installation of appropriate information signages at strategic wildlife crossings, compensatory reforestation, monitoring the use of corridors/canopies/culverts by elephants and roadkill, Gee's Golden Langur and Trilaminate Hill Turtles, clearing blockages if any along the animal trails or movement routes and implementing speed limits for vehicles to reduce wildlife road kills.

11. SOCIAL ENVIRONMENT RISKS, IMPACTS, AND MITIGATION

11.1 INTRODUCTION

The following sections identify and discuss the predicted beneficial and adverse social impacts associated with the construction and operation of the Project, focusing on the impacts likely to be experienced by the communities living and working within the social study area – including Gelephu Thromde, Gelephu Gewog, Samtenling Gewog, Umling Gewog, Chhuzanggang Gewog, Serzhong Gewog, and Tareythang Gewog. Within the context of the assessment, special attention is given to vulnerable groups such those living below poverty level, persons with disabilities, single headed household, women, children and youth living in difficult circumstances, elderly, households with unemployed youth and underlying conditions, who may be disproportionately affected by the Project's developments. It is noted that there are no Indigenous Peoples (IP) populations within the social study area. Therefore, IPs so have not been considered within the context of vulnerable groups.

11.2 LAND ACQUISITION

In developing the Project, land will be permanently and temporarily acquired in the social study area. Land will be permanently acquired for the development of the road and bridges, and temporary land acquisition will occur for associated temporary facilities, such as ancillary infrastructure, laydown areas, batching, worker camps and disposal areas.

There are approximately 226 land plots that are subject to land acquisition. Approximately 18 structures are located within the ROW, of which 11 structures in Gelephu Thromde are estimated to be households[110]. The existing land cover categories include Agriculture, Bare Ground, Built-up, Successional Rangeland, Forest, Riparian Rangeland and Water. ***Table 11.1*** provides an overview of the potential land acquisition impacts associated with each land cover.

Table 11.1 Potential Land Acquisition Impacts and Displacement

Land Cover	Potential Land Acquisition Impacts	Expected displacement (physical, economic or negligible)
Agriculture	Disruptions to farming activities.	Physical and economic
Bare Ground	Negligible to minimal displacement and impact on livelihoods.	Negligible
Built-up	Displacement of residents and businesses.	Physical and economic
Forest	Economic displacement of accessing timber and non-timber forest products.	Economic
Riparian Rangeland	Disruptions to grazing areas, water quality and access, and biodiversity.	Physical and economic
Successional Rangeland	Disruptions to grazing areas and pastoralist livelihoods.	Physical and economic
Water	Disruptions to water quality, access, water flow patterns, and biodiversity.	Economic

[110] Estimates were based on a desktop review of GIS and field observations.

The land acquisition process will be led by the Department of Surface Transport (DoST), in accordance with the Project's Resettlement Action Plan (RAP), which is being developed to achieve the requirements of the *Environmental and Social Standard (ESS) on Land Acquisition, Restrictions on Land Use and Involuntary Resettlement (ESS-5).* This assessment focusses on the current understanding of land acquisition; the assessment should be updated as more information becomes available.

11.2.1 PHYSICAL AND ECONOMIC DISPLACEMENT

The road alignment will pass through one (01) Thromde and three (03) Gewogs, (starting at Gelephu Thromde and ending at Tareythang Gewog). The construction of new infrastructure will require the acquisition of land, which will lead to physical[111] and economic displacement. Economic displacement is expected to be both permanent and temporary[112]. A review of GIS data and consultations with local communities suggests that at least 226 plots will be directly impacted by the Project's Right of Way (ROW). It is estimated that 11 of the structures in the ROW within Gelephu Thromde may be households that will be physically displaced (refer to ***Figures 8.3***). This estimate is based on a combination of GIS data for land plot ownership, structures and land use.

It was noted during consultations that agricultural land plots often contained multiple structures, including residential and non-residential structures (i.e. sheds, observation towers, barns and fencing). Therefore, it is estimated that the remaining seven (07) structures in the ROW are non-residential structures (e.g. lookout posts used to look out for animals or used for border security purposes) that will require compensation.

Based on a review of baseline information of the social study area, it is estimated that the land use of the plots that will be directly affected by the Project are primarily agricultural, which includes rice paddies and maize, vegetables and areca nut plantations (refer to ***Section 8.4.1.1***). Approximately 55.69% of the land cover within the social study area is relatively low-density agricultural (33.63%) and pastoral areas (22.06%), which are concentrated in the Umling, Chhuzanggang and Tareythang Gewogs.

Built-up areas comprise approximately 9.54% of the Project footprint and approximately 95.01% of built-up land within the social study area is located in Gelephu Thromde (66.13%) and Tareythang Gewog (28.88%). In these built-up areas, there are commercial structures, such as small shops, and other commercial establishments, such as restaurants. Shops and other commercial structures may range from legal structures to temporary and informal structures (not recognised by the government) but may be of value to the affected communities. It is in these built-up areas where the greatest scale of physical and economic displacement is expected. There are no schools or hospitals within the Project footprint, however, there are four (04) health centers and two (02) schools in the social study area. There was no cultural heritage sites identified within ROW.

[111] Refers to the loss of shelter and assets resulting from land acquisition associated with the Project that requires the PAPs to relocate.

[112] 'Permanent economic displacement' occurs when people are relocated or lose access to the land or resources that form the basis of their livelihood, and they are no longer able to return to these activities in their original location. 'Temporary economic displacement', on the other hand, is when people experience a temporary disruption to their livelihoods due to limited access to resources, such as forests, grazing lands, or access roads, but can return to their activities once temporary facilities are removed.

Additionally, the presence of irrigated agricultural land, such as rice paddies and maize, among other vegetables and areca nut plantations, highlights the need for measures to safeguard water resources, as they are vital to local agricultural production and livelihoods.

Based on this, it is estimated that the majority of the displacement impacts associated with the Project's land acquisition requirements will be agricultural and pastoral activities.

In addition, it was found that while the social study area extends through a total of 15 community forests, the Project will intersect only two (02) of the community forests. The two main community forests in Chhuzanggang are the Thongjabi Yueling and the Chhuzanggang community forest. The latter forest is further divided into four (04) blocks – namely Chaskhar, Dawathang, Nimaling and Thonjabi. Together, the two (02) forests cover an area of about 254 ha. The total land area of community forests within the ROW is 28.76 ha, which includes Phunsumthang (4.90 ha), Taklaithang (21.15 ha) and Chuzhingtae (2.71 ha) blocks. The Project will isolate sections of community forest that are outside of the ROW by reducing ecological connectivity and accessibility. It is likely this isolation will contribute to its ecological degradation, which will need to be mitigated as part of the land acquisition process. The Project will further traverse closely to two (02) others community forest in Chhuzanggang Gewog and in Tareythang Gewog. Therefore, the Project may impact on these communities – specifically the households, who are community forest users.

While the community forests do not serve as a key source of income for many of local communities, they do generate products that are used at the household and local level, and for agricultural purposes. These households rely on the community forests for products such as Cham trees, firewood (inferior trees), sand, gravels and boulders, as well as bamboo, and other water resources for personal use. The Project construction and operation may also cause temporary or permanent access restrictions to community forests, or forests in general, in addition to agricultural lands.

11.2.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The built-up areas comprise approximately 9.54% of the project footprint. These areas largely exist in Gelephu Thromde and Tareythang Gewog. It is within the built-up areas where physical displacement of an estimated 11 households is most likely to occur.

The remainder of the Project extends through agricultural and/ or forested areas. These low-density areas help to reduce the potential for the physical displacement to result due to the acquisition of land for the project. The types of agricultural land affected include subsistence farming and grazing, with no large-scale commercial farming identified. While large scale commercial farming was not identified, semi-commercial farming was identified. The small-holder farming system is prevalent in Bhutan, with farmers normally selling small quantities of surplus to earn cash income; this subsistence farming is semi-commercial in nature, and vital for rural livelihood. Areca Nut is a primary cash crop in Chhuzanggang (1215 MT) and Umling (1171 MT) suggesting the presence of semi-commercial farming. Moreover, small to medium commercial activities (such as shops) are also found to be prevalent around the social study area, which may be impacted by land acquisition.

In addition to losing access to land for income generation, people may lose their crops – i.e. the crops currently being grown. If agricultural crops, including perennial trees, are removed during construction, it will result in a loss of income. Land clearing of at least two (02) community forests is expected as these are directly impacted by the road, which is expected to result in

economic displacement. Avoiding and minimizing the number of affected land plots and structures were key considerations in determining the Project design. Where possible, this has been done. Despite seeking to minimize displacement, it is anticipated that physical displacement will still occur.

Those being physically displaced as a result of the Project will be offered the following forms of compensation and resettlement assistance:

- Like-for-like land either within the village, Gewog or Dzongkhags, if available, (in line with the Land Act of Bhutan 2007). Where like for like land is not available, an option to provide available land with full support to develop the land would be offered.
- Compensation at replacement cost.
- Livelihood restoration support, and
- Options for resettlement to the designated sites identified by the relevant government authorities (in line with ESS-5 principles outlined in the Resettlement Action Plan [RAP]).

Relocation could cause disruption to the existing socio-cultural and economic environment. However, relocation of project affected persons (PAPs) within villages, Gewogs and Dzongkhags will avoid or minimize the degree of disruption to existing livelihood activities and existing socio-cultural and economic networks.

The amount of available like-for-like land will be determined subsequent to the receipt of surveys that will need to be undertaken for an assessment of assets that will be lost, including a census and asset inventory. This survey data will provide the basis for determining what constitutes like-for-like land.

While it is not anticipated that a resettlement site will be required or developed, if one is required, in line with ESS-5 the project will provide PAPs access to essential social and physical infrastructure, including schools, healthcare, water, electricity, and transportation networks, with service levels that are equal to or exceed pre-displacement levels. The sites will support livelihoods through ensuring proximity to nearby agricultural land, community forests, employment opportunities, and consideration of cultural, religious, and community needs, ensuring social cohesion and proximity to community leaders.

Based on the above analysis, the project's potential impact resulting from land acquisition, and specifically physical displacement, will be direct, adverse, high in magnitude, regional in extent, and long term in duration, with an overall pre-mitigation significance of ***High***. This impact will be further delineated once the census and asset inventory has been completed.

11.2.1.2 PROPOSED MITIGATION MEASURES

The following mitigation measures are designed to address the needs of PAPs that are both physically and economically displaced due to relocation, as well as those PAPs being economically displaced while remaining on their existing land.

Management measures to meet regulatory and international standards include:

- Develop and implement a Resettlement Action Plan (RAP), and applying ESS-5[113] and national laws, notably The Land Act of Bhutan 2007 to relocate landowners / users within villages, Gewogs / Thromdes or Dzongkhags, in order to minimize livelihood disruption and retain local population.

[113] ESS5 – Land Acquisition, Restrictions on Land Use and Involuntary Resettlement.

- Engage with PAPs regarding their resettlement preferences and alternative livelihood options will be conducted in line with meaningful and participatory engagement principles.
- Ensure that all land users have been identified during the land acquisition process, including (i) those with formal legal rights to land or assets; (ii) those without formal legal rights but who have claims recognized under national law; and (iii) those without recognized legal rights or claims to the land or assets they occupy.
- Ensure that the compensation provided reflects the full replacement cost, as outlined in ESS-5, and where possible, seek to provide in-kind compensation. This will be based on a market valuation study.
- Ensure the provision of equal rights and access to banking services is implemented, enabling PAPs to securely manage and access their compensation funds, which includes
    - Providing access to and education of financial services; and
    - Payments will be made into a bank account in the joint name of husband and wife where the property is jointly owned.
- Consider the following measures to ensure vulnerable groups are not disproportionately impacted by land acquisition:
    - Ensure vulnerable groups (e.g., women, children, elderly, disabled and CALD) receive adequate support and compensation.
    - Ensuring vulnerable households are aware of Grievance Redressal Mechanism (GRM) and Livelihood Restoration Programs (LRPs); and
    - Supporting the formation of women-led Self-Help Groups (SHGs) to foster economic independence among resettled women through savings, credit access, and entrepreneurship.
- Ensure resettlement sites take into consideration proximity to social infrastructure and provision of services. The following measures will be considered to mitigate the socio-cultural, economic and spiritual impacts associated with physical displacement:
    - Proximity to essential social infrastructure, such as schools, healthcare facilities, and markets.
    - Access to physical infrastructure like water, electricity, sanitation, and drainage systems, with improved service levels compared to previous conditions.
    - Proximity to nearby agricultural land and local markets to support livelihoods dependent on farming.
    - Employment, job transition and training opportunities and support to restore or improve livelihood conditions.
    - Consideration of spiritual needs, places of worship, and kinship networks to maintain religious, cultural and social cohesion.
    - Connected to transportation networks and major roads, and

- Efforts to ensure proximity to community leaders, including religious leaders, for maintaining cultural and religious practices.

- Ensure that PAPs opting for relocation with the local area have access to the same or improved services and LRPs.
- Implement monitoring and evaluation measures, both internal and external, which will ensure that PAPs relocating in the local area maintain livelihood conditions that are equal to or greater than pre-displacement levels.
- Engineering, Procurement, and Construction (EPC) will follow the criteria for identifying appropriate locations for temporary facilities (i.e. ancillary infrastructure, laydown areas, batching, worker camps and disposal areas) to avoid or minimize economic and socio-cultural impacts on the villages. The following mitigations measures will be in place:

  - All temporary facilities should not be located upstream of any water sources and should not affect the water quality of mountain springs and streams used by the community for their water supply.

  - Locations of all temporary facilities will be agreed with the communities, compensated and necessary ceremonial rites and offerings conducted before any use by the EPC or its subcontractors.

  - Workers' accommodations will be located away from settlements and sacred locations such as ceremonial grounds, cremation grounds.

  - Temporary roads and disposal areas will not be located on agricultural land, residential land, privately used communal land under use by communities and Non-Timber Forest Product (NTFP) areas unless communal land and NTFP area have already been identified and included in the survey and covered in the RAP.

  - Quarry sites will be located and construction to avoid livelihood impacts and will be rehabilitated post-use.

  - Borrow pits, laydown areas and worker camps will avoid or minimize impacts on community forests, residential or agricultural land plots, and

  - Waste disposal areas will be located at a safe distance from residential or agricultural areas.
- Implement the GRM. This will provide an appropriate channel for stakeholders to voice their concerns, including opportunities for written and verbal communication. Ensure vulnerable groups are informed of their rights and the ways in which they can communicate their grievance.
- Ensure engagement activities are conducted as part of government-led land acquisition process so that stakeholders are aware of the process, as well as seek support or lodge grievances if required.
- Apply appropriate mitigation measures (outlined in ***Section 9.1.1.1***) to avoid or minimize vibration disturbances (i.e. construction traffic) in erosion and landslide prone areas to reduce the amount of physical displacement due to health and safety requirements.
- Where possible, provide like-for-like agricultural land to ensure that PAPs can continue their farming or grazing activities with minimal disruption, maintaining their pre-displacement

livelihoods. If like-for-like land to facilitate pre-displacement livelihood activities is unavailable for resettlement, provide cash compensation to the affected households at market rates, followed by livelihood restoration through other means.

- Ensure that meaningful consultation with PAPs informs the development of LRP programs to align with their specific needs, preferences and vulnerabilities.
- If like-for-like land to facilitate pre-displacement livelihood activities is unavailable for resettlement, livelihoods will be restored by facilitating access to agricultural or non-agricultural employment, providing training for alternative skills or agro-processing opportunities and offering financial support (i.e. microfinancing).
- Provide short-term livelihood restoration measures to replace the loss of social safety nets typical of agricultural areas, such as subsidies, stipends, and food supplies.
- The following skills and training development support will be provided to PAPs:
    - Vocational training programs for PAPs to develop technical and professional skills suited to the region's job opportunities and leveraging existing skills and work experience.
    - Providing scholarships to vulnerable households to offset the economic impact of displacement.
    - Skill development programs to help economically displaced individuals acquire new skills relevant to local job markets, improving their employability, and
    - Literacy programs to improve employability and enhance their ability to access information and services.
- The following accessibility measures, which were identified during consultations with stakeholders, and will be implemented by the Project:
    - Providing free transportation to ensure economically displaced persons, especially vulnerable groups, can access educational institutions, job markets, and essential services.
    - Expanding and/or redirecting public transport routes to improve connectivity in resettled areas, ensuring that displaced populations can integrate into the regional economy.
    - Ensuring that newly established or resettled communities, especially those with elderly, Persons with Disabilities, widowed or other marginalized household members, have equal or improved physical access to essential services, markets, and social amenities when compared to pre-displacement levels.

11.2.1.3 RESIDUAL SIGNIFICANCE

While many of the Project mitigation measures will help to decrease the impact, the extent of physical displacement is yet to be confirmed as the land acquisition process has not been initiated. It is important that the RAP guiding the resettlement process is publicized for feedback from PAPs, updated to the extent feasible based on feedback, and implemented, to ensure the process meets national laws as well as the requirements of ESS-5.

It is pertinent that compensation and allocation of alternate lands (relocation area) be provided prior to acquisition of land from the PAPs. In case of delays between valuation and payment of

compensation, interim changes to economic conditions of the PAPs shall be factored, and compensation shall be adjusted accordingly. In case of project exigencies that requires land acquisition, the project shall ensure all interim support – financial and / or interim housing support shall be provided by the project.

In addition, the stakeholder engagement plan should be actively implemented, and regular reviews undertaken based on stakeholder feedback. Continued vigilance and ongoing monitoring, both internal and external, will be needed to ensure issues and concerns relating to land acquisition and resettlement are appropriately managed and addressed.

The proposed mitigation measures would reduce the magnitude of the impact from high to substantial (taking into consideration the proposed compensation for any damage), so the project's potential impacts resulting from land acquisition and physical displacement during construction are estimated to be direct, adverse, medium in magnitude, regional in context, and short-term in duration, with an overall residual significance of ***Substantial***.

11.3 OCCUPATION AND LIVELIHOODS

The Project has the potential to generate a range of beneficial and adverse impacts linked to employment.

11.3.1 EMPLOYMENT OPPORTUNITIES

The size of the construction workforce is expected to fluctuate based on the timing and type of activities to be undertaken. At peak, the construction workforce is expected to reach about 6,000 workers, of which 1,500 – 2,000 workers are expected to be skilled laborers and 2,100 – 3,500 workers are expected to be unskilled laborers.

The workforce will consist of a mix of workers from: (i) the project area, (ii) elsewhere in Bhutan, and (iii) from abroad.

In relation to workers from aboard, it is anticipated that the bulk of these workers will be sourced from India, due to the Project's proximity to the Indian border and lower wage rates of Indian workers as compared to Bhutanese workers. Moreover, it was reported by officials at the Regional Labor and Human Resource Office in Gelephu Thromde that the office was largely dependent on Indian labor contractor for arranging workers. This has been further discussed in the subsequent sections.

The Project will therefore have a positive impact on the local economy by providing increased work opportunities to locals. Influx of workers from different parts of the country and across the border from India will also boost local businesses such as hotels, rental income, restaurants, grocery stores, and other local shops, which is discussed in the subsequent section.

11.3.1.1 IMPACT ASSESSMENT AND SIGNIFICANCE

There are a considerable number of employment opportunities due to the size of the construction workforce required (between 3,600 – 6,000 at its peak).

While the Project will most likely source a portion of its workers from India, there is an opportunity for local workers looking for work to take roles on the Project. Much of the local population in the project area is currently employed in the agricultural sector, which may limit the opportunity for local people to be involved in the Project construction. Having said this, in the dry winter season when farm activities are minimal, with the Project potentially providing an employment avenue during the winter season.

In addition, based on the information provided in the baseline, there are low numbers of highly qualified technicians and management/professional level staff in the Gewogs within the project area, however there are opportunities to source workers from localities.

Moreover, some of the unemployed youth may look to work and take up job opportunities offered by the Project. The Gyalsung[114] is a mandatory one-year training program for 18-year-olds in Bhutan, combining military training, life skills, and specialized education to foster independence, skill development, and national unity. It aims to prepare nearly 13,000 youth annually for successful and different contributions to society. The first intake of Gyalsung training is due to commence in 2024, this initiative will not only cultivate skilled young workers but will also enhance employment opportunities for the Project by generating a more capable workforce,

[114] Gyalsung – Bhutan's National Service. https://gyalsung.bt/about-gyalsung-2/

incentivising further upskilling, and also contributing to Bhutan's economic and social development. This presents a real opportunity for the Project, as it can capitalize on the youth who are trained via the Gyalsung.

The employment opportunities made available by the Project, could bring transformative benefits, especially for youth and women, who could greatly benefit from stable, waged jobs and consistent incomes. Expanding access to these opportunities could enhance their economic independence and resilience while diversifying income sources for families traditionally reliant on agriculture and remittances.

Men, too, could benefit from the availability of reliable local employment, allowing them to support their families without needing to seek work across borders, particularly during the dry season.

Altogether, local employment growth has the potential to reduce reliance on external labor and remittances, fostering a stronger, self-sustaining local economy. It is expected that these receptors will exhibit a high degree of sensitivity to (positive) change in direct local employment opportunities. As this is a beneficial impact, the significance of the impact has not been assessed.

However, while employment will have a beneficial impact, in instances where better pay and benefits are offered by the Project (when compared to local jobs), this can lead to workers leaving their existing positions to capitalize on employment opportunities offered by the Project. This can result in a reduction in the local skills pool. While there is a potential risk that this could occur, given a number of the roles are expected to be filled by workers from abroad, this is not expected to be a significant risk.

11.3.1.2 PROPOSED ENHANCEMENT MEASURES

Measures to meet regulatory and international standards and enhance the impact include:

- Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment to people who live in the project area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider inclusive strategies that create equitable opportunities for vulnerable groups by setting clear goals for hiring and supplier diversity, and providing targeted training and support, organizations can ensure that all individuals have fair access to employment and contracting opportunities.
- Conduct an assessment within the project area to identify potential employment and procurement opportunities. Consider providing training opportunities to build local capacity to contribute to the Project.
- Inform local communities of employment opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate.
- Notify local training facilities of the skills that will be required during the course of the Project, in particular construction. Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.

11.3.1.3 RESIDUAL SIGNIFICANCE

The proposed measures would enhance the magnitude of the impact, which means that the significance is likely to increase. However, given this is a beneficial impact, it has not been further assessed.

11.3.2 BUSINESS OPPORTUNITIES

During construction, the Project will require a range of goods and services, which will present opportunities for businesses, locally and elsewhere in Bhutan as well as abroad.

In addition, the Project's workforce is likely to increase demand for local goods and services. During their down time, workers are likely to spend money in the project area (e.g. eating at local restaurants). The demand for agriculture (fruits and vegetables) and livestock products (milk and milk products) may increase during the road construction works.

As a result, there is potential for local and national businesses to experience an increase in revenue, which is a positive impact. This may also lead to existing local businesses expanding or new businesses being established to meet the Project's demands – which will provide further employment opportunities (i.e. indirect employment).

During operation, the Project will improve connectivity and enhance accessibility. While this will increase traffic, it also presents an opportunity for local businesses, to meet the needs of those transiting through the area, and also lead to new businesses being established to meet the needs of those transiting through the area (e.g. via roadside shops). There is potential for this to increase spend, and again, generate indirect employment opportunities in the project area.

11.3.2.1 IMPACT ASSESSMENT AND SIGNIFICANCE

The demand for goods and services, by the Project and/or its workforce, and the enhanced accessibility once constructed will present further economic opportunities for existing businesses and potentially see new businesses being established . This will likely generate indirect employment opportunities within the social study area.

There are a number of existing businesses within the social study area such as small shops and restaurants. It is expected that these local businesses (amongst others, such as hotels, rental units, equipment providers) will, to an extent, be able to capitalise on these opportunities. Based on the primary data collection process, anecdotally, some businesses are already seeing the opportunity, and planning ahead for it, so that they are positioned to capitalize on development of the Project.

The magnitude of the impact will depend not only on the Project and the initiatives it introduces, but also on the initiative and business acumen of local entrepreneurs. There is an opportunity for the Project to support local entrepreneurs in capitalizing on the opportunities.

It is also important to consider the vulnerable groups within the social study area, such as women, youth and disabled people. These groups may be more susceptible to changes and may find it more difficult to capitalise on employment opportunities from the Project. Again, there is an opportunity for the Project to introduce measures to support vulnerable groups to capitalize on the Project opportunities.

As this is a beneficial impact, the significance of the impact has not been assessed.

11.3.2.2 PROPOSED ENHANCEMENT MEASURES

Measures to meet regulatory and international standards and enhance the impact include:

- Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider inclusive strategies that create equitable opportunities for vulnerable groups by

setting clear goals for hiring and supplier diversity, and providing targeted training and support, organizations can ensure that all individuals have fair access to employment and contracting opportunities.

- Inform local businesses of employment opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate.
- Consider providing training opportunities to build local capacity to contribute to the Project. Promote bank credit and self-financing facilities among the affected households, to enable small income-generating activities.
- Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.

11.3.2.3 RESIDUAL SIGNIFICANCE

The proposed measures would enhance the magnitude of the impact, which means that the significance is likely to increase. However, given this is a beneficial impact, it has not been further assessed.

11.4 IN-MIGRATION

The Project will result in an increase or influx in population in the local area. This can result from the employment opportunities linked to the Project, either directly by the Project or indirectly through the businesses that provide goods and services to the Project.

In addition, the Project is a large-scale infrastructure development, and will lead to job seekers and business entrepreneurs moving into the project area with a viewing to capitalizing on employment and business opportunities. This can exacerbate the increase in population driven by the Project.

As a result of this increase or influx in population[115] in the project area, the following can occur:

- Additional pressure on existing infrastructure and services (e.g. health care, roads, airports, markets/shops, schools). For instance, the current baseline conditions suggest that health-care facilities (including infrastructure and human capital) in the project area are already stretched (meaning that the facilities struggle to meet current needs). This pressure can further reduce the capacity of existing infrastructure and services to meet the needs of local communities in the project area. This can lead to longer wait times and diminished quality of service, as well as reduced access to and increased wear and tear on infrastructure.
- An increase in the number of individuals with disposable income. Although this can have a positive impact – e.g. additional spend on local goods and services - it can also result in negative impacts, such as an increase in the use of drugs and alcohol, which can lead to an increase in anti-social behavior within local communities in the project area. Increased presence of workers in the project area may also increase the cost of living, as demand (and willingness or ability to pay) for goods and services may increase substantially which can also contribute to or exacerbate inflation.

[115] Population change (influx and outflux) is usually described as a first order social impact which has the potential to create second order social impacts, such as impacts on community infrastructure and services, changes in sense of community, sense of place, social cohesion, and community networks etc.

- Lead to conflict within local communities. This can stem from a variety of issues including jealousy that 'outsiders' have successfully secured positions within the Project. This can further exacerbate anti-social behavior and/or lead to a breakdown in social cohesion.
- Change in existing social structures and networks. The introduction of new people can disrupt existing structures and networks, impacting the social cohesion that exists in an area. This disruption can also heighten the risk of further exclusion of vulnerable groups, particularly women and the elderly, while increasing the potential for issues such as Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH), and other forms of Gender-Based Violence (GBV), which are addressed in subsequent sections.

The above potential impacts are further explored below.

11.4.1 INFRASTRUCTURE AND SERVICES

The Project activities will place additional pressure on existing infrastructure and services (e.g. health care, roads, airports, markets/ shops, schools). Pressure on infrastructure and services may be further exacerbated if workers employed by the Project bring their families with them when they move to the Project area for work, as this would further increase the population size.

11.4.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Construction

At peak, the construction workforce is expected to reach approximately 6,000 workers. This will be in addition to those who may be employed by the businesses that service the Project (e.g. restaurants used by the workforce).

The Project is expected to employ around 1,500 – 2,500 skilled workers, based on the current understanding of the skill sets available locally, it is anticipated that a number of workers will be brought in from elsewhere in Bhutan and/or from abroad.

In addition, while the Gewogs within the social study area offer a good quality standard of infrastructure services, they are already experiencing a shortage of workers and skilled professionals in the area. This shortage poses challenges for the local community, as it limits the capacity to sustain and enhance services. With a potential influx of population, the demand for professionals—such as healthcare workers, educators, and other skilled trades—would likely increase, intensifying the existing pressure on an already strained hiring process. This could further complicate the Gewogs to maintain the quality of services needed to support the growing population and development in the region.

While there are health facilities in each of the Gewogs located in the social study area, the current baseline conditions suggest that health-care facilities in the social study area are stretched. In other words, the facilities are struggling to meet current demand. This pressure can further reduce the capacity of existing infrastructure and services to meet the needs of local communities in the social study area. This can lead to longer wait times and diminished quality of service, as well as reduced access to and increased wear and tear on infrastructure.

Additionally, six public schools serve the social study area, with one boarding school and a vocational training institute. The area lacks a university, prompting students to pursue higher education outside Bhutan, influx of new people could put additional pressure on these institutions affecting the capacity to service current residents.

It is also noted that during the winter months, the social study area attracts visitors from the northern parts of Bhutan, as they head south to take advantage of the warmer weather. This often results in a temporary influx in population, people who access the services and infrastructure available in the area. The pressure experienced during the winter months could be compounded by the Project.

Based on the above analysis, the project's potential impacts resulting from pressure on existing infrastructure and services during construction are estimated to be direct, adverse, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***.

Operation

The improved connectivity amongst the Gewogs, which will be created by the Project, will likely generate an increase in population traveling either permanently or temporarily to the area and/ or through the area (due to influx), which is likely to place additional pressure on existing infrastructure and services (e.g. health care, markets/ shops, schools).

As previously discussed, this could reduce the capacity of the existing infrastructure and services to meet the needs of the local residents (as well as the additional population added by the Project). In particular, this can lead to longer wait times and diminished quality of services as well as reduced access to and increased wear and tear on infrastructure. Of particular note are health care facilities and local shops/ markets. (Unlike during construction, it is not anticipated that this issue will impact access to the road network, given the Project will increase the capacity of the road network to service local community needs.) In addition, the inconvenience caused by these pressures can impact social cohesion and establish a feeling of resentment, on the part of residents, towards the Project.

Based on the above analysis, the project's potential impacts resulting from pressure on existing infrastructure and services during operation are estimated to be indirect, adverse, low in magnitude, regional in extent, and medium-term in duration, with an overall pre-mitigation significance of ***Substantial***.

11.4.1.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement an Influx Management Plan, including for foreign workers. This plan should identify strategies to manage not only influx, but also the implications of influx. It should work in tandem with the Community Development Plan, Workforce Management Plan and Worker Code of Conduct. These documents collectively should establish a robust system for managing and monitoring potential impacts associated with influx.
- Develop and implement a comprehensive Community Development Plan (CDP) that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider investments in upgrading local infrastructure and public services, such as healthcare, education, and transportation, to meet the needs of the growing population and reduce pressure on existing resources, to ensure that both new and existing residents benefit from improved facilities, helping to maintain community harmony.
- Implement the Labor Management Procedure (LMP) that aligns with international good practice standards, including but not limited to World Bank ESS-2. The LMP should:

- Establish employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, national extraction, social origin, age, marital or relationship status, sexual orientation. or trade union activity. As part of the hiring process, age checks will be conducted.
- Establish employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
- Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
- Establish employment practices that ensure workers are provided an easy-to-understand contract that specifies working hours, overtime hours, breaks, and holidays.
- Establish safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.
- Establish a work environment with zero tolerance of SEA/SH.
- Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline clearly requirements regarding safeguarding the health and wellbeing of all workers (including women), such as the following:
    - Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
    - A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest.
    - Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
    - Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety.
    - Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.
    - Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.
    - Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.
    - Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
    - Zero tolerance of SEA/SH.
- Develop and implement a Workforce Accommodation Plan (WAP) that align with the international good practice standards, such as *Workers' Accommodation: A Guidance Note*

by IFC and EBRD. The WAP should address both living standards and social infrastructure to cater the influx of workers . The WAP should consider:

- Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed.
- Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water.
- Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired.
- Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar.
- Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs.
- Offer essential shops, personal care services, and banking or ATM facilities within easy reach.
- Designate gathering areas for social events, cultural celebrations, and prayer rooms.
- Arrange shuttle services to nearby centers and information on public transportation options.
- Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces.
- Implement regular cleaning, prompt repair services, and pest control to maintain living standards.
- Consider vulnerable populations within the design of the accommodation facilities, specifically ensuring there are appropriate security arrangements in place and accessibility reflects the needs of the workforce.

- Develop local opportunities through training programs with skill sets that match the Project requirements. This may form part of a livelihood restoration or social investment program.
- Coordinate with local authorities and services providers (e.g. the local hospital) to monitor challenges relating to the increased demand and collaborate on efforts to address these issues, efforts which would also support any pressures caused by the operation of the project.
- Consider busing workers to and from the Project site to avoid creating additional traffic – e.g. pick up local workers at central points and bus them to site, bus workers from the worker accommodation camp(s) to site.
- Conduct ongoing engagement with stakeholders so that stakeholders are aware of the timing of construction activities (e.g. peak construction periods).
- Implement and maintain an internal GRM for workers, including contractor and subcontractor workers.

- Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.

11.4.1.3 RESIDUAL SIGNIFICANCE

The management measures will help to reduce the magnitude of the impact by prioritizing local employment and procurement opportunities, thereby reducing the extent of likely influx and the associated pressure that this can place on local infrastructure and services. Communication of the Project's local hiring approach to the broader social study area (and immediately surrounding areas) will help in realizing local opportunities, in addition to local economic developments.

Additionally, the Project will help to moderate the intensity of the impact by accommodating the construction workforce in worker accommodation camp(s) and providing workers with a range of onsite services, such as the ones specified in the mitigation measures in the above section; thereby reducing the need for workers to access local services.

Ongoing engagement with local authorities and service providers will also better prepare people for these impacts, helping them to plan for additional hiring of people (and potential training and/or upskilling of providers to meet the additional demand caused by the construction and operation of the Project).

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the project's potential impacts resulting from pressure on existing infrastructure and services during *construction* are estimated to be direct, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the Project's potential impacts resulting from pressure on existing infrastructure and services during operation are estimated to be indirect, adverse, low in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Moderate***.

11.4.2 SOCIAL COHESION

Large-scale transitions, the introduction of new projects, and changes to both the built and natural environment, along with the influx of new people, can impact the social cohesion, stability, and character of a locality. While the incoming workforce may contribute positively by boosting the population and revitalizing the local economy, there is also a risk of diminishing the community's identity and sense of unity.

The arrival of new people who may not share the same values or cultural identity could lead to tensions, diminishing the cohesion between the existing population and new people moving into an area. Previous experience with similar developments has shown that such changes can sometimes result in perceptions of the incoming population as 'outsiders', potentially leading to conflict or similar that disrupts the harmony of a place. Therefore, it is crucial to manage these transitions thoughtfully to minimize negative social impacts and promote inclusive growth.

In addition, an influx of new people with disposable income could have both positive and negative consequences. On the one hand, increased spending on local goods and services could stimulate the local economy. On the other hand, it might also lead to a rise in alcohol consumption (which is already an issue in the local communities), increasing instances of anti-social behavior amongst people. A rise in disposable income could also drive up the cost of living, as demand and willingness or ability to pay for goods and services grows, potentially making it harder for long-term residents to afford the area.

The introduction of new people could lead to conflict within the local community, stemming from differences in values, or social norms, as well as resentment over 'outsiders' securing employment opportunities related to the Project. These tensions may exacerbate anti-social behavior and further destabilize social cohesion, leading to a breakdown in community unity. The arrival of new people could also disrupt established social structures and networks, affecting the current level of social cohesion. This disruption could weaken the social bonds, highlighting the need for proactive efforts to foster integration and understanding among both new and long-standing residents. As noted during consultation, the impact on community cohesion is seen by some as inevitable, given the significant changes the Project is expected to bring to the social study area. The extent to which these changes are felt will largely depend on the effectiveness of decision-making processes, especially those aimed at mitigating key impacts. Thoughtful planning and meaningful engagement with local stakeholders are crucial to ensuring that these transitions promote inclusivity and minimize disruption.

11.4.2.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

While the Project brings potential for economic growth, it risks transforming the community's current identity and impacting social cohesion. Respecting cultural and religious sites, supporting vulnerable groups, ensuring sustainable local livelihoods, and protecting vital community resources are essential to maintaining the social fabric that defines this interdependent and culturally rich population. This can occur during construction, as a result of workers and job seekers moving into the area, as well as during operation, as a result of more people transiting through the area.

While the population is culturally diverse, with prominent Buddhist and Hindu communities in which religious sites, and culturally significant festivals form an essential part of local identity. Changes brought about by the Project must consider these cultural practices to preserve the social harmony that currently defines the community.

The social study area economy is largely reliant on agriculture and small businesses. Community resources like water for irrigation and community forests for household products is important. Any disruption to these businesses or resources may strain local economic stability, and lead to impacts on social cohesion, especially with the introduction of migrant laborers whose employment helps balance local labor needs but also introduces economic competition.

Community forests, which supply resources for local households, hold value, with practices that strengthen local social bonds. These forests form an important part of a community's identity. The Project, if it alters access or management of these resources, could disrupt traditional relationships with the land and weaken community connections.

The rates of youth out-migration, which during consultations stakeholders linked to limited education as well as job opportunities within the social study area, have increased the reliance on remittances in the social study area, making families vulnerable to economic shifts if migration patterns change. The Project could shift local employment dynamics, potentially drawing youth back but also risking a loss of local cultural practices and values as new influences emerge.

In addition, the extent of the project and improved connectivity amongst the Gewogs will likely generate an increase in population traveling either to the social study area. This could increase visitor numbers, which may strain existing community relationships as the area adapts to accommodate the changing population. This shift could lead to a sense of displacement among

long-term residents, who may feel their way of life and community identity are being altered. Additionally, the introduction of different cultural practices and behaviors might create divisions, making it challenging to maintain the unity and strong social bonds that previously defined the community.

Based on the above analysis, the Project's potential impacts resulting from reduced social cohesion during construction are estimated to be indirect, adverse, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***.

11.4.2.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement an Influx Management Plan, including for foreign workers. This plan should identify strategies to manage not only influx, but also the implications of influx. It should work in tandem with the Community Development Plan (CDP), Workforce Management Plan and Worker Code of Conduct. These documents collectively should establish a robust system for managing and monitoring potential impacts associated with influx.
- Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider measures that address potential increases in the cost of living and prevent displacement of long-term residents, and inclusive strategies that create equitable opportunities for vulnerable groups by setting clear goals for hiring and supplier diversity, and providing targeted training and support, organizations can ensure that all individuals have fair access to employment and contracting opportunities. The CDP should aim to bring together new and existing residents, fostering social interactions and building connections. This might include cultural festivals, sports events, and community-building workshops designed to create a shared sense of belonging.
- Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline clearly requirements regarding safeguarding the health and wellbeing of all workers (including women), such as the following:
    - Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
    - A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest.
    - Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
    - Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety.
    - Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.

- Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.
- Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.
- Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
- Zero tolerance of SEA/SH.

- Develop and implement a LMP that aligns with international good practice standards, including but not limited to World Bank ESS-2. The LMP should:
  - Establish employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, , social origin, age, marital or relationship status, sexual orientation.. As part of the hiring process, age checks will be conducted.
  - Establish employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
  - Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
  - Establish employment practices that ensure workers are provided an easy-to-understand contract that specifies working hours, overtime hours, breaks, and holidays.
  - Establish safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.
  - Establish a work environment with zero tolerance of SEA/SH.
- Develop and implement a WAP that aligns with the international good practice standards, such as *Workers' Accommodation: A Guidance Note by IFC and EBRD*. The WAP should address both living standards and social infrastructure to cater the influx of workers . The WAP should consider:
  - Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed.
  - Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water.
  - Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired.

- Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar.
- Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs.
- Offer essential shops, personal care services, and banking or ATM facilities within easy reach.
- Designate gathering areas for social events, cultural celebrations, and prayer rooms.
- Arrange shuttle services to nearby centers and information on public transportation options.
- Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces.
- Implement regular cleaning, prompt repair services, and pest control to maintain living standards.
- Consider vulnerable populations within the design of the accommodation facilities, specifically ensuring there are appropriate security arrangements in place and accessibility reflects the needs of the workforce.

- Develop transparent and inclusive communication channels to keep residents informed about the Project's developments and progress. Clear communication helps manage expectations and reduces uncertainty, promoting cooperation and minimizing resistance.
- Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.

11.4.2.3 RESIDUAL SIGNIFICANCE

The residual impact on social cohesion is likely to be low, as proactive efforts to integrate new and existing residents, manage economic disparities, and strengthen community bonds will reduce potential tensions and promote a more inclusive, cohesive, and resilient community.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the project's potential impacts resulting from reduced social cohesion during construction are estimated to be indirect, adverse, medium in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Moderate***.

11.4.3 LABOR AND WORKING CONDITIONS

If appropriate safeguards are not put in place, there is the potential for workers to experience a range of impacts. These can be linked to the recruitment, hiring and onboarding process, lower daily wages, overtime over, as well as the conditions present at site, which can create health and safety risks.

The Project workforce will consist of approximately 50 '" direct workers', including government employees under the DoST and individual consultants engaged through its Project Implementation Unit. In addition, about 2,000–2,500 'contracted workers' will be employed by

the Project, primarily through contractors, with a smaller number engaged by the supervision engineer. The contractors are expected to engage subcontractors and suppliers to support various aspects of project construction, who also fall under the 'contracted workers' category. The Project will not involve the engagement of any primary supply workers.

As per the requirements of ESS-2, written Labor Management Procedures (LMP) must be developed and implemented for the Project. These procedures will outline the management of different categories of project workers in compliance with national labor laws and ESS-2. The LMP will address the following key areas: (i) working conditions and management of worker relationships such as terms and conditions of employment, nondiscrimination and equal opportunity, and worker's organizations; (ii) protecting the work force including defining a minimum age for workers, prohibition of child labor and forced labor; (iii) grievance mechanism (for the workers); and (iv) occupational health and safety (OHS). This section covers these labor aspects other than OHS.

11.4.3.1 PRE-MITIGATION IMPACT ASSESSMENT SIGNIFICANCE

The size of the contracted workers is expected to fluctuate over the course of the construction process based on the timing and type of activities to be undertaken. The tentative estimate for the workforce required during the construction phase of the Project peaks at 2,000-2,500 number of workers. This comprises 600-750 skilled laborers and 1,400–1,750 unskilled laborers.

It is expected that the workforce will consist of a mix of workers from: (i) the social study area, (ii) elsewhere in Bhutan, and (iii) from abroad.

Without appropriate safeguards there is potential for the rights of workers to be impacted, including workers directly employed by the Project as well as by the contracted workers, and workers within the Project primary supply chain.

If safeguards are not in place a range of potential impacts can arise, including:

- Potential employment of children and forced or bonded labor. This risk is often higher for vulnerable groups (e.g. migrant workers). According to the World Bank ESS-2, the minimum age for non-hazardous work is 14 years old, unless national law specifies a higher age. A child over the minimum age and under the age of 18 will not be employed or engaged in connection with the Project in a manner that is likely to be hazardous. According to the Labor and Employment Act of Bhutan of 2007, the minimum age of children to work is 13 and the children in the age group of 13 to 17 years are allowed to work in restaurants and other services provided they are not exposed to any hazardous conditions.
- Accidents, injuries or other health and safety risks, which can arise from inappropriate working conditions, such as excessive working hours and insufficient breaks (See ***Section 11.4.4***).
- Potential for discriminatory practices to occur in the hiring and dismissal processes.
- Potential for discrimination against workers that join unions (or other similar organizations) or take part in collective bargaining.
- Inappropriate or delayed payments to workers. This can include unfair wages.
- Inappropriate or excessive working hours. This can include a lack of management or oversight of overtime work, a lack of sufficient breaks, and limited or no access to public holidays and various forms of leave (e.g. parental leave, annual leave, sick leave).

- Risk of association with contractors (e.g. service contracts) or third parties (e.g. recruitment agents) not adhering to relevant laws and international standards and guidance. This includes a risk of associating with contractors and third parties linked to Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH).

Based on the above analysis, the Project's potential impacts resulting from labor and working conditions during construction are estimated to be direct, adverse, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***. The focus here has been on construction, as the limited employment is expected during operation. The infrastructure will be managed by DoST, under existing DoST management frameworks.

11.4.3.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Implement the following Labor Management Procedure (LMP) aligned with international good practice standards, including but not limited to World Bank ESS-2. All workers engaged by the Project shall comply to the following procedures:
    - **Procedures to Manage workers:** The Project will follow the below procedures in providing terms and conditions of employment, nondiscrimination and equal opportunity, and worker's organizations:
        - Contractors will provide job/employment contracts with clear terms and conditions, including rights related to work hours, wages, overtime, compensation and benefits, annual holiday and sick leave, maternity leave and family leave.
        - Employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation. As part of the hiring process, age checks will be conducted.
        - Employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
        - Employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
        - Safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.
        - Ensure a work environment with zero tolerance of SEA/SH.
        - Reasonable efforts should be made to ascertain that third parties who engage contracted workers are legitimate and reliable entities which have in place labor management procedures applicable to the project which are in accordance with national labor law and ESS-2.
- **Child and Forced Labor:** The following procedures will be followed to prevent child and forced labor in the Project:

- The minimum age of the worker to be engaged in the Project is 18. Age verification of all workers will be conducted by the contractors from Citizenship Identity Cards, Birth certificates, School Leaving Certificates, Health Cards issued by relevant authorities.
- Prohibition of the use of forced labor (i.e., compulsory labor, such as indentured labor, bonded labor, or similar labor-contracting arrangements.) No trafficked persons will be employed in connection with the project.

- **Grievance Mechanism**: Contractors will establish a Worker's Grievance Mechanism. All workers will be informed of the Worker's Grievance Mechanism to raise work-related grievances, including any sensitive and serious grievances on SEA/SH.
- **Code of Conduct**: Workers agree to sign the following code of conduct, which should be cascaded to contracted workers and supply chain workers:
    - Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
    - A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest.
    - Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
    - Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety.
    - Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.
    - Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.
    - Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.
    - Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
    - Zero tolerance of SEA/SH.
- **Workers Accommodation:** Contractors will develop and implement a workers accommodation plan (WAP) that align with the international good practice standards, such as *Workers' Accommodation: A Guidance Note by IFC.* The WAP should address both living standards and social infrastructure to cater the influx of workers . The WAP should consider:
    - Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed.
    - Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water.
    - Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired.

- Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar.
- Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs.
- Offer essential shops, personal care services, and banking or ATM facilities within easy reach.
- Designate gathering areas for social events, cultural celebrations, and prayer rooms.
- Arrange shuttle services to nearby centres and information on public transportation options.
- Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces.
- Implement regular cleaning, prompt repair services, and pest control to maintain living standards.
- Consider vulnerable populations within the design of the accommodation facilities, specifically ensuring there are appropriate security arrangements in place and accessibility reflects the needs of the workforce.

- Develop and implement a comprehensive Community Development Plan (CDP) that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. Develop a Supply Chain Management Plan. The Plan should be designed to ensure that sourcing of all suppliers, materials and equipment used for construction and operation are sourced ethically, in in line with the commitments outlined in the Project's human resources policy.

11.4.3.3 RESIDUAL SIGNIFICANCE

Implementation of the labor management procedures, along with the proposed code of conduct and LMP outlined above, will help to reduce the likelihood of an impact eventuating. For this reason, the residual significance was assessed as ***Low***.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the Project's potential impacts resulting from labor and working conditions during construction are estimated to be direct, adverse, low in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Low***.

11.4.4 WORKER HEALTH AND SAFETY

There are a number of health and safety related issues that workers are likely to be exposed to on any large-scale development. Without appropriate safeguards in place, these issues can lead to accidents, injuries, and fatalities.

11.4.4.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The nature of the Project, in particular the construction activities, presents a range of health and safety risks to workers, including those employed by Project as well as contracted workers.

Potential workforce health and safety risks include:

- Accidents and injuries which may occur as a result of construction activities, if safe work practices are not followed. Examples include:
    - The use of large mobile equipment such as excavators, bulldozers, and graders present health and safety risks if not handled appropriately.
    - Non-compliance with health and safety programs, poor safety culture and inappropriate use of worker personal protective equipment (PPE) may place workers at risk of accidents and injuries.
    - An increase in the number of vehicles increases the potential for an accident or injury to occur.
    - Manual handling associated with day-to-day construction activities can result in injuries, and
    - Storage and use of fuels and other flammable materials, which if not stored and managed appropriately could contribute to a fire incident and possible injury.

  The above is not an exhaustive list of potential risks and hazards but presents examples of the types of activities that could contribute to an accident or injury during construction.
- Occupational diseases that are caused or aggravated by exposure to workplace hazards and are often categorized into the following groups - musculoskeletal disorders, mental disorders, noise-induced hearing loss, infectious and parasitic disease, respiratory diseases, contact dermatitis, cardiovascular diseases and occupational cancer. These diseases often develop as a result of poor working conditions and poor hygiene. Some occupational diseases manifest shortly after exposure, while others take longer to manifest after exposure. Examples include:
    - Repetitive work movements which may cause lateral epicondylitis (i.e. tennis elbow).
    - Conducting activities that generate large amounts of dust, which may result in or exacerbate respiratory problems.
    - Working in areas of loud noise, particularly from large machinery and blasting, may result in hearing loss.
    - Working with hazardous substances may result in respiratory issues (e.g. asthma) or contact dermatitis.
- Infectious diseases refer to illnesses caused by a diverse range of pathogens that can be transmitted through means such as:
    - Disease vectors (e.g. mosquitos), which may result in diseases such as dengue fever.

- Ingestion of unsanitary food and water, which may result diseases such as salmonella, E.coli, and listeria (e.g. diarrhea), and
- Human or pest contact, which may result in diseases such as (e.g. sexually transmitted infections (STIs), tuberculosis, influenza and rabies). Tuberculosis is present in Bhutan, so is a known risk factor.

- Human-wildlife (in particular elephants but also wild boars, amongst other animals) interactions, which are known to occur within the project impact area. These interactions often occur at key times during the harvest season from evening until dawn. These interactions present a risk to workers, with the risk heightened when construction works occur in agricultural areas at harvest time. The habitat fragmentation that will likely result from the Project could increase human-elephant conflicts.
- Environmental conditions, such as extreme temperatures, storm events, landslides or other similar natural hazards, all present a risk to workers. High temperatures and landslides are known to occur in the project impact area.

Health and safety risks can impact workers in a range of ways – from temporary illness to long-term impacts. The worst-case scenario would be a fatality, or multiple fatalities, which has occurred on other similar types of large-scale developments, during the construction phase.

Current baseline conditions heighten the potential risk for a health and safety related impact occurring. For example, access to adequate healthcare is a contributing factor to the effective management of infectious diseases. Due to the prevalence of disease transmission, such as tuberculosis and Hepatitis B, an outbreak could quickly spread through the community and impact the workforce, which could exacerbate the pressure that is already being experienced by healthcare providers within the social study area.

The baseline conditions indicate that human-wildlife interactions are a regular occurrence, in particular during the lead up to and during the harvest season from evening to dawn. This heightens the likelihood that workers will come across elephants during their work. The Impact Assessment of the Biological Environment (***Chapter 9*** of the ESIA) revealed substantial human-elephant conflict in the area, with frequent crop damage and occasional human casualties. Elephant movement patterns overlap with the project impact area, and the habitat fragmentation resulting from the Project could exacerbate the existing human-elephant conflicts.

In addition, the project impact area experiences high temperatures throughout the summer months, which heightens the risk of heat stress and fatigue occurring. The project impact area also has experienced landslides, which again, heightens the risk to the workforce.

With the potential for a fatality resulting from construction activities or health issues such as the spread of disease, the potential impact was assessed as high. In making this determination, consideration was also given to the make-up of the workforce, given the majority of migrant workers, who will likely constitute a sizeable portion of the workforce, may have a limited understanding of the local environment and potential language barriers, this could heighten the risk further.

Based on the above analysis, the project's potential impacts resulting from worker health and safety conditions during construction are estimated to be direct, adverse, high in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***High***.

11.4.4.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement a Health and Safety Management Plan that applies to workers and contracted workers. It will be important that the Plan puts in place strategies to minimize the risk associated with human-wildlife interactions, as well as local issues, such as exposure to tuberculosis, heat stress and landslides.
- Provide an induction and on-going training for all workers, including contracted workers, regarding health and safety. This should include the wearing of appropriate PPE, good hygiene practices and information relating to infectious diseases, and the management of risks and hazards.
- Ensure workers have personal protective equipment (PPE) appropriate to their role. Supervisors should be required to monitor the wearing of PPE.
- Require workers (including contracted workers) to complete a Job Hazard Analysis (JHAs) prior to undertaking construction activities, as well as conduct daily toolbox discussions to ensure hazards are identified and management measures are implemented. The JHAs should consider environmental conditions, particularly extreme temperatures (and heat stress) as well as landslides.
- Ensure equipment is well maintained and sufficient lighting is available to maintain a safe work environment.
- Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan.
- Training staff on species encounters, implementing wildlife-safe speed limits, installing signage at crossings, and clearing obstructions on wildlife trails.
- Develop and implement waste management procedures to ensure appropriate storage and removal of waste to reduce the potential occurrence of infectious diseases.
- Implement pest control measures, such as monitoring of stagnant water bodies and waste storage areas, as these can create vector habitat.
- Conduct medical assessments of workers before they are mobilized to the site, including screening for infectious diseases and other health issues, to ensure they are fit for work. Coordinate with local health officials to undertake pre-mobilisation health checks, which should be required prior to workers commencing work. This should be used to ensure that workers are fit for the role that they will be undertaking. Safeguards should be put in place to ensure that the health check process does not contribute to discriminatory hiring practices.
- Provide health/ medical care to workers and contractors at the Project site for minor health issues (e.g. minor injuries, colds, sprains, etc.) and preventative care (e.g. vaccines, health awareness training).
- Coordinate with local health officials on their infectious disease management and prevention strategies to ensure workers are made aware of requirements to report infections and preventative measures. There should be a focus on diseases with high transmission rates, which can be transmitted quickly between workforce and community.
- Regular communication should be maintained with local health officials and emergency services (e.g. firefighting services) to monitor new health and safety issues that may be

impacted by, or impact the Project workforce, and collaborate on solutions to address these issues.

- Develop and implement an emergency response plan, including response to an infectious disease outbreak, in consultation with local health care providers.
- Provide a dedicated trained Emergency Medical Technician (EMT) or other medical emergency resource on-site, including medical emergency transportation, to address medical emergencies and coordinate with local hospitals for higher level care.
- Establish and implement a GRM for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain, should have access to a GRM to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised. Routine monitoring of the GRM process should be undertaken.
- .
- Develop and implement a WAP that aligns with the international good practice standards, such as *Workers' Accommodation: A Guidance Note by IFC and EBRD*. The WAP should address both living standards and social infrastructure to cater the influx of workers . The WAP should consider:
    - Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed.
    - Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water.
    - Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired.
    - Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar.
    - Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs.
    - Offer essential shops, personal care services, and banking or ATM facilities within easy reach.
    - Designate gathering areas for social events, cultural celebrations, and prayer rooms.
    - Arrange shuttle services to nearby centers and information on public transportation options.
    - Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces.
    - Implement regular cleaning, prompt repair services, and pest control to maintain living standards.

- Consider vulnerable populations within the design of the accommodation facilities, specifically ensure there is appropriate security arrangements in place and accessibility reflects the needs of the workforce

11.4.4.3 RESIDUAL SIGNIFICANCE

Implementation of a health and safety management plan, along with the proposed management strategies outlined, will help to reduce the likelihood of the impact eventuating eventuate. However, given a fatality is still possible, the residual significance was assessed as substantial.

The proposed mitigation measures would reduce the magnitude of the impact from high to substantial, so the project's potential impacts resulting from health and safety conditions during construction are estimated to be direct, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

11.5 COMMUNITY INFRASTRUCTURE AND WELLBEING

11.5.1 PHYSICAL INFRASTRUCTURE

An influx in population, particularly during construction, will likely place additional pressure on existing services and infrastructure, which is discussed in ***Section 11.4.1.***

However, in addition, the Project itself may place additional pressure on existing services and infrastructure. This can reduce the capacity of existing infrastructure and services to meet the needs of local communities in the social study area. The result can be longer waiting times and diminished quality of service for local communities, as well as reduced access to and/ or increased wear and tear on existing infrastructure.

11.5.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

There is potential for the Project to place pressure on the following:

Road Network

The existing road network will be essential in transporting workers, goods, and services to and from the Project area, but this activity will inevitably increase wear and tear, congestion, and the potential for accidents. This could lead to frustration among local communities in the project impact area or, in the worst-case scenario, accidents could result in a serious injury or fatality (see ***Section 11.5.2 for*** further details).

According to the Traffic and Transport Impact Assessment, during the construction phase, traffic is expected to increase significantly. This will be from buses shuttling workers from their accommodation to the site, workers commuting via motorbikes, and deliveries of suppliers and equipment. Such an increase can lead to congestion, causing delays and inconvenience for road users, potentially leading to frustration or anxiety during extended traffic delays. Additional health and safety impacts associated with traffic increase are discussed in ***Section 11.5.2***.

Additionally, the construction phase will involve the movement of a large number of vehicles and result in potential temporary and permanent road closures, which may cause disturbance for those living nearby.

Provision of Water

The Project will need water for a range of activities, such as dust management as well as potable water for workers. While communities in the social study area have access to piped water, which

comes from rivers, streams and springs, many of these are seasonal and dry out during the summer seasons. As a result, some Gewogs have introduced water restrictions during the dry season. The Project could exacerbate this issue if it seeks to access the sources currently used by the communities in the project impact area.

Since rivers, streams and springs are the main source of water for communities, construction activities could potentially lead to pollution or degradation of water resources, further curtailing the communities' dependence on rivers, streams and spring water.

According to the ***Chapter 9.3*** Surface Water Quality and Hydrology Assessment, construction activities—including road and bridge construction, earthworks, and wastewater disposal—pose risks to surface water quality and hydrological patterns. Specifically, increased runoff, erosion, and sedimentation may degrade water quality through higher levels of Total Suspended Solids (TSS) and Total Dissolved Solids (TDS), and pollutants like pH-altering substances, oils, and nutrients.

Moreover, ***Chapter 9.4*** Soil and Groundwater Quality Assessment concluded that given the area's mountainous terrain, soil is prone to erosion, with fertile topsoil concentrated in limited regions. Therefore, construction activities—land clearing, earthworks, and foundation installations—are likely to disturb soil structures and promote erosion, especially during rainy periods, which may result in impacts on the soil quality from erosion, compaction, and possible contamination. Without mitigation, loose sediment may contribute to turbidity in local water bodies, impacting both local agriculture and groundwater quality. In addition, compaction from heavy machinery can reduce soil permeability, impeding natural drainage.

Waste Management

The Project will generate a range of waste streams, some of which will need to be accommodated locally. Waste generation during construction includes domestic waste from the influx of population (workforce), construction debris, and hazardous wastes (e.g., oils, lubricants, and chemicals).

Chapter 9.5 Waste Management Impact Assessment was prepared and concluded that unmanaged waste risks polluting soil, air, and water, while large quantities of hazardous materials (e.g., fuels and oils) may lead to localized contamination. The influx of construction workers is expected to strain local waste management systems, potentially impacting public health and environmental quality.

The existing waste infrastructure appears to be sufficient to meet the current needs of the communities in the social study area. The existing landfill is lined with leachate pits and is managed by the Environmental Division, Gelephu Thromde. This landfill can accept general domestic waste. The Project will place pressure on the existing waste management services. However, it is recommended the existing landfill be expanded to ensure the capacity of the waste management services are maintained to meet community needs, as it will be important that community needs can still be met.

Based on the above analysis, the Project's potential impacts resulting from pressure on physical infrastructure during construction are estimated to be direct, adverse, potentially high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***.

11.5.1.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Coordinate with local authorities and services providers (e.g. the local hospital) to monitor challenges relating to the increased demand and collaborate on efforts to address these issues.
- Implement mitigation measures outlined in the respective Impact Assessment relating to waste, water and traffic (***Chapter 9*** of the ESIA).
- Develop and implement a water management plan that includes monitoring mechanisms. Consider inclusion of a water sharing agreement with the communities in the Project impacted area.
- Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan, including monitoring mechanisms.
- Develop and implement waste management procedures, including ongoing community consultation, to ensure appropriate storage and disposal of waste and the timely removal of waste to reduce the potential occurrence of disease.
- Consider busing workers to and from the Project site to avoid creating additional traffic – e.g. pick up local workers at central points and bus them to site, bus workers from the worker accommodation camp(s) to site.
- Conduct ongoing engagement with stakeholders so that stakeholders are aware of the timing of construction activities (e.g. peak construction periods), especially schools and temples, to avoid accidents, as students tend to walk along the narrow should of existing roads.
- Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.
- Develop and implement a Logistics Management Plan to work in tandem with the traffic management plan to map out how logistics will work, including the timing and pathway used to transport equipment and materials to locations that are hard to access. Keep the community informed about timing and potential road and access closures.

11.5.1.3 RESIDUAL SIGNIFICANCE

Through careful planning, adherence to best practices, and continuous monitoring, the Project can limit adverse effects on physical infrastructures and communities. Each mitigation measure will be aligned with international standards and is tailored to the specific risks posed by the Project's mountainous, hydrologically dynamic setting.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the project's potential impacts resulting from pressure on physical infrastructure during construction are estimated to be direct, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

11.5.2 HEALTH, SAFETY AND WELLBEING

The Project poses various health, safety, and wellbeing risks to communities within the project impact area, which require careful attention. Key physical hazards include the operation of heavy machinery, the presence of an active construction site, and increased traffic flow from the transport of goods, materials, and workers, all of which elevate the potential for accidents and create congestion, leading to unsafe conditions for local residents.

Additionally, the increased movement and influx of people may change the prevalence of infectious diseases. Standing water, resulting from excavation or trenching, along with poor waste management, can attract disease vectors, thus heightening the risk of vector-borne diseases, including diseases that may already present in the area.

Post-construction road use also presents challenges, as the anticipated heavy vehicle traffic is unfamiliar to the local population, who live close to the road and lack the experience to navigate this new level of traffic safely, raising the likelihood of accidents.

Beyond physical impacts, the Project may influence mental health, as the uncertainty and pressures associated with the changes likely to arise as a result of the Project can result in psychological distress, including fear, grief, and anxiety. These psycho-social impacts, affecting individual and community wellbeing, can manifest in strained family relationships, diminished community trust, and decreased resilience, all of which could impact Project acceptance and disrupt social cohesion. Addressing these risks holistically is essential to promoting health, safety, and wellbeing in the affected communities.

11.5.2.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

While the impact, as described above, is expected to be localized, the potential outcome of this impact is an injury, or worst-case scenario, a fatality.

The social study area, particularly Gelephu Thromde, benefits from a structured healthcare system covering primary, secondary, and tertiary facilities, with government funding and agreements with India allowing complex cases to receive specialized care. Despite accessible hospitals, clinics, and outreach services in the project impactarea, substantial health concerns remain, notably non-communicable diseases (NCDs), substance abuse, and family planning challenges, all of which impact community health, safety, and wellbeing.

Human-wildlife conflict, especially between humans and elephants, poses a safety risk, particularly to farmers who face crop damage and, at times, fatalities. Response teams are active during crop seasons to manage incidents, but additional safety measures are necessary to prevent loss of life and livelihood. The Project could exacerbate the extent to which human-wildlife conflict occurs. This is further discussed in the ***Chapter 10*** Impact Assessment of the Biological Environment.

The project impact area reliance on several rivers does not eliminate seasonal water shortages, which persist and can affect both personal and public health. While piped water and safe sanitation facilities are generally available, water scarcity during certain seasons underscores the need for sustainable water management to support community health and wellbeing (as described in ***Section 11.6.1***).

In Gelephu Thromde, crime rates are higher, compared to elsewhere in the social study area, due to a larger population and the presence of entertainment venues, with substance abuse and domestic violence as key issues. The government's Safe City Project aims to improve security in Gelephu Thromde, which is essential for the wellbeing and safety of residents.

In addition, healthcare access, already uneven, with Gewogs reliant on outreach clinics while Gelephu Thromde hosts a regional referral hospital, may be further strained by an influx of workers and increased population movement from the Project. Coupled with prevalent health issues like alcohol-related illnesses, adequate healthcare and community health programs are critical for maintaining family stability and addressing social challenges. Gender disparities also heightens social vulnerabilities, as many women depend on informal labor and small-scale

agriculture while facing underreported domestic violence. Support from NGOs such as RENEW and local safety initiatives will be crucial in addressing these compounded pressures, especially as the road project introduces new social interactions and influences.

Several groups are particularly vulnerable, including healthcare workers and patients who are affected by limited resources and prevalent issues such as non-communicable diseases and substance abuse, placing an additional burden on healthcare facilities. Farmers and rural residents are at particular risk from human-wildlife conflict and water scarcity, which impacts both their safety and livelihoods.

Based on the above analysis, the Project's potential impacts resulting from health, safety and wellbeing during construction are estimated to be indirect, adverse, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Substantial***.

11.5.2.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan, including monitoring mechanisms. It will be important to work with the local police in developing the Traffic Management Plan.
- Look at opportunities to minimize traffic, and reduce speed limits, during peak times, such as school times / when kids are travelling to and from school.
- Develop and implement a water management plan that includes monitoring mechanisms. Consider inclusion of a water sharing agreement with the communities in the Project impacted area.
- Guidance should be provided for contractors working within the perimeter of the construction site to ensure they are insured, thereby protecting the rights and interests of the driver and pedestrians.
- Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline clearly requirements regarding safeguarding the health and wellbeing of all workers (including women), such as the following:
    - Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
    - A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest.
    - Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
    - Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety.
    - Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.
    - Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.

- Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.
- Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
- Zero tolerance of SEA/SH.

11.5.2.3 RESIDUAL SIGNIFICANCE

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the project's potential impacts resulting from pressure on physical infrastructure during construction are estimated to be indirect, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***. The focus here has been on construction, as the limited employment is expected during operation. The infrastructure will be managed by DoST, under existing DoST management frameworks.

11.5.3 AMENITY VALUE

Amenity value refers to the characteristics that influence and enhance a person's or community's appreciation of a particular area. These values are derived from the pleasantness, aesthetic coherence and cultural and recreational attributes of an area. There are a range of factors that can impact the amenity of an area, including increases in dust, noise, waste and vibrations.

Earthworks during the construction phase will likely generate dust and noise which have the potential to reduce the amenity value of the project impact area. Additionally, movement of material such as sand, cement, and tar, could lead to additional dust and noise. Blasting of mountains / hills for alignment with technical specifications of the highway may cause vibrations and shock waves generated from the explosions. These impacts have the potential to negatively affect human health (e.g. increasing ambient pressure can cause lung and eardrum damage) and the stability of nearby fixed structures (e.g. ground vibrations can disrupt the foundations of infrastructure), which can reduce the amenity value.

11.5.3.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Construction

1. Noise and Vibration

Noise and vibration will be produced throughout the construction phase of the project, potentially causing nuisance, sleep disturbances, and adverse long-term health effects if not managed effectively.

Prolonged exposure to excessive noise can diminish the amenity value of an area, making it unfavorable for living, and poses a public health risk, further discussed in ***Section 11.4.4.***

The Noise and Vibration Impact Assessment (NVIA) included in the physical environment impact assessment (***Chapter 9***) highlights that construction activities—such as site preparation, earthworks, road surfacing, and bridge construction—will generate noise and vibration. Noise impacts are expected to vary by distance, with substantial effects within 70 m, moderate impacts from 70–110 m, low impacts from 110–180 m, and negligible impacts beyond. Gelephu Thromde and Tareythang Gewog, which have the highest residential populations located in proximity to the Project are anticipated to be the most affected areas due to the high concentration of

sensitive receptors in close proximity to the Project. The census and asset inventory will further clarify the exact number of affected households, community forests, and other receptors.

The NVIA also anticipates high but short-term vibration emissions during construction, affecting areas within 200 m of the construction activities. Due to the large structures that will be constructed, such as bridges, these areas may experience intensified vibration levels, necessitating further detailed assessments where structures are within 200 m of the construction activities.

2. Air Quality

Project air emission sources during construction are expected to be from large diesel generators, aggregate crushing plants, concrete batch plants, small diesel generators, non-road construction equipment, construction vehicles, and fugitive dust.

The generation of dust can exacerbate existing respiratory issues, such as asthma and respiratory illnesses, and impact the local amenity value. It is noted that respiratory illnesses are a leading cause of morbidity in the project impact area, based on data from Central Regional Referral Hospital. The potential impacts on health are further discussed ***Section 11.4.4.*** Often such impacts have a disproportionate impact on vulnerable populations.

3. Construction Significance

The Project's potential impacts resulting from noise, vibration and air emissions during construction are estimated to be indirect, adverse, high in magnitude (taking into consideration the susceptibility of local residences to effects from air emissions), local in extent, and short-term in duration, with an overall pre-mitigation significance of ***High***.

Operation

1. Noise and Vibration

The operational noise impact from increased traffic on newly constructed or expanded roadways has social implications, particularly for residents and communities near the roads. As traffic volume and speed are projected to increase over time, corresponding rises in noise levels may reduce the quality of life, especially for vulnerable groups such as the elderly, children, and individuals with health conditions sensitive to noise disturbances.

According to the NVIA, modeling for future scenarios (2035, 2053) and a worst-case maximum capacity scenario indicates that residents within 110 m of the road may experience higher noise levels during day and night than what is experienced currently, which could affect mental well-being and diminish overall comfort in their homes. The assessment also concluded that medium-distance residents are expected to face moderate noise levels, which may still lead to reduced social cohesion and discourage outdoor activities; while those located over 300 meters from the Project will likely experience minimal impacts.

2. Air Quality

Modeling of traffic flows has been conducted for the operation of the road, for 2035 and 2053 (please refer to the impact assessment – air quality, in the physical environment section of the ESIA). A substantial proportion of the vehicles are anticipated to be electric (by 2035) and therefore have no significant contribution to air pollution and can be discounted. By 2053 all

vehicles are assumed to be electric and therefore impacts to air quality will be negligible as there are zero exhaust emissions.

3. Operation Significance

The overall impacts associated with operational road traffic are therefore anticipated to be ***Negligible*** when looking at air quality, but ***Moderate*** for noise.

11.5.3.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Preparation and implementation of the Construction Environmental Management Plan (CEMP), including monitoring mechanisms.
- Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan, including monitoring mechanisms.
- Review noise assessment results following the completion of the census and asset inventory to identify any areas exceeding acceptable noise levels and implement appropriate noise reduction strategies.
- Conduct ongoing engagement with stakeholders so that stakeholders are aware of the timing of construction activities (e.g. periods of increased noise and dust).
- Implement and maintain a community GRM, so that stakeholders can raise issues and concerns.

11.5.3.3 RESIDUAL SIGNIFICANCE

The noise and vibration impact during the construction phase is projected to be high but short-term, affecting residents and structures close to active construction sites. While the CEMP and additional strategies aim to minimize these impacts, residual effects will persist, particularly for sensitive receptors within 110 m.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the project's potential impacts resulting from reduced amenity values during construction are estimated to be indirect, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

During the operational phase, noise impacts from increased traffic will lead to long-term noise exposure, particularly in residents and structures close to the road infrastructure. Proposed mitigation measures, including noise barriers and low-noise road surfaces, are anticipated to reduce but not entirely eliminate the impact. After implementing these mitigations, the impact on residential areas could be reduced, however, noise impacts may persist for residents close to major traffic routes.

The NVIA highlights that as the area develops, the noise impact is likely to remain a significant factor, affecting both current and future residents.

The proposed mitigation measures would reduce the magnitude of the impact from substantial to moderate, so the Project's potential impacts resulting from reduced amenity values during operation are estimated to be direct, adverse, low in magnitude, local in context, and long-term in duration, with an overall residual significance of ***Moderate***.

11.6 GENDER ASSESSMENT

11.6.1 LAND USE AND ACQUISITION

The Project will result in a change to the existing land uses, as a result of permanent and temporary land acquisition. The resulting permanent and temporary physical and economic displacement will likely mean that households, at least some, will become more economically vulnerable. The primary responsibility of managing the home with reduced purchasing power would likely fall upon women.

It will be important that structured and inclusive consultations be held, with a particular focus on gathering input from women in the Project impacted area. This should involve creating safe, accessible spaces for women to express their concerns and needs, particularly regarding GBV risks and the potential for increased unpaid domestic responsibilities. Women's representation should be embedded within monitoring and reporting activities, creating space for them to have meaningful participation during the Project and ensuring that issues affecting them are addressed promptly.

11.6.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

It is estimated that 226 plots will be directly impacted by the project ROW and estimated that 11 of the structures in Gelephu Thromde may be households that will be physically displaced. A substantial portion of the land to be acquired for the Project is used for agricultural practices, therefore, any land acquisition will impact land-based livelihoods, including agricultural income. The gender-disaggregated profile of the affected households is not yet available.

It is understood from the consultations within the social study area that while women own land as part of their inheritance, the land is often taken care of by the entire family. Therefore, the potential exists that women may not be actively involved in the land acquisition process, specifically the negotiation and compensation process. In some households, women may own land as a part of their inheritance. The head of the households (men or women) will be involved in the land acquisition process. As per the existing regulations, decisions on land cannot be taken without the consent of the head of the households and other family members of a household.

Regardless, while the compensation will be paid by the Project, women will lose one of their most valuable assets, which is land. This is an important consideration.

Based on the above analysis, the project's potential impacts resulting from gender assessment of land use and acquisition are estimated to be direct, adverse, high in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of ***High***.

11.6.1.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Development and implementation of the Gender Action Plan (GAP), with ongoing monitoring.
- Women should be specifically asked to attend the meetings regarding land acquisition, and agreement should be done jointly with the landowner and their spouse so that women are aware of the dealings. In situations where women hesitate to participate in these discussions, prior meetings should be held separately with women to provide them with all the information required and help them participate in the process and/or arrive at decisions. Women should be informed in a culturally and locally appropriate manner, meaning consideration will need to be given to local language requirements.

- Implementation of a fair land acquisition compensation scheme (based on a market valuation).
- Prioritization of employment opportunities for those who have been physically and economically displaced, including women, based on their interests and skills.
- Partnership with local institutions, such as RENEW, to provide targeted technical and vocational training to help upskill women, enabling them to participate in the employment opportunities created by the Project.
- Partnership with local institutions, such as RENEW and the Police, to provide local awareness raising campaigns about women's rights.
- Ongoing engagement opportunities, outside of those associated with land acquisition, should be appropriately planned so that girls and women are in a position to activity participate and contribute.

11.6.1.3 RESIDUAL SIGNIFICANCE

After the implementation of mitigation measures, the residual impact significance of land use changes and land acquisition, particularly for land owned by women, is likely to be moderate. While efforts to provide fair compensation, alternative livelihoods, and support for women landowners can reduce the severity of impacts, the potential for economic disruption and loss of traditional land rights may still affect women's socioeconomic stability and empowerment.

The proposed mitigation measures would reduce the magnitude of the impact from high to moderate, so the project's potential impacts resulting from gender assessment of land use and acquisition are estimated to be direct, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

11.6.2 WOMEN SAFETY AND WELLBEING

The risk of GBV is a substantial concern in the context of the Project. If gender-sensitive policies are not implemented, the Project could contribute to an unsafe environment for women. This can put women at risk, and have longer-term social consequences, such as increased trauma, stigma, and reduced participation in the society and economy.

11.6.2.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

According to the National Commission for Women and Children (NCWC), emotional abuse consistently ranks as the most common form of GBV nationwide, followed closely by physical abuse (NCWC). In southern Bhutan (where the social study area is situated), it is understood that emotional abuse is the most prevalent form of GBV, including behaviors such as humiliation, intimidation, and controlling actions within intimate relationships. The extent of the impact is shown by a national study conducted 2017, which found that 15.8% of ever-partnered women aged 15-64 reported experiencing emotional abuse, with 8.6% affected within the past year (NCWC Study).

During consultations in the social study area, alcohol abuse was seen by stakeholders a a primary factor contributing to GBV in the Project area. The Project will generate an influx of people in the area – through direct and indirect employment. It is expected that this increased population will predominantly be men from outside the social study area. This increase in population could worsen existing GBV issues, as unfamiliarity with local norms combined with elevated alcohol consumption could create conditions where emotional and physical abuse become more prevalent. Additionally, this influx could heighten social tensions, potentially creating an unsafe

environment for local women if adequate protections and awareness programs are not implemented.

The Project could also deepen gender inequalities in unpaid domestic and care work. Currently, women in Bhutan, including in the social study area, hold a significant share of household responsibilities, and in instances where male family members take on Project-related employment, women could face an increased workload managing both household and care duties. This additional burden could limit women's access to educational or employment opportunities arising from the Project, reinforcing traditional gender roles.

Moreover, the Project's impact on household labor dynamics could hinder progress in education for women and girls. Although 65.8% of girls in Bhutan complete lower secondary school, compared to 53.6% of boys (which is reflective of the social study area, based on conservations with local stakeholders), families may prioritize household labor over education to take advantage of the Project's economic benefits. This could lead to girls being pulled out of school, thereby limiting their future opportunities and increasing their vulnerability to GBV and social dependency.

Based on the above analysis, the project's potential impacts resulting from women safety and wellbeing are estimated to be indirect, adverse, high in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***High***.

11.6.2.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement the Gender Action Plan (GAP), with ongoing monitoring.
- Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline clearly requirements regarding safeguarding the health and wellbeing of all workers (including women), such as the following:
    - Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
    - A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest.
    - Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
    - Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety.
    - Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.
    - Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.
    - Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.

- Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
- Zero tolerance of SEA/SH.

- Actively monitoring of the code of conduct and consequences are clearly articulated to workers in the event that the code of conduct is breached.
- Provision of training on the code of conduct, and this training should be reinforced through internal communication channels established by the Project.
- Develop and implement a LMP that aligns with international good practice standards, including but not limited to World Bank ESS-2. The LMP should:
  - Establish employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation. As part of the hiring process, age checks will be conducted.
  - Establish employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
  - Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
  - Establish employment practices that ensure workers are provided an easy-to-understand contract that specifies working hours, overtime hours, breaks, and holidays.
  - Establish safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.
  - Establish a work environment with zero tolerance of SEA/SH.
- Employ, as part of the Project team, a dedicated GBV specialist who can oversee initiatives and work closely with an established GBV service provider to ensure effective intervention and response. Gender mainstreaming efforts in resettlement planning, hiring practices, and community engagement processes will prioritize women's needs, aiming for equitable employment opportunities and fostering an inclusive environment for all.
- Provide support to women's groups that focus on providing literacy programs, including financial and digital literacy training, to empower community members with the knowledge to manage finances and engage in local business activities. The development of a women-managed market space could create a safe and supportive environment for female entrepreneurs, while low-interest credit schemes could provide critical financial resources for women-led enterprises. These initiatives not only offer sustainable livelihoods but also help strengthen the local economy, creating a more resilient and inclusive community.
- Partner with local organizations, like RENEW, Tarayana Foundation, Police and other CSOs engaged in community development initiatives in the social study area, to support efforts in

addressing social challenges such GBV, women's rights, domestic violence, teenage pregnancy, and alcoholism through awareness campaigns and community support programs. Coordinating efforts with local GBV service providers will ensure a clear referral pathway within the GRM to support individuals affected by SEA/SH incidents.

- Provide safe, anonymous reporting avenues for women to raise concerns and grievances. The team responsible for managing grievances, reports of gender-based violence, and other related incidents should have appropriate training to manage such issues.
- Collaborate with RENEW, the local hospital and local police in putting in place a reporting avenue, as these organizations are already collaborating to provide women a safe space to raise concerns.
- Apply gender-specific design principles, such as those in Crime Prevention Through Environmental Design (CPTED), to enhance women's safety within Project facilities by creating an environment that promotes a sense of security through clear visibility, natural surveillance, adequate lighting and controlled access points, while also ensuring appropriate facilities like restrooms, breastfeeding rooms, and secure accommodation measures such as women-only floors, well-lit areas, and security escorts when needed.
- The need for providing additional measures to ensure safety of women should not act as a deterrent towards employment of female workers and employees in the construction phase. The Project should give equal opportunities to everyone including women.

11.6.2.3 RESIDUAL SIGNIFICANCE

The management measures will help to reduce the magnitude of the impact by providing a safer environment for women. Additionally, grievance mechanisms and a breach on the workforce code of conduct would discourage gender-based violence.

However, residual impacts may include continued instances of GBV due to deeply ingrained societal norms, potential underreporting of incidents, and challenges in fully ensuring accountability.

The proposed mitigation measures would reduce the magnitude of the impact from high to moderate, so the project's potential impacts resulting from women safety and wellbeing are estimated to be indirect, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

11.6.3 ECONOMIC OPPORTUNITIES

The Project has the potential to provide formal employment opportunities in range areas, such as construction, administration, and support services, increasing women's involvement in paid economic activities. This would help contribute to bridging the labor force participation gap between men and women.

11.6.3.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Paid employment can enable women to contribute to household income and gain financial independence. It could help reduce dropout rates for girls and encourage them to pursue higher education or vocational fields, empowering the next generation of women to access high-demand sectors, as girls will have role models to follow.

In addition, the compensation received from land acquisition by women, presents another substantive economic opportunity for women. Properly distributing and managing these funds

can empower women to secure long-term financial independence. This compensation can support their investment in property or other assets and can be used to invest in other income-generating ventures, including starting agriculture practices in a new land. Women can also use the funds to access higher education or vocational training, equipping them with skills for future employment. Properly managed, these funds can elevate women's economic standing, enabling them to take greater control of household finances and decision-making, while also fostering intergenerational wealth and economic empowerment for future generations.

Overall, the Project has the potential to contribute to economic empowerment, enhanced educational outcomes, and increased social equality for women, leading to long-term positive changes in their roles within the household and society at large. In order to realize this potential, a range of strategies will need to be implemented, as described below.

As this is a beneficial impact, the significance of the impact has not been assessed.

11.6.3.2 PROPOSED ENHANCEMENT MEASURES

Measures to meet regulatory and international standards and enhance the impact include:

- Develop and implement a Gender Action Plan (GAP), with ongoing monitoring.
- Since more women than men participate in farming activities, develop and implement climate smart, women friendly agriculture and livestock technologies in the project impact area to enhance rural incomes and Partnerships with CSOs involved in rural development.
- Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment of women who live in the social study area. Communicate the Project's local hiring policy widely, in an effort to discourage opportunistic jobseekers. As part of the CDP, consider inclusive strategies that create equitable opportunities for vulnerable groups (including women) by setting clear goals around hiring. The aim should be to ensure that all individuals have fair access to employment and contracting opportunities.
- Develop and implement a LMP that aligns with international good practice standards, including but not limited to World Bank ESS-2. The LMP should:
    - Establish employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation o. As part of the hiring process, age checks will be conducted.
    - Establish employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
    - Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
    - Establish employment practices that ensure workers are provided an easy-to-understand contract that specifies working hours, overtime hours, breaks, and holidays.
    - Establish safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent

to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.

- Establish a work environment with zero tolerance of SEA/SH.

- The project should prioritize employment opportunities for those who have been physically and economically displaced, including women, based on their interests and skills.
- Partnership with local institutions, such as RENEW and Tarayana, to provide targeted technical and vocational training to help upskill women, enabling them to participate in the employment opportunities created by the Project.
- Partnership with local institutions, such as RENEW, Tarayana and Police, to provide local awareness raising campaigns targeting women's rights.
- Support economic empowerment by looking at opportunities to support microloans, such as those provided by Tarayana Foundation, and grants to women affected by physical and economic displacement with interest in establishing enterprises, particularly in Project-related areas such as catering, transportation, and material supply.
- Offer leadership development programs to women, focusing on capacity-building in areas such as financial literacy, negotiation, and management skills, which are essential for assuming leadership roles.
- Adhere to a policy of equal treatment, non-discrimination and equal pay for equal work. Additionally, include requirements around rights of women workers in the code of conduct, policies and protocols for contractors. Training should be provided on all policies and procedures once developed.
- The need for providing additional measures to ensure safety of women should not act as a deterrent towards employment of female workers and employees in the construction phase. The Project should give equal opportunities to everyone including women.

11.6.3.3 RESIDUAL SIGNIFICANCE

The Project has the opportunity to contribute to women's increased role in leadership and decision-making by implementing gender-responsive policies that promote equal representation in key Project activities and decision-making bodies. By fostering an environment that actively encourages women's participation in governance structures, the Project can help break down traditional gender barriers and empower women to take on leadership positions within their communities, leading to longer-term social change beyond the Project's duration.

The proposed measures would enhance the magnitude of the impact, which means that the significance is likely to increase. However, given this is a **beneficial** impact, it has not been further assessed.

11.7 VULNERABILITY RISK ASSESSMENT

11.7.1 SEXUAL EXPLOITATION AND ABUSE AND SEXUAL HARASSMENT

Sexual Exploitation and Abuse (SEA) involves taking advantage of a person's vulnerability or position of dependence for sexual purposes, including using differential power or trust to coerce sexual acts or gain benefits. Sexual Harassment (SH) refers to any unwanted, unwelcome behavior of a sexual nature - whether verbal, non-verbal, or physical - that creates a hostile, intimidating, or offensive environment. Both SEA and SH are abuses of power that undermine

the dignity and safety of individuals, often addressed through policies aiming to prevent and respond to these forms of misconduct.

The Project has the potential to transform local economies, improve access, and support development in the Sarpong District. However, it also poses risks, particularly for vulnerable populations who may face an increased likelihood of SEA/SH.

Vulnerable groups, including women-headed households, women, children, persons with disabilities, the elderly, and households with unemployed youth, are particularly susceptible to the risks associated with the Project. Limited resources, social isolation, and a lack of access to protective services heighten the risk of SEA/SH incidents, especially with the influx of workers during construction and new residents during the Project's operation.

The pre-existing issues of Gender Based Violence (GBV), compounded by high rates of alcohol consumption, further increase these risks. These pre-existing issues are present within the social study area, as reflected in the baseline.

11.7.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

As outlined in ***Section 11.6.2*** alcohol abuse is a primary factor contributing to GBV in the project area. The anticipated influx of new workers, who are not familiar with the community's dynamics and identity in the social study area, can exacerbate existing challenges such as Gender-Based Violence (GBV), trafficking, child marriage, domestic violence (DV), and harassment, including workplace harassment. Additionally, this influx could heighten social tensions, potentially creating an unsafe environment for vulnerable groups if adequate protections and awareness programs are not implemented.

Child marriage and trafficking in persons remain impacting vulnerable people in Bhutan, especially young girls and women. Although child marriage is illegal, during consultation it was raised as a current concern in the social study area. Early marriage often curtails educational opportunities for young girls, exposing them to heightened health risks and perpetuating cycles of poverty. Concurrently, trafficking in persons, while less visible, poses a growing threat, with Bhutanese citizens sometimes becoming targets for trafficking networks. This issue can be exacerbated by the fact that the Project will improve connectivity between locations as well, the proximity with international borders and by limited cross-border monitoring.

Project activities increase risks for Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH) especially women, children and LGBT+ Some key risk factors include high labor influx, close proximity of construction activities to communities, limited awareness and understanding on SEA/SH reporting, limited capacity of implementing agency to monitor and respond to SEA/SH and limited availability of services in the project affected areas.

Furthermore, in Bhutan, limited job opportunities and rural-to-urban migration have led some individuals, particularly young women, to engage in sex work, often under coercive or exploitative conditions. The interconnection between prostitution and trafficking in person is further complicated by the Project's improved connectivity and the proximity of international borders, where traffickers can more easily move victims across boundaries.

Financial, digital, and general literacy gaps between women and men in the social study area also create barriers to accessing support systems and services. Interactions with new workers, accommodation camps, and population influx creates additional risks of intensified trafficking in persons, especially in areas close to schools and residential properties and neighborhoods.

The unique demographic profile of Sarpang District, characterized by its significant Hindu and Buddhist influences. Health and educational facilities, though well-developed, may be strained by the influx. For these reasons, rigorous monitoring and protective measures are essential to mitigate SEA/SH risks and ensure the safety and well-being of vulnerable groups.

Organizations like the *National Commission for Women and Children (NCWC)* and RENEW provide support frameworks for victims. The Royal Bhutan Police handles SEA/SH cases, though reporting can be challenging due to cultural perceptions and fear of retaliation, which Bhutan is actively addressing through awareness and support programs (The Bhutanese, 2023).

In the social study area, through consultations, it is understood that the local health care providers, local police, and organizations, such as RENEW, work closely together to provide a linked-up system to provide a more holistic approach to supporting victims. This means that there are a range of avenues through which victims can seek support.

The need for the Project to implement robust preventive measures, in line with the World Bank's SEA/SH Policy, is critical. These measures include strict contractor obligations, Codes of Conduct, awareness programs, and safe, confidential reporting mechanisms tailored to the district's socio-cultural landscape, as further outlined in the following sub-section. Addressing these vulnerabilities proactively, and ensuring continuous compliance with SEA/SH protocols, is vital to protect the rights and dignity of diverse communities, allowing the Project to contribute to sustainable, inclusive development without exacerbating social risks.

Based on the above analysis, the project's potential impacts resulting from sexual exploitation and abuse and sexual harassment are estimated to be indirect, adverse, substantial in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***Substantial***.

11.7.1.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment, including women who live in the social study area. As part of the CDP, consideration will be given to including inclusive strategies that create equitable opportunities for vulnerable groups (including women) by setting clear goals for hiring. By providing targeted training and support, organizations can ensure that all individuals have fair access to employment and contracting opportunities.
- Incentive to women's groups that focus on providing literacy programs, including financial and digital literacy training, to empower community members with the knowledge to manage finances and engage in local business activities. The development of a women-managed market space could create a safe and supportive environment for female entrepreneurs, while low-interest credit schemes could provide critical financial resources for women-led enterprises. These initiatives not only offer sustainable livelihoods but also help strengthen the local economy, creating a more resilient and inclusive community in Sarpang District.
- Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline requirements regarding safeguarding the health and wellbeing of all workers (including vulnerable populations, such as women), such as the following:

- Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity.
- A policy against poaching workers employed by the Project, promoting job stability and discouraging conflicts of interest.
- Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment.
- Adherence to safety protocols and proper use of PPE to minimize risks and promote health and safety.
- Proper use and maintenance of Project equipment and resources to prevent damage, wastage, and ensure efficiency.
- Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers.
- Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly.
- Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions.
- Zero tolerance of SEA/SH.

- Actively monitoring of the code of conduct and ensuring consequences are clearly articulated to workers in the event that the code of conduct is breached.
- Provision of training on the code of conduct, and this training should be reinforced through internal communication channels established by the Project.
- Develop and implement a LMP that aligns with international good practice standards, including but not limited to World Bank ESS-2. The LMP should:
  - Establish employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation. As part of the hiring process, age checks will be conducted.
  - Establish employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification.
  - Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
  - Establish employment practices that ensure workers are provided an easy-to-understand contract that specifies working hours, overtime hours, breaks, and holidays.
  - Establish safeguards if recruitment agents are utilized. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent

to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld.

- Establish a work environment with zero tolerance of SEA/SH.

- Partner with local organizations, like RENEW, Tarayana Foundation and other CSOs engaged in community development initiatives in the social study area, to support efforts in addressing social challenges such as GBV , domestic violence, teenage pregnancy, and alcoholism through awareness campaigns and community support programs.
- Partner with local organizations like RENEW, Tarayana Foundation, Police and other CSOs to support raising community awareness through workshops and informational sessions to help educate residents on identifying, reporting, and preventing GBV and SEA.
- Provide safe, anonymous reporting avenues for people to raise concerns and grievances. The team responsible for managing grievances, reports of gender-based violence, and other related incidents should have appropriate training to manage such issues.
- Apply gender-specific design principles, such as those in Crime Prevention Through Environmental Design (CPTED), to enhance safety within Project facilities by creating an environment that promotes a sense of security through clear visibility, natural surveillance, adequate lighting and controlled access points, while also ensuring appropriate facilities like restrooms, breastfeeding rooms, and secure accommodation measures such as women-only floors, well-lit areas, and security escorts when needed.
- The need for providing additional measures to ensure safety of women should not act as a deterrent towards employment of female workers and employees in the construction phase. The Project should give equal opportunities to everyone including women.

11.7.1.3 RESIDUAL SIGNIFICANCE

The management measures will help to reduce the magnitude of the impact by providing a safer environment for all. However, residual impacts may include continued instances of GBV due to deeply ingrained societal norms, trafficking in person due to improved connectivity, potential underreporting of incidents, and challenges in fully ensuring accountability.

On the other hand, the Project's enhanced road connectivity presents substantial opportunity to empower women, and other vulnerable groups, and enhance their economic participation. Improved accessibility can enable women to organize and form support networks and cooperatives, creating pathways for skills development and economic independence. It will be important to put in place measures to realize these opportunities, as described in the below sub-section.

The proposed mitigation measures would reduce the magnitude of the impact from high to moderate, so the project's potential impacts resulting from sexual exploitation and abuse and sexual harassment are estimated to be indirect, adverse, medium in magnitude, local in context, and short-term in duration, with an overall residual significance of ***Moderate***.

11.8 CULTURAL HERITAGE ASSESSMENT

11.8.1 CULTURAL HERITAGE RESOURCES

Cultural heritage is an integral part of Bhutan's identity. The Cultural Heritage Impact Assessment (CHIA) identified 26 cultural heritage resources in total, including at least six (06) Hindu temples, and fifteen community forests, located within or adjacent to the study social

impact area. Each of the sites were classified as non-designated, meaning they lack formal legal protection under Bhutanese or international law.

The CHIA was based on the Heritage Impact Assessments guidelines for Cultural World Heritage Sites (ICOMOS) and World Bank ESS8, along with Bhutan's Environmental Assessment Act of 2000, which mandates environmental impact assessments identify impacts and mitigation strategies.

The 26 cultural heritage resources were identified through a series of investigations, including desk-based research - using academic studies, remote sensing, satellite imagery, and historical maps - and a field survey, where a visual walkover helped confirm and uncover cultural heritage sites, including intangible heritage values.

The temples, from a cultural heritage lens, were classified as medium to low sensitivity due to their local, rather than national or international, cultural significance and their lack of formal protection. While, the fifteen community forests identified in the Impact Area are classified as medium sensitivity, given their importance to local stakeholders. As outlined in ***Section 11.2.1,*** there is approximately 28.76 ha of community forest within the ROW that will be subject to land acquisition and economic displacement. These impacts will be mitigated through the following measures: providing compensation at full replacement cost, ensuring temporary facilities avoid NTFP land areas, and providing both short and long-term livelihood restoration measures, such as food supplies and vocational training (refer to ***Section 11.2.1.2***).

11.8.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

The assessment of potential impacts to cultural heritage considers both tangible and intangible resources to fully capture the project's implications on heritage.

Tangible cultural heritage includes physical artifacts, sites, and structures - such as archaeological sites, historic buildings, places of worship, and potential settlements - passed down through generations. Limited archaeological work in the area suggests the potential for undiscovered cultural heritage within the social study area.

Intangible cultural heritage includes locations with cultural, artistic, or religious significance, traditional knowledge and practices, and living heritage resources, such as shrines and ritual sites. These intangible heritage features, often tied to both tangible and intangible value, could be impacted by restricted access. Around 10 festivities have been identified in the Impact Area of which all belong to Buddhist tradition, and two (02) belong to the Hindu tradition and Dashain.

Potential impacts reflect the range of ways in which cultural heritage might be affected by project activities. Direct impacts are often physical and arise from earthworks and construction, potentially altering or damaging the sites, while indirect impacts include the visual, noise, and dust disturbances that may alter the cultural landscape around heritage sites.

Construction

During the construction phase, potential direct impacts include ground disturbance from earthworks, which could directly affect cultural heritage resources, specifically those located near the construction corridor. Such disturbances may lead to the partial or complete removal of culturally significant resources, including sacred sites, archaeological remains, or other historically valuable features.

This includes two (02) community forests – Gaden Phunsumthang / Gaden Community Forest in Tareythang and Thrungthu Community Forest in Tareythang – which will be directly affected by the Project's construction as a small part of the cultural heritage site will be lost or damaged, resulting in a loss of scientific or cultural value, as follow:

- Gaden Phunsumthang / Gaden Community Forest: The resource is situated partially within the construction corridor. Any sacred tree or intangible cultural heritage will be partially removed by earthworks, resulting in a direct impact.
- Thrungthu Community Forest: The resource is situated partially within the construction corridor. Any sacred tree or intangible cultural heritage will be partially removed by earthworks, resulting in a direct impact. Indirect impacts are anticipated due to environmental changes around cultural heritage sites. These include visual intrusion, where new structures such as bridges and embankments may alter the aesthetic and historical context of the sites. Noise generated by construction activities could introduce disruptive auditory elements, impacting the setting of cultural heritage resources. Dust from construction may further affect the environment, potentially compromising the visual and physical integrity of these cultural sites. Additionally, temporary or permanent restrictions on access could limit traditional community interactions with specific cultural sites, particularly throughout the construction phase.

Based on the current Project design, and consultations with local communities, it is not anticipated that any of the 17 religious structures will need to be relocated. However, they may be indirectly impacted by dust and noise during the construction. Of particular note are three (03) structures of Kuenga Chholing temple has the potential to temporarily restrict access and introduce intrusive dust and noise elements through construction- associated works, changing the physical environment or setting of the cultural heritage resource.

Additional, routine cultural practices may be temporarily affected during construction works, most of which are recorded to be religious festivities.

Based on the above analysis, the Project's potential impacts resulting from the CHIA of medium-sensitivity resources during construction are estimated to be direct, adverse, medium in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***Substantial***.

The project's potential impacts resulting from the CHIA of low-sensitivity resources during construction are estimated to be indirect, adverse, low in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of ***Low***.

Operation

The CHIA concluded that no direct impacts to medium or low sensitivity cultural heritage resources are expected at the operation phase of the Project, and limited indirect impacts have been identified within the Project's impact area, which might include:

- The potential for permanently restricting access for traditional users or researchers to existing cultural heritage resources.
- The potential introduction of mobile, intermittent intrusive visual elements into the physical environment or setting of cultural heritage resources.
- The potential introduction of intermittent intrusive auditory elements into the physical environment or setting of cultural heritage resources.

Based on the above analysis, the project's potential impacts resulting from the CHIA of low-sensitivity resources during operation are estimated to be indirect, adverse, low in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***Moderate***.

11.8.1.2 PROPOSED MITIGATION MEASURES

Management measures to meet regulatory and international standards include:

- Develop and implement a Cultural Heritage Management Plan (CHMP) to manage and protect tangible and intangible cultural heritage resources throughout the project's lifecycle. The CHMP should address measures for access management, ongoing monitoring, stakeholder engagement, and procedural guidance for unexpected discoveries.
    - The CHMP should include a long-term monitoring plan to assess residual impacts on cultural sites, ensuring ongoing compliance with mitigation measures and adapting practices if new issues arise.
- Establish a Memorandum of Understanding (MoU) with local communities to ensure access to cultural sites is preserved. This arrangement will be agreed upon with stakeholders before construction begins to prevent conflicts or disruptions in community practices.
- Undertake a detailed, site-specific survey of cultural heritage resources before construction starts to verify the findings of the CHIA. This should form part of the census and asset inventory being undertaken for the RAP.
- Establish a Chance Finds Procedure. This procedure is designed to handle unexpected discoveries of archaeological or cultural materials during construction. It includes halting construction upon discovery and notifying cultural authorities to properly document and protect the findings according to international standards like the World Bank's Environmental and Social Standards (ESS8).
- Implement temporary barriers and dust control measures (like water spraying) to be used to minimize dust and protect sensitive sites from construction activities.
- Ongoing consultations with the diverse local communities will help inform the CHMP and ensure that traditional values and uses of cultural heritage resources are respected.
- Implement and maintain a community grievance mechanism, so that stakeholders can raise issues and concerns arising from the project's impact on cultural heritage.
- Visual and noise monitoring will help detect any unforeseen impacts during construction and operation of the Project, allowing for prompt adjustments to minimize adverse effects. An appropriate baseline will need to be established prior to commencing construction, and monitoring should continue post-construction and into operation to determine if an impact has occurred. If noise or visual impacts are identified, mitigation measures will need to be established.

11.8.1.3 RESIDUAL SIGNIFICANCE

By implementing proactive management plans, pre-emptive impact assessments, and responsive mitigation measures, the project can reduce its potential harm to cultural heritage resources, thus preserving the cultural landscape and ensuring compliance with both national and international cultural preservation standards.

However, the CHIA concluded that the direct impacts presented in ***Section 11.8.1.1*** may not change with the imposition of the mitigation measures presented in this impact assessment. The only mitigation measure that would be effective in reducing the significance of direct physical impact would be avoidance via rerouting. If this were to be applied, the resulting post-mitigation significance would be negligible to no impact.

Therefore, the proposed mitigation measures would maintain the magnitude of the impact as substantial, so the project's potential impacts resulting from CHIA of medium-sensitivity resources during construction are estimated to be direct, adverse, medium in magnitude, local in extent, and long-term in duration, with an overall pre-mitigation significance of ***Substantial***.

At the same time, the proposed mitigation measures would reduce the magnitude of the indirect impacts, so the project's potential impacts resulting from cultural heritage assessment of low-sensitivity resources during construction would be considered ***Negligible***.

For the operation phase of the project, the proposed mitigation measures would reduce the magnitude of the impact from moderate to low, so the project's potential impacts resulting from the CHIA of low-sensitivity resources during operation are estimated to be indirect, adverse, low in magnitude, local in context, and medium-term in duration, with an overall residual significance of ***Low***.

11.9 SOCIO-CULTURAL DYNAMICS AND ESS-7

The social study area have different socio-cultural linguistic groups. The qualitative assessment of communities in the Project affected area based on four criteria detailed in World Bank's ESS7 indicating that there is no presence of Indigenous Peoples. These have been given in the table below.

Criteria	Remarks
Self-identification as member of a distinct indigenous social and cultural group and recognition of this identity by others	The majority population in the Impact Area are Buddhists and Hindus, belonging to the Ngalong and Sharchop, and Lhotsham groups respectively. No one identified as a member of distinct social or cultural groups.
Collective attachment to geographically distinct habitats, ancestral territories, or areas of season use or occupation, as well as the natural resources in these areas	No collective attachment (to areas such as geographical locations, habitats, seasonal uses, or occupations) was found to be present within the groups in the social study area.
Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture	None of the groups present in the social study rea were identified as having a distinct cultural, socio-political or economic institution separate from the mainstream culture.
A distinct language or dialect, often different from the official language or languages of the country or region in which they reside	No distinct language or dialect was reported to be spoken in the social study Area. A considerable number of community members are also well versed in Hindi and other languages.

11.9.1.1 PRE-MITIGATION IMPACT ASSESSMENT AND SIGNIFICANCE

Recognizing the presence of diversity in the Project affected area, it will be important to ensure inclusive stakeholder engagements and meaningful consultations. These are particularly essential for certain groups that for various reasons may be missed in the participatory stakeholder engagement processes. The reasons include low literacy levels, limited access to information due to language barriers among others. Based on the assessment of socio-cultural dynamics, in the project.

11.9.1.2 PROPOSED MITIGATION MEASURES

Proposed mitigation measures include the following:

- Inclusive stakeholder engagement and meaningful consultations with all beneficiaries in a medium that is easily accessible to all.
- Strengthening the above Cultural Heritage Management Plan to ensure that all tangible and intangible cultural heritages include the practices of the diverse groups residing in social study area .
- Ensuring that all plans containing activities to address additional vulnerabilities brought on by the project activities are inclusive.

11.9.1.3 RESIDUAL SIGNIFICANCE

Following implementation of mitigation measures, the residual risk associated with exclusion of any one of the multiple socio-cultural groups is assessed to be ***Low.***

12. CUMULATIVE IMPACT ASSESSMENT

12.1 INTRODUCTION

A Cumulative Impact Assessment (CIA) was conducted for the Gelephu-Tareythang Road Project in conjunction with the Environmental and Social Impact Assessment (ESIA).

Cumulative impacts are generally considered as those which are additive or interactive in nature that arise as a result of an impact from the Project interacting with an impact from another activity to create an intensified impact. This CIA will include the cumulative impact on Valued Environmental and Social Components (VECs) in past, ongoing and proposed development activities within the region, including the planned infrastructure within the Gelephu Mindfulness City (GMC).

This assessment is a rapid CIA, as it has been carried out over a short time and with limited information. An updated CIA will be carried out during the project implementation. As an outcome of this assessment, a detailed Term of Reference will be developed for the updated CIA.

12.1.1 SCOPE AND OBJECTIVES

This CIA has been conducted in accordance with the WB ESF and International Finance Corporation's (IFC; part of the World Bank Group) *Good Practice Handbook on Cumulative Impact Assessment and Management* (IFC, 2013).

The Good Practice Handbook provides a methodology for identifying the most significant cumulative impacts, focusing on valued environmental and social components (VECs), which are: (i) rated as highly valued by potential project-affected communities and/or the scientific community; and (ii) cumulatively impacted by the project under evaluation, and by other projects and/or by natural environmental and social external stressors.

The objectives of the CIA are:

- Use the outcomes of the ESIA Report to determine spatial and temporal boundaries, identify VEC's and all development and external natural and social stressors affecting them
- Recognize and identify how the Project, along with other existing and future projects may contribute to cumulative impacts on the predicted future condition of the identified VEC's; and
- Develop measures to ensure these are avoided and/or minimized to the greatest extent possible.

12.1.2 LIMITATIONS

The CIA report was drafted in view of the following limitations and caveats:

- Incomplete information about other projects and activities (e.g., the information is not available in the public domain);
- Incomplete baseline information of the selected VECs; and
- Uncertainty with respect to the implementation of future projects.

12.1.3 RELEVANT GUIDELINES AND CRITERIA

To achieve these objectives and gain an understanding of the complexities of cumulative impacts, this Chapter presents a Cumulative Impact Assessment (CIA), which has been undertaken largely in accordance with international best practice guidance documents, such as:

- European Union "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999); and
- IFC "Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets" (2013);
- IFC "Performance Standards on Environmental and Social Sustainability" (2012); and
- World Bank "World Bank Environmental and Social Framework." World Bank, Washington, DC (2016).

12.1.4 SOURCES OF INFORMATION

The following sources of information have been referenced for the repot:

- Gelephu Mindfulness City Economic Framework . Interim Final Report (CISTRI, 2 September 2024)
- Gelephu Mindfulness City, Infrastructure Strategies Report Draft 3 (ARUP, September 2024)
- Construction of Municipal Boundary Wall (Dzongkhag Administration, Sarpang, Date not available)
- Royal Government of Bhutan Department of Law and Order, Ministry of Home Affairs Letter (MOHA, 12 June 2024)
- Gelephu Mindfulness City, GLU Pre-Concept 100% Draft Submission (NACO, 13 August 2024)

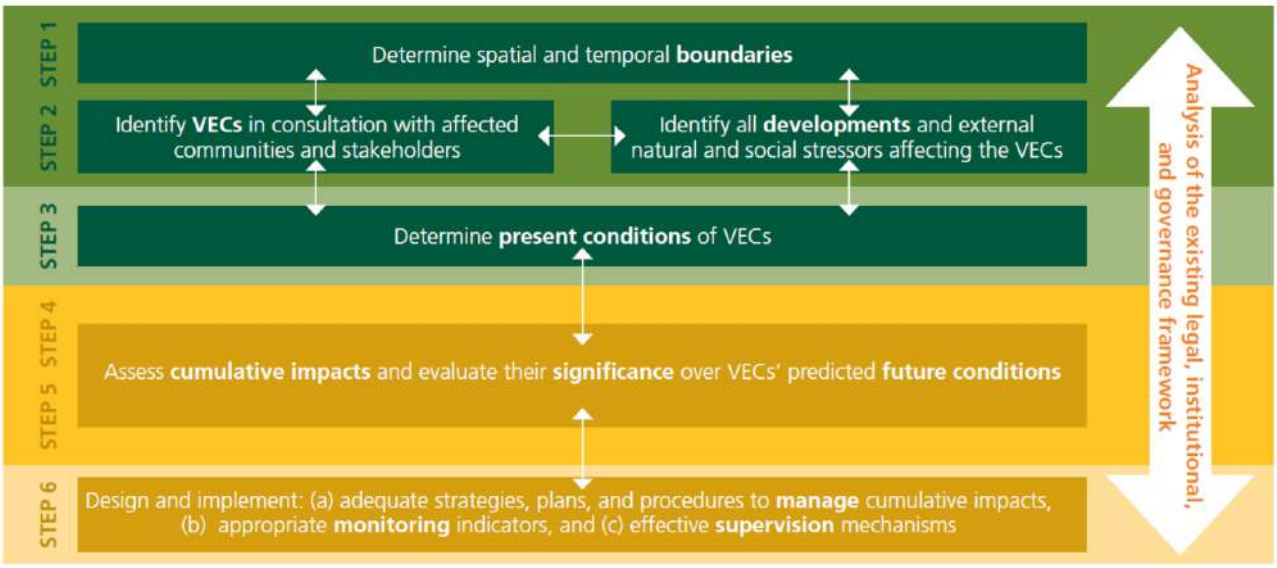
12.2 APPROACH AND METHODOLOGY

The methodology is based on a six-step process outlined in ***Figure 12.1*** and used in conjunction with the World Bank Group environmental, health, and safety guidelines, which contain basic requirements and good international practices.

As this CIA forms part of the overall ESIA, the general conditions and VECs are already known, as are the impacts from the Project (as part of the impact assessment) and the proposed mitigation, management and monitoring measures. Given this, VECs and impacts have been quickly established, with an emphasis placed on the steps pertaining to CIA and management.

In developing the methodology for this CIA, emphasis has been placed upon following a largely qualitative approach, allowing for identification of general trends and then developing appropriate management, mitigation and monitoring measures. This is primarily due to lack of clear data or information on surrounding projects. Given this approach, the majority of the methodology relies upon the use of professional judgements, complemented by ERM's understanding of the Project and impacts and experience with similar projects in similar settings.

Figure 12.1 The Six Steps for the Cumulative Impact Assessment[116]



12.2.1 OVERALL METHODOLOGY

12.2.1.1 DETERMINING SPATIAL AND TEMPORAL BOUNDARIES

The methodology used in the setting of spatial and temporal boundaries is largely qualitative. The following factors have been established within the methodology:

- Temporal boundaries have been set based on a desktop review of available information pertaining to other proposed projects within the area;
- ERM's understanding of the projects currently within and proposed to be developed within the local area; and
- Geographic boundaries are a composite of the distance to the identified VECs, assessed impacts of the Project and the degree to which they may overlap with other external projects and stressors to impact upon an identified VEC.

12.2.1.2 IDENTIFICATION OF VECS AND IDENTIFICATION OF DEVELOPMENTS AND NATURAL AND SOCIAL STRESSORS THAT MAY AFFECT THE VECS

This CIA is based on review of existing documents including the ESIA. VECs are defined as sensitive receptors within the ESIA.

External developments, also known as reasonably foreseeable future actions, are identified utilizing knowledge gained through the ESIA process (including field observations), stakeholder engagement and the interpretation of readily available external data. It is then necessary to determine the extent of the various impacts of these projects in order to establish whether there is the potential for an overlap in Project impacts that could lead to measurable cumulative impacts. Key to this are the following elements:

- Identification of appropriate geographical/spatial boundaries;
- Identification of temporal boundaries;
- Consideration of impact type;

[116] Source: General RCIA Methodology, IFC Handbook, 2013

- Determination of any "aggravating factors" that may be evident within a particular project identified for inclusion within the CIA;
- Identification of potential externalities, that is a project ability to influence (either positively or negatively) the behaviors of other operations in the area.

12.2.1.3 DETERMINE THE VEC BASELINE

The baseline is determined through the collection of primary and secondary information on the VECs which defines the baseline for the final VECs, their spatial and temporal extent, existing conditions, sensitivity to change, resilience/recovery time, existing stressors and trend in condition. As this CIA forms part of the overall ESIA with the assessment informed by public consultations and baseline studies conducted as part this, the general conditions and VECs are already known.

12.2.1.4 ASSESS CUMULATIVE IMPACTS TO VECS

Cumulative impacts on the VECs arise from interactions between the Gelephu-Tareythang Project, other projects, and other stressors. Focus is given to projects and stressors that have a temporal and spatial overlap with one another.

A largely qualitative approach was taken for the CIA. This is to enable a focus upon identification of trends across the various projects in the area, their temporal and spatial interactions and how these are likely to impact upon VECs. Whilst impacts arising from the Project have been defined and assessed in isolation, it can be difficult to accurately quantify cumulative impacts as there can be a high degree of uncertainty in interactions with other projects and activities that may be occurring in the area, as well as a lack of confirmed project information. Therefore, the impacts are to be assessed qualitatively based on the identified trends and grouped according to impact type, rather than VEC.

12.2.1.5 EVALUATE SIGNIFICANCE OF THE CUMULATIVE IMPACTS TO VECS PREDICTED FUTURE CONDITIONS

The significance of predicted cumulative impacts to the viability/sustainability of the affected VECs is evaluated. The CIA is also based on the assumption that all assessed residual impact levels within the ESIA are achievable.

12.2.1.6 DESIGN AND IMPLEMENTATION OF MANAGEMENT AND MITIGATION MEASURES

Based upon identification of broad impact trends, broad scale mitigation measures will need to be developed. This includes not only management of impacts where the Project has control but also consultation and liaison with government officials and third parties where impacts are outside of the Project's direct control.

12.3 SCOPE FOR THE CUMULATIVE IMPACT ASSESSMENT

12.3.1 TEMPORAL AND SPATIAL BOUNDARIES

12.3.1.1 TEMPORAL SCOPE

The Project preparation, including the Feasibility Study and Detailed Engineering Design (DED), is scheduled to commence in September 2024 and be completed in Q4 2025. The civil work is planned to commence in Q1 2026. The construction is projected to take approximately 3.5 years and be complete by Q4 2029. Long-term performance-based maintenance is scheduled to take

place over the life of the asset. Temporal delineation for a CIA is a challenge due to the inherent uncertainty about potential future projects and activities. The following are the basic rules of thumb to determine temporal boundaries for the assessment according to the IFC CIA Guidelines.

1. Use the time frame expected for the complete life cycle of the proposed development (including construction, operation, and decommissioning).
2. Specify whether the expected time frame of the potential effects of proposed development can extend beyond (a).
3. Use the most conservative time frame between (a) and (b).

Using professional judgment to balance between overestimating and underestimating, and make sure to document the justification or rationale.

4. Exclude future actions if (i) they are outside the geographical boundary, (ii) they do not affect VECs, or (iii) their inclusion cannot be supported by technical or scientific evidence.

The timelines for existing and planned developments are given in ***Section 12.3.2.2*** and are based on publicly accessible information. While the temporal extent of impacts from these projects is longer due to their life expectancy, it is difficult to predict impacts with any certainty that far into the future, as such, the temporal scope of the CIA was established as a maximum 30-year time frame.

12.3.1.2 SPATIAL SCOPE

According to IFC Good Practice Handbook on Cumulative Impact Assessment (2013), determining the spatial boundary of the CIA includes:

- the area to be directly affected by the Project or activities which is known as the direct impact area;
- identifying the VECs within the DIA and whether they occupy a wider area beyond the DAI;
- considering the distance an effect can travel, and other impacts the VEC may be exposed to within its range.

The spatial scope of the CIA covers the extent of the scope identified in the ESIA and the extent of other planned development considered in the CIA. The spatial scope of the CIA is therefore the direct impact area as defined in the ESIA, with a maximum extent of 2km radius from the project boundary, and the indirect impact area which includes the areas within the four Gewogs (Gelephu, Umling, Chhuzanggang, and Tareythang) which total approximately 31.41 km^2, plus the extent of the GMC.

It is noted the Project lies close to the India border and therefore there may be transboundary effects. Where information is available, this has been included as part of the assessment.

12.3.2 IDENTIFICATION OF VECS

12.3.2.1 STAKEHOLDER ENGAGEMENT

ERM developed a Stakeholder Engagement Plan (SEP) early in the Project's planning phase to ensure effective stakeholder involvement throughout its execution. Stakeholder engagement included information on key standards and legislation guiding stakeholder involvement, stakeholder identification, analysis and mapping, strategies for communication with each stakeholder group, and community grievance mechanisms.

ERM conducted multiple rounds of consultations on various issues, including scoping meetings to identify environmental and social concerns and gather information to inform the identification of risks and impacts associated with the Project.

Consultation was undertaken from 30 August to 03 September 2024, with key stakeholder groups and decision-makers to understand the overall Project planning, including the execution plan. This provided an opportunity to assess the socio-economic baseline conditions of the Thromdes/Gewogs through which the proposed Project would traverse.

Stakeholder consultations focused on issues and concerns of affected persons, other and interested parties, vulnerable and marginalized groups. Key information interviews (KIIs) were undertaken with representatives from various stakeholder groups, including, but was not limited to, representatives from NGOs operating in the Impact Area, leaders of the Gewog and Chiwogs, the Land Commission, local health care service providers, local police, local schools, and businesses. Focused Group Discussion (FGD) were undertaken with various groups, including adult men (above 18 years of age), adolescent girls (15 to 18 years of age) and women above 18 years of age.

The identification of VECs was based on these consultations.

12.3.2.2 OTHER DEVELOPMENTS AND EXTERNAL STRESSORS

Existing and Planned Development

The following developments are planned to begin construction in the future, or the development already exists within the immediate proximity to the Project Site.

Figure 12.2 presents the planned developments in the region considered in the CIA.

The construction of Mindfulness City Development Area (Gelephu Mindfulness City, GMC).

- Location: Sarpang Dzongkhag, Bhutan
- Description: based on the current plan, the new city development area will have nine (09) centers. The development area that will be considered in this assessment is the center 1 to 5 which is Gelephu city. The Gelephu new city include
  - Center 1 – Mau River East
  - Center 2 – Gelephu town
  - Center 3 – Industrial city
  - Center 4 – Dekiling
  - Center 5 – Sarpang town

- The development area and phasing will be divided into four main phases which have been considered in the planning and phasing of infrastructure assets for GMC. The Phases are divided as follows: Phase 1 - Foundation (2025 – 2035), Phase 2 - Development (2036 – 2045), Phase 3 - Diversification (2046-2065), and Phase 4 - Consolidation (2066-2125). Phase 1 covers an area of 60 sq. km and includes the retrofit and expansion of the existing Gelephu Town, the New Town cluster and the airport expansion (this is Center 2, the western portion of Center 1 between the Mau and Taklai rivers, and a small section of Center 1 around the Tareythang Gaylsung center).

- The total GMC Masterplan area is +- 2,500 sq.km, with total Gross Developable Land Area being +-73 sq. km The size of the GMC, in terms of cumulative developable land, will be built up through the four phases: in Phase 1 there will be 357.5 ha development land; Phase 2 will have 644.9 ha development land; Phase 3 will have 1,905.3 ha development land; and Phase 4 will have 7,316.9 ha development land.

    - Under the adopted population growth scenario, the GMC will grow gradually from about 48,000 residents in 2025 to a build-out population of one million residents by 2125, averaging an annual compounded growth rate of 3.1% over the full 100-year period. The employment growth scenario adopted mirrors the growth pattern of the total population, growing from about 30,000 in 2025 to 657,500 by 2125. The tourism visitation growth scenario is based on a capped development capacity equivalent to four times the target total resident population of 1,000,000, with total tourism visitation of 4 million to be achieved by 2085, growing gradually from an estimated 108,000 visitors in 2025.

    - Priority anchor projects have been identified for Phase 1 of the GMC which include projects under the following topics: Spiritual; Green Energy/Tech Industries; Aviation and Logistics; Agritech and Forestry; Health and Wellness; Education and Knowledge; and Tourism.

    - Two landfill sites are proposed, one in Center 3 and one in Center 4, and do not overlap with the project area. A total of 8-10 waste transfer stations are proposed for the GMC, with two potential stations within the project area to be developed in Phase 2 in Gelephu and Phase 4 closer to Tareythang. A total of 12 water treatment plants are proposed for the GMC, none of which are located in the project area. Three substations for energy supply are proposed in the project area.

    - The key focus of the development is the 'Gelephu City Area' (Centers 1-5), characterized by plains and paddy fields, offering opportunities to integrate city-wide infrastructure (e.g., future international airport, dry port, transport network), enhance active travel and minimize landslide hazards.

    - Timeline: the development timeline is planned for over the next 100 years hence it is estimated that the project will end by the year 2125.

Gelephu International Airport

- Location: Samtenling Gewog, Sarpang District, Bhutan

- Description: The existing airport is currently used for domestic flights and small aircraft, with a runway length of 1.5 kilometers. The new airport plan aims to increase its capacity and accommodate international flights. The development will be carried out in three phases:
    - Short-term: Terminal expansion
    - Long-term: Design target
    - Vision: Reservation area for future expansion

- The airport will have a runway length of 2.5 kilometers to 3 kilometers and a terminal size of 15,500 to 38,000 square meters during the opening and development phases.

For future expansion, the runway length will be extended to 3.5 kilometers, and the terminal size will increase to 61,000 square meters.

- Timeline: Construction is expected to begin in 2025 and conclude in 2030, as per the current plan.

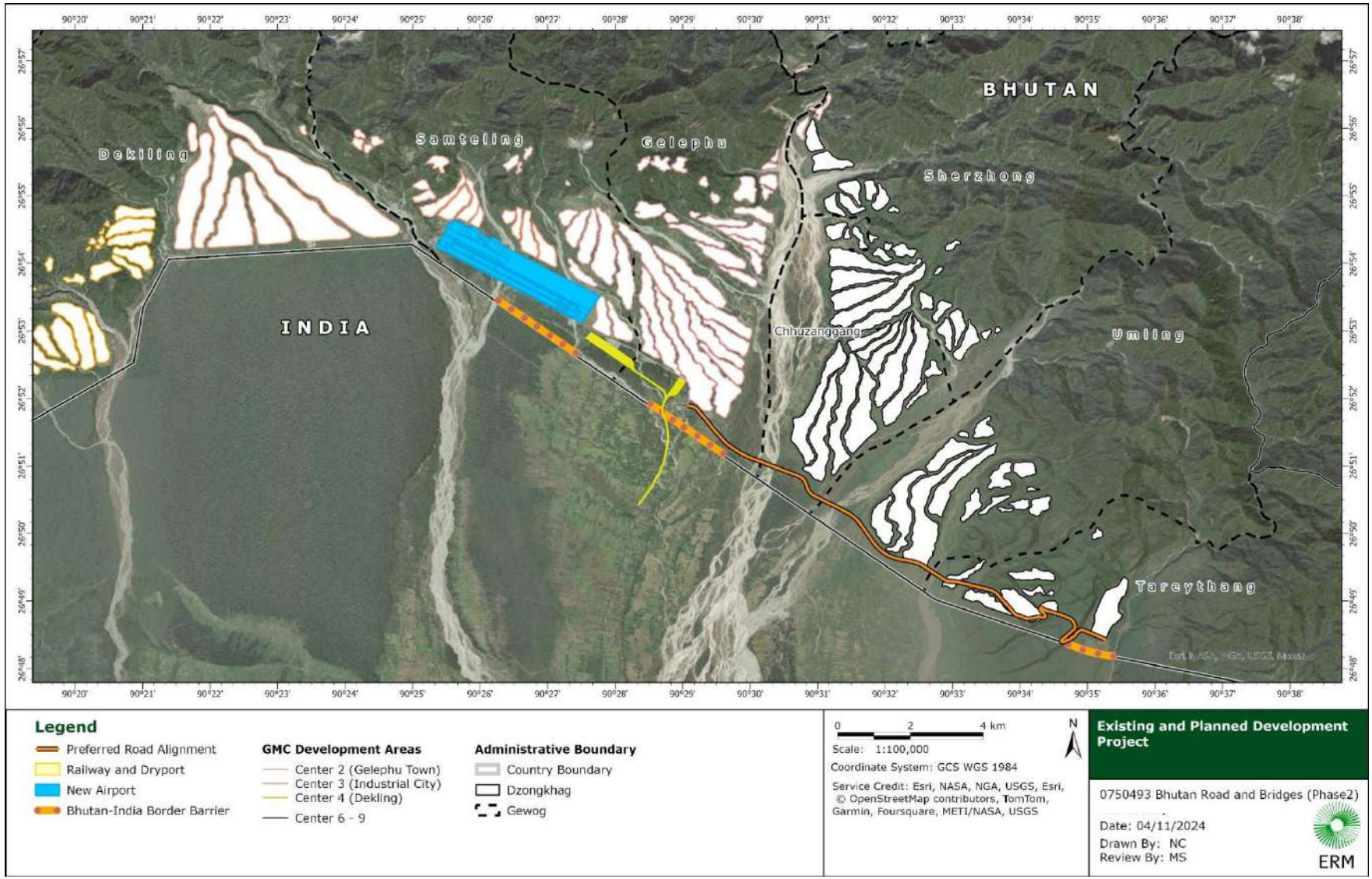
Railway and Dry port

- Location: Gelephu, Bhutan near the India and Bhutan border.
- Description: The railway will be funded by the Indian government, which is expected to be 60 km long, connecting from Kokrajhar in Assam to Gelephu. The railway area will be separated between the dry port and passenger platform. The dry port's total area in Gelephu is now 26.07 acres, situated approximately 1km from Gelephu Thromde along the Sarpang-Gelephu highway. Site development works (including construction of boundary wall, retaining wall, entry-exit gates with security cabin, parking lots, approach and internal road, cable duct and footpath and drainage works) have been completed, with work now progressing on the construction of processing structures.
- Preliminary engineering and traffic surveys for the railway were undertaken in June 2023. Northeast Frontier Railways (NFR) submitted the draft Final Location Survey to the Railway Board in September 2024.
- Timeline: the dryport is under construction and expected to be completed 2027, and the railway is expected to be done in 2026 in the current plan.

Municipal Boundary Wall

- Location: In Sarpang Dzongkhag, near the southern border with India, within Samtenling Gewog, Gelegphu Gewog, and Tareythang Gewog of Bhutan.
- Description: The wall will be 1.10, 2.25, and 2.4 kilometers long in Tareythang Gewog, Gelegphu Gewog, and Samtenling Gewog, respectively. It will be a 500 mm thick reinforced retaining wall (RRM). The total height, including the barbed wire, will be ~3.3 m from ground level (wall height: ~2.3 m, barbed wire: ~1.0 m). The wall will have a buried part 900 mm deep from ground level.
- Timeline: Under construction.

Figure 12.2 Locations of the Other Developments Considered in the CIA



External Drivers

External stressors/drivers are sources or conditions that could affect or cause physical, biological, or social stress on VECs, such as natural environmental and social drivers, human activities, and external stressors. These can include climate change, population influx, natural disasters, or deforestation, among others.

Climate Change

The climate of Bhutan is diverse due to dramatic variations in elevation and varies significantly according to latitude and altitude. The climate of Bhutan and the project area is detailed in Chapter 6 of the ESIA.

Climate Related Risks and Impacts

The climate risk assessment is summarized in Chapter 9 of the ESIA. The impacts of climate change on Bhutan include: increase in the likelihood of heatwaves and droughts; changes to patterns of river discharge and water availability; impact forest composition and forest health and therefore reduced erosion control and natural disaster mitigation as forests prevent landslides and reduce the impact of flash floods; increased risk of forest fires; and impact to agriculture which often takes place on slopes that are vulnerable to landslides and soil erosion. In addition, many of the potential climate changes and impacts projected for Bhutan are likely to disproportionately affect the poorest groups in society.

Climate changes could exacerbate the impacts of the Project and other developments in the area. These potential effects of climate change highlight the importance of considering external drivers in the CIA. They also underscore the need for adaptive management strategies that can help to mitigate the project's impacts in the context of a changing climate.

Risk is a function of hazard, exposure and vulnerability. When the existing socioeconomic vulnerabilities are compounded with the climate hazards and population density, the top five Dzongkhags most at risk from climate impacts are: Samtse, Monggar, Sarpang, Punakha and Dagana.[117]

Natural Disasters

Sarpang district has a high risk of hazards, including earthquakes, landslides, flooding, forest fires, hailstorms and windstorms. Research shows that Sarpang is in the top five districts for natural hazard occurrence in Bhutan[118]. Details on natural disasters , such as seismic hazards, landslides and flooding, are detailed in Chapter 6 of the ESIA. Natural hazards are inherent to the Project setting and could potentially occur during the construction and operation phases, representing a contextual risk to the Project. Natural hazard impacts, such as damage to infrastructure or loss of life, can exacerbate Project impacts, particularly social impacts.

In-Migration

At mid-year 2020, the international migrant stock in Bhutan counted 53,612 people, representing around 6,9% of the entire population and, according to UN data, 8,088 of them

[117] Climate change vulnerability analyses and mapping for national adaptation plan (NAP) formulation process in Bhutan (2022) National Environment Commission.
[118] Multi-hazard zoning for national scale population risk mapping: a pilot study in Bhutan Himalaya (2023) Karma Tempa & Kezang Yuden

were female (2,2% of the international migrant stock)[119]. Most foreigners living in Bhutan come from India, Nepal, the USA, Australia and Thailand, and migrate here for work related reasons or, like a small number of women (10%) do, for marriage purposes.

Given Sarpang District's proximity to India, specifically the state of Assam, a number of cultural similarities have been observed among the population of Sarpang District when compared to its Indian counterpart. This may be attributed to the open access that exists between the two countries, which results in a high degree of trade between the two countries. It was found through consultations in the Impact Area that a large number of workers from India are present in Sarpang District, due to their lower wage rates as compared to their Bhutanese counterparts.

Moreover, the areas closer to the Indian border, most notably the Gelephu Thromde, also have small to medium hotels for tourists that visit from India. It is estimated that Sarpang District had about 263 tourist arrivals in the year 2019. The number of tourists dropped in 2020, which can be attributed to the Covid-19 pandemic[120]. However, these numbers do not reflect the day tourists.

The Project will also result in an increase or influx in population in the local area. This can result from employment, either directly by the Project or indirectly through the businesses that provide goods and services to the Project. The project is a large-scale infrastructure project and will lead to job seekers moving into an area with a view to capitalize on employment opportunities, which can exacerbate the increase in population driven by the Project.

This increase in population in the local area (due to influx) may place additional pressure on existing infrastructure, services, resources and facilities, such as water, health, education, farming, housing. There may also be an increase in the number of individuals with disposable income, the potential for conflict within local communities and changes to the existing social structures and networks.

12.3.2.3 SELECTION OF VECS

Screening

The Valued Environmental, Social and Ecosystem Components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment that are likely to be the most sensitive receptors to the cumulative impacts of other projects and stressors in combination with the proposed project.

A set of VECs were identified through stakeholder engagement. A VEC screening process was conducted to determine which of the VECs would be included in the CIA. To be screened into the CIA, a VEC must be confirmed to be valued by an identifiable stakeholder group and/or the scientific community and must be reasonably expected to be affected by some combination of other projects and/or external stressors. Findings from the VEC screening process are presented in Table 12.1.

[119] United Nations Department of Economic and Social Affairs, Population Division (2020). International Migrant Stock 2020.
[120] Bhutan Tourist Monitor (2020) Planning and Research Services Tourism Council of Bhutan

Table 12.1 VEC Screening and Selection

Potential VEC	Rationale	Impacted by Project	Impacted by other projects and stressors	Screened into the CIA	Justification, comments
Ambient Air Quality	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	No significant residual effects	Yes potential for cumulative impacts	Yes	Cumulative impacts on air quality due to road traffic during construction and operation of Project with other planned development.
Ambient Noise	Not raised in stakeholder consultations. Expert judgement used to derive VEC.	Yes	Yes	Yes	Cumulative impacts on ambient noise for some receptors experiencing impact due to the Project, combined with operation of other planned development.
Water Resources	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	Yes	Yes	Yes	Cumulative impacts on including water quality, geomorphology, and sediment transport.
Terrestrial Habitat Loss	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	No significant residual effects	Yes	No	This VEC has not been screened into the CIA because the overall impact of the project is expected to be low due to the site-specific nature of the loss and due to the amount of agricultural land in the project area. The project will be achieving No Net Loss (NNL) for natural habitat and the impact associated with the loss of habitat in specific locations is addressed in the habitat fragmentation VEC.
Habitat Fragmentation	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	Yes	Yes	Yes	Cumulative impact due to moderate and long-term impact from the project, combined with further fragmentation from other Planned development and stressors.

Potential VEC	Rationale	Impacted by Project	Impacted by other projects and stressors	Screened into the CIA	Justification, comments
Wildlife Movement and Human-Wildlife Conflict	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	Yes	Yes	Yes	Cumulative impact on wildlife movement due to the creation of barriers from the Project and other planned development.
Community Forests and Livelihoods	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	Yes	Yes	Yes	Cumulative impact of the Project on Physical and Economic Displacement due to land acquisition.
Social Infrastructure and Services	Valued by stakeholders according to consultations. Expert judgement used to derive VEC.	Yes	Yes, GMC to improve infrastructure and services	No	This VEC has not been screened into the CIA as the overall outcome of the combined projects in the region will improve infrastructure and services.

Final VECs

Using results of stakeholder consultations, field surveys, data analysis, and literature review, the following VECs were selected for the CIA study: ambient air quality, ambient noise, water resources, habitat fragmentation, wildlife movement and human-wildlife conflict, and community forests and livelihoods.

The impacts and CIA assessment approach for each of selected VECs are summarized in ***Table 12.2***.

Table 12.2 VECs and Assessment Approach

VEC	Key Impacts to Consider	Assessment Metrics
Physical Components		
Air Quality	Impact from dust and emissions during construction phase and VOCs in operation phase from the Project and other developments. Multiple projects in the area are expected to generate similar types of air pollutants.	Qualitative assessment of the level of impact to air quality.
Ambient Noise	Impact from Gelephu-Tareythang Road Project and other developments on ambient noise levels during construction and operational phases. This could affect nearby communities and wildlife.	Qualitative assessment of the level of impact to ambient noise.

VEC	Key Impacts to Consider	Assessment Metrics
Water Resources	Impact from Gelephu-Tareythang Road Project, other developments and external drivers on water quality and availability for both drinking and agriculture.	Qualitative assessment of the level of impact to water quality and availability.
Biological Components		
Habitat Fragmentation	Direct habitat loss within the project footprint. Fragmentation of the wider habitat mosaic, edge effects and loss of habitat connectivity. These may result in altered microclimates, altered predator-prey interactions and habitat selection.	Habitat loss and qualitative assessment of the level of impact from fragmentation on ecosystem integrity.
Wildlife Movement and Human-Wildlife Conflict	Barrier effects (fragmentation) and changes in flows that may lead to degradation of ecosystem integrity. The cumulative loss and disturbance of terrestrial habitats from the Project and other developments could have significant impacts on local biodiversity resources. Habitat loss and fragmentation may alterations to Asian Elephant traditional routes, thereby resulting in increased human-wildlife conflict incidences around the area.	Qualitative assessment of the level of impact to wildlife movement and the likely impact on human-wildlife conflict.
Social Components		
Community Forests and Livelihoods	Impact from Gelephu-Tareythang Road Project, other developments and climate change on physical displacement and economic displacement. The cumulative impacts on socio-economic conditions from the Project and other developments can range from changes in land use, increased traffic, and positive and negative impacts on local businesses and employment.	Qualitative assessment of the level of impact resulting from changes in livelihoods and displacement.

12.4 BASELINE STATUS OF THE VECS

The CIA has been completed in conjunction with the main ESIA, therefore the baseline status of the VECs is provided in Chapters 6 Physical Environment, 7 Biological Environment, and 8 Socio-Economic Baseline of the main ESIA. Therefore, the CIA should be read in conjunction with these chapters.

12.5 ASSESS CUMULATIVE IMPACTS ON VECS AND DETERMINE THE EFFECT SIGNIFICANCE

The focus of this CIA is to predict to what extent the Gelephu-Tareythang Road Project may contribute, in combination with the other proposed projects and activities screened into the assessment, to cumulative impacts on the selected VECs.

The significance of cumulative impacts is considered for each VEC – the significance is not evaluated in terms of the magnitude of change but in terms of VEC response and the resulting condition and sustainability. Cumulative impact significance definitions used in this CIA are:

- **Low** – VEC would not experience noticeable changes;
- **Moderate** – VEC would experience noticeable changes, but within natural variations;

- **Substantial** – VEC would experience changes beyond natural variation, but within its range of tolerance/resilience; and
- **High** - VEC would experience changes that would likely exceed its range of tolerance/resilience and the viability of the VEC would be threatened.

12.5.1 CUMULATIVE IMPACTS ON AIR QUALITY

12.5.1.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to ambient air quality are:

- The construction of other planned projects in the region, including the GMC. Overlapping construction phases with projects may lead to cumulative impacts of dust emissions and exhaust emissions from construction traffic; and
- The operation of other planned projects in the region, including the GMC. During the operational phases of all projects, it is expected that there will be ongoing emissions from all forms of associated traffic and transport.

During construction, emissions and dust pollution may arise from increased traffic, construction machinery and earthworks. Detailed mitigation measures for the construction phase would reduce the project's potential impacts on ambient air quality to an overall residual significance of low. Given the short-term nature of construction impacts and the fact that they will be local in extent, it is considered that there is very little temporal or spatial overlap in impacts with the other planned development in the area. Therefore, there will be no significant cumulative impacts arising during construction phase for air quality.

Existing ambient air quality is good and the airshed is not considered degraded. During the operational phase of the project there will be ongoing emissions from traffic using the road for travel between Gelephu and Tareythang. Cumulative impacts may occur from similar emissions from the operation of the GMC, Gelephu International Airport and the Railway and Dry Port. While increased air travel may result in an increase in emissions, airports do not typically result in exceedance of AQ standards. The GMC will cause an increase in population and therefore an increase in associated activities that may produce emissions, such as increased transport. The railway and dry port will also bring increased traffic through a potential increase in trade across southern Bhutan.

However, of note is that the proportion of vehicle anticipated to be electric is expected to increase, with a substantial number being electric by 2035, and all vehicles to be electric by 2053[121]. Therefore, impacts from the Project to ambient air quality will be low as there are zero exhaust emissions. As such, it is considered the Project will have a decreasing impact to air quality from moderate (short-term operational phase) to negligible (long-term operational phase) even when combined with other planned development. It is also considered that GMC will promote public transport, promote electric transport and target 200% renewable energy supply reducing any potential emissions across the entire GMC area.

The residual effect on air quality from the Project is low. It is considered that while other external stressors such as the Gelephu International Airport, the Railway and Dry Port, and the GMC will

[121] The GMC Sustainability Framework details key indicators and targets. Under the "Transport Vision Scenario" for transport within the GMC, the Bhutan Government has committed to ensuring 100% electric vehicle coverage. The Government has committed to monitoring progress towards success in achieving the "Vision Scenario", intervening to influence behavior towards achieving desired outcomes and monitoring political, social, environmental, economic and economic trends and changes.

contribute to long-term air quality impacts, given the Project will have negligible operational impacts, the cumulative effect is therefore ***Low***.

This is dependent on the Bhutan Government commitment to promoting all electric vehicles.

12.5.2 CUMULATIVE IMPACTS ON AMBIENT NOISE

12.5.2.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to ambient noise include:

- Existing and planned development could result in additional noise impact to sensitive receptors during both construction and operational phases.

All construction activities and changes in road traffic can have noise impacts on the surrounding receptors. Operation of the Project is likely to result in changes in traffic volume, speed and composition along existing or widened roads, and will introduce new road sections that will pass receptors.

The GMC has a direct spatial and temporal overlap with the Project. Development of the GMC through to 2125 will introduce noise impacts during construction and operation with receptors closest to the project having the most significant cumulative impact. As the GMC develops, road traffic on the project will increase to capacity and therefore potential noise impacts will also increase. It is also recognized that development of the GMC will introduce more receptors to the area and therefore a greater population will be impacted by the Project in the future. In-migration to the area as a result of the expansion of the GMC will not only lead to a greater number of receptors but also additional background noise.

The Gelephu International Airport will introduce noise impacts through aviation and potential changes in traffic flows to the area. The Railway and Dry Port will introduce rail noise impacts and additional traffic to the area for trade. An increase in the use of the airport and dry port may mean an increase in the use of the Project for onward travel. This may lead to greater noise impact on receptors closest to the project as it nears capacity.

The residual effect on ambient noise from the Project is moderate. The Project, in combination with the GMC, Gelephu International Airport, the Railway and Dry Port and in-migration stressors will lead to an overall impact of ***Substantial***.

12.5.3 CUMULATIVE IMPACTS ON WATER RESOURCES

The hydrology of the project area is intricate, with extensive catchment areas that includes the Himalayan mountains reaching up to 2,000 meters in height, and several river channels transporting rainfall runoff. The river system is characterized by main rivers flowing north to south from the Himalayas, with tributaries moving in an east-west direction.

12.5.3.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to water resources in terms of water quality and availability for both drinking and agriculture include:

- Existing and planned development could result in flow regime changes of surface water. Construction activities for developments may lead to unmanaged domestic waste from workforce therefore affecting water quality;

- Settlement development and an increased population could negatively impact water quality from increased litter and surface pollution and well as the availability of water for drinking versus for use in agriculture;
- Changes in land use (for example an increased in agricultural development or reduced terrestrial habitat due to development) could result in land clearance and agricultural runoff and change in surface water flows; and
- Climate change and natural hazards could affect water flows, river discharge and water availability. Changes to rainfall patterns and increase in heavy rainfall, may lead to increased flood risk.

There are several existing and proposed developments which may also affect tributaries of various sizes and seasonal flows which feed into the river basins. The planned developments in the area are likely to contribute to increased stormwater runoff, soil erosion through construction activities and potential increased sedimentation impacts to water bodies without proper mitigation. Wastewater disposal is a key concern, and the developments in the area are likely to contribute to reduced water quality without secured mitigation measures in place. The Project itself will implement mitigation measures to a point where it is considered that the potential impact to erosion and sedimentation is negligible. In addition, it is noted that the planned developments in the area will also be required to mitigate potential impacts through the construction phases, and the construction phase is short-term. Considering the extent of the planned development across the region, it is considered that there will be an increase in impact on erosion and sedimentation, and on water quality, due to a cumulative effect.

The Gelephu International Airport will cross the Big Aiepoly and Small Aiepoly, tributaries of the Manas River, that run through the site. The rivers (Paitha, Big Aiepoly and Small Aiepoly) are dry for a large part of the year, and only flow intermittently during the monsoon seasons. It is proposed that the rivers are culverted at the airport. Construction and culverting of rivers has the potential to change the hydrology and flow of water which can lead to changes in erosion and sedimentation. Construction over rivers also has potential risks of pollution from wastewater or other contaminants should effective mitigation not be put in place. The change in land use from agriculture and forest to impermeable surfaces of the airport will change the drainage of the area and may result in increased stormwater runoff. Just to the southeast of the International Airport is the planned development for the Railway and Dry port with construction of the dry port underway. The development will cross at least one minor tributary and may impact minor tributaries during construction. The proposed railway and dry port will not directly affect any of the major rivers or their channels and are not expected to result in a large increase in stormwater runoff.

While the GMC does not have detailed plans for development, it will cross 35 rivers, and it is expected that elements of the project will cause disruption to natural water flows and therefore a cumulative impact is likely. The GMS will have a major impact on the land use of the region and is likely to significantly change the permeability of the area and therefore the drainage and stormwater run-off, with the potential to increase flood risk. The GMC and change in land use will also affect erosion control and sedimentation in the region.

The operation of the Project overlaps with the operation of the other planned major development in the region. All developments will have an impact on drainage systems and surface water runoff. The intensity of flooding can be increased by blocked road gullies, drains and sewers, saturated and waterlogged land, and an increase in hard surfaces. However, it is noted that all

projects in the area will need to be designed to a standard where it is ensured the drainage systems do not cumulatively increase any risk of flooding across the region.

Climate change will have combined impact on natural water flow, however, projections for future river flows due to impact on glacial and river systems show mixed results, with some showing increases and others showing decreases. Projected predictions suggest a potential overall increase in precipitation at the national level especially. The cumulative impact of changing weather patterns and changing natural flows due to the Project could lead to increased flood risk, already a key natural disaster in the area.

Linked with climate risk is the external stressors of natural disasters, especially flooding and landslides. Project activities have the potential to increase risk of occurrence, either due to soil erosion and land instability during construction or due to changes in water flows and patterns. The Project will be designed and managed during construction and operation to ensure that there is no increased risk to the population of the region.

The residual impact on water resources from the Project is Moderate. The Project, in combination with the developments of the GMC, Gelephu International Airport, and the Railway and Dry Port, and the stressors of climate change and natural disasters will lead to an overall impact of ***Substantial***.

This cumulative impact will be transboundary in nature, and therefore solutions for monitoring and mitigation must consider collaboration with the relevant Indian authorities.

12.5.4 CUMULATIVE IMPACTS ON HABITAT FRAGMENTATION

12.5.4.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to habitat fragmentation include:

- Existing and planned development which may lead to habitat loss, fragmentation and degradation of the terrestrial habitat;
- Settlement development and changes in land use (for example an increase in agricultural development or reduced terrestrial habitat due to development) could result in habitat clearance and increased fragmentation; and
- Climate change impacts such as changes in phenology, forest structure, reduced forest health, increased incidence of pests and disease and increased risk of forest fires.

While the direct habitat loss will be restricted to the project footprint, fragmentation of the habitat mosaic, edge effects and loss of habitat connectivity will extend beyond the immediate project footprint. These will result in altered microclimates, altered predator-prey interactions and habitat selection, noise, air emissions, increased human and construction activities during the construction phase, and increased traffic and other human activity during the operation phase.

Existing and planned development in the area is likely to create a cumulative impact on habitat fragmentation. The overall GMC plan covers an expansive area including the four Thromde/Gewogs in which the Project runs through. The Project Road is expected to be at capacity in 2053; by 2053, according to the planned phasing of the GMC, the total developable land of the GMC will be between 1,002 ha and 2,908 ha. The GMC will lead to development and changes in land use across the region and result in habitat loss and fragmentation on habitat already affected by the Project, with potential impacts such as edge effects, habitat degradation and loss of biodiversity.

The current Gelephu Airport is located to the west of the urbanized area, surrounded by shrubs/forests and between Big Aiepoly and Small Aiepoly Rivers. The current Gelephu International Airport runway is 1,500m while the expansion is expected to be approximately 3,000m in length. This will require the removal of habitat to accommodate the increase size of the airport. The Dry Port is expected to cover an area of approximately 30 acres, including land that is currently vegetated with trees and shrubs. It is expected that all habitat tewould be lost during construction. The combination of GMC, Gelephu International Airport, the Railway and Dry Port, and the Municipal Boundary Wall would substantially transform the region and create a mosaic of development and terrestrial habitat.

It is noted that a significant portion of the region is already developed in terms of agricultural land, and therefore the loss of terrestrial habitat is limited to those pockets that are remaining. However, the planned development will further exacerbate this fragmentation.

Functional habitat connections have been maintained in the region through the use of corridors such as along the Bhutanese Himalayan foothills that includes the formally recognized Biological Corridor 3. As part of the road alignment and design, plans to establish an elephant corridor, including the design of the bridges to include an elephant corridor wide enough to facilitate elephant movement are under review. If designed and implemented effectively, these passageways/ corridors will potentially mitigate some habitat fragmentation impacts to the Asian elephant populations, by retaining connectivity between the forested patches on the south and north of the road alignment.

Climate changes could exacerbate the impacts of the Project and other developments in the area. Changes in temperatures and precipitation patterns can impact forest composition and forest health. Rising temperatures and snowmelt may cause northward and migration of forests and associated species. Increased drought conditions in combination with increased lightening risks can increase risk of forest fires. Changes in precipitation patterns and increased temperature can stress forests, making them more vulnerable to diseases, pests and invasive species. Forest and intact habitats also aid erosion control and natural disaster mitigation as they prevent landslides and reduce the impact of flash floods.

The residual impact from the Project on habitat fragmentation is moderate. The Project, in combination with the developments of GMC, Gelephu International Airport, the Railway and Dry Port and Municipal Boundary Wall, and the stressors of climate change and natural disasters will lead to an overall impact of ***Substantial***.

12.5.5 CUMULATIVE IMPACTS ON WILDLIFE MOVEMENT AND HUMAN-WILDLIFE CONFLICT

12.5.5.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to wildlife movement and human-wildlife conflict include:

- Existing and planned development resulting in habitat loss and fragmentation, thereby the loss of traditional routes for wildlife movement and potential for increased interaction of humans and wildlife;
- Settlement development and changes in land use (for example an increase in agricultural development or reduced natural terrestrial habitat due to urban development) could result in further habitat loss and increased fragmentation within the vicinity of the Project;

- Exacerbation of climate change-related impacts resulting in migration of forests and associated species. Climate projections may mean that subtropical species populate southern margins, and some alpine species may decrease; and
- In-migration and increasing human populations, leading to increased likelihood of wildlife and human interaction.
- Potential deforestation in the forests of India, south of the Project site which serve as crucial elephant habitats, has resulted in the degradation and loss of their natural habitats, along with a reduction in their food and water resources. This habitat loss is likely to result in displacement of the elephants and thereby, contributing to the increased presence of elephants in urban and agricultural areas.[122]

The Project Area experiences significant human-wildlife conflict, particularly involving Asian Elephants. This area is part of a critical migration corridor where elephants frequently traverse settlements, causing crop and property damage and, occasionally, human fatalities. The conflict peaks during the wet season (from July to early September), which is the beginning of ripening season of rice and corn, and it is also the calving season for elephants as the wet season provides plenty of vegetation/food[123]. Reports from July to early September 2023 document over 65 incidents, highlighting an upward trend in frequency and intensity.

The Project's construction will exacerbate existing human-wildlife conflict due to habitat loss and fragmentation, which may disrupt traditional elephant routes and push these animals into human-populated areas. This disruption will likely increase crop damage, property destruction, and human casualties. Based on the data provided by the Department of Forest and Park Services (DoFPS) [124], elephant sightings have been recorded throughout the foothills of Sarpang Dzongkhag. Herds typically move through the Ripu and Chirang Reserve Forests and enter Bhutan through dry riverbeds or openings in the municipal boundary wall.

The current movement mostly follows a south-north direction along the Paitha River, Big Aiepoly River and Small Aiepoly River. The main envisaged barrier for the future movement of elephants in this area will be the presence of the Gelephu International Airport, Railway and Dry Port. The Gelephu Tareythang Road does not overlap with these facilities. However, as these facilities are adjacent to each other, they have the potential to create a singular barrier for elephant movement extending from Samtenling to Tareythang. It is noted in the GMC masterplan that there is the intention to include a shift of the elephant corridors around the GMC including the airport. Therefore, no design guidelines regarding elephants are included in the river passages over which the airport will expand.

In addition, the creation of the GMC and its residential areas involves land use change which will further prevent the movement of the elephant across the countryside. Cumulative habitat loss and barriers to movement will force species such as the Asian Elephant away from traditional movement and routes or increase potential for human-wildlife conflict.

There are several existing and proposed developments, including the GMC, which will contribute to potential impact to wildlife movement and increases in human-wildlife conflict. The GMC is expected to lead to significant development across the four Thromde/Gewogs within which the road Project runs, due to increased accessibility and urbanization.

[122] Fernando, P., and Pastorini, J. (2011). Range-wide status of Asian elephants. Gajah, 35, 15-20.
[123] *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*
[124] Department of Forestry and Park Services, 2023. Bhutan Elephant Corridor Project (unpublished)

It is also recognized that development of the GMC and the Project will lead to in-migration and increase in human population in the region during both the construction (due to influx of workers) and operational phases (due to development of the Project vicinity and GMC as described above), thus increasing the chances of human-wildlife interaction.

Given the proximity of the project to the Indian boundary, it is important to note the cumulative transboundary effect of the Project, particularly in terms of wildlife movement. The Municipal Boundary Wall will be 1.10, 2.25, and 2.4 kilometers long in Tareythang Gewog, Gelegphu Gewog, and Samtenling Gewog, respectively. This will create a significant barrier to wildlife, including the Asian Elephant which are known to travel across the Bhutan-India border regularly, with high populations known to inhabit the Chirang Ripu National Park and the Royal Manas National Park.

Climate change impacts may exacerbate the effect of the Project on wildlife movement, as changes in temperature and rainfall patterns may force a migration and change in species distribution across the landscape. With habitat loss, fragmentation and barriers to movement from development, this migration may be impeded and the envelope and habitat/ niches in which species thrive may be reduced.

The ESIA proposes the following measures to mitigate the anticipated increase in human-wildlife conflict:

- Elephant Corridor Establishment: Creating dedicated wildlife passages and underpasses to maintain safe migratory routes.
- Community Protection Measures: Training programs for construction staff, speed limits to prevent wildlife-vehicle collisions, and strategic signage to alert road users of wildlife crossings.
- Infrastructure Reinforcement: Installing community electric or steel fences and developing early warning systems to protect agricultural lands and mitigate property damage.
- Community Engagement: Initiatives to train local communities in crop depredation reporting and promote planting less attractive crops to elephants.

Mitigation has been designed into the project in order to allow for safe wildlife movement and preferred alignment design aims to minimize the impact to existing wildlife habitats. An elephant corridor design is currently under evaluation to address the loss of habitat connectivity. Animal passages (crossing paths/ underpasses) will be constructed at important animal crossings sites along the roads.

The first step of mitigation hierarchy, namely Avoidance, has been applied by integrating provision for the safe passage of elephants under the bridges. In particular, the Mau River Bridge is integrating a minimum of 250 m wide elephant corridor on eastern riverbank, with an average vertical clearance of 8.15 m, and a minimum clearance of 5.80 m at the East abutment in line with Good International Industry Practice (GIIP). Similarly, the smaller bridges on Taklai River, Langer River and Singye River are maintaining a minimum height of 6.5 m.

With regards to the phasing of the GMC development, the cumulative impact on elephant movement in Chhuzanggang will occur from approximately year 2046. As the construction of the main elephant corridor will commence alongside the road construction, it is envisaged that with proper design, the local populations would utilize the alternative/ new corridors provided by 2046.

The residual impact of the Project on wildlife movement and human-wildlife conflict is moderate. The Project, in combination with the developments of GMC, Gelephu International Airport, the Railway and Dry Port and Municipal Boundary Wall, and the stressors of climate change and in-migration, will lead to an overall impact of ***Substantial***.

This cumulative impact will be transboundary in nature, and therefore solutions for monitoring and mitigation must consider collaboration with the relevant Indian authorities.

12.5.6 CUMULATIVE IMPACTS ON COMMUNITY FORESTS AND LIVELIHOODS

12.5.6.1 KEY STRESSORS AND IMPACTS

Key stressors and impacts to community forests and livelihoods include:

- Existing and planned development, and construction and operation of infrastructure resulting in physical and economic displacement due to land acquisition. Development will lead to changes to settlement patterns and land use patterns;
- In-migration and increasing populations changing the social structure and networks of the area, with potential for additional pressure on existing infrastructure and services;
- Natural disasters such as earthquakes, flooding, wildfire, landslides may damage local infrastructure, community resources and have the potential to cause injuries and fatalities.

The Project Road alignment will pass through one Thromde and three Gewogs, requiring land acquisition that will cause physical and economic displacement. The Project will directly impact 226 plots, mainly used for agriculture or housing, and will impact 15 community forests, cutting through two of them, affecting the communities and livelihoods.

Avoiding and minimizing the number of affected land plots was a key consideration in determining the Project design. Those being physically displaced will be offered options through requirements under Bhutan's Land Act 2007, and the Resettlement Action Plan (RAP) in line with ESS5 principles. While it is noted that relocation to resettlement sites may cause disruption to the existing socio-cultural and economic environment, relocation of project affected persons within villages, Gewogs and Dzongkhags will avoid or minimize the degree of disruption to existing livelihood activities and existing socio-cultural and economic networks. Economic displacement will also be addressed through the RAP and will ensure that compensation associated with economic displacement is equal to or greater than the replacement value of lost assets and livelihood opportunities.

Notably the construction of the GMC will have a significant cumulative impact when considered alongside the Project. The GMC overlaps spatially with the Project, with the development of these areas for the GMC to be phased through to the year 2125. The GMC will change the land uses and economic activities through creation of "centres". The GMC extent overlaps will all 15 community forests considered within the ESIA. It is expected that the GCM will lead to both physical and economic displacement. It is therefore important that any mitigation planned as part of this Project, considers the changing land use and development through the GMC.

The GMC is anticipated to have economic benefits for the area and livelihoods of communities. While the GMC will require the likely displacement of communities, including those reliant on agriculture, it is expected that improved infrastructure (i.e. water, electricity) will advance agrifood and forestry industrial operations. The GMC notes the need to be cautious on its impact on existing farmers, who adopt traditional farming methods and the risk of displacement. Raising the productivity level and climbing the value chain of the agri-food cluster and forestry will

require change management and buy-in from existing farmers and landowners. The GMC also notes the rise of laminated timber as an alternative construction material is an opportunity for Gelephu to become a manufacturing, testing, expertise and export hub for its related products and processes.

The GMC will bring development to rural areas. Forests are very important for the rural communities in Bhutan, as they supply many products like timber, fuelwood, grazing fodder and vegetables. Urban development may weaken the link between people and forests and thereby reducing the contribution that community forests have for livelihood improvement, environmental conservation and sustainable use of forests. Development may also weaken traditions and intangible cultural heritage that community forest contain.

The development of the GMC and the Project will lead to in-migration and increases in population in the region during both the construction and operational phases. At peak, the construction workforce is expected to reach about 2,500 workers, including a mix of skilled laborers and unskilled laborers. It is expected that construction of the GMC will bring in an additional need for workers. This influx of workers may strain existing infrastructure and services, such as healthcare and education, potentially diminishing their quality and availability.

The majority of the country's agricultural land and infrastructure is located along drainage basins that are highly vulnerable to flooding, particularly riverine flooding caused by heavy monsoon rains and glacial melt. Natural disasters which impact lives and livelihoods will have a cumulative impact on the population of the region. Mitigation, including resettlement will need to consider appropriate locations in order to minimize risk to the population from natural disasters.

The land acquisition process will be led by the Department of Surface Transport (DoST), in accordance with the Project's Resettlement Action Plan (RAP)It is considered that the involvement of the RGoB in the mitigation for physical and economic displacement will involve collaboration across other planned development in the region, to coordinate and ensure that no measures implemented as part of this Project would be undone by future development, particularly the GMC.

The Project, in combination with the developments of GMC, Gelephu International Airport and the Railway and Dry Port, and the stressors of natural disasters and in-migration, will lead to an overall impact of **substantial.**

12.6 CONCLUSIONS OF THE CIA

In conclusion, the cumulative impacts of the Project encompass significant challenges across multiple environmental and social aspects. Key stressors include increased ambient noise from development activities, potential alterations to water resources due to construction and land use changes, habitat fragmentation affecting wildlife movement, and heightened human-wildlife conflict. The project's implications extend to land acquisition, resulting in physical and economic displacement for local communities, particularly those reliant on agriculture and community forests. The interconnectedness of these issues is further amplified by the anticipated growth of the GMC, which will intensify pressures on local ecosystems and infrastructure. ***Table 12.3*** summarizes the relative contribution of the planned development and external stressors to the overall cumulative impact on VECs.

To address these impacts, the implementation of comprehensive mitigation strategies, including effective community engagement, wildlife corridors, and a robust Resettlement Action Plan, will be crucial. Ongoing collaboration with governmental bodies and stakeholders will help ensure

that mitigation measures are effective and that the adverse effects of development are minimized, promoting sustainable growth and resilience in the region.

Table 12.3 RELATIVE CONTRIBUTION AND OVERAL CUMULATIVE IMPACT ON VECS

VEC	Relative contribution* to overall cumulative impact and key justification.						Overall impact
	Gelephu-Tareythang Road (the Project)	Gelephu Mindfulness city	Gelephu International Airport	Railway and Dry Port	Municipal Boundary Wall	External Stressors	
Air Quality	Minor – increased traffic though expected that vehicle use will transition to all electric.	Moderate – increase in population and associated increase construction and traffic. Expected that GMC will implement public transport and electric vehicle initiatives.	Minor – emissions from planes, though airports do not typically result in exceedance of AQ standards.	Minor – increased traffic movement to port and across southern Bhutan with increased trade, and movement of trains	Minor – potential low construction dust impact but no impacts during operation.	N/A	Low
Ambient Noise	Moderate – increase in traffic with new road close to receptors.	Major – increase in traffic and population size. Construction expected through all phases of GMC development.	Moderate – increase in air traffic and noise from planes.	Minor – increased traffic movement to port and across southern Bhutan with increased trade, and train movement.	Minor – potential construction noise but no operational impact	N/A	Substantial
Water Resources	Moderate – crosses major and minor rivers with impacts to hydrology and water quality.	Major – crosses 35 rivers with impacts to hydrology and water quality. Increased population and need for water resources. Increased population with higher risk of pollution to water from communities.	Moderate – crosses several rivers with impacts to hydrology and water quality.	Minor – crosses rivers, potential impact to water quality from pollutants from transport.	Minor – potential construction impact to water quality from pollutants, no impact during operation.	Moderate - changes to rainfall patterns and increase in heavy rainfall.	Substantial
Habitat Fragmentation	Moderate – road cuts through natural habitat and community forests, fragmenting landscape further	Major – extensive land use changes across the region, loss of natural habitat and increased disturbance through increased population and associated activities.	Minor –loss of habitat, however the habitat is already fragmented and disturbed by existing airport.	Minor –habitat loss, however habitat is already fragmented and disturbed by existing port area and railway.	Minor – minor loss of habitat though habitat already fragmented.	Minor - Climate change impacts such as reduced forest health, increased incidence of pests and disease and increased risk of forest fires.	Substantial
Wildlife Movement and Human-Wildlife Conflict	Moderate - habitat loss and fragmentation, which may disrupt traditional elephant routes. Mitigation measures implemented	Major - habitat loss, land use change, changes in traditional routes for wildlife, increased population and therefore greater risk of conflict.	Minor – minor habitat loss, however movement already restricted by existing airport,	Minor - minor habitat loss, however movement already restricted by existing dry port,	Moderate – restriction of wildlife movement across the Bhutan-India border.	Minor – climate change-related impacts and in-migration leading to increased likelihood	Substantial

VEC	Relative contribution* to overall cumulative impact and key justification.						Overall impact
	Gelephu-Tareythang Road (the Project)	**Gelephu Mindfulness city**	**Gelephu International Airport**	**Railway and Dry Port**	**Municipal Boundary Wall**	**External Stressors**	
	such as wildlife corridors.		and low population density in the area.	and low population density in the area.		of wildlife and human interaction.	
Community Forests and Livelihoods	Moderate – project requires land acquisition leading to physical and economic displacement. Project cuts through two community forests, affecting the communities and livelihoods.	Major – major changes in land use, construction and new development leading to physical and economic displacement and changes to settlement patterns. Likely that the GMC will impact all community forests in the area and change the livelihoods of the area.	Minor – potential minor land use change for expansion, however the community is already and disturbed by existing airport.	Minor - potential minor land use change for expansion, however the community is already and disturbed by existing dry port.	N/A	Minor - in-migration and increasing populations and natural disasters which damage local infrastructure, community resources and have the potential to cause injuries and fatalities.	Substantial

*Note: *Relative contribution - Major (>50%), moderate (25 - 50%) and minor (<25%)*

12.7 PROPOSED CIA MANAGEMENT STRATEGY

12.7.1 OVERVIEW

Effective application of the mitigation hierarchy (avoid, reduce, mitigate, and compensate) to manage individual planned developments and stressors contribution of cumulative impacts is recommended as best practice. The Project and other planned development in the impacted area should incorporate project design features that include physical and procedural controls to avoid and reduce possible impacts that are planned as part of the projects. The responsibility for the management of cumulative impacts ought to be collective, requiring individual actions to eliminate or minimize each individual development's contributions. Project sponsors should be responsible for mitigating their own contribution to cumulative impacts, as well as participating in collaborative management efforts. Moreover, management measures recommended during the CIA process may ultimately be effective only if the Bhutan government becomes actively involved. The project sponsors should foster collaboration by participating, to the extent feasible and practicable, in working groups and/or government initiatives. The collaboration should be aimed at addressing management of potential impacts on regional resources to which the projects could incrementally contribute with respect to cumulative impacts.

12.7.2 POSSIBLE MONITORING, MITIGATION AND MANAGEMENT MEASURES

Alongside the mitigation and monitoring measures described in ESIA impact assessment chapters for individual topics possible further possible recommendations for mitigation and management measures to avoid/minimize/restore potential cumulative impacts on the selected VECs are described here (***Table 12.4***). Considering the cumulative effects, it will be imperative that GMC is a key collaborator on further monitoring, mitigation and management measures.

Table 12.4 Further possible monitoring, mitigation and management measures

VEC	Possible Monitoring, Mitigation and Management Measures	Responsible Agencies
Air Quality	Implementation of a regional air quality monitoring program, to regularly look at and report on levels of emissions across the impact area and the effects of any cumulative emissions from planned development. Implement an adaptive management approach to continually reassess the efficacy of mitigation measures and adjust them as necessary. This process includes regular monitoring, evaluation of results, and adjustments to strategies as conditions change or more information becomes available. Encourage collaboration and communication between different projects within the impact area. Sharing information about schedules, activities, and impact mitigation strategies can help coordinate efforts, reduce redundancy, and minimize cumulative impacts. Collaboration on the objective of the GMC to promote public transport use through creating mixed-use neighborhoods interconnected by mobility hubs, providing accessible and inclusive low emission public transport options and integrated with active travel routes to maximize connectivity. This includes the target of >38% public transport modal share and 100% coverage of electric public transport infrastructure within the GMC. This is to be led by the Royal Government of Bhutan. Collaboration on the objective of the GMC to incorporate community-scale infrastructure to maximize use of clean fuels and electric vehicles. This includes the target of 100% electric vehicle use within the GMC and 100% of mobility hubs with parking provision to have electric vehicle charging points. This is to be led by the Royal Government of Bhutan.	DoST, MoIT (in collaboration with other relevant governing bodies, such as GMC)

VEC	Possible Monitoring, Mitigation and Management Measures	Responsible Agencies
Ambient Noise	Implementation of a regional noise monitoring program, to regularly look at and report on noise levels across the impact area. Strategic implementation of speed limits for traffic in areas of high receptor sensitivity. Collaboration on the objective of the GMC to promote public transport use and minimize private car use. This includes targets of 0.3 cars per household and < 8%Taxi, car sharing and private car mode share by full build out. This is to be led by the Royal Government of Bhutan.	DoST, MoIT (in collaboration with other relevant governing bodies, such as GMC)
Water Resources	Implementation of a monitoring program for water quality. All proposed development must include an effective strategy for managing sediment to maintain downstream river geomorphic functioning and minimizing the river's erosion potential. Engage with the Bhutan Meteorological Department on early warning systems and future forecasting of rainfall events (e.g. implement real-time hydrological monitoring stations to assess changes in water levels, flow rates, and quality, particularly during monsoon seasons) so that potential risks can be addressed promptly and activate pre-storm monitoring and maintenance activities. Collaborate with other Bhutan government departments, such as Department of Forests and Park Services and the Department of Environment & Climate Change on projects including the "Bhutan Strategic Programme on Climate Resilience (SPCR): Analysis of Climate Impact on Water Scarcity – Scoping Study on Water Sources Drying Up", "Advisory Services and Analytics Project for the Bhutan Water Sector" and "E-Flow II" projects. Engage local communities in collaboration with the Gewog and Thromde Administrations in maintaining vegetated areas around highways and in awareness campaigns on the importance of protecting water resources. Develop a feedback mechanism for residents to report road or drainage issues that could impact water resources, enhancing responsiveness to environmental risks. Collaboration with the relevant Indian authorities in terms of knowledge sharing, monitoring, and promotion of mitigation measures.	DoST, MoIT (in collaboration with other relevant governing bodies e.g. DoFPS, DoECC and GMC)
Habitat Fragmentation	Facilitate a CIA committee (led by the Department of Forest and Park Services and local government Administration) with other projects and government representation to govern a system for managing cumulative impacts. This system, however, should be compliant with Bhutan regulations and align with international good practices. Implement an adaptive management approach to continually reassess the efficacy of mitigation measures and adjust them as necessary. This process includes regular monitoring, evaluation of results, and adjustments to strategies as conditions change or more information becomes available. Establish a reporting scheme for monitoring and common results database on the movement of elephants and other wildlife, in coordination with the Department of Forest and Park Services. Encourage collaboration and communication between different projects within the impact area. Sharing information about schedules, activities, and impact mitigation strategies can help coordinate efforts, reduce redundancy, and minimize cumulative impacts. Coordinate closely with qualified partners such as government working groups on forest conservation. Collaborate with other Bhutan government departments. Maintain transparency about the project's impacts and mitigation strategies. Regularly engage with local communities and other stakeholders to address concerns and incorporate their input into decision-making processes.	DoFPS in collaboration with DoST and GMC

VEC	Possible Monitoring, Mitigation and Management Measures	Responsible Agencies
	Organize regular training programs for workers involved in the project. This could include best practices in waste management, strategies to reduce noise and air pollution, and information about the importance of protecting local ecosystems.	
Wildlife Movement and Human-Wildlife Conflict	Continued and further research into wildlife movement in the impact area, to enhance mitigation measures promoted through planned development. Collaboration with other proposed development on a scheme of promoting wildlife movement in the region. Budget to be allocated for a strategic and comprehensive movement plan to include wildlife crossings based on industry best practices and recent academic research to maintain the safe passageway of animals between the natural habitats surrounding the project. Implementation and collaboration with the Bhutan Government and local communities on monitoring plans for critical species such as the Asian Elephant, Gee's Golden Lemur and Trilaminate Hill Turtles. It is critical that elephant corridors promoted through the Project are extended. Collaboration with other planned development to ensure that corridors are respected and enhanced. Suitable fencing with trenches to be included in the budget of the planned development to help navigate elephant movement and avoid conflict and crop loss. Share available data related to biodiversity value within the area to other projects as well as engage available data from other projects for continuous biodiversity management. Share best practices in addressing adverse impacts on biodiversity and encourage other projects to share their practices. Collaboration with the Ministry of Agriculture and Livestock (MoAL) and the Department of Forest and Park Services to incorporate lessons learnt into a strategic approach across all developments in the region (National Human - Wildlife Conflicts Management Strategy). Collaboration with the relevant Indian authorities in terms of knowledge sharing, monitoring, and promotion of mitigation measures.	DoFPS and MoAL in collaboration with DoST and GMC
Community Forests and Livelihoods	Implement a monitoring and evaluation scheme to track agriculture land and land use conversion, to assess livelihood activities particularly for those that depend on terrestrial biodiversity and forest land (e.g. forest product extraction). Provide livelihood restoration for project affected households. Implement monitoring and evaluating to understand changes/impacts (if any) on livelihood activities that depend on water resources quality and quantity (such as agriculture, livestock rearing and domestic use). Identify and enumerate the number of households affected by the loss of community forests and agricultural land acquired by the project. Consult affected communities to discuss ways in which their loss of access to community forests can be compensated. Agricultural intensification schemes to make land more productive so that the impact on overall productivity in the impact area is mitigated. Consider women's crucial role in the management of agriculture and forest resources. The distinct impacts of land (and forest) acquisition on women should be documented and addressed properly. Implement monitoring and reporting as required under the Resettlement Action (RAP) as given below: ▪ (i) measure and report on the progress in the preparation and implementation of the approved RAP; (ii) identify problems and risks, if any, and the measures to mitigate them; and (iii) assess if the compensation and other assistance provided are in accordance with provisions of the approved RAP.	DoST, MoIT (in collaboration with other relevant governing bodies, such as GMC)

VEC	Possible Monitoring, Mitigation and Management Measures	Responsible Agencies
	▪ The project proponent (DoST) to ensure the following Key Performing Indicators (KPIs) are followed as part of the monitoring: o Field supervision; o Dashboard of activities progress; o Timeline/Schedule; and o Weekly meeting. ▪ A self-monitoring program shall be established and shall be the responsibility of the authorized personnel, which shall include the following indicators at a minimum: o Implementation progress, o Compensation progress, o Replacement land development and status, o Health of PAPs, o Budget and expenditures, o Quality of the compensation process, including issues relating to consultations, gender, ethnic minority, vulnerable groups, grievance, transparency and disclosure, and o Outcomes of the implementation of the Compensation Plan. ▪ An external completion audit by resettlement professionals is required to assess whether livelihoods and living standards have been restored or improved. ▪ Prior to the start of any site clearing or construction activities, DoST shall prepare a Land Acquisition Compensation Completion Report confirming that PAHs have received compensation for the land area for permanent or temporary use by the Project including the EPCC and its subcontractors. The report could be stand alone or integrated into the applicable monitoring report. Ensure grievance mechanism is well socialized. Ensure meaningful participation of project-affected local communities in all phases of the project – planning, implementing, monitoring and evaluation. Conduct regular socialization, consultation and monitoring activities with relevant stakeholders. Develop relevant community development programs for the affected people in coordination with government authorities.	

12.1.1 HOLISTIC APPROACH TO BIODIVERSITY (FRAGMENTATION AND HUMAN-WILDLIFE CONFLICT)

The ESIA provides an assessment of fragmentation and human-wildlife conflicts within the project area and additional risks associated with the proposed Gelephu-Tareythang road (Project) construction. However, a broader perspective is necessary to include the cumulative impacts expected from the GMC development. A holistic approach is crucial when planning mitigation measures, extending beyond the immediate project area to consider the home range of affected wildlife species.

The Biodiversity Management Plan (BMP) will detail additional activities for implementation by the DoFPS. These activities may include implementation within the jurisdictions of the Sarpang District Forest Office (DFO) and two protected areas: Phibsoo Wildlife Sanctuary (PWS) and Royal Manas National Park (RMNP). The activities will look at three components which encompass social, environmental and institutional solutions. The activities will focus on components including the protection of life and livelihoods from human-wildlife conflict, habitat enhancement and migration corridor development, and monitoring and capacity building. This holistic approach whereby impacts are mitigated through collaboration and numerous channels is essential to ensuring the success of Project.

- The cost estimates to account for project implementation throughout its duration, considering the DoFPS capacity, available local resources (materials, equipment, and community labor), and the potential need for international resources, which would incur additional costs are estimated in the Environment and Social Management Plan (ESMP).

12.7.3 IMPLEMENTATION RESPONSIBILITIES

The Project Proponent is the Department of Surface Transport, Ministry of Infrastructures and Transport. It is crucial that the project Proponent work with other Government organizations, particularly the DoFPS, to ensure that cumulative impacts are addressed at a strategic level as well as Project specific mitigation and monitoring.

It is recommended that activities be implemented to improve the environmental and social management planned development in the region in a stepwise manner—first creating tools for better management, next building institutional capacity and data, and finally consolidating knowledge and information into strategic plans.

There is a need for more capacity building within the key regulatory agencies in Bhutan in terms of evaluating project impacts, cumulative impacts, and compliance monitoring and enforcement. Capacity building is required in terms of the assessment and management of cumulative impacts on VECs such as those caused by the Project in combination with other projects, activities, and stressors.

There is also a need for effective construction and operation phase monitoring and enforcement. A much more robust compliance monitoring, enforcement program, and adaptive management is needed to achieve sustainable development in Bhutan. The Government should consider more use of participatory monitoring by local communities of construction and operation.

13. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

13.1 INTRODUCTION

An Environmental and Social Management Plan (ESMP) has been prepared for the Project's development as part of the ESIA. The purpose of this ESMP is to provide a consolidated summary of all the Environmental and Social (E&S) commitments relevant to the Project. The ESMP will document the proposed set of management, mitigation, and monitoring measures and specific actions to be taken at all stages of the Project development to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The ESMP can be updated as the Project proceeds through detailed design and construction to reflect the results of discussions with stakeholders and to include details of any other E&S developments.

13.2 SCOPE OF THE ESMP

The objective of this ESMP is to provide a framework to safeguard the environment and community against activity which may cause harm or nuisance as identified during the ESIA process. The ESMP includes the following:

- Mitigation measures for adverse impacts;
- Enhancement measures for positive impacts;
- Monitoring activities for Project development and throughout Project's life;
- Implementation schedule; and
- Stakeholder responsibilities.

13.3 INSTITUTIONAL ARRANGEMENTS

13.3.1 OVERVIEW

Institutional arrangements are intended to meet the requirement of World Bank ESS that in turn will make sure that the National laws are not violated during the construction and operational stages of the project.

The Project Proponent, DoST, will be responsible for complying with and implementing the Environmental and Social Management Plans, monitoring the Construction Contractor's environmental and social performance, engaging with affected communities, managing the project's grievance program, amongst other environmental and social responsibilities.

DoST will need to implement robust compliance monitoring and an enforcement program, with adaptive management. An Institutional Strengthening Management Plan will be required, which will include recommended interventions, such as staffing, capacity building, and budget requirements.

13.3.2 IMPLEMENTING AGENCIES

Institutions responsible for addressing environmental and social issues in the project are mentioned ***Table 13.1***.

Table 13.1 Institutions and their Roles in Addressing Environmental and Social Issues in the Project

Institutions	Roles and Responsibilities
Ministry of Infrastructure and Transport (MoIT)	MoIT as lead agency with centralized PMU; implementing units within relevant ministries and technical partners.
Department of Surface Transport (DoST)	DoST is the lead agency within the PIU. The DoST will implement the ESIA/ESMP, which has to be reviewed and approved by the World Bank as the financing agency of the project. DoST is directly responsible for managing the E&S risks of individual projects under the program including the implementation and monitoring.
Ministry of Energy and Natural Resources (MoENR)	The MoENR will support the technical requirements for the natural resources and forestry items for the project.
Department of Forestry and Park Services (DoFPS)	The DoFPS imposes conditions on the acquisition of right of way on forest lands, such as replacement of cut trees, and takes a lead role in BMP implementation, specifically in implementation of net gain framework including human-wildlife conflict management
Department of Energy and Climate Change (DECC)	The Department of Energy and Climate Change will support to conduct the ambient air quality monitoring and noise monitoring during the project implementation.
Local Government (Sarpang Dzongkhag Administration and Gelephu Thromde).	The local Government (Thromde, Dzongkhag and Gewog Administrations will support and facilitate in addressing the Social and Environment issues.

13.3.3 IMPLEMENTATION ARRANGEMENT OF ESMP

Project Management Unit (PMU)

The Project Steering Committee (PSC) and Project Director will coordinate with the Ministry of Finance (MoF) and head the Project Management Unit (PMU) to be established under the Ministry of Information and Technology (MoIT). The Department of Surface Transport (DoST) will establish a Project Implementation Unit (PIU) to implement the project. The DoST will also be responsible for operation, management, and maintenance of the highway upon completion.

The DoST will be ultimately responsible for the proper implementation of ESMP as the project owner. DoST will need to ensure that the ESMP E&S requirements are adequately reflected in the project bidding documents, ensure all the administrative approvals are in place for all the plans and documents on related E&S aspects; and prepare quarterly reports on E&S performance of the Project. DoST as the owner of the Project will provide ongoing support to the Supervision Engineer during the project construction.

DoST will be responsible for monitoring the Construction Contractor's environmental and social performance, engaging with affected communities, managing the project's grievance program, amongst other environmental and social responsibilities. They will need to ensure that the Project is constructed and operated in conformance with World Bank standards and project commitments, as well as Bhutan legislation and regulations. DoST will need to implement robust compliance monitoring and an enforcement program, with adaptive management. An

Institutional Strengthening Management Plan will be required, which will include recommended interventions, such as staffing, capacity building, and budget requirements.

The PIU currently has a government appointed E&S focal point in the DoST, which is a temporary arrangement for the project preparation/current stage. During the project implementation DoST will engage both a dedicated environmental specialist and a social specialist. •Department of Forests and Park Services (DoFPS) to address biodiversity impacts and for implementation of additional conservation measures towards achieving Net Gain.

Supervision Engineer

The Supervision Engineer ensures the effective implementation of the ESMP by monitoring compliance, conducting site inspections, reporting on E&S performance, conduct required E&S training and coordinating with DoST and contractors. They also provide recommendations for corrective actions and support training to build capacity for managing environmental and social risks throughout the project. The supervision engineer should be adequately qualified to supervise the project according to WB standards.

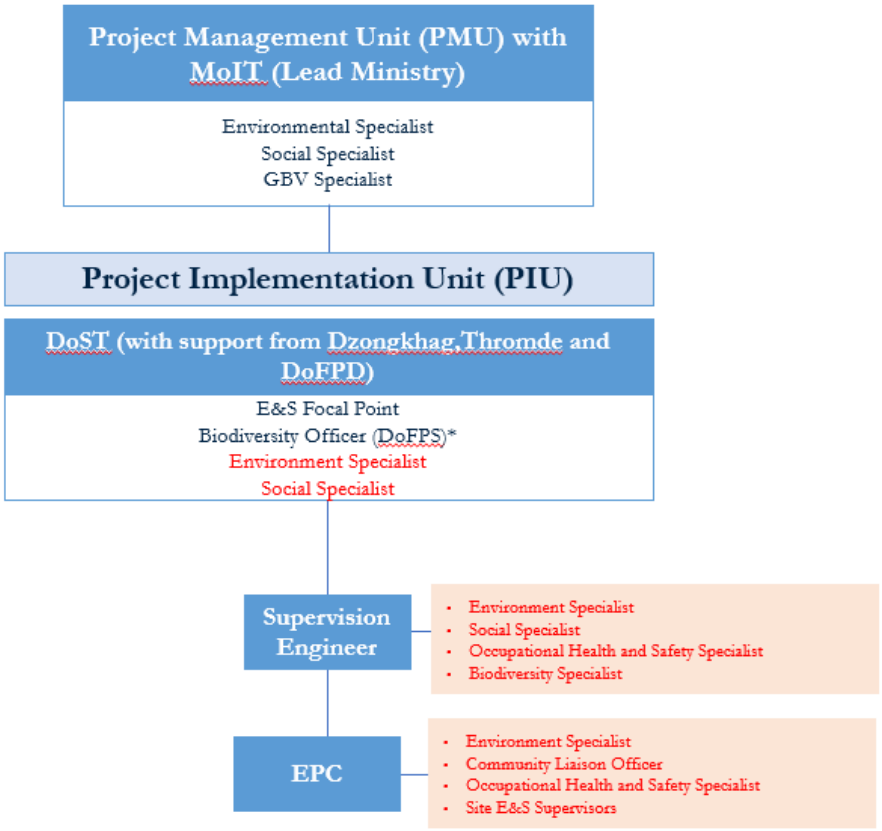
The Supervision Engineer will supervise the EPC contract's implementation of the ESMP and civil works. The Supervision Engineer will have a full E&S team to supervise the contractors and provide capacity building to the contractor workers. The Supervision Engineer E&S team at a minimum will have an environmental specialist, a social specialist, an OHS specialist and a Biodiversity Specialist to monitor the contractor during the project implementation.

Contractors

The contractor's role in the ESMP involves ensuring that all environmental and social safeguards are implemented during project construction. This includes following the mitigation measures outlined in the ESMP, managing waste, minimizing disruptions to local communities, and ensuring safety standards are met. The contractor is responsible for training their staff on environmental and social best practices, monitoring compliance, and reporting any issues to the Project Implementation Unit. They must also work closely with the Supervision Engineer to address any environmental or social concerns during the project's execution. The contractor will also need to employ an Environmental Specialist, Community Liaison Officer; Occupational Health and Safety Specialist and adequate Site supervisors.

The organizational chart showing different organizations associated with project activities and providing an overview of the institutional setup related to the implementation of the ESMP is shown in ***Figure 13.1***.

Figure 13.1 Implementation Arrangements for ESMP



*DoFPS rep to act as ECoW

The existing and proposed human resource for ESMP implementation is ***Table 13.2***.

Table 13.2 Proposed Human Resource for ESMP Implementation

Institution	Personnels /Expert	Existing	Proposed
Project Management Unit (PMU)	Environmental Specialist		1
	Social Specialist		1
	GBV Consultant		1
Project Implementation Unit (PIU) (DoST)	E&S Focal Point	1	none
	Biodiversity Officer (DoFPS)		1
	Environment Specialist		1
	Social Specialist		1
Supervision Engineer	Environmental Specialist		1
	Social Specialist		1
	Occupational Health and Safety Specialist		1

Institution	Personnels /Expert	Existing	Proposed
	Biodiversity Specialist		1
Contractor (for each construction package)	Environmental Specialist		1
	Community Liaison Officer		1
	Occupational Health and Safety Specialist		1
	Site E&S supervisors		2

13.3.4 INCLUSION OF ESMP IN CONTRACT DOCUMENTS

In order to make the Contractors fully aware of the implications of the ESMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in ESMP. The Contractor will be made accountable through contract documents for the obligations regarding the environmental and social components of the project. DoST must include the following Environmental, Social, Health and Safety (E&S) Conditions in the bidding documents:

- Verify the Past performance of the proposed Contractor on E&S aspects including sexual exploitation and abuse and gender-based violence;
- Adequate E&S Specialists in contractor team (Environmental Specialist, OHS specialist, Community Liaison Officer and site supervisors);
- Code of conduct of Contractor's Personnel;
- Management Strategies and Implementation Plans for the ESMP and Monitoring Measures; and
- Preparation of the Contractor's Environment and Social Management Plan (CESMP) including the Labor Management Procedure requirements as detailed under the Labor Management Plan (LMP) that aligns with international good practice standards, including but not limited to World Bank ESS-2.

13.3.5 CAPACITY BUILDING AND TRAINING

The environmental and social training will help to ensure that the requirements of the ESMP are clearly understood and followed by all project personnel. The Supervision Engineer will be required to conduct the E&S training, the competencies of the Supervision Engineer training team for capacity building training will include a thorough knowledge and experience of WB Environmental and Social Framework (ESF) and E&SG guidelines. The trainings will be provided to different professional groups separately, such as managers, skilled personnel, unskilled labors, and camp staff.

Capacity building will be aimed at strengthening the technical Staff of PMU, PIU relevant technical staff of DOST who are involved in the management of environmental and social issues associated with project, contractors E&S team and the local representatives of the Gelephu Thromde and Project impact Gewogs in the field of environmental management and social development.

The contractor will also be required to provide environmental and social trainings to its staff under the direction of the Supervision Engineer to ensure the effective implementation of the ESMP. The details of the recommended training are detailed in ***Table 13.3***.

Table 13.3 Environmental and Social Training Programs

Training topics	Target Audience	Trainer	Schedule
Environmental and Social Risk Management of the Project and ESMP requirements of the Contractor; World Bank Group Environmental Health and Safety Guidelines.	All the technical Staff of PMU, PIU relevant technical staff of DOST who are involved in the management of environmental and social issues associated with project. Contractors E&S team And the local representatives of the Gelephu Thromde and Project impact Gewogs.	E&S Staff of the Supervision Engineer who has a thorough knowledge of the WB ESF and guidelines.	During the initial stages of the Project implementation. The training will be repeated every six months.
Wildlife shepherding, prohibition of poaching/ foraging, biodiversity management and human-elephant conflict[125]	Contractors E&S team Quick Response Team (QRT) Local representatives of the Gelephu Thromde and Project impact Gewogs where HWC is common DoFPS.	E&S Staff of the Supervision Engineer who has a thorough knowledge of the WB ESF and guidelines.	During the initial stages of the Project implementation and prior to implementation of the BMP. The training will be repeated every six months.
Stakeholder Engagement, Prevention and response to SEA/SH, management of Grievance Mechanism, implementation of livelihood restoration activities,	All the technical Staff of PMU, PIU relevant technical staff of DOST who are involved in the management of environmental and social issues associated with project. Contractors E&S team And the local representatives of the Gelephu Thromde and Gewogs in the Impact Area.	E&S Staff of the Supervision Engineer who has a thorough knowledge of the WB ESF and guidelines.	During the initial stages of the Project implementation. The training will be repeated every six months.
Construction Monitoring for Environmental and Social issues, auditing, incident reporting procedures and emergency preparedness and response procedures.	Site Engineers of the Contractor and E&S Site Supervisors.	E&S Staff of the Supervision Engineer.	On a monthly basis.

[125] Note that the Component 3 of the BMP will identify further training needs of the team.

Training topics	Target Audience	Trainer	Schedule
Code of Conduct and Occupational Health and Safety	Construction crew.	Contractors E&S Staff.	Prior to the start of the construction activities and during the construction activities (To be repeated as needed).

13.4 KEY REMARKS FOR ESMP IMPLEMENTATION

The two following points should be considered regarding the implementation of the ESMP:

- Responsibility for Implementation and Reporting: The PIU holds the accountability for the implementation and reporting of the ESMP. It is essential for PIU to internally assign tasks to a certain individuals or teams, ensuring their accountability in effectively planning, implementing, monitoring, assessing, and reporting on each topic outlined in the ESMP.
- Streamlining Mitigation Measures: Within ESMP, it is important to note that certain mitigation measures may overlap or be applicable to multiple topics. In such cases, there is no need for redundant actions. Replicated actions for similar measures can be avoided, ensuring efficiency in the implementation process.

Prior to construction the PIU will need to award contracts to Engineering Procurement and Construction (EPC) Contractor(s). The selected EPC Contractor will be required to develop a Contractor's Environmental and Social Management Plan (CESMP), in accordance with the RGoB and World Bank requirements established in the overall Project Framework ESMP, for review and approval by DoST.

As part of this CESMP, they ensure their workers understand and comply with Worker Code of Conduct prepared under the Labor Management Procedure. The Worker Code of Conduct will be based as compliance with all Bhutanese laws and regulations emphasizing the importance of appropriate worker behavior with local residents, respect for local communities and their customs, protection of the environment, prohibit sexual harassment, exploitation, abuse, proper sanitation and waste manage at the project sites, community health and safety. The Code of Conduct will also include disciplinary sanctions (e.g., penalties up to dismissal, and referral for potential legal sanction) for workers violating this Code of Conduct. The Code of Conduct will also be made available to local communities.

Prior to mobilizing construction crews in the field, DoST will require the EPC Contractor to conduct induction training for all project workers and subsequently for all new hires. This induction training will include:

- Occupational health and safety (H&S) training for all field crews, including provision of appropriate personal protective equipment (PPE) to all personnel;
- Health screening and testing of field crews;
- Introduction to work conditions and the Worker Grievance Redress Mechanism and procedures;
- Environmental Management Measures;
- Local social and cultural sensitivity training; and
- Project's Worker Code of Conduct training and cultural sensitivity training and awareness, including penalties, with a requirement that all personnel sign a copy of the code.

13.5 REPORTING

The reports required during construction are summarized in the table below.

Report	Description	Responsible Party	Frequency of Reporting
Environmental and Social Monitoring Reports	These reports document the ongoing monitoring of environmental and social impacts, implementation status of proposed mitigation measures, monitoring against KPIs set and compliance status against national regulations, the ESMP, and donor or investor requirements.	The PIU, based on inputs from the contractor and the Supervision Engineer	Quarterly during construction.
Incident/Non-compliance Reports	These reports document any incidents, accidents, or non-compliance with environmental and social safeguards, investigation report and any status of proposed corrective actions taken.	The contractor, with oversight from the Supervision Engineer and PIU.	As and when incidences/ non-compliances are identified.
Health, Safety, and Environmental (HSE) Reports	These include details on workplace safety, environmental management practices, and health conditions and statistics non the project operations, such as volume of waste generated, lost time injury (LTI) rates, first aid kit incidences etc.	The contractor, under the supervision of the Supervision Engineer.	Monthly during construction.
Progress Reports	These reports shall include the monthly project progress, status on land clearing, any incidences recorded, equipment maintenance and workforce statistics.	Supervision Engineer.	Monthly during construction.
Training and Capacity Building Reports	These track the training sessions provided to project staff, contractors, and local workers on environmental and social issues.	The contractor, with support from the PIU and any appointed environmental or social specialists.	Quarterly during construction.
Grievance Redress Mechanism (GRM) Reports	These documents any complaints or grievances raised by local communities or workers, detailing how they were resolved.	The contractor, in coordination with the PIU.	Monthly during construction

13.6 SPECIFIC MANAGEMENT PLANS

The management plans presented below are necessary to effectively implement the mitigation and management measures committed by DoST. DoST will be responsible for implementing the ESMP and has the duty to assign the responsible parties (EPC contractor) to the preparation and implementation of each plan.

Table 13.4 Management Plans

Management Plan	Summary	Status	Responsibility
Construction E&S Management Plan To Include (but not limited to): • Dust Management Plan • Air Quality Management Plan • Water Management Plan (with Water Use/Extraction Plan and Stormwater Management Plan) • Waste Management Plan • Hazardous Material Spill Response Plan • Employee Grievance Mechanism	The plan outlines measures to mitigate, monitor, and manage environmental and social impacts during the project's design and construction stages, to offset them, or to reduce them to acceptable levels. • Dust and Air Quality: Strategies for controlling dust and pollutants to meet air quality standards. • Water: Management of water usage, stormwater, soil erosion, contamination, and runoff, including spill containment and water quality monitoring. • Waste: Procedures for waste reduction, handling, storage, and disposal. • Hazardous Material: Identification of hazards, spill categorization, notification procedures, and emergency response. • Employee Grievances: Framework for addressing and resolving employee complaints.	To be prepared before construction	EPC Contractor
Occupational Health and Safety Management Plan	Document ensures the management of health and safety for employees, the public, and the environment. It addresses physical and chemical hazards on the project site and includes guidelines for personal protection and safe operations for employees and subcontractors.	To be prepared before construction	EPC Contractor
Emergency Preparedness and Response Plan (or Emergency Response Plan) To include Fire prevention Plan	The plan is essential for preparing for, responding to, and recovering from natural disasters or catastrophes. It involves risk assessment, mitigation strategies, disaster planning, and community education to ensure safety by minimizing damage and exposure to hazards. Additionally, a fire prevention plan should identify major fire hazards, necessary fire protection equipment, and responsible individuals. The contingency Plan and Disaster Management Plan will also be covered under the overall EPRP.	To be prepared before construction	EPC Contractor
Traffic Management Plan	Outlines measures to ensure the safety of road workers and users during construction. It includes details on work hours, project specifics, management systems, work phases, required signage, speed limits, road levels, site access and egress, and communication and emergency procedures.	To be prepared before construction	EPC Contractor, DoST

Management Plan	Summary	Status	Responsibility
Biodiversity Management Plan	Outlines the mitigation and monitoring measures to be implemented throughout the Project lifecycle within the project area for biodiversity impacts identified through the ESIA.	Drafted	DoST and DOFPS
Invasive Species Management Plan	Sets out the measures that would be used by the EPC to control and prevent the spread of invasive non-native species (INNS) and how they would be managed or removed where required.	Drafted	DoST and DOFPS
Stakeholder Engagement Plan (SEP) To include Community Grievance Mechanism	Outlines the process that will be followed in order to listen to, collaborate with, or inform stakeholders about project activities. Development of the SEP involves identifying, mapping and prioritizing stakeholders to determine the best tactics for effective engagement. Grievance mechanism is a framework to address complaints and resolve grievances in a timely, effectively and culturally appropriate manner.	Drafted	DoST
Resettlement Action Plan (RAP) To include Livelihood Restoration Plan	A RAP details procedures and actions for resettling and compensating affected individuals and communities. It identifies all affected people, justifies their displacement, sets eligibility criteria, determines compensation rates, and outlines assistance for relocation and reconstruction. Livelihood Restoration Plan describes the baseline socio-economic situation, proposes measures to compensate affected people and restore their livelihoods to pre-project levels or better, sets monitoring and reporting requirements, and outlines an implementation schedule.	Drafted	DoST
Gender Action Plan (GAP)	Aimed at addressing gender-specific concerns and social impacts of a proposed project. The GAP's objective is to integrate gender issues into all project phases through planning, implementation, monitoring, and evaluation. It seeks to enhance women's participation, ensure they benefit from the project, and reduce their social vulnerability, particularly regarding land security and safety during construction.	Drafted	DoST
Influx Management Plan	Identifies socio-economic risks, impacts, and opportunities from project-induced influx. It describes mitigation and management strategies for these aspects.	Framework Drafted	DoST
Local Content Plan To include a Recruitment Policy	Develops strategies and programs to bridge gaps between local supplier capabilities and corporate procurement standards. It addresses staffing, procurement, health, safety, environment (HSE), and budgeting, and designs a strategy for local procurement implementation.	To be prepared before construction	DoST
Community Development Plan	Details the benefits for project area communities and sets expectations and requirements for managing community development initiatives, ensuring clear understanding among all stakeholders throughout the project phases.	Framework Drafted	DoST

Management Plan	Summary	Status	Responsibility
Labor Management Procedure To include Human Resources Policy, Accommodation Management Plan, and a Code of Conduct	LMP outlines the project's labor procedures and Worker Code of Conduct, identifies key labor requirements and risks, and helps the project developer allocate resources to address these issues, including an action plan. The Accommodation Plan details compliance, reporting, roles, supervision, and training requirements related to labor and working conditions, including camp/accommodation.	Framework Drafted	DoST
Supply Chain Management Plan	Focuses on coordinating and optimizing the flow of goods, services, and information across the supply chain. It ensures that all materials and components are sourced ethically, without child or forced labor.	To be prepared before construction	DoST
Contractor Management Plan	Ensures that contractors and workers comply with health and safety laws and organizational policies. It includes guidelines for contractor selection, induction training, monitoring/supervision, and performance evaluation.	To be prepared before construction	DoST

13.7 MITIGATION MEASURES AND MONITORING PLANS

The environmental and social mitigation measures cover the impacts assessed in the ESIA throughout the Project's lifetime. Depending on the mitigation measure, it will have a different time frame to be implemented and monitored. The mitigation measures covered in the ESMP include mitigation measures for: Environmental Impacts; Biodiversity Impacts; Traffic Impacts; Occupational Social and Health Impacts; Community Social and Health Impacts; Gender Impacts; Human Rights Impacts; Climate Change Risk Impacts; Greenhouse Gases (GHG) Impacts; Unplanned Events Impacts; and Cumulative Impacts. They also cover training and capacity building for the community, workers, local government (Gelephu Thromde and Project Impact Gewogs) and national Government.

Accordingly, the monitoring plan will verify the effectiveness of the mitigation measures listed above. Key objectives of the monitoring process are to:

- Determine the timing for conducting audit/monitoring actions throughout the project lifecycle.
- Identify and monitor specific parameters that require assessment.
- Identify the locations or receptors where monitoring activities will be focused.
- Establish the intervals or frequency at which monitoring activities should be conducted.
- Ensure adherence to relevant standards, regulations, and guidelines set by regulatory authorities, industry best practices, or specific project requirements.

By incorporating these elements into the monitoring plan, the Project can effectively track and evaluate the performance of mitigation measures, identify any shortcomings or potential risks, and take appropriate actions to address them, promoting a sustainable and responsible project implementation. The details of measures and monitoring plans are presented below .

Table 13.5 Monitoring PLans

Identifier	Phase	Aspect	Monitoring Parameter	Location/Receptors	Frequency	Responsible Party
M1	Construction	Air quality	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust and record inspection results. Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	Within construction site and along the transport roads	Daily	EPC Contractor
M2	Construction	Air quality	Carry out regular site inspections to monitor compliance with the Air Quality Management Procedure, record inspection results and identify any events that require further investigation or actions.	Within construction site	Monthly	EPC contractor
M3	Construction And Operation	Air Quality	Undertake site boundary PM10 monitoring. Monitors should be positioned upwind and downwind of construction activities and relocated as construction works evolve.	At residential areas near the construction site and transport roads	Quarterly	EPC contractor
M4	Construction	Noise	Monitor the noise level	At locations of the affected receptors	Quarterly	EPC contractor
M5	Construction	Surface Water Quality	Establish a regular monitoring program to assess the health of riparian buffers, checking for signs of erosion, plant health, and water quality	Within construction site and along the transport roads	Monthly	EPC Contractor
M6	Construction	Surface Water Quality	Conduct regular water quality monitoring at runoff discharge points to detect pollutants and initiate corrective actions if contamination is detected	Within construction site and along the transport roads	Monthly	EPC Contractor
M7	Construction and Post-Construction	Surface Water Quality	Regularly monitor areas prone to erosion and rehabilitate with native vegetation to enhance stability	Within construction site and at locations of the affected receptors	Monthly	EPC Contractor
M8	Construction	Surface Water Quality	Conduct daily monitoring of effluent water quality.	Within construction site	Daily	EPC Contractor

M9	Construction	Biodiversity	Monitor habitat clearance closely to minimize risk of inadvertent additional clearing.	Within construction site	Daily	EPC Contractor
M10	Construction	Social	Monitoring of worker health and safety and other issues, such as: monitoring the wearing of PPE; Regular communication should be maintained with local health officials and emergency services (e.g. firefighting services) to monitor new health and safety issues; routine monitoring of grievance mechanism; actively monitoring of the code of conduct and consequences are clearly articulated to workers in the event that the code of conduct is breached.	Within construction site	Weekly	EPC Contractor & DoST
M11	Construction	Social	Implement pest control measures, such as monitoring of stagnant water bodies and waste storage areas, as these can create disease vector habitats.	Within construction site	Weekly	EPC Contractor
M12	Construction	Unplanned Events	Monitor seismic activity and avoid working in higher risk areas (e.g. steep slopes that must be disturbed), during periods of high activity.	Within construction site	Daily	EPC Contractor
M13	Construction	Unplanned Events	Closely monitor slope stability, especially those slopes most susceptible to landslides and where construction activity is occurring directly above a settlement or populated area. The construction contractor will include a slope stability monitoring strategy as part of the Response Plan to detect movement of overburden material, which could serve as an early warning of a potential landslide	Within construction site	Weekly	EPC Contractor
M14	Construction and Operation	Climate Change Risk Assessment	Monitor real-time weather conditions to be prepared for potential severe weather events	In the region and within construction site	Daily	EPC Contractor
M15	Construction	Hazardous material waste management	Check storage tanks and vehicles for leaks on at least a weekly basis	Within construction site	Weekly	EPC Contractor
M16	Construction	Domestic Waste	Regularly remove the organic / kitchen waste from the camp. Compost or recycle as possible	Within construction site	Weekly	EPC Contractor

M17	Operation	Noise	Implementing noise management plans and standard operating procedures to ensure compliance.	Project Site and surrounding residential area	On-going monitoring and periodical audit	DoST
M18	Operation	Noise	If any noise complaints are received, the problem source and any potential noise reducing measures should be identified and evaluated for implementation during the works.	Project Site and surrounding residential area	Per incident	DoST
M19	Operation	Surface Water Quality	Develop and implement a water management plan that includes monitoring mechanisms.	Project Site and surrounding residential area	Quarterly	DoST
M20	Operation	Invasive species	Monitoring of replanted sites -Where plant establishment is determined to have failed, reestablishment is to occur. Monitoring of invasive species - Monitor accidental introduction of invasive species at the planting sites or at other places within the project area.	Project area	Quarterly	DoST
M21	Operation	Biodiversity	Species monitoring – appropriate frequent monitoring of elephants' movement and corridors usage by elephants, frequent monitoring of the canopy bridge usage by Gee's Golden Langur, frequent monitoring of the culvert usage by Trilaminate Hill Turtles through the use of camera traps	Project area	Monthly	DoST & DoFPS
M22	Operation	Social	Implement monitoring and evaluation measures, both internal and external, which will ensure that PAPs relocating in the local area maintain livelihood conditions that are equal to or greater than pre-displacement levels and to ensure issues and concerns relating to land acquisition and resettlement are appropriately managed and addressed.	Project area	Quarterly	DoST
M23	Operation	Social	Coordinate with local authorities and services providers (e.g. the local hospital) to monitor challenges relating to the increased demand and collaborate on efforts to address these issues, efforts which would also support any pressures caused by the operation of the project.	Project area	Quarterly	DoST

M24	Operation	Traffic	Monitoring and frequent repair of the road surfaces.	Project area	Monthly	DoST
M25	Operation	Traffic	Keep records of traffic incidents during	Traffic incidents	Per incident	DoST
M26	Operation	Traffic	Keep records of any traffic-related grievance and resolution	Grievance and resolution	Monthly	DoST
M27	Operation	Greenhouse Gas Assessment	Develop a monitoring and evaluation system for road usage, including the number and types of vehicles.	Project Site	On-going monitoring and periodical audit	DoST

Table 13.6 Mitigation Measures

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
Physical Environment (PE)1	Ambient air quality	Construction dust	Dust Control Measures: Regularly applying water on construction sites, unpaved roads, and material storage areas to minimize fugitive dust emissions	Construction	Visual inspection Work Protocol	EPC Contractor
PE2	Ambient air quality	Construction dust	Covering Stockpiles: Ensuring that material stockpiles, such as sand, gravel, and other fine materials, are covered to prevent wind erosion and dust generation.	Construction	Visual inspection Work protocol	EPC Contractor
PE3	Ambient air quality	Construction dust	Site Planning: i. Plan Project layout so that machinery and dust causing activities are located away from receptors, as far as is possible. ii. Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site. iii. Consider fences and enclosures around specific operations where there is a high potential for dust production and the site is active for an extensive period. iv. Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. v. Limit site runoff (of water or mud) to prevent egress of material to other areas which can create dust emissions when dried. vi. Keep site fencing, barriers and scaffolding clean using wet methods. vii. Cover, seed or fence stockpiles to prevent wind whipping.	Construction	Management Plan Visual inspection Project design	EPC Contractor
PE4	Ambient air quality	Construction dust	Dust Management: • Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	Construction	Records and reports	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in a logbook. • Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. • Where construction compounds cannot be hard standing, use lignin-based surface sealants or watering as required/available to suppress dust generation. • Only use cutting, grinding, or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems. • Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate. Use lignin-based surface sealants where possible to reduce water consumption. • Minimize drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate. • Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. • Avoid bonfires and burning of waste materials • Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.			
PE5	Ambient air quality	Construction dust	Track out on hard standing public roads: • Use water-assisted dust sweeper(s) on hard standing access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.	Construction	Work protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Avoid dry sweeping of large areas. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. • Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). • Where a construction site is fenced off, access gates to be located at least 10 m from sensitive receptors where possible.			
PE6	Ambient air quality	Construction dust	Construction traffic: • Ensure all vehicles switch off engines when stationary - no idling vehicles. • Avoid the use of diesel- or petrol-powered vehicles practicable. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. • Impose and signpost a maximum-speed-limit of 30 kph on surfaced and 10 kph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided) and implement awareness training for drivers.	Construction	Project design Work protocol	EPC Contractor
PE7	Noise and vibration	Construction and operation noise	Siting noisy activities and plant as far as possible from sensitive receptors;	Construction	Project Design Record and Reports	EPC Contractor
PE8	Noise and vibration	Construction and operation noise	Configuring the construction traffic control system to minimize the need for mobile plant to reverse. Where reversing cannot be avoided, construction contractors will use alternatives to tonal reversing alarms, such as visual and/or broadband noise emitting models, that provide a safe system of work;	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE9	Noise and vibration	Construction noise	Where possible, selecting quieter plant and vehicles, e.g., electric powered equipment instead of combustion engines	Construction	Project Design	EPC Contractor
PE10	Noise and vibration	Construction noise	Switching off plant and vehicle engines when not in use	Construction	Work Protocol	EPC Contractor
PE11	Noise and vibration	Construction noise	Lowering items in a controlled manner rather than dropping them from heights	Construction	Work Protocol	EPC Contractor
PE12	Noise and vibration	Construction noise	Lining chutes and bins with damping material	Construction	Work Protocol	EPC Contractor
PE13	Noise and vibration	Construction noise	Locating stationary equipment in acoustically treated enclosures, where practicable	Construction	Project Design	EPC Contractor
PE14	Noise and vibration	Construction noise	Regularly maintaining equipment, plant and enclosures	Construction	Work Protocol	EPC Contractor
PE15	Noise and vibration	Construction noise	Installing mufflers or silencers as per manufacturer recommendations	Construction	Project Design	EPC Contractor
PE16	Noise and vibration	Construction noise	Avoiding vibration from activities over extended periods by implementing alternative techniques	Construction	Work Protocol	EPC Contractor
PE17	Noise and vibration	Construction noise	Effective communication with the occupants of the nearby sensitive receptors that could be at risk of being exposed to higher (although temporary) noise emissions during significant stages of work	Pre-construction Construction	Records and Reports	EPC Contractor
PE18	Noise and vibration	Construction noise	Ensuring that site personnel are aware of the recommendations for noise mitigation	Pre-construction Construction	Work Protocol Training plan	EPC Contractor
PE19	Noise and vibration	Construction noise	Constructing the accommodation in areas exposed to the least noise and vibration	Construction	Project Design	EPC Contractor
PE20	Noise and vibration	Construction noise	Increasing the sound insulation of façade elements	Construction	Project Design	EPC Contractor
PE21	Noise and vibration	Construction noise	Providing alternative means of ventilation to reduce the need to open windows during the periods of high external noise	Pre-Construction	Project Design	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
P22	Noise and vibration	Construction noise	Temporary relocation of affected receptors would be possible where there are no additional mitigation measures, and it is noted that some properties may be relocated permanently for other reasons.	Pre-Construction	Work Protocol, Relocation Plan	EPC Contractor, DoST
PE23	Noise and vibration	Operation noise	The WB Toll Roads Guidance provides a list of noise control measures can be applied to reduce the noise impact from the operation noise. The measures are summarized below: • Construction of the road below the level of the surrounding land; • Noise barriers along the border of the right-of-way (e.g. earthen mounds, walls, and vegetation); • Insulation of nearby building structures (typically consisting of window replacements); • Use of road surfaces that generate less tire noise such as stone-matrix asphalt	Pre-Construction, Construction and Operation	Project Design	EPC Contractor
PE24	Noise and vibration	Operation noise	Installation of noise barriers for densely populated areas, or for receptors worst affected by operational noise (as indicated during detailed design).	Construction	Project Design	EPC Contractor
PE25	Noise and vibration	Operation noise	New low noise road surface would be laid as part of the Project, which would be smooth and free of significant irregularities, and the road surface is to be regularly maintained, to minimize noise from road surface degradation	Operation	Project Design, Monitoring and maintenance	DoST
PE26	Surface water quality and hydrology	Hydrology	Sufficient drainage capacity to withstand the design rainfall of RP100.	Construction Operation	Project Design	Project Designer
PE27	Surface water quality and hydrology	Hydrology	The highway is designed to have 2% slope for drainage purposes. 2% slope is typically used to improve drainage by guiding rainwater off the road surface to culverts along the sides of the highway.	Pre-Construction	Project Design	Project Designer
PE28	Surface water quality and hydrology	Hydrology	Ensure a comprehensive hydrological and hydraulic study is completed to ensure engineering design each bridge location is met to ensure strong climate resilience for the future discharge rates due to climate change impacts (~potential 20% increase in flow)	Pre-construction Construction	Project Design	Project Designer

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE29	Surface water quality and hydrology	Hydrology	Detailed design to include bioengineering and slope protection work, established engineering structures. Some of the nature-based solutions are: • Riparian buffer zones • Bio-swales • Bioengineering techniques • Floodplain restoration and reconnection • Revetments with natural materials • Green terraces or stepped banks • Wetland and aquatic vegetation planting • Sediment control with vegetated buffer mats	Pre-construction Construction	Project Design	Project Designer
PE30	Surface water quality and hydrology	Hydrology	Defined legal sites for excavation of sand, gravel and aggregates. • Limit the material extraction from the river only in the deposited areas and no excavations in the active river channels. • Use materials only from legal sites and plants with licenses on extraction of construction materials. This will be spelled out in the bidding documents, in work contracts and will be verified in the C-ESMP prepared by the Contractors • Obtain a permit from local authorities for opening and/or use of borrow areas and quarries • Extraction of sand and gravel will be spread over the longest length possible from seasonal rivers so that no section of river bed is excessively disturbed • Source the material from the dry river beds and the non-perennial streams. • After the completion of extraction, the site will be properly fenced and closed, landscaped	Pre-Construction, Construction, Post-Construction	Project Design Records and Reports	Project Designer
PE31	Surface water quality and hydrology	Hydrology	Borrow sites will be restored after completion of the works	Construction Operation	Project design	EPC Contractor
PE32	Surface water quality and hydrology	Erosion and sedimentation	Prohibit the Contractor from clearing or disturbing any land beyond those approved by the Authorities.	Construction	Project design Management plan	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE33	Surface water quality and hydrology	Erosion and sedimentation	Implement the grievance mechanism, which will allow local stakeholders to inform Authorities and the Contractor of any erosion and sedimentation issues. Install approved sediment control measures before initiating land disturbing activities such that drainage from all disturbed areas is directed to a sediment control facility (e.g., silt fence, sediment trap, sediment pond)	Throughout Project Life Cycle	Management plan	EPC Contractor, DoST
PE34	Surface water quality and hydrology	Erosion and sedimentation	Preserve as much natural vegetation as possible especially near streams, floodplains, wetlands, steep slopes, and residential areas.	Throughout Project Life Cycle	Project design	Project Designer, EPC Contractor
PE35	Surface water quality and hydrology	Erosion and sedimentation	Remove, store, and seed or cover topsoil, along with associated leaf litter and organic matter, for post-construction land stabilization	Construction, Post-Construction	Records and Reports Project Design	EPC Contractor
PE36	Surface water quality and hydrology	Erosion and sedimentation	Manage excavated material by providing silt fencing / straw bales / berms around all topsoil / soil stockpiles and spoil disposal sites prior to commencement of earthworks	Construction, Post-Construction	Records and Reports Project Design	EPC Contractor
PE37	Surface water quality and hydrology	Erosion and sedimentation	Prohibit the Contractor from side-casting or discharge to streams of any excavated material	Throughout Project Life Cycle	Management plan Project design	EPC Contractor
PE38	Surface water quality and hydrology	Erosion and sedimentation	All excavated material must either be re-used as fill material or hauled and properly disposed of at an approved spoil disposal site	Construction Operation Decommissioning	Project design Management plan	EPC Contractor
PE39	Surface water quality and hydrology	Erosion and sedimentation	Provide proper drainage controls to manage water flow through disturbed areas and to direct surface water away from steep slopes or other erodible areas to natural drainage ways	Throughout project life cycle	Project design	EPC Contractor
PE40	Surface water quality and hydrology	Erosion and sedimentation	Protect exposed slopes by installing cut-off drains above and toe-drains below high cuts and provide terracing as	Construction	Project design	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			needed so as to avoid the potential concentration of stormwater runoff across disturbed soil			
PE41	Surface water quality and hydrology	Erosion and sedimentation	Conduct grading, excavation, and slope stabilization in a progressive manner across the site to minimize soil exposure both in terms of area and duration	Construction	Project design	EPC Contractor
PE42	Surface water quality and hydrology	Erosion and sedimentation	Stabilize disturbed areas as soon as possible in a progressive manner	Construction	Records and Reports, Project design	EPC Contractor
PE43	Surface water quality and hydrology	Erosion and sedimentation	Provide properly designed gabions/retaining walls for all spoil disposal sites	Construction	Project design	EPC Contractor, Project Designer
PE44	Surface water quality and hydrology	Erosion and sedimentation	Ensure all erosion and sediment control measures are in place and functioning properly before the advent of the monsoon season	Pre-construction Construction	Records and Reports, Management plan	EPC Contractor
PE45	Surface water quality and hydrology	Erosion and sedimentation	Provide regular (at least monthly) inspection of all erosion and sediment control structures to ensure they are working properly	Throughout Project Life Cycle	Management plan Records and Reports	EPC Contractor. DoST
PE46	Surface water quality and hydrology	Erosion and sedimentation	Provide gravel or concrete pathways along routes expected to receive heavy pedestrian traffic to reduce the risk of erosion	Pre-construction Construction	Project design	EPC Contractor
PE47	Surface water quality and hydrology	Erosion and sedimentation	Apply the stockpiled topsoil to help stabilize disturbed areas and promote the re-establishment of local native vegetation	Construction, Post-construction	Work protocol Management plan	EPC Contractor
PE48	Surface water quality and hydrology	Erosion and sedimentation	Use native grass seed and species to vegetatively stabilize disturbed areas. Use of invasive or foreign species is expressly prohibited	Construction, Post-construction	Work protocol Management plan	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE49	Surface water quality and hydrology	Erosion and sedimentation	Restrict vehicular traffic and pedestrian movement over vegetatively stabilized areas	Throughout project lifecycle	Work protocol Management plan Project design	EPC Contractor
PE50	Surface water quality and hydrology	Erosion and sedimentation	Maintain, and repair as needed, the erosion and sediment control facilities until vegetation is successfully established and the disturbed areas are effectively stabilized	Throughout project lifecycle	Work protocol Management plan Project design	EPC Contractor
PE51	Surface water quality and hydrology	Erosion and sedimentation	Provide special sediment control measures to minimize the increase of sediment entering the micro-hydropower plant intakes to avoid affecting the turbines, or provide electricity to the local villages	Throughout Project Lifecycle	Management plan Project design	EPC Contractor, DoST
PE52	Surface water quality and hydrology	Erosion and sedimentation	Limit the material extraction from rivers to deposit areas only and prohibit excavations in active river channels.	Construction	Management plan	EPC Contractor, DoST
PE53	Surface water quality and hydrology	Erosion and sedimentation	Include an experienced sediment and erosion control inspector	Throughout Project Lifecyle	Management plan	EPC Contractor, DoST
PE53	Surface water quality and hydrology	Surface water quality degradation	The Contractor will be required to prepare a Stormwater Management Plan describing in detail the methods it will use to minimize impacts to water quality.	Pre-construction Construction Post-construction	Project design	EPC Contractor
PE54	Surface water quality and hydrology	Surface water quality degradation	Ensure all drainage from these facilities including worker camps is directed to one or more stormwater basin to allow settling of suspended solids prior to discharge	Pre-construction Construction Post-construction	Project design	EPC Contractor
PE55	Surface water quality and hydrology	Surface water quality degradation	Limit the material extraction from the river only in the deposited areas and no excavations in the active river channels.	Pre-construction Construction Post-construction	Project design	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE56	Surface water quality and hydrology	Surface water quality degradation	Construction-use cement shall be bagged and stored on an impervious surface in a covered area to prevent exposure to water sources. The drainage from the cement storage area shall be directed to the stormwater basin for suspended solid settling prior discharge.	Construction	Project design	EPC Contractor
PE57	Surface water quality and hydrology	Surface water quality degradation	Redirect surface drainage around the spoil disposal areas to minimize runoff.	Construction	Project design	EPC Contractor
PE58	Surface water quality and hydrology	Surface water quality degradation	The stormwater basins will be regularly maintained to maintain its storage volume and the pH tested on a regular basis as the runoff can be highly alkaline (i.e., high pH). Treat water in the basin for high pH with a neutralizing acid (e.g., muriatic acid) as needed before discharge to a receiving stream.	Pre-construction Construction Post-construction	Project design	EPC Contractor
PE59	Surface water quality and hydrology	Surface water quality degradation	Provide an impervious surface and covered area for all workspace	Construction	Work protocol, Project design	EPC Contractor
PE60	Surface water quality and hydrology	Surface water quality degradation	Use a drip tray to collect oil and grease during vehicle maintenance	Construction Post-construction	Work protocol	EPC Contractor
PE61	Surface water quality and hydrology	Surface water quality degradation	Repair any leaking vehicles or equipment immediately	Throughout Project Lifecycle	Work protocol Management plan Records and reports	EPC Contractor
PE62	Surface water quality and hydrology	Surface water quality degradation	Direct all drainage potentially exposed to oil and grease to an oil/water separator	Construction	Work protocol Project design	EPC Contractor
PE63	Surface water quality and hydrology	Surface water quality degradation	Ensure all drainage is directed to one or more stormwater basins to allow settling of suspended solids prior to discharge	Construction	Work protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
					Project design	
PE64	Surface water quality and hydrology	Surface water quality degradation	For Spoil Disposal Areas: Redirect surface drainage around the spoil disposal areas. Provide a settling basin for drainage from the spoil disposal areas Test the pH of the water in the settling basins and add neutralizing material (e.g., lime) if any evidence of acidic conditions, which can promote the mobilization of metals.	Pre-construction Construction Post-construction	Work protocol Management plan Project design	EPC Contractor
PE65	Surface water quality and hydrology	Surface water quality degradation	Prohibit the discharge of any untreated wastewater to any receiving water	Throughout Project Lifecycle	Management plan Work protocol Project design	EPC Contractor, DoST
PE66	Surface water quality and hydrology	Surface water quality degradation	Prohibit open defecation by project workers	Throughout Project Lifecycle	Training plan Management plan Work Protocol	EPC Contractor
PE67	Surface water quality and hydrology	Surface water quality degradation	Provide an enhanced septic system with a bioreactor or similar design or a package wastewater treatment facility for each of the project access road worker camps. The wastewater treatment system selected must be designed to meet the Bhutan national water quality standards and the WBG EHS guidelines, whichever is stricter, and avoid any contamination of local potable water sources	Construction	Management plan Project design	EPC Contractor
PE68	Surface water quality and hydrology	Surface water quality degradation	Provide a wastewater treatment facility (e.g., a package wastewater treatment plant) at worker camps to treat domestic wastewater prior to discharge to a receiving water	Construction	Management plan Project design	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE69	Surface water quality and hydrology	Surface water quality degradation	The wastewater treatment facility will provide secondary treatment and ensure, through regular/frequent monitoring that the effluent meets the Bhutan national water quality standards and the WBG EHS guidelines, whichever is stricter	Construction	Management plan Project design Records and Reports	EPC Contractor
PE70	Surface water quality and hydrology	Surface water quality degradation	Ensure the effluent discharge locations for all wastewater treatment plants are downstream of all sites used by local residents for potable water	Construction	Records and Reports	EPC Contractor
PE71	Surface water quality and hydrology	Surface water quality degradation	Provide separate portable toilets for men and women at each of the project work areas. These toilets will be emptied on a regular basis by sewage trucks. These trucks will transport and discharge the wastewater into the wastewater treatment facility influent for treatment prior to discharge to a receiving water	Construction	Project Design Work Protocol	EPC Contractor
PE72	Surface water quality and hydrology	Surface water quality degradation	Maintain the wastewater treatment facilities in accordance with manufacturer specifications and conduct daily monitoring of effluent water quality.	Construction	Records and Reports	EPC Contractor
PE73	Surface water quality and hydrology	Drainage	Regular inspection and maintenance of drainage and culverts to ensure no blockage and also perform routine surveys of the area to make sure the slopes are maintained during the operation of the road	Operation	Records and Reports	DoST
PE74	Surface water quality and hydrology	Drainage	Strictly prohibit disposal of solid wastes by local people	Construction	Records and Reports	DoST
PE75	Surface water quality and hydrology	Drainage	Avoid disposal of any excess material in natural drainage paths	Construction	Work Protocol Records and Reports	EPC Contractor
PE76	Surface water quality and hydrology	Drainage	If temporarily disposed, clear drainage path prior to start of rainy season	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE77	Surface water quality and hydrology	Drainage	Sufficient drainage capacity to withstand the design rainfall of RP100.	Throughout Project Lifecycle	Project Design	EPC Contractor, DoST
PE78	Surface water quality and hydrology	Drainage	Regularly monitor areas prone to erosion and rehabilitate with native vegetation to enhance stability	Construction and Post-Construction	Records and Reports	EPC Contractor, DoST
PE79	Surface water quality and hydrology	Drainage	Engage with the Bhutan Meteorological Department on early warning systems and future forecasting of rainfall events (e.g. implement real-time hydrological monitoring stations to assess changes in water levels, flow rates, and quality, particularly during monsoon seasons) so that potential risks can be addressed promptly and activate pre-storm monitoring and maintenance activities	Throughout Project Life Cycle	Records and Reports	DoST
PE80	Surface water quality and hydrology	Drainage	Install oil-water separators in areas with heavy traffic or rest stops to capture vehicle pollutants and prevent contamination of nearby water sources.	Construction	Project Design	EPC Contractor
PE81	Surface water quality and hydrology	Drainage	Provide adequate facilities for spill containment and quick response measures to minimize impact on water resources in case of hazardous spills	Construction	Project Design	EPC Contractor
PE82	Surface water quality and hydrology	Drainage	Engage local communities in maintaining vegetated areas around highways and in awareness campaigns on the importance of protecting water resources	Post-Construction	Training Plan Records and Reports	EPC Contractor, DoST
PE83	Surface water quality and hydrology	Drainage	Develop a feedback mechanism for residents to report road or drainage issues that could impact water resources, enhancing responsiveness to environmental risks	Construction	Management Plan Records and Reports	DoST
PE84	Surface water quality and hydrology	Drainage	Preserve and maintain natural vegetation buffers along riverbanks near the highway to filter runoff, stabilize banks, and provide habitat for aquatic species	Post-Construction	Project Design	EPC Contractor, DoST
PE85	Surface water quality and hydrology	Drainage	Encourage riparian restoration by planting native vegetation to control erosion and filter sediments, helping maintain water quality in streams and rivers	Post-Construction	Reports and Records	EPC Contractor, DoS

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE86	Soil and groundwater quality	Soil compaction and damage	Prohibit the Contractor from clearing or disturbing any land beyond those approved by the Authorities.	Pre-Construction	Records and Reports	EPC Contractor
PE87	Soil and groundwater quality	Soil compaction and damage	Install and maintain approved erosion control measures before initiating land disturbing activities to protect soil resources.	Pre-Construction	Work Protocol, Records and Reports	EPC Contractor
PE88	Soil and groundwater quality	Soil compaction and damage	Remove, store, and cover topsoil, along with associated leaf litter and organic matter, for postconstruction land stabilization.	Construction, Post-Construction	Work Protocol, Records and Reports	EPC Contractor
PE89	Soil and groundwater quality	Soil compaction and damage	Apply the stockpiled topsoil to help stabilize disturbed areas and promote the re-establishment of local native vegetation.	Construction, Post-Construction	Work Protocol, Records and Reports	EPC Contractor
PE90	Soil and groundwater quality	Soil compaction and damage	Aerate compacted soils and provide soil amendments (e.g., fertilizer) as needed to restore the productivity of agricultural soils.	Post-Construction	Work Protocol, Records and Reports	EPC Contractor
PE91	Soil and groundwater quality	Contamination of soil and groundwater	At various construction sites, the vehicles and equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refueling sites are kept away from drainage channels and water bodies.	Construction	Work Protocol	EPC Contractor
PE92	Waste management	Waste management	Avoiding and/or minimizing waste generation where practical by improvements or changes in the project design or site procedures.	Pre-construction	Project Design	Project Designer
PE93	Waste management	Waste management	Reusing / recycling / recovering materials where possible and thereby negating / minimizing disposal requirements (e.g. by waste segregation according to type, separation of recyclable materials such as metal, reuse of wood from site hoarding/concrete formwork, utilization of excavated material for filling or landscaping).	Pre-construction	Project Design	Project Designer

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE94	Waste management	Waste management	Ensuring that all treatment and disposal options comply with best practice and all relevant guidelines and legislation.	Pre-construction, Construction	Project Design, Work Protocol	Project Designer, EPC Contractor
PE95	Waste management	Waste management	Coordinate with local authorities for waste disposal and ensure that waste management aligns with local standards and practices, including the identification of disposal sites and obtaining relevant permits	Pre-construction, Construction	Project Design, Work Protocol	Project Designer, EPC Contractor
PE96	Waste management	Worker mobilization/influx	DoST to Support the Gelephu Environmental Division to expand the existing land fill in Gelephu to be able to manage the increase in domestic hazardous wastes.	Pre-Construction	Management Plan	EPC Contractor
PE97	Waste management	Worker mobilization/influx	EPC contractor to Develop Waste Management Plan for various specific waste streams prior to commencing of construction and submit to DoST for approval. Minimum requirements include: • Provide appropriate waste storage areas and waste segregation practices • Separate domestic waste from construction waste; • Food waste collected and composted or transported to vermicompost treatment area • Transport all non-recyclable domestic waste by the Gelephu Environmental Division waste collector or the EPC construction contractor will be responsible for ensuring the safe transport of solid waste in covered trucks/containers to an approved solid waste landfill at least once a week for disposal. Domestic solid waste transported and disposed at the Gelephu landfill with approval from Gelephu Environmental Division. • Store solid waste temporarily on site in designated areas. The storage area shall include a covered concrete pad to avoid direct contact with precipitation and surface runoff and be fenced to prevent wind-blown litter. Waste storage containers shall be covered, tip-proof, weatherproof, and scavenger proof;	Construction	Management Plan	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Transport all other construction debris offsite for disposal at Gelephu landfill with approval from Gelephu Environmental Division; • Remove all construction-related debris from the site both during construction and at the completion of construction. • Separate out hazardous waste containers (oil, gas and chemical containers) and return back to vendor for proper disposal. No hazardous materials can be disposed in the area. Hazardous waste must be stored and safely managed.			
PE98	Waste management	Worker mobilization/influx	Maintain all facilities in a neat and tidy condition and keep all construction sites free of litter	Construction	Work Protocol	EPC Contractor
PE99	Waste management	Worker mobilization/influx	Random disposal of solid waste shall be strictly prohibited	Construction	Work Protocol	EPC Contractor
PE100	Waste management	Worker mobilization/influx	Provide easily identifiable and marked litter bins/garbage receptacles at convenient locations within the worker camps and work areas to reduce the potential for litter and discourage negligent behavior	Construction	Records and Reports	EPC Contractor
PE101	Waste management	Worker mobilization/influx	Train workers in the principle of the 3R's (reduce, reuse, and recycle) and apply this to the extent possible: • Segregate recyclables and perishables at the worker camps and provide separate clearly marked containers. • Collect, recycle, reuse, or make available to local scrap dealers all metal, empty cement bags, various containers, glass, wood, plastics, packaging material, wooden pallets, spent batteries, and rejected materials.	Construction	Training Plan Records and Reports	EPC Contractor
PE102	Waste management	Worker mobilization/influx	Training and waste management for health and safety to be included in contractors contract document.	Construction	Training Plan Records and Reports	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE103	Waste management	Worker mobilization/influx	The burning and burial of domestic wastes within fill or backfill areas will be prohibited	Construction	Project Design	EPC Contractor
PE104	Waste management	Worker mobilization/influx	Inert construction debris (e.g., waste concrete), can be disposed of within the designated spoil disposal areas that are confirmed to be both environmental and socially safe.	Construction, Post-Construction	Work Protocol	EPC Contractor
PE105	Waste management	Worker mobilization/influx	Transport all other construction debris offsite for disposal at government-approved solid waste disposal facilities that are confirmed to be both environmental and socially safe.	Post-Construction	Work Protocol	EPC Contractor
PE106	Waste management	Worker mobilization/influx	Remove all construction-related debris from the site both during construction and at the completion of construction	Post-Construction	Work Protocol	EPC Contractor
PE107	Waste management	Worker mobilization/influx	Separate our hazardous waste containers (oil, gas and chemical containers) and return back to vendor for proper disposal. No hazardous materials can be disposed in the area.	Construction	Work Protocol	EPC Contractor
PE108	Waste management	Worker mobilization/influx	Support to expand the existing land fill in Gelephu to be able to manage the increase in domestic hazardous wastes.	Pre-Construction	Project Design	EPC Contractor, Project Designer
PE109	Waste management	Worker mobilization/influx	Support to expand the existing land fill in Gelephu to be able to manage the increase in domestic hazardous wastes. Separate our hazardous waste containers (oil, gas and chemical containers) and return back to vendor for proper disposal. No hazardous materials can be disposed in the area.	Pre-Construction	Project Design	EPC Contractor, Project Designer
PE110	Waste management	Wastes generated from site clearance, excavations land clearing	Covering material during heavy rainfall	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE111	Waste management	Wastes generated from site clearance, excavations land clearing	Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin)	Construction	Work Protocol	EPC Contractor
PE112	Waste management	Wastes generated from site clearance, excavations land clearing	Controlling the excessive use of water during spraying to prevent the generation of runoff contaminated with elevated levels of suspended solids	Construction	Work Protocol	EPC Contractor
PE113	Waste management	Wastes generated from site clearance, excavations land clearing	Segregation of the surface water system for the stockpile area and the fitting of silt traps where appropriate	Construction	Work Protocol, Project Design	EPC Contractor
PE114	Waste management	Wastes generated from site clearance, excavations land clearing	Locating stockpiles to minimize potential visual impacts	Construction	Work Protocol, Project Design	EPC Contractor
PE115	Waste management	Wastes generated from site clearance, excavations land clearing	Minimizing land intake of stockpile areas as far as possible	Construction	Work Protocol, Project Design	EPC Contractor
PE116	Waste management	Wastes generated from site clearance,	Provide fencing within designated areas to separate sensitive habitats and prevent stockpiling in unsuitable locations; and designate appropriate haulage roads	Construction	Records and Reports	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		excavations land clearing				
PE117	Waste management	Wastes generated from site clearance, excavations land clearing	Minimizing excavation requirements as far as possible	Construction	Project Design Work Protocol	EPC Contractor, Project Designer
PE118	Waste management	Wastes generated from site clearance, excavations land clearing	Balancing cut and fill requirements	Construction	Work Protocol	EPC Contractor, Project Designer
PE119	Waste management	Wastes generated from site clearance, excavations land clearing	Evaluating the potential for maximizing the re-use of excavated materials for example, within landscape mounds	Construction, Post-Construction	Records and Reports	EPC Contractor, Project Designer
PE120	Waste management	Wastes generated from site clearance, excavations land clearing	Considering treatments for unsuitable excavated materials e.g. upgrading of subsoils to topsoil by mixing with compost	Construction, Post-Construction	Records and Reports	EPC Contractor
PE121	Waste management	Wastes generated from site clearance, excavations land clearing	Providing an area within the construction site to allow for sorting and segregation of materials	Construction	Work Protocol	EPC Contractor
PE122	Waste management	Wastes generated from site	Segregating waste materials from site clearance, excavations land clearing, according to type in order to	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		clearance, excavations land clearing	facilitate re-use and recycling (e.g. soils from land clearing and cuttings to be reused for embankments.			
PE123	Waste management	Wastes generated from site clearance, excavations land clearing	Co-ordinate material deliveries to site in order to minimize storage time on site and the likelihood of causing damage	Construction	Work Protocol	EPC Contractor
PE124	Waste management	Wastes generated from site clearance, excavations land clearing	Consider on site mulching of vegetation to reduce bulk and review opportunities for possible use within landscaping areas	Construction, Post-Construction	Records and Reports Work Protocol	EPC Contractor
PE125	Waste management	Wastes generated from site clearance, excavations land clearing	Training site staff in waste minimization practices	Construction	Training Plan	EPC Contractor
PE126	Waste management	Hazardous material waste management	Prohibit the disposal of any hazardous material or waste on-site	Across Project Life Cycle	Work Protocol	EPC Contractor
PE127	Waste management	Hazardous material waste management	Identify a suitable disposal location for the hazardous wastes	Construction	Project Design	EPC Contractor
PE128	Waste management	Hazardous material waste management	Provide training for staff using hazardous materials regarding proper care, handling, storage, transport, and disposal of hazardous materials and wastes. Only trained and authorized personnel shall handle hazardous materials and waste	Construction	Training Plan Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE129	Waste management	Hazardous material waste management	Maintain an inventory of all hazardous materials (e.g. diesel fuel, oils, solvents, paints)	Construction	Work Protocol Records and Reports	EPC Contractor
PE130	Waste management	Hazardous material waste management	Store all hazardous materials/wastes in designated and controlled (i.e., fenced with restricted entry) locations in suitable containers as prescribed by the manufacturer	Construction	Work Protocol	EPC Contractor
PE131	Waste management	Hazardous material waste management	Locate hazardous material/waste storage facilities at least 100 m from any perennial or intermittent stream channel	Construction	Project Design	EPC Contractor
PE132	Waste management	Hazardous material waste management	Identify all hazardous materials with hazard signage and have appropriate Material Safety Data Sheets posted at the storage facility, and kept on file at the site office	Construction	Records and Reports	EPC Contractor
PE133	Waste management	Hazardous material waste management	Provide an impervious floor and secondary containment with capacity of at least 110% of the largest container for all hazardous liquids, including access road, hydropower facility, and transmission line components	Construction	Project Design	EPC Contractor
PE134	Waste management	Hazardous material waste management	Provide spill kits at all work areas where hazardous materials are used and, in all vehicles, transporting hazardous materials, and ensure staff are trained in their effective use	Construction	Work Protocol	EPC Contractor
PE135	Waste management	Hazardous material waste management	Practice good housekeeping to store the hazardous materials in accordance with their hazard category	Construction	Work Protocol	EPC Contractor
PE136	Waste management	Hazardous material waste management	Prohibit the storage of empty fuel or oil drums	Construction	Work Protocol	EPC Contractor
PE137	Waste management	Hazardous material waste management	Dispose of hazardous waste at an approved waste disposal site or recycling company in accordance with Bhutan regulations and international good practice. Hazardous waste must transported to approved hazardous waste incinerator in Thimpu. Transported at least monthly.	Construction	Records and Reports Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
PE138	Waste management	Hazardous material waste management	Include in the construction contractors bid documents a requirement that in the event there are no approved disposal facilities for hazardous and/or special wastes, the contractor is responsible for properly transporting and disposing of such waste	Construction	Records and Reports Work Protocol	EPC Contractor
PE139	Waste management	Hazardous material waste management	Retain transport and disposal certificates documenting proper chain of custody for disposal of hazardous wastes	Construction	Records and Reports	EPC Contractor
			Biodiversity			
Biological Environment (B)1	Terrestrial Habitat	Loss of terrestrial habitat and component ecological populations	The Project will appoint an Ecological Clerk of Works (ECoW) to oversee and implement ecological mitigation measures.	Pre-construction	Visual Inspection	DoFPS Biodiversity Officer
B2	Terrestrial Habitat	Loss of terrestrial habitat and component ecological populations	The Ecological Clerk of Works to conduct a site walk through to confirm no species of conservation significance are present within the working areas. If any are present, translocate these species to a suitable area.	Pre-construction	Visual Inspection	DoFPS Biodiversity Officer
B3	Terrestrial Habitat	Wildlife mortality Increased human-wildlife conflict	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 Fauna Shepherding Protocol included in the Biodiversity Management Plan (BMP). In short, before any tree cutting, a visual inspection by the Project staff and Department of Forests and Park Services of Bhutan (DoFPS) officer should be conducted to identify the presence of wildlife, nests, or any species of conservation concern. If animals are found, especially species of conservation interest, ecologists or DoFPS officers should be contacted to safely relocate the animals.	Pre-construction	Training Plan Management Plan Visual Inspection Records and Reports	DoFPS Biodiversity Officer

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
B4	Terrestrial Habitat	Inadvertent loss of additional habitat	Demarcate areas to be cleared in advance with tape or fencing, to avoid inadvertent/ accidental additional clearing. The EcoW to monitor habitat clearance closely during construction to minimize risk.	Pre-Construction	Work Protocol, Visual Inspection	EPC Contractor Health Safety and Environment Manager
B5	Terrestrial Habitat	Inadvertent loss of additional habitat	Prohibit clearing vegetation outside of designated areas by all Project staff, workers, all contractors and personnel engaged in/or associated with the Project.	Pre-Construction	Work Protocol, visual inspection	EPC Contractor Health Safety and Environment Manager
B6	Terrestrial Habitat	Increased foraging of forest produce due to influx of workers.	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 conservation of significant species.	Pre-Construction, Construction	Training Plan, Work Protocol, Records and Reports	EPC Contractor Health Safety and Environment Manager
B7	Terrestrial Habitat	Increased foraging of forest produce due to influx of workers.	Checkpoints should be used to manage access and inspect vehicles for wood and timber products taken from areas of natural habitat within the project area.	Construction	Work Protocol, Records and Reports	EPC Contractor Health Safety and Environment Manager
B8	Terrestrial Habitat	Loss of terrestrial habitat and component ecological populations	Rehabilitate / reforest the temporary laydown areas and workers' camps to pre-construction conditions once construction is complete.	Post-construction	Work Protocol, Records and Reports	DoST E&S Field Officer
B9	Terrestrial Habitat	Loss of terrestrial habitat and component ecological	Rehabilitation/ reforestation will be implemented to compensate for residual impacts and achieve a no net loss of terrestrial Natural habitat. Develop an addendum Biodiversity Management Plan in consultation with the Department of Forest & Park Services (DoFPS). The	Before completion of construction	BAP	DoST E&S Manager

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		populations or functions	calculation of the required rehabilitation area will take into account: • Any overlap with Critical Habitat areas • The quality of the loss of habitat • The current habitat quality of the proposed rehabilitation site. If on-site rehabilitation is determined to be unfeasible, actions to enhance existing habitats will be considered as compensatory measures for the habitat loss.			
B10	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	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.	Construction	Records and Reports, Work Protocol	DoST E&S Field Officer
B11	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	The Project, e.g., ECoW works with the DoFS to install and frequently 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.	Construction	Records and Reports, Work Protocol	DoST E&S Field Officer
B12	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Preserve the eastern bank of Mau River as a natural passage to facilitate the movement of Asian Elephants until the elephant corridor is implemented. At the time of this assessment, this measure is being considered in the design of the elephant corridor and is included in The Gelephu Mindfulness City Masterplan. A monitoring program to track use of the eastern bank of Mau River by Asian elephants should be commenced prior to construction activities.	Construction	Project Design	DoST E&S Field Officer
B13	Terrestrial Habitat	Increased risk of wildlife mortality	Install and maintain wildlife fencing in areas where habitats support a variety of species, especially the eastern and western part of the Project adjacent to the subtropical	Construction	BMP	DoST E&S Field Officer

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		Increased human-wildlife conflict	forest and warm broadleaf forest. The specific locations of the wildlife fencing are to be determined in the BMP.			
B14	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Allocate adequate budget to establish and maintain wildlife crossings that are designed based on industry best practices and recent academic research to maintain safe passageway of animals between the natural habitats surrounding the Project such as: • Elephant corridor, taking into account the minimum size required and alignment as close as possible to the existing pathways utilized. (Electric) fencing with trench can be applied to navigate elephant's movement. Trenches, however, are prone to filling with water during the rainy season, and their sides may collapse if the soil structure is unstable, reducing their effectiveness as barriers. The project (e.g., ECoW) should collaborate with the DoFPS to conduct annual maintenance of the trenches after the rainy season to ensure their continued functionality. The cost for establishment and maintenance of the elephant corridor is specified in the BMP. Install and maintain wildlife fencing in areas where habitats support a variety of species, especially the eastern and western part of the Project adjacent to the subtropical forest and warm broadleaf forest. The specific locations for the wildlife fencing will be confirmed in the BMP. • Vegetated canopy bridge/ feeder ropes/ glider poles for arboreal species, i.e., Gee's Golden Langur. The specific locations for the canopy bridge will be confirmed in the BMP. • Crossings, such as culvert for Trilaminate Hill Turtles can minimize the fragmentation impact on this species, e.g. possibly to the west of the Project where the species was found during the field survey.[126] The	Construction and Operation	Project Design	DoST E&S Field Officer

[126] Mondal, I., Kumar, R. S., Habib, B., & Talukdar, G. (2016). Modelling fine scale movement corridors for the tricarinate hill turtle. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *41*, 719-725.

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			specific locations for the culverts will be confirmed in the BMP.			
B15	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Habitat Quality Improvement: Enhancing resources within protected areas through grassland development, nursery establishment, and invasive species management.	Pre-construction and Construction	Project Design	DoST E&S Manager and DoFPS Biodiversity Specialist
B16	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Prioritize the creation of a "Migration Corridor Pilot" consisting of an initial corridor development on available government land, with plans for potential expansion requiring additional funding.	Pre-construction and Construction	Project Design	DoST E&S Manager and DoFPS Biodiversity Specialist
B17	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Resource Availability: Development of waterholes and mineral licks to support wildlife within protected zones, reducing the incentive to move into human-occupied areas.	Pre-construction and Construction	Project Design	DoST E&S Manager and DoFPS Biodiversity Specialist
B18	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	The Project, e.g., ECoW works with the DoFPS to install and frequently maintain appropriate information signages at strategic wildlife crossings. The monitoring program outlined in the BMP will help identify areas with high wildlife movement. It is suggested to use high-visibility, reflective materials for signage, ensuring they are easily seen in low-light conditions.	Operation	Project Design, visual inspection	DoST E&S Field Officer
B19	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	The Project, i.e., ECoW collaborates with the DoFPS frequently monitor elephants' movement along the road and corridors usage by elephants to evaluate the success of the corridor.	Operation	Monitoring campaign, records and reports	DoST E&S Manager and DoFPS

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B20	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	The Project, i.e., ECoW collaborates with the DoFPS to frequently monitor the canopy bridge usage by Gee's Golden Langur.	Operation	Monitoring campaign, records and reports	DoST E&S Manager and DoFPS
B21	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	The Project, i.e., ECoW collaborates with the DoFPS to frequently monitor the culvert usage by Tricarinate Hill Turtles.	Operation	Monitoring campaign, records and reports	DoST E&S Manager and DoFPS
B22	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.	Operation	Work Protocol, site inspection	DoST E&S Field Officer
B23	Terrestrial Habitat	Increased risk of wildlife mortality Increased human-wildlife conflict	Department of Surface Transport (DoST) is responsible for collecting carcass due to roadkill, the Project ECoW works with the DoFPS and DoST to monitor this data.	Operation	Work Protocol	DoST E&S Field Officer
B24	Terrestrial Habitat	Habitat degradation from increased noise generation, air emissions etc.	Use fencing and hoarding where minor project infrastructure (such as buildings) is adjacent to natural habitat patches.	Construction and Operation	Project Design, Records and Reports	DoST E&S Manager
B25	Terrestrial Habitat	Increased fugitive dust emissions and risk of invasive	Implement a wheel wash system during construction to ensure minimize dust dispersion and movement of organic materials	Construction	Work Protocol	EPC Contractor Health Safety and

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		species spread.				Environment Manager
B26	Terrestrial Habitat	Increased fugitive dust emissions	Include water spraying of disturbed areas to minimize fugitive dust dispersion.	Construction	Work Protocol	EPC Contractor Health Safety and Environment Manager
B27	Terrestrial Habitat	Increased risk of felling and poaching activities due to worker influx.	Educate the staff and stakeholders about (i) Illegal Felling and Extraction of Trees, (ii)Harvest of Non-Wood Forest Product regulated as Forest and Nature Conservation Rules and Regulations, 2023, (iii) legal consequences of poaching and consuming bush meat. .	Begin during pre-construction, ongoing	Training Plan	EPC Contractor Health Safety and Environment Manager
B28	Terrestrial Habitat	Habitat Degradation - Invasive Species	Rehabilitate disturbed land that is not used with native species.	Post-Construction	Work Protocol, Records and Reports	DoST E&S Field Officer
B29	Terrestrial Habitat	Increased risk of invasive species spread	Develop an Invasive Species Management Plan to manage invasive species within the Project area so that any introduction or proliferation does not impact natural habitats in the proximal areas. The measures to prevent the transmission of invasive species should be planned and implemented, e.g., the Project to install wheel wash bays to remove dirt and plant material from vehicle wheels before entering and leaving the Project area during the construction. The Invasive Species Management Plan will include the invasive monitoring program, associated timeline, and the recommendation for invasive removal, where appropriate.	Begin during pre-construction, ongoing	Work Protocol, Records and Reports	DoST E&S Manager
B30	Terrestrial Habitat	Increased risk of invasive species spread	Removal of Lantana camara for habitat improvement: Lantana camara is an invasive exotic weed which is found spreading throughout the elephant's habitat under Sarpang dzongkhag	During construction and operation	Work Protocol, Records and Reports	DoST E&S Field Officer

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
B31	Terrestrial Habitat	Wildlife disturbance due to increased noise generation	Ensure that noise levels are minimized during nighttime operations by using quieter equipment and scheduling noisier activities for daytime working hours where possible.	Construction	Work Protocol	DoST E&S Manager
B32	Terrestrial Habitat	Wildlife 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.	Construction	Work Protocol	DoST E&S Manager
B33	Terrestrial Habitat	Wildlife disturbance due to artificial lighting	Use timers for permanent and temporary lighting where possible to avoid unnecessary light at night-time. Cowls, matt screens and directional lighting will be used to minimize artificial lighting of natural habitat areas	Construction and Operation	Work Protocol	DoST E&S Manager
B34	Aquatic Habitats	Aquatic species loss due to increased sedimentation	See Hydrology Mitigation Methods under PE44 – PE96	Throughout Project life cycle	-	
B35	Aquatic Habitats	Aquatic species loss due to increased sedimentation	Ensure the gabion basket shore protection and any wing wall construction are designed to appropriate standards to avoid historic design failures.	Pre-Construction	Project Design	Design Engineer
B36	Aquatic Habitats	Aquatic species loss due to increased sedimentation arising from increased risk of landslide and flooding.	Ensure designs factor in an adequate margin of safety in light of potential for extreme, climate change-driven weather (e.g. 1:500 or 1:1000 year flood)	Pre-Construction	Project Design	DoST E&S Manager

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B37	Aquatic Habitats	Decreased migratory route due to presence of physical barriers.	Assess and reduce risk factors to fish movement and survival in headwaters spawning and rearing areas.	Pre-Construction	Records and Reports, Visual Inspection	DoFPS Biodiversity Officer
B38	Aquatic Habitats	Aquatic species loss due to increased sedimentation	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 crossing before wet season.	Construction	Work Protocol, Project Design	DoST E&S Manager
B39	Aquatic Habitats	Aquatic species loss due to increased sedimentation	Stabilize areas disturbed by road and bridge construction by combined use of proper compaction, use of geotextile/erosion blankets, silt fencing, and reclamation using and native species of grasses, shrubs and trees to establish ground cover vegetation and stabilization	Construction	Project Design, Records and Reports	DoST E&S Field Officer
B40	Aquatic Habitats	Aquatic species loss due to increased sedimentation	Undertake before and after mark recapture and or telemetry studies of fish in affected watersheds to improve long-term understanding and management.	Pre-Construction and Construction	Monitoring Report	DoST E&S Manager
B41	Aquatic Habitats	Aquatic species loss due to increased sedimentation	The most intensive construction activities of the bridge, which can affect the water flow significantly, should be avoided during peak spawning seasons of Golden Mahseer (monsoon season).	Construction	Work Protocol	DoST E&S Manager
B42	Human - Wildlife Conflict	Human - Wildlife Conflict	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 *Fauna Shepherding Protocol* included in the Biodiversity Management Plan (BMP). Establish and implement the elephant corridor, considering the "least cost path analysis".	Construction	Work Protocol	DoST E&S Field Officer and DoFPS Biodiversity Officer

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B43	Human - Wildlife Conflict	Human - Wildlife Conflict	Establish a communication channel with the responsible team of the Department of Forestry and Park Services to notify the presence of Asian Elephant and ask for intervention in case of risk of attack from Asian elephants.	Construction	Work Protocol	DoST E&S Field Officer and DoFPS Biodiversity Officer
B44	Human - Wildlife Conflict	Human - Wildlife Conflict	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.	Construction	Work Protocol, visual inspection	DoST E&S Field Officer
B45	Human - Wildlife Conflict	Human - Wildlife Conflict	Minimize nighttime construction activities	Construction	Work Protocol, Project Design	DoST E&S Manager
B46	Human - Wildlife Conflict	Human - Wildlife Conflict	Implement speed limits during construction (30 km per hour) for vehicles to reduce wildlife road kills.	Construction	Work Protocol, Project Design	DoST E&S Manager
B48	Human - Wildlife Conflict	Human - Wildlife Conflict	Construct animal passages (crossing paths/ underpasses) at important animal crossing sites along the roads. (Electric) fences are recommended by the communities.	Construction	Project Design	DoST E&S Manager
B49	Human - Wildlife Conflict	Human - Wildlife Conflict	Clear blockages (e.g. fallen tree/ landslide) if any along the animal trails or movement routes.	Construction and Operation	Work Protocol and Site Inspection	DoST E&S Field Officer
B50	Human - Wildlife Conflict	Human - Wildlife Conflict	Encourage the community to plant crops less preferred by elephants, however, farmers must weigh the technical, economic, safety issues and practicality of switching to less elephant-preferred crops. The cultivated crops in the Sarpang Forest with the strongest positive correlation to conflict incidents include maize, paddy, mustard, and areca nut, while cardamom shows a negative correlation. The survey in the area suggested that cereals (61.83%) were the most impacted crop, followed by the damage to areca nut trees (37%) and other fruit trees including banana, mango, orange, and litchi at 36%. The cultivated crops in	Construction and Operation	Project Design	DoST E&S Manager and DoFPS

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			the Sarpang Forest with the strongest positive correlation to conflict incidents include maize, paddy, mustard, and areca nut, while cardamom shows a negative correlation.			
B51	Human - Wildlife Conflict	Human - Wildlife Conflict	It is suggested the DoFPS form a Quick Response Teams (QRTs). The Project ECoW works with the DoFPS to Establish the community engagement program that trains communities on reporting crop and wildlife depredation. It is reported that 36% respondents did not report crop depredation incidents to the agencies i) they were unaware of the reporting system, ii) the damage caused by elephants was minimal, and iii) they were tolerant towards such damage due to Buddhism	Construction and Operation	Project Design	DoST E&S Manager and DoFPS
B52	Human - Wildlife Conflict	Human - Wildlife Conflict	The Project ECoW should maintain regular communication with the DFO on a monthly basis regarding reported HWC cases. This data is essential for evaluating the effectiveness of the mitigation measures implemented to address HWC, helping to identify both successes and areas for improvement.	Construction and Operation	Project Design, Work Protocol	DoST E&S Manager and DoFPS
B53	Human Wildlife Conflict	Increased risk of human wildlife conflict	Frequent monitoring of key wildlife corridors, such as the elephant corridor, canopy bridges, and other animal crossings, and ensure these are free of obstructions.	Operations	Monitoring records	DoFPS
B54	Human Wildlife Conflict	Increased risk of human wildlife conflict	Avoid conducting construction activities at night, 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	Construction	HWC records	DoST E&S Manager
B55	Ecosystem Services	Increased pressure onto existing water sources	Limit sourcing water from nearby rivers or streams that are used by local villages for potable water. Note that this is particularly pertinent near the Tareythang area.	Construction	Work Protocol	DoST E&S Manager
B56	Ecosystem Services	Increased risk of sedimentation, thereby	Ensure proper erosion and sediment control measures are implemented.	Construction	Project Design, Records and Reports	DoST E&S Manager

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		reducing water quality				
B57	Ecosystem Services	Increased pressure onto existing water sources	Provide safe potable water to households relying on water sources downstream of construction activities, via extending of the project's water system, well installation or piping water from upstream locations.	Construction and Operation	Work Protocol	DoST E&S Manager
B58	Ecosystem Services	Increased pressure onto existing water sources	If surface water will be utilized for Project use, a water use/extraction plan will be developed at a later stage. Any impact on water supply due to project activities should be compensated/replaced or restored.	Construction	Management Plan	DoST E&S Manager
			Social			
Social Environment(SE1	Land Acquisition	Physical & Economic displacement	Ensure the development and implementation of a Resettlement Action Plan (RAP), and applying ESS5 and national laws, notably The Land Act of Bhutan 2007 to relocate landowners / users within villages, Gewogs / Thromdes or Dzongkhags (as identified), in order to minimize livelihood disruption and retain local population	Pre-construction, prior to land acquisition	Resettlement Action Plan (RAP) document	DoST
SE2	Land Acquisition	Physical & Economic displacement	Engage with PAPs regarding their resettlement preferences and alternative livelihood options will be conducted in line with meaningful and participatory engagement principles.	Pre-construction, prior to land acquisition and throughout Project Life Cycle	Resettlement Action Plan (RAP) document and records of engagement	DoST
SE3	Land Acquisition	Physical & Economic displacement	Ensure that all land users have been identified during the land acquisition process, including (i) those with formal legal rights to land or assets; (ii) those without formal legal rights but who have claims recognized under national law; and (iii) those without recognized legal rights or claims to the land or assets they occupy.	Pre-Construction and, prior to land acquisition	Resettlement Action Plan (RAP) document	DoST
SE4	Land Acquisition	Physical & Economic displacement	Ensure that the compensation provided reflects the full replacement cost, as outlined in ESS5, and where possible,	Pre-Construction, prior to land acquisition	Records of compensation	DoST

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			seek to provide in-kind compensation. This will be based on a market valuation study.		/ land replacement	
SE5	Land Acquisition	Physical & Economic displacement	Ensure the provision of equal rights and access to banking services is implemented, enabling PAPs to securely manage and access their compensation funds, which includes • Providing access to and education of financial services; and • Payments will be made into a bank account in the joint name of husband and wife where the property is jointly owned.	Pre-Construction, prior to land acquisition and throughout project life cycle (as per the RAP)	Records of RAP implementation and monitoring / evaluation reports as required under the RAP	DoST
SE6	Land Acquisition	Physical & Economic displacement	Ensure vulnerable groups are not disproportionately impacted by land acquisition: • Ensure vulnerable groups (e.g., women, children, elderly, disabled and CALD) receive adequate support and compensation. • Ensuring vulnerable households are aware of Grievance Redressal Mechanism (GRM) and Livelihood Restoration Programs (LRPs); and • Supporting the formation of women-led Self-Help Groups (SHGs) to foster economic independence among resettled women through savings, credit access, and entrepreneurship.	Pre-Construction, prior to land acquisition and throughout project life cycle (as per the RAP)	Records of RAP implementation and monitoring / evaluation reports as required under the RAP	DoST
SE7	Land Acquisition	Physical & Economic displacement	Ensure resettlement sites take into consideration proximity to social infrastructure and provision of services. The following measures will be considered to mitigate the socio-cultural, economic and spiritual impacts associated with physical displacement: • Proximity to essential social infrastructure, such as schools, healthcare facilities, and markets. • Access to physical infrastructure like water, electricity, sanitation, and drainage systems, with improved service levels compared to previous conditions.	Pre-Construction and, prior to land acquisition	Resettlement Action Plan (RAP) document	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Proximity to nearby agricultural land and local markets to support livelihoods dependent on farming. • Employment, job transition and training opportunities and support to restore or improve livelihood conditions. • Consideration of spiritual needs, places of worship, and kinship networks to maintain religious, cultural and social cohesion. • Connected to transportation networks and major roads, and • Efforts to ensure proximity to community leaders, including religious leaders, for maintaining cultural and religious practices. •			
SE8	Land Acquisition	Physical & Economic displacement	Ensure that PAPs opting for relocation with the local area have access to the same or improved services and LRPs.	Prior to construction and throughout Project Life Cycle	Records of RAP implementation and monitoring / evaluation reports as required under the RAP	DoST
SE9	Land Acquisition	Physical & Economic displacement	Implement monitoring and evaluation measures, both internal and external, which will ensure that PAPs relocating in the local area maintain livelihood conditions that are equal to or greater than pre-displacement levels.	Prior to construction and throughout Project Life Cycle	Records of RAP implementation and monitoring / evaluation reports as required under the RAP	DoST

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SE10	Land Acquisition	Physical & Economic displacement	Engineering, Procurement, and Construction (EPC) will follow the criteria for identifying appropriate locations for temporary facilities (i.e. ancillary infrastructure, laydown areas, batching, worker camps and disposal areas) to avoid or minimize economic and socio-cultural impacts on the villages. The following mitigations measures will be in place: • All temporary facilities should not be located upstream of any water sources and should not affect the water quality of mountain springs and streams used by the community for their water supply. • Locations of all temporary facilities will be agreed with the communities, compensated and necessary ceremonial rites and offerings conducted before any use by the EPC or its subcontractors. • Workers' accommodations will be located away from settlements and sacred locations such as ceremonial grounds, cremation grounds. • Temporary roads and disposal areas will not be located on agricultural land, residential land, privately used communal land under use by communities and Non-Timber Forest Product (NTFP) areas unless communal land and NTFP area have already been identified and included in the survey and covered in the RAP. • Quarry sites will be located and constructed to avoid livelihood impacts and will be rehabilitated post-use. • Borrow pits, laydown areas and worker camps will avoid or minimize impacts on community forests, residential or agricultural land plots, and • Waste disposal areas will be located at a safe distance from residential or agricultural areas.	Prior to construction and throughout Project Life Cycle	Records of RAP document	DoST
SE11	Land Acquisition	Physical & Economic displacement	Implement the community GRM. This will provide an appropriate channel for stakeholders to voice their concerns, including opportunities for written and verbal communication. Ensure vulnerable groups are informed of	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

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			their rights and the ways in which they can communicate their grievance.			
SE12	Land Acquisition	Physical & Economic displacement	Ensure engagement activities are conducted as part of government-led land acquisition process so that stakeholders are aware of the process, as well as seek support or lodge grievances if required.	Throughout Project Life Cycle	Records and Reports	DoST
SE13	Land Acquisition	Physical & Economic displacement	Apply appropriate mitigation measures to avoid or minimize vibration disturbances (i.e. construction traffic) in erosion and landslide prone areas to reduce the amount of physical displacement due to health and safety requirements.	Throughout Project Life Cycle	Records and Reports Project Design	EPC Contractor
SE14	Land Acquisition	Physical & Economic displacement	Where possible, provide like-for-like agricultural land to ensure that PAPs can continue their farming or grazing activities with minimal disruption, maintaining their pre-displacement livelihoods. If like-for-like land to facilitate pre-displacement livelihood activities is unavailable for resettlement, provide cash compensation to the affected households at market rates, followed by livelihood restoration through other means.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE15	Land Acquisition	Physical & Economic displacement	Ensure that meaningful consultation with PAPs informs the development of LRP programs to align with their specific needs, preferences and vulnerabilities.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE16	Land Acquisition	Physical & Economic displacement	If like-for-like land to facilitate pre-displacement livelihood activities is unavailable for resettlement, livelihoods will be restored by facilitating access to agricultural or non-agricultural employment, providing training for alternative skills or agro-processing opportunities and offering financial support (i.e. microfinancing).	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE17	Land Acquisition	Physical & Economic displacement	Provide short-term livelihood restoration measures to replace the loss of social safety nets typical of agricultural areas, such as subsidies, stipends, and food supplies.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

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SE18	Land Acquisition	Physical & Economic displacement	The following skills and training development support will be provided to PAPs: • Vocational training programs for PAPs to develop technical and professional skills suited to the region's job opportunities and leveraging existing skills and work experience. • Providing scholarships to vulnerable households to offset the economic impact of displacement. • Skill development programs to help economically displaced individuals acquire new skills relevant to local job markets, improving their employability, and • Literacy programs to improve employability and enhance their ability to access information and services.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE19	Land Acquisition	Physical & Economic displacement	The following accessibility measures, which were identified during consultations with stakeholders, and will be implemented by the Project: • Providing free transportation to ensure economically displaced persons, especially vulnerable groups, can access educational institutions, job markets, and essential services. • Expanding and/or redirecting public transport routes to improve connectivity in resettled areas, ensuring that displaced populations can integrate into the regional economy. • Ensuring that newly established or resettled communities, especially those with elderly, disabled, widowed or other marginalized household members, have equal or improved physical access to essential services, markets, and social amenities when compared to pre-displacement levels.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE20	Occupation and Livelihoods	Employment opportunities	Develop and implement a comprehensive CDP that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider inclusive strategies that create equitable opportunities for	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

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			vulnerable groups by setting clear goals for hiring and supplier diversity, and providing targeted training and support, organizations can ensure that all individuals have fair access to employment and contracting opportunities.			
SE21	Occupation and Livelihoods	Employment opportunities	Conduct an assessment within the social study area to identify potential employment and procurement opportunities. Consider providing training opportunities to build local capacity to contribute to the Project.	Prior to construction and throughout construction phase	Documentary and photographic evidence, RAP document	DoST
SE22	Occupation and Livelihoods	Employment opportunities	Inform local communities of employment opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate.	Pre-construction and throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE23	Occupation and Livelihoods	Employment opportunities	Notify local training facilities of the skills that will be required during the course of the Project, in particular construction. Implement and maintain a project GRM, so that stakeholders can raise issues and concerns.	Pre-construction and throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE24	Occupation and Livelihoods	Business opportunities	Inform local businesses of employment opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate.	Pre-construction and throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE25	Occupation and Livelihoods	Business opportunities	Consider providing training opportunities to build local capacity to contribute to the Project. Promote bank credit and self-financing facilities among the affected households, to enable small income-generating activities.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE26	In-Migration	Infrastructure and services	Develop and implement an Influx Management Plan, including for foreign workers. This plan should identify strategies to manage not only influx, but also the implications of influx. It should work in tandem with the Community Development Plan, Workforce Management Plan and Worker Code of Conduct. These documents collectively should establish a robust system for managing and monitoring potential impacts associated with influx.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE27	In-Migration	Infrastructure and services	Develop and implement a comprehensive Community Development Plan (CDP) that outlines specific procedures for prioritizing employment to people who live in the social study area. Communicate the Project's local hiring policy widely to discourage opportunistic jobseekers. As part of the CDP, consider investments in upgrading local infrastructure and public services, such as healthcare, education, and transportation, to meet the needs of the growing population and reduce pressure on existing resources, to ensure that both new and existing residents benefit from improved facilities, helping to maintain community harmony.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE28	In-Migration	Infrastructure and services	Develop and implement a Labor Management Procedure (LMP) that aligns with international good practice standards, including but not limited to World Bank ESS-2.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE29	In-Migration	Infrastructure and services	Develop and implement a workforce code of conduct, which should be cascaded to contracted workers and supply chain workers. The code of conduct should outline clearly requirements regarding safeguarding the health and wellbeing of all workers (including women), such as the following: • Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity. • A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest. • Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment. • Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety. • Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

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			• Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers. • Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly. • Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions. • Zero tolerance of SEA/SH.			
SE30	In-Migration	Infrastructure and services	Develop and implement a Workforce Accommodation Plan (WAP) that aligns with the international good practice standards, such as *Workers' Accommodation: A Guidance Note by IFC and EBRD*. The WAP should address both living standards and social infrastructure to cater the influx of workers. The WAP should consider: • Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed. • Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water. • Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired. • Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar. • Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs. • Offer essential shops, personal care services, and banking or ATM facilities within easy reach.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST

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			• Designate gathering areas for social events, cultural celebrations, and prayer rooms. • Arrange shuttle services to nearby centers and information on public transportation options. • Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces. • Implement regular cleaning, prompt repair services, and pest control to maintain living standards. • Consider vulnerable populations within the design of the accommodation facilities, specifically ensure there is appropriate security arrangements in place and accessibility reflects the needs of the workforce.			
SE31	In-Migration	Infrastructure and services	Develop local opportunities through training programmes with skill sets that match the Project requirements. This may form part of a livelihood restoration or social investment program.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE32	In-Migration	Infrastructure and services	Coordinate with local authorities and services providers (e.g. the local hospital) to monitor challenges relating to the increased demand and collaborate on efforts to address these issues, efforts which would also support any pressures caused by the operation of the project.	Construction	Management Plan, Work Protocol	DoST, EPC Contractor
SE33	In-Migration	Infrastructure and services	Consider busing workers to and from the Project site to avoid creating additional traffic – e.g. pick up local workers at central points and bus them to site, bus workers from the worker accommodation camp(s) to site.	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE34	In-Migration	Infrastructure and services	Conduct ongoing engagement with stakeholders so that stakeholders are aware of the timing of construction activities (e.g. peak construction periods).	Throughout Project Life Cycle	Management Plan Records and Reports	DoST
SE35	In-Migration	Infrastructure and services	Implement and maintain a project GRM for workers, including contractor and subcontractor workers.	Throughout Project Life Cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
					Records and Reports	
SE36	In-Migration	Social cohesion	Develop transparent and inclusive communication channels to keep residents informed about the Project's developments and progress. Clear communication helps manage expectations and reduces uncertainty, promoting cooperation and minimizing resistance.	Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST
SE37	Labor and working conditions	Working conditions	Implement the following Labor Management Procedure (LMP) aligned with international good practice standards, including but not limited to World Bank ESS-2. All workers engaged by the Project shall comply to the following procedures: ● Procedures to Manage workers: The Project will follow the below procedures in providing terms and conditions of employment, nondiscrimination and equal opportunity, and worker's organizations: ○ Contractors will provide job/employment contracts with clear terms and conditions, including rights related to work hours, wages, overtime, compensation and benefits, annual holiday and sick leave, maternity leave and family leave. ○ Employment practices that ensure workers are not discriminated against on the grounds of race, color, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation . As part of the hiring process, age checks will be conducted. ○ Employment practices that ensure passports or other forms of identification are not withheld. An offer can be made to workers to store the relevant forms of identification in a safe location, but workers should always have access to their identification. ○ Employment practices that ensure workers are paid appropriately and in a timely	Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST

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			manner, informed by national standards and industry benchmarks. ○ Safeguards if recruitment agents are utilised. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt). Passports or other forms of identification should not be withheld. ○ Ensure work environment with zero tolerance of SEA/SH. ○ Reasonable efforts should be made to ascertain that third parties who engage contracted workers are legitimate and reliable entities which have in place labor management procedures applicable to the project which are in accordance with national labor law and ESS-2. • Child and Forced Labor: The following procedures will be followed to prevent child and forced labor in the Project: ○ The minimum age of the worker to be engaged in the Project is 18. Age verification of all workers will be conducted by the contractors from Citizenship Identity Cards, Birth certificates, School Leaving Certificates, Health Cards issued by relevant authorities. ○ Prohibition of the use of forced labor (i.e., compulsory labor, such as indentured labor, bonded labor, or similar labor-contracting arrangements.) No trafficked persons will be employed in connection with the project. • Grievance Mechanism: Contractors will establish a Worker's Grievance Mechanism. All workers will be informed of the Worker's Grievance Mechanism to			

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			raise work-related grievances, including any sensitive and serious grievances on SEA/SH. • Code of Conduct: Workers agree to sign the following code of conduct, which should be cascaded to contracted workers and supply chain workers: o Prohibition of being under the influence of alcohol or drugs while on duty to ensure safety and productivity. o A policy against poaching workers employed by the project, promoting job stability and discouraging conflicts of interest. o Respectful behavior and zero tolerance for harassment, abuse, or discrimination in the workplace, fostering a safe and inclusive environment. o Adherence to safety protocols and proper use of personal protective equipment (PPE) to minimize risks and promote health and safety. o Proper use and maintenance of project equipment and resources to prevent damage, wastage, and ensure efficiency. o Wildlife awareness instruction and information on the human-wildlife interaction, which applies to animals that are in danger, or are dangerous to workers. o Compliance with confidentiality requirements, ensuring that sensitive information about the project is protected and not disclosed improperly. o Guidelines for ethical behavior, including honesty, integrity, and professionalism in all work-related activities and interactions. o Zero tolerance of SEA/SH. • Workers Accommodation: Contractors will develop and implement a workers accommodation plan			

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			(WAP) that align with the international good practice standards, such as *Workers' Accommodation: A Guidance Note by IFC.*. The WAP should address both living standards and social infrastructure to cater the influx of worker. The WAP should consider: ○ Ensure clean, safe, and comfortable housing with adequate lighting, ventilation, heating/ cooling and private sleeping arrangements. Motelling arrangements should be allowed. ○ Provide sufficient, regularly cleaned bathrooms, showers, laundry facilities, and access to clean drinking water. ○ Offer nutritious meal options, in a designated dining area, and cooking facilities if self-catering is desired. ○ Include on-site or nearby healthcare, mental health support, and emergency medical resources. In establishing healthcare facilities, it will be important that space is provided for sick bays, in instances workers may need to quarantine or similar. ○ Create spaces for sports, relaxation, and entertainment, including outdoor areas and common rooms with games or TVs. ○ Offer essential shops, personal care services, and banking or ATM facilities within easy reach. ○ Designate gathering areas for social events, cultural celebrations, and prayer rooms. ○ Arrange shuttle services to nearby centres and information on public transportation options. ○ Ensure secure personal storage, locked accommodation, and respect for privacy, especially in shared spaces.			

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			○ Implement regular cleaning, prompt repair services, and pest control to maintain living standards. ○ Consider vulnerable populations within the design of the accommodation facilities, specifically ensure there is appropriate security arrangements in place and accessibility reflects the needs of the workforce.			
SE38	Labor and working conditions	Worker health and safety	Develop and implement a Health and Safety Management Plan that applies to workers and contracted workers. It will be important that the Plan puts in place strategies to minimize the risk associated with human-wildlife interactions, as well as local issues, such as exposure to tuberculosis, heat stress and landslides.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor, DoST
SE39	Labor and working conditions	Worker health and safety	Provide an induction and on-going training for all workers, including contracted workers, regarding health and safety. This should include the wearing of appropriate PPE, good hygiene practices and information relating to infectious diseases, and the management of risks and hazards.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor, DoST
SE40	Labor and working conditions	Worker health and safety	Ensure workers have personal protective equipment (PPE) appropriate to their role. Supervisors should be required to monitor the wearing of PPE.	Pre-construction, Construction	Work Protocol	EPC Contractor, DoST
SE41	Labor and working conditions	Worker health and safety	Require workers (including contracted workers) to complete a Job Hazard Analysis (JHAs) prior to undertaking construction activities, as well as conduct daily toolbox discussions to ensure hazards are identified and management measures are implemented. The JHAs should consider environmental conditions, particularly extreme temperatures (and heat stress) as well as landslides.	Pre-construction, Construction	Management Plan, Work Protocol, Records and Reports	EPC Contractor, DoST
SE42	Labor and working conditions	Worker health and safety	Ensure equipment is well maintained and sufficient lighting is available to maintain a safe work environment.	Pre-construction, Construction	Work Protocol	EPC Contractor, DoST

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SE43	Labor and working conditions	Worker health and safety	Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor, DoST
SE44	Labor and working conditions	Worker health and safety	Training staff on species encounters, implementing wildlife-safe speed limits, installing signage at crossings, and clearing obstructions on wildlife trails.	Pre-construction, Construction	Management Plan, Training delivered, Records and Reports	EPC Contractor, DoST
SE45	Labor and working conditions	Worker health and safety	Develop and implement waste management procedures to ensure appropriate storage and removal of waste to reduce the potential occurrence of infectious diseases.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor,
SE46	Labor and working conditions	Worker health and safety	Implement pest control measures, such as monitoring of stagnant water bodies and waste storage areas, as these can create vector habitat.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor,
SE47	Labor and working conditions	Worker health and safety	Conduct medical assessments of workers before they are mobilized to the site, including screening for infectious diseases and other health issues, to ensure they are fit for work. Coordinate with local health officials to undertake pre-mobilization health checks, which should be required prior to workers commencing work. This should be used to ensure that workers are fit for the role that they will be undertaking. Safeguards should be put in place to ensure that the health check process does not contribute to discriminatory hiring practices.	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor,
SE48	Labor and working conditions	Worker health and safety	Provide health/ medical care to workers and contractors at the Project site for minor health issues (e.g. minor injuries, colds, sprains, etc.) and preventative care (e.g. vaccines, health awareness training).	Pre-construction, Construction	Management Plan Records and Reports	EPC Contractor,
SE49	Labor and working conditions	Worker health and safety	Coordinate with local health officials on their infectious disease management and prevention strategies to ensure workers are made aware of requirements to report infections and preventative measures. There should be a	Pre-construction, Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST

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			focus on diseases with high transmission rates, which can be transmitted quickly between workforce and community.			
SE50	Labor and working conditions	Worker health and safety	Regular communication should be maintained with local health officials and emergency services (e.g. firefighting services) to monitor new health and safety issues that may be impacted by, or impact the Project workforce, and collaborate on solutions to address these issues.	Pre-construction, Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST
SE51	Labor and working conditions	Worker health and safety	Develop and implement an emergency response plan, including response to an infectious disease outbreak, in consultation with local health care providers.	Pre-construction, Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST
SE52	Labor and working conditions	Worker health and safety	Provide a dedicated trained Emergency Medical Technician (EMT) or other medical emergency resource on-site, including medical emergency transportation, to address medical emergencies and coordinate with local hospitals for higher level care.	Pre-construction, Throughout Project Life Cycle	Management Plan Records and Reports	EPC Contractor, DoST
SE53	Labor and working conditions	Worker health and safety	Establish and implement a GRM for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain, should have access to a GRM to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised. Routine monitoring of the GRM process should be undertaken.	Pre-construction, Construction	Management Plan, Training Delivered	EPC Contractor, DoST
SE54	Community infrastructure and wellbeing	Physical infrastructure	Implement mitigation measures outlined in the respective Impact Assessment relating to waste, water and traffic.	Pre-construction, Construction	Management Plan, Work Protocols, Records and Reports	EPC Contractor
SE55	Community infrastructure and wellbeing	Physical infrastructure	Develop and implement a water management plan that includes monitoring mechanisms. Consider inclusion of a water sharing agreement with the communities in the Project impacted area.	Pre-construction, Throughout Project Life Cycle	Management Plan, Records and Reports	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE56	Community infrastructure and wellbeing	Physical infrastructure	Develop and implement a Logistics Management Plan to work in tandem with the traffic management plan to map out how logistics will work, including the timing and pathway used to transport equipment and materials to locations that are hard to access. Keep community informed about timing and potential road and access closures.	Throughout project life cycle	Management Plan	DoST
SE57	Community infrastructure and wellbeing	Health, safety and wellbeing	Look at opportunities to minimize traffic, and reduce speed limits, during peak times, such as school times / when kids are travelling to and from school.	Throughout project life cycle	Management Plan	DoST
SE58	Community infrastructure and wellbeing	Health, safety and wellbeing	Guidance should be provided for contractors working within the perimeter of the construction site to ensure they are insured, thereby protecting the rights and interests of the driver and pedestrians.	Throughout project life cycle	Management Plan	DoST
SE59	Gender assessment	Amenity Value	Management measures to meet regulatory and international standards include: • Preparation and implementation of the Construction Environmental & Social Management Plan (C-ESMP), including monitoring mechanisms. • Develop and implement traffic management measures, which should be implemented through a Traffic Management Plan, including monitoring mechanisms. • Review noise assessment results following the completion of the census and asset inventory to identify any areas exceeding acceptable noise levels and implement appropriate noise reduction strategies. • Conduct ongoing engagement with stakeholders so that stakeholders are aware of the timing of construction activities (e.g. periods of increased noise and dust). • Implement and maintain a project GRM, so that stakeholders can raise issues and concerns.	Pre-construction, Construction	Management Plan, Work Protocols	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE60	Gender assessment	Land Use and Acquisition	Development and implementation of the Gender Action Plan (GAP), with ongoing monitoring.	Pre-construction, Construction	Management Plan, Work Protocols	EPC Contractor
SE61	Gender assessment	Land Use and Acquisition	Women should be specifically asked to attend the meetings regarding land acquisition, and agreement should be done jointly with the landowner and their spouse so that women are aware of the dealings. In situations where women hesitate to participate in these discussions, prior meetings should be held separately with women to provide them with all the information required and help them participate in the process and/or arrive at decisions. Women should be informed in a culturally and locally appropriate manner, meaning consideration will need to be given to local language requirements.	Pre-construction, Construction	Management Plan, Work Protocols, Training Delivered	EPC Contractor
SE62	Gender assessment	Land Use and Acquisition	Implementation of a fair land acquisition compensation scheme (based on a market valuation).	Throughout project life cycle	Management Plan	DoST
SE63	Gender assessment	Land Use and Acquisition	Prioritization of employment opportunities for those who have been physically and economically displaced, including women, based on their interests and skills.	Throughout project life cycle	Management Plan	DoST
SE64	Gender assessment	Land Use and Acquisition	Partnership with local institutions, such as RENEW, to provide targeted technical and vocational training to help upskill women, enabling them to participate in the employment opportunities created by the Project.	Throughout project life cycle	Management Plan	DoST
SE65	Gender assessment	Land Use and Acquisition	Partnership with local institutions, such as RENEW and the Police, to provide local awareness raising campaigns about women's rights.	Throughout project life cycle	Management Plan	DoST
SE66	Gender assessment	Land Use and Acquisition	Ongoing engagement opportunities, outside of those associated with land acquisition, should be appropriately planned so that girls and women are in a position to actively participate and contribute.	Throughout project life cycle	Management Plan	DoST
SE67	Gender assessment	Women safety and wellbeing	Actively monitoring of the code of conduct and consequences are clearly articulated to workers in the event that the code of conduct is breached.	Throughout project life cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE68	Gender assessment	Women safety and wellbeing	Provision of training on the code of conduct, and this training should be reinforced through internal communication channels established by the Project.	Throughout project life cycle	Management Plan	DoST
SE69	Gender assessment	Women safety and wellbeing	Employ, as part of the Project team, a dedicated GBV specialist who can oversee initiatives and work closely with an established GBV service provider to ensure effective intervention and response. Gender mainstreaming efforts in resettlement planning, hiring practices, and community engagement processes will prioritize women's needs, aiming for equitable employment opportunities and fostering an inclusive environment for all.	Throughout project life cycle	Management Plan	DoST
SE70	Gender assessment	Women safety and wellbeing	Provide support to women's groups that focus on providing literacy programs, including financial and digital literacy training, to empower community members with the knowledge to manage finances and engage in local business activities. The development of a women-managed market space could create a safe and supportive environment for female entrepreneurs, while low-interest credit schemes could provide critical financial resources for women-led enterprises. These initiatives not only offer sustainable livelihoods but also help strengthen the local economy, creating a more resilient and inclusive community in social study area.	Throughout project life cycle	Management Plan	DoST
SE71	Gender assessment	Women safety and wellbeing	Partner with local organizations, RENEW, Tarayana Foundation, Police and other CSOs, engaged in community development initiatives in the social study area, to support efforts in addressing social challenges such GBV, women's rights, domestic violence, teenage pregnancy, and alcoholism through awareness campaigns and community support programs. Coordinating efforts with local GBV service providers will ensure a clear referral pathway within the GRM to support individuals affected by SEA/SH incidents.	Throughout project life cycle	Management Plan	DoST
SE72	Gender assessment	Women safety and wellbeing	Provide safe, anonymous reporting avenues for women to raise concerns and grievances. The team responsible for managing grievances, reports of gender-based violence,	Throughout project life cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			and other related incidents should have appropriate training to manage such issues.			
SE73	Gender assessment	Women safety and wellbeing	Collaborate with RENEW, the local hospital and local police in putting in place a reporting avenue, as these organisations are already collaborating to provide women a safe space to raise concerns.	Throughout project life cycle	Management Plan	DoST
SE74	Gender assessment	Women safety and wellbeing	Apply gender-specific design principles, such as those in Crime Prevention Through Environmental Design (CPTED), to enhance women's safety within Project facilities by creating an environment that promotes a sense of security through clear visibility, natural surveillance, adequate lighting and controlled access points, while also ensuring appropriate facilities like restrooms, breastfeeding rooms, and secure accommodation measures such as women-only floors, well-lit areas, and security escorts when needed.	Throughout project life cycle	Management Plan	DoST
SE75	Gender assessment	Economic opportunities	Develop and implement a Gender Action Plan (GAP), with ongoing monitoring.	Throughout project life cycle	Management Plan	DoST
SE76	Gender assessment	Economic opportunities	Since more women than men participate in farming activities, develop and implement climate smart, women friendly agriculture and livestock technologies in the social study area to enhance rural incomes and Partnerships with CSOs involved in rural development.	Throughout project life cycle	Management Plan	DoST
SE77	Gender assessment	Economic opportunities	Project should prioritize employment opportunities for those who have been physically and economically displaced, including women, based on their interests and skills.	Throughout project life cycle	Management Plan	DoST
SE78	Gender assessment	Economic opportunities	Partnership with local institutions, such as RENEW and Tarayana, to provide targeted technical and vocational training to help upskill women, enabling them to participate in the employment opportunities created by the Project.	Throughout project life cycle	Management Plan	DoST
SE79	Gender assessment	Economic opportunities	Partnership with local institutions, such as RENEW, Tarayana and Police, to provide local awareness raising campaigns targeting women's rights.	Throughout project life cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE80	Gender assessment	Economic opportunities	Support economic empowerment by looking at opportunities to support microloans, such as those provided by Tarayana Foundation, and grants to women affected by physical and economic displacement with interest in establishing enterprises, particularly in Project-related areas such as catering, transportation, and material supply.	Throughout project life cycle	Management Plan	DoST
SE81	Gender assessment	Economic opportunities	Offer leadership development programs to women, focusing on capacity-building in areas such as financial literacy, negotiation, and management skills, which are essential for assuming leadership roles.	Throughout project life cycle	Management Plan	DoST
SE82	Gender assessment	Economic opportunities	Adhere to a policy of equal treatment, non-discrimination and equal pay for equal work. Additionally, include requirements around rights of women workers in the code of conduct, policies and protocols for contractors. Training should be provided on all policies and procedures once developed.	Throughout project life cycle	Management Plan	DoST
SE83	Gender assessment	Economic opportunities	The need for providing additional measures to ensure safety of women should not act as a deterrent towards employment of female workers and employees in the construction phase. The Project should give equal opportunities to everyone including women.	Throughout project life cycle	Management Plan	DoST
SE84	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	Incentives to women's groups that focus on providing literacy programs, including financial and digital literacy training, to empower community members with the knowledge to manage finances and engage in local business activities. The development of a women-managed market space could create a safe and supportive environment for female entrepreneurs, while low-interest credit schemes could provide critical financial resources for women-led enterprises. These initiatives not only offer sustainable livelihoods but also help strengthen the local economy, creating a more resilient and inclusive community in Sarpang District.	Throughout project life cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
SE85	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	Partner with local organisations, like RENEW, Tarayana Foundation and other CSOs engaged in community development initiatives in the social study area, to support efforts in addressing social challenges such a GBV, domestic violence, teenage pregnancy, and alcoholism through awareness campaigns and community support programs.	Throughout project life cycle	Management Plan	DoST
SE86	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	Partner with local organisations like RENEW, Tarayana Foundation, Police and other CSOs to support raising community awareness through workshops and informational sessions to help educate residents on identifying, reporting, and preventing GBV and SEA.	Throughout project life cycle	Management Plan	DoST
SE87	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	Provide safe, anonymous reporting avenues for people to raise concerns and grievances. The team responsible for managing grievances, reports of gender-based violence, and other related incidents should have appropriate training to manage such issues.	Throughout project life cycle	Management Plan	DoST
SE88	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	Apply gender-specific design principles, such as those in Crime Prevention Through Environmental Design (CPTED), to enhance safety within Project facilities by creating an environment that promotes a sense of security through clear visibility, natural surveillance, adequate lighting and controlled access points, while also ensuring appropriate facilities like restrooms, breastfeeding rooms, and secure accommodation measures such as women-only floors, well-lit areas, and security escorts when needed.	Throughout project life cycle	Management Plan	DoST
SE88	Vulnerability Risk Assessment	Sexual Exploitation and Abuse and Sexual Harassment	The need for providing additional measures to ensure safety of women should not act as a deterrent towards employment of female workers and employees in the construction phase. The Project should give equal opportunities to everyone including women.	Throughout project life cycle	Management Plan	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
Cultural Heritage (CH)1	Cultural Heritage	Impact from ground disturbances from earthworks	Develop and implement a Cultural Heritage Management Plan (CHMP) to manage and protect tangible and intangible cultural heritage resources throughout the project's lifecycle. The CHMP should address measures for access management, ongoing monitoring, stakeholder engagement, and procedural guidance for unexpected discoveries. The CHMP should include a long-term monitoring plan to assess residual impacts on cultural sites, ensuring ongoing compliance with mitigation measures and adapting practices if new issues arise.	Throughout project life cycle	Management Plan	DoST
CH2	Cultural Heritage	Impact from ground disturbances from earthworks	Establish a Memorandum of Understanding (MoU) with local communities to ensure access to cultural sites is preserved. This arrangement will be agreed upon with stakeholders before construction begins to prevent conflicts or disruptions in community practices.	Pre-construction, Construction	Management Plan, Work Protocols	EPC Contractor
CH3	Cultural Heritage	Impact from ground disturbances from earthworks	Undertake a detailed, site-specific survey of cultural heritage resources before construction starts to verify the findings of the CHIA. This should form part of the census and asset inventory being undertaken for the RAP.	Pre-construction, Construction	Management Plan, Work Protocols	EPC Contractor
CH4	Cultural Heritage	Impact from ground disturbances from earthworks	Establish a Chance Finds Procedure. This procedure is designed to handle unexpected discoveries of archaeological or cultural materials during construction. It includes halting construction upon discovery and notifying cultural authorities to properly document and protect the findings according to international standards like the World Bank's Environmental and Social Standards (ESS8).	Pre-construction, Construction	Management Plan, Work Protocols	EPC Contractor
CH5	Cultural Heritage	Impact from ground disturbances from earthworks	Implement temporary barriers and dust control measures (like water spraying) to be used to minimize dust and protect sensitive sites from construction activities.	Construction	Management Plan, Work Protocols	EPC Contractor
CH6	Cultural Heritage	Impact from ground disturbances	Ongoing consultations with the diverse local communities will help inform the CHMP and ensure that traditional	Pre-construction, Construction	Records and Reports	DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		from earthworks	values and uses of cultural heritage resources are respected.			
CH7	Cultural Heritage	Impact from ground disturbances from earthworks	Implement and maintain a community grievance mechanism, so that stakeholders can raise issues and concerns arising from the project's impact on cultural heritage.	Pre-construction, Construction	Records and Reports	DoST
CH8	Cultural Heritage	Impact from ground disturbances from earthworks	Visual and noise monitoring will help detect any unforeseen impacts during construction and operation of the Project, allowing for prompt adjustments to minimize adverse effects. An appropriate baseline will need to be established prior to commencing construction, and monitoring should continue post-construction and into operation to determine if an impact has occurred. If noise or visual impacts are identified, mitigation measures will need to be established.	Pre-construction, Construction	Records and Reports	DoST
Traffic (T)1	Road Design	Impact from Road Design	Road design follows the Bhutan Standard "ICS:93.080.10, Draft Bhutan Standard on Road Geometric Design and Alignment Requirements, Bhutan Standards Bureau", with enhancements based on international standards to improve safety.	Pre-Construction	Project Design	Project Designer
T2	Road Traffic	Impact from Road Traffic	Traffic Management Plan: ● A detailed schedule and route plan for the transportation of materials and equipment compatible with construction activities; ● Coordination of worker transportation from worker camps to job sites and from local communities to the worker camps; ● Maps of commuting routes and modes (pedestrian or vehicular) and worker access points to parking areas for Project work sites; ● Plans for ridesharing or bus transportation for workers;	Construction	Management Plan Work Protocol Records and Reports	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Strategy for minimizing effects on local residents associated with temporary road closures and detours; and • Plans for scheduling worker shifts to minimize congestion			
T3	Road Traffic	Impact from Road Traffic	Work with the local authorities to fund and expand, complete repairs to, or provide durable surfaces for all local roads that would be used to access Project worksites	Pre-Construction	Records and Reports	DoST
T4	Road Traffic	Impact from Road Traffic	Review the suitability of Gatshel Lam SE, including its road surface, width and alignment, to carry heavy vehicles; provide surface improvements resulting in width and durability suitable for anticipated loads; establish procedures to address safety risks associated with truck traffic in close proximity to structures; install safety measures (such as temporary concrete road edge barriers) to protect footpaths, outdoor use areas, and existing residences and commercial buildings along the road	Pre-Construction	Records and Reports Project Design Work Protocol	DoST
T5	Road Traffic	Impact from Road Traffic	Work with local authorities to repair road surfaces damaged during construction (including providing funding for and/or completing repairs to address such damage).	Post-Construction	Records and Reports Project Design	EPC Contractor
T6	Road Traffic	Impact from Road Traffic	Work with local authorities to support the implementation of necessary safety measures for pedestrians, bicyclists, and drivers, persons with disabilities, children, elderly, including: • Implement safe corridors and crossings for pedestrians and bicyclists along construction vehicle routes, especially on roads with anticipated high traffic volumes, large vehicles, and areas with a high concentration of amenities (schools, markets, etc.); • Provide adequate and visible and reflective traffic signs and speed controls, especially in areas with high population density or high concentration of amenities;	Construction	Records and Reports Project Design	EPC Contractor, DoST

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			• Design solutions for sensitive areas where congestion could occur (bottlenecks and intersections); • Enhance traffic safety awareness among the local community.			
T7	Road Traffic	Impact from Road Traffic	Integrate the construction traffic aspect into the Community Grievance Mechanism and Employee Grievance Mechanism during construction.	Construction	Management Plan	DoST
T8	Road Traffic	Impact from Road Traffic	Identify and enforce driver qualification and training requirements for all drivers specific to the type of vehicle (light and heavy vehicles), whether employees or contractors. Include requirements in applicable contracts.	Construction	Training Plan Work Protocol	EPC Contractor, DoST
T9	Road Traffic	Impact from Road Traffic	Establish and enforce consistent safe driving practices for all drivers, whether employees or contractors: • Require rest and break standards that comply with industry and national standards; • Structure contracts with truck contractors to avoid incentives for speeding or insufficient fatigue breaks; • To the degree permissible by law, require daily or periodic drug and alcohol testing for all drivers; • Equip trucks with speed governors or on-board GPS, and/or monitor vehicle speed and location; • To the degree allowed by law, enforce driver quality through loss of jobs or contracts for individual drivers for drug or alcohol offenses, chronic or egregious speeding, or other notable or repeated unsafe behaviors; • Require scheduled, preventative vehicle maintenance according to manufacturers' recommendations for all Project vehicles, whether owned by Project or a contractor; • Require completion of a vehicle safety checklist daily prior to vehicle operation on public roads; • Provide uniform in-vehicle communications systems that enable contact with truck traffic controllers and other drivers.	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
Unplanned Events (UE)1	Unplanned Events	Natural Disasters	Emergency Preparedness and Response Plan - describing in detail the procedures the Contractor will put in place in the event of a natural disaster. This plan, which will be prepared by the Contractor, will describe emergency procedures and communication protocols in the event of an earthquake.	Throughout Project Life Cycle	Management Plan	EPC Contractor, DoST
UE2	Unplanned Events	Natural Disasters	Design facilities (e.g., bridges) to withstand earthquakes. Any new infrastructure shall at least follow the requirements of new proposed draft Indian seismic code (IS 1893:2023).	Pre-Construction	Project Design	Project Designer
UE3	Unplanned Events	Fires	Develop and implement measures to reduce the risk of man-made fires occurring, including: ● Prohibit worker smoking outside of designated areas within the Worker Camps during construction; ● Prohibit smoking outside of designated areas during the operational phase; ● Storage of highly flammable and combustible materials in designated locations with appropriate firefighting equipment available (e.g. fire blanket, extinguishers); and ● As part of the preparation of the Emergency Preparedness and Response Plan, liaise with relevant third-party bodies to develop specific local plans for responses and use of the emergency services in the event of a fire.	Throughout Project Life Cycle	Work Protocol Management Plan	EPC Contractor, DoST
UE4	Unplanned Events	Traffic Accidents	*Refer to Traffic control and additional measures (T1-T9)*	-	-	
UE5	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Equipment should be up to industry standard and serviced regularly to prevent oil spills in a designated area with adequate safety and environmental protection measures for large equipment repair.	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
UE6		Accidental Oil, Chemical, Hazardous Material Spills	A spill response plan should be in place and construction workers should be trained during orientation and during monthly training	Construction	Management Plan	EPC Contractor
UE7	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	On-site storage areas for hydrocarbons and other chemicals should be constructed in a way that potential tank failures can be contained including bunds and surface hard standing	Construction	Project Design	EPC Contractor
UE8	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Hazardous material storage will be constructed on an impermeable surface and the bulk storage facility will be bunded. The Project will restrict storage and handling of hazardous materials and fuels to bunded areas of sufficient capacity to contain a release	Construction	Project Design	EPC Contractor
UE9	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Refueling of equipment and vehicles will be carried out in designated areas on hard standing ground to prevent seepage of any spillages into the ground. Collection systems will be installed in these areas to manage any spills, fuels will be collected and either reused, treated by incineration or removed by a local business partner. Drip trays must be used when refueling and servicing vehicles or equipment, where it is not on a hard standing surface	Construction	Work Protocol	EPC Contractor
UE10	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Leaking equipment must be repaired immediately or be removed from site to facilitate repair	Construction	Work Protocol	EPC Contractor
UE11	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Hazardous material spill response plan - includes community sensitization/ notifications when required. The Project will maintain spill clean-up and response capability adequate for addressing spills for all phases of the Project. All spills will be immediately contained and cleaned up. Contaminated areas will be remediated, and post remediation verification will be carried out	Construction	Management Plan	EPC Contractor
UE12	Unplanned Events	Accidental Oil, Chemical,	Appropriately sized spill kit kept onsite relevant to the scale of the activity taking place must be available	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
		Hazardous Material Spills				
UE13	Unplanned Events	Accidental Oil, Chemical, Hazardous Material Spills	Maintain an incidents and complaints register in which all incidents or complaints involving the public are logged	Construction	Records and Reports Work Protocol	EPC Contractor
UE14	Unplanned Events	Occupational Health and Safety	OHS Management Plan: • Hazard identification and assessment; • Identification and provision of personal protective equipment (PPE) to all concerned workers; • Pre-employment screening protocols for all employees including contractors and sub-contractors which will include medical checks appropriate to World Health Organization's (WHO) recommendations, the individual's country of origin and vaccinations; • Workers will be provided with primary health care and basic first aid at all worksites; • Regular medical check-ups and centralized medical treatment for all workers of the Project (including contractors and sub-contractors) will be provided; and • Workforce, including contractors and sub-contractors, will be provided with health awareness training (and refreshers), including hazardous works, a significant briefing of hygiene practices (such as hand washing), implementation of educational outreach to increase awareness of major communicable disease and how to protect against infection and about transmission routes and the symptoms of the communicable diseases of concerns (including STIs).	Construction	Management Plan Work Protocol	EPC Contractor, DoST
UE15	Unplanned Events	Occupational Health and Safety	Emergency Preparedness and Response Plan - require all appointed contractors establish their own EPRP or adopt the Project's	Construction	Management Plan	EPC Contractor, DoST
						Jengkhurung

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
Climate Change (CC)1	Climate Change Risk Assessment	Water Availability	If possible, recycle water used for road cleaning to water the roadside greenery	Construction	Work Protocol	EPC Contractor
CC2	Climate Change Risk Assessment	Flood Risk	Complete the flood modeling for the entire length of the Gelephu Tareythang road	Pre-Construction	Records and Reports	Independent Third Party
CC3	Climate Change Risk Assessment	Flood Risk	Coordinate with the design of upstream infrastructure associated to the Gelephu Mindfulness City to integrate water retention structures that would reduce the flow and risk of flooding along the road	Pre-Construction	Project Design	DoST
CC4	Climate Change Risk Assessment	Flood Risk	Integrate the results on the full model to the detailed engineering design of the road and bridges and include at least the risk associated with a 100-year return period, taking into consideration the effects of climate change	Pre-Construction	Records and Reports	Project Designer
CC5	Climate Change Risk Assessment	Flood Risk	Design facilities and infrastructure (e.g., bridges, accommodation) to withstand flooding, including but not limited to the following measures: ● Avoid placement of any vulnerable infrastructure (e.g. electrical installations) within natural drainage channels and floodplains and ensure that the finished floor levels of buildings are above modelled flood zones; ● Debris protection will be provided at the base of the piers in the river crossings to protect the piers from impacts. Scour protection will also be provided in the form of boulders surrounding the base of the foundation; ● 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; and ● Box culverts will be introduced perpendicular to the highway at regular intervals along the embankment section to allow potential flood water	Pre-Construction	Project Design	Project Designer, EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
			to flow underneath the highway preventing flooding of the highway.			
CC6	Climate Change Risk Assessment	-	Emergency Preparedness and Response Plan – describe emergency procedures and communication protocols for alerting local villages and construction workers of any emergency conditions	Throughout Project Life Cycle	Management Plan	EPC Contractor
CC7	Climate Change Risk Assessment	Landslide	Integrate slope stabilization structures (e.g. retaining walls, gravity walls, etc.) in the detailed design of the road	Construction	Project Design	EPC Contractor, Project Designer
CC8	Climate Change Risk Assessment	Landslide	Reduce soil erosion by maintaining existing vegetation or revegetating ground movement areas through geotextiles or similar techniques along the 500 m road segment near Tareythang	Construction, Post-Construction	Project Design Records and Reports	EPC Contractor
CC9	Climate Change Risk Assessment	Landslide	Ensure correct drainage of rain and groundwater to avoid building up pressure on soil structure	Construction	Project Design	EPC Contractor
CC10	Climate Change Risk Assessment	Landslide	Stabilize the slope by including supporting structures (e.g. retaining walls, gravity walls, etc.) or by stabilizing the soil structure	Construction	Project Design	EPC Contractor
CC11	Climate Change Risk Assessment	Landslide	Emergency Preparedness and response plan – including specific measures for landslides: ● Monitor slope stability ● Avoidance of landslide prone areas in siting and design; and ● Minimize disturbance of steep slopes by careful selection and siting of the Project.	Throughout Project Life Cycle	Management Plan	EPC Contractor, DoST
CC12	Climate Change Risk Assessment	Extreme Heat	Schedule heavy labor work during cooler parts of the day	Construction	Work Protocol	EPC Contractor
CC13	Climate Change Risk Assessment	Extreme Heat	Set up cooling areas and provide heat protection for worker.	Construction	Work Protocol	EPC Contractor

Identifier	Aspect	Impact / Activity	Proposed Mitigation	Implementation Schedule	Verification Means	Implementing Party
CC14	Climate Change Risk Assessment	Cyclone and Hurricane	Implement safety procedures during severe weather.	Construction	Work Protocol	EPC Contractor
Greenhouse Gas (GHG)1	Greenhouse Gas Emissions	-	Where possible, replace traditional equipment with more fuel-efficient alternatives, electric machinery, or hybrid solutions.	Construction	Project Design	EPC Contractor
GHG2	Greenhouse Gas Emissions	-	Reduce emissions by using low-carbon construction materials, such as low-emission cement	Construction	Project Design	EPC Contractor

13.8 SUMMARY OF IMPACTS

The summary of residual impacts after the ESMP implementation are detailed in ***Table 13.7***.

Table 13.7 Impact assessment summary

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Construction Phase Impacts and Risks		
Physical Environment		
Dust from earthworks and vehicular movement	Substantial	**Low**
Emissions from construction equipment and traffic	Substantial	Low
Noise and vibration from construction	Substantial	low
Alteration of natural water flows	Substantial	Moderate
Erosion and sedimentation	Moderate	Low
Water quality degradation/pollution	Moderate	Low
Soil compaction and damage	Moderate	Low
Contamination of soil and groundwater	High	Moderate
Waste generated by workers	Substantial	Low
Waste from site clearance and exaction	Substantial	Low
Hazardous material waste	Substantial	Low
Increased traffic during construction	Substantial	Moderate
Natural hazard such as seismic hazards, forest fires	High	Substantial
Traffic accidents from construction traffic	**High**	
Accidental spills from oils and chemicals	High	Moderate
OHS risks during construction	High	Moderate
Climate- change induced risks - flood	High	Low
Climate- labor under extreme heat	Moderate	Low
Greenhouse gases emissions	Moderate	Low
Impact on Biological Environment		
Terrestrial habitat loss (0.19 km2)	Moderate	Low
Habitat degradation from construction, invasive species	Moderate Low	Low
Disturbance to terrestrial wildlife	Low	Negligible
Impact on aquatic habitat	Moderate	Low
Human-wildlife conflict	High	Moderate
Ecosystem services on water usage	Moderate	Low
Social Impacts		
Physical and economic displacement	High	Moderate
Labor influx and in-migration	Substantial	Moderate
Social cohesion from labor influx	Substantial	Moderate
Labor and working conditions	Substantial	Low
Worker health and safety	High	Moderate
Community infrastructure and wellbeing	Substantial	Moderate
Community health and safety risks	Substantial	Moderate
Amenity Value (air and noise)	High	Moderate
Gender impacts from land acquisition	High	Moderate

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Women's safety and wellbeing	High	Moderate
Sexual exploitation and abuse, and sexual harassment	Substantial	Moderate
Cultural heritage resources	Low	Negligible
Operational Phase Impacts and Risks		
Impact on air quality from traffic during operation	Negligible	Negligible
Noise and vibration from traffic during operation	High	Moderate
Alteration of natural flows and Pollution from road and bridge surfaces	Moderate	Low
Traffic impacts during operation	Beneficial	
Greenhouse gases emissions	Moderate	Low
Habitat fragmentation for threatened mammals	High	Moderate
In-migration – SEA/SH risks	Substantial	Moderate
Air and noise impacts on the community	Moderate	Moderate
Cultural heritage resources	Moderate	Low

13.9 COST ESTIMATE

The overall cost for the ESMP implementation is estimated at 8,050,000 USD as detailed in ***Table 13.8***.

Table 13.8 ESMP Implementation Costs

Sr. No.	Description of Item	Unit	Item Total (USD)
A	**Contractors Budget**		
1	Contractors preparation of C-ESMP including OHC Plans		Included in Construction Cost
2	Contractors ESHS Staff		Included in Construction Cost
3	Construction of Elephant & Amphibian crossings		Included in Construction Cost
4	Canopy Bridges (3 bridges)	LS	200,000
5	Noise Barriers (1-2 km in length at key sensitive receptors)	LS	500,000
6	Waste Management - Support to Gelephu Environmental Division to Expand the existing landfill to handle the increase in general waste.	LS	300,000
7	Waste Management - Transport of Hazardous waste to Approved Hazardous Waste landfill	LS	50,000
8	Dust Management - watering and dust supression chemical spay	LS	100,000
9	Site/OHS facilities for workers (PPE)	LS	50,000

10	Training of Workers on Code of Conduct for Health and Safety, STIs, GBV/SH/AIDs	LS	100,000
11	Wastewater treatment facilities (incl. mobile toilets at worksites)	LS	100,000
12	Environmental Monitoring during construction by a third party - air, noise monitoring at sensitive receptors, soil & water quality monitoring	LS	200,000
	Sub-Total A		1,600,000
B.	**Operational Budget**		
15	Training Capacity Building		150,000
16	Biodiversity Management Plan Implementation	LS	4,200,000
17	RAP Implementation - land acquisition, resettlement, compensation	LS	1,000,000
18	SEP Implementation - ongoing engagement	LS	150,000
19	CDP Implementation - implementation of community development programs	LS	250,000
	Ongoing environmental monitoring during operation (5 years) - quarterly air quality, monthly noise at sensitive receptors, water quality.	LS	400,000
	Ongoing traffic monitoring (5 years)(traffic incidences, road surface degradation etc.) & GHG assessment (road usage, number/type of vehicle)	LS	250,000
20	Auditing		50,000
	Sub-Total B		6,450,000
	Total		**8,050,000**

14. STAKEHOLDER ENGAGEMENT PLAN

14.1 PROJECT STAKEHOLDERS

The World Bank ESS 10 – Stakeholder Engagement and Information Disclosure definition of stakeholder has been referred to for the purpose of this analysis. It refers to ***stakeholders*** as individuals or groups who:

- Are affected or likely to be affected by the Project **(Project Affected Parties)**, and
- May have an interest in the Project **(Other Interested Parties)**.

Details of these stakeholders are given below. Please refer to the Stakeholder Engagement Plan (SEP) for complete information on these stakeholders and the proposed stakeholder engagement activities during the construction and operational stages.

14.1.1 PROJECT AFFECTED PARTIES

Project-affected parties are persons, groups, and other entities near the project sites that are directly influenced (actually or potentially) by the project and/or have been identified as most susceptible to change associated with the project and who need to be closely engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures. The affected parties for the Project are given below.

Table 14.1 Project Affected Parties by Stakeholder Group

Stakeholder Groups	Project-Affected Parties
Local Communities	• Landowners • Land Users (Farm labor/Tenant Farmers/Livestock Rearers) • Community Forest Users • Small Businesses / Shops / Restaurants • Fish farms • Vulnerable groups – Women Headed Households, Senior Citizens, Households Below the Poverty Line (BPL), ant workers from India and other countries
Institutional Stakeholders	• Community Forest User Groups
Vulnerable / Disadvantaged Groups	• Women – Women headed households, Single Mothers, Domestic Violence Survivors • Elderly • Persons with Disabilities • Youth – Unemployed, Orphan, Who have been in difficult circumstances • Households Below Poverty Line • Landless households • Households owning less than 2 acres of land

14.1.2 VULNERABLE INDIVIDUALS OR GROUPS

The Project recognizes the need to understand whether vulnerable groups are disproportionately affected by impacts. These groups are often unable to express their concerns or not in a position to react to the impacts due to various social barriers or may not even understand the impacts of a project. The vulnerability may be as a result of an individual/group's gender, sexuality, race, age, health, ethnicity, education level, income level, average landholding size or any other form of marginalized groups. Department of Surface Transport (DoST) understands that strategies

are needed to ensure that vulnerable groups can access stakeholder engagement opportunities, hence vulnerable populations are recognized as a specific stakeholder group and measures will be taken to ensure they have opportunities to provide feedback and submit grievances, as well as accessing Project benefits. The vulnerable individuals or groups in the Project include:

- Women
  - Women Headed Households,
  - Single Mothers, and
  - Domestic violence survivors.
- Elderly
- Persons with Disabilities,
  - Physical, and
  - Others (intellectual, hearing, speaking, visual, and other disabilities)
  - Those living with severe underlying health conditions
- Youth
  - Unemployed, and
  - Orphaned
  - Youth who have been in difficult circumstances
- Income Level
    - Households Below Poverty Line (BPL), and
- Unskilled construction workers landholding size
  - Landless households
  - Households owning less than 2 acres

14.1.3 OTHER INTERESTED PARTIES

Other interested parties are individuals/groups/entities that may not experience direct impacts from the project but who consider or perceive their interests as being affected by the project and/or who could affect the project and the process of its implementation in some way. The other interested parties in the Project are given below.

Table 14.2 Other Invested Parties By Stakeholder Group

Stakeholder Groups	Other Interested Parties (OIP)
Local Communities	• General Public
Institutional Stakeholders	• Local Journalists / Media • Academicians • Non-Government Organisations (NGOs) / Civil Society Organisations (CSOs) such as SNV Bhutan, Disabled Persons, WWF Bhutan, Bhutan Foundation, Bhutan Ecological Society (BES), Respect, Educate, Nurture, Empower Women (RENEW),

	Ability Bhutan Society, Tarayana Foundation, Draktsho, Royal Society for Protection of Nature (RSPN), Lode n Foundation, SABA Bhutan. • Social Infrastructure - Schools /Colleges, Health Centres, Religious Organisations, etc.
Government Bodies/Regulatory Authorities	• Dzongkhag and Dungkhag Administration Thromde (Municipality) • Gewogs (Blocks) • Gelephu Mindfulness City (GMC) Management • National Land Commission Secretariat (NLCS) • Ministry of Energy and Natural Resources – Department of Forests and Park Services • Ministry of Energy and Natural Resources – Department of Environment and Climate Change • Natural Resources Development Corporation (NRDCL).

14.2 CONSULTATION MEETINGS

Three sets of consultations were undertaken for the preparation of the SEP. The first round was undertaken during the scoping phase of the Project, from ***18 to 24 July***. This served to help better understand the local context, including the stakeholders present in the project impacted area.

A second round of consultations was conducted from ***30 August to 3 September 2024*** to collect primary data, including to gather information to inform the identification of risks and impacts associated with the project. As part of the site visit key informant interviews and focused group discussions were undertaken with community members representing various demographics of the social study area. This included women, adolescent girls, youth groups, Non-Government Organisations (NGOs), business owners, farmers / cultivators, teachers and healthcare practitioners.

The consultations served to assess current stakeholder understanding of the project, stakeholder engagement preferences, grievance tools currently being used, and strategies needed to ensure that vulnerable groups are able to access stakeholder engagement opportunities. Some of the key discussion points included, but not limited to, awareness levels about the Project, access to services, profile of communities, gender norms and attitude in the community, facilities in the impact area, capturing the occupational profile of the communities, average income levels, discussions and opinions of NGOs / Community-based Organisations (CBOs), level of Project's engagement with vulnerable groups.

Details of these consultations are described in ***Table 14.3*** below. The PAPs consulted include the local population, public services such as schools, and local healthcare facilities. Groups of women above 18 years of age, adolescent girls (15-18 years of age), men and boys below and above 18 years of age, cultivators/agricultural labor/land users, vulnerable population and women (general consultations) from multiple Thromdes/Gewogs were consulted. Other Interested Parties included local and national government bodies/representatives, NGOs and

CSOs. A total of 69 women and 49 men participated in the Focus Group Discussions (FGDs). Of these, 39 were adolescent girls between the ages of 15 and 18 years of age[127].

Additionally, the Gelephu Mindfulness City (GMC) Governor undertook an additional stakeholder consultation on the ***27 September 2024***, at various locations in the Project area, such as in Gelephu Thromde, Umling Gewog and Gelegphu Gewog. It is estimated that about 70% of the landowners in the Project area attended the consultations. Moreover, elected officials of the local governments attended. Landowners from nearby areas were also encouraged to participate in the consultations. Discussions focused on compensation modalities for land, cash crop and structures falling under the proposed Project.

From October 13th – 31st 2024, Social Specialist, DoST and Gender Expert, World Bank held consultations with many stakeholders in Thimphu and Gelephu as follows:

- business license holders (small, medium, large such as import traders, food (pickles, dried food.), e-commerce business, women exporters, clearing agents, worker loaders, construction, wood-based industry, taxi drivers, and exporters),
- institutions such as BCCI, Export Associations,
- CSOs (RENEW, Tarayana Foundation, Bhutan Youth Development Fund), telecom and internet operators, RENEW Microfinance, and She Cycle (CBO)
- government organizations (Department of Trade, Department of Revenue and Customs, Thromde, Sarpang Dzongkhag Officers (Agriculture, Livestock, RNR, etc.) and Royal Bhutan Police.

The key points discussed, and issues noted, include:

- Easiness of business and trade in Bhutan especially for women.
- Targeted skilling and capacity building of women
- Existing challenges for business, clearing agents and traders especially women
- General gender issues and concerns in the community and skills and capacity of service providers.

Table 14.3 Details of Public Consultation Meetings

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
18 July 2024	Visual observations, consultations	• Gelephu Thromde	• Executive Engineer, DoST • Dy. Executive Engineer, DoST
		• National Research and Development Centre for Aquaculture, Department of Livestock, Ministry of Agriculture and Livestock (MoAL)	• Livestock Production Officer

[127] Numbers reflect the participation of consultations undertaken from 30 August to 3 September 2024.

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
19 July 2024	Visual observations, consultations	• Gelephu Thromde	• Dy Chief Urban Planner, Gelephu Thromde • Survey Engineer • Senior Urban Planner
		• Gyalsung Center, National Service Academy, Tareythang	• Head of Academy
		• Primary Health Centre (PHC), Umling	• Health Care Worker
		• Chhuzanggang Gewog	• Gewog Representatives
		• Tareythang Gewog	• Community Member and Former Chiwog Head
		• Umling Gewog	• Community Member

20 July 2024	Visual observations, consultations	• Samtenling Gewog Office	• Gewog Representatives
			  ○ Mangmi
			  ○ Senior Gewog G.A.O
			  ○ Samtenling Chiwog Tshogpa
			  ○ Samthenthang Chiwog Tshogpa
			  ○ Chhokorling Dechen-Pelri Chiwog Tshogpa
			  ○ Dechen-Pelri Chiwog Tshogpa
			• Khenpagang Chiwog Tshogpa

		• Gelegphu Gewog	• Administrative Officer and Gewog Representatives
			  ○ Perlithang Khaed Chiwog Mangmi
			  ○ Perlithang Khaed Chiwog Tshogpa
			  ○ Pemathang Chiwog Tshogpa
			  ○ Lekidthang Chiwog Tshogpa
			  ○ Dzomlingthang Chiwog Tshogpa
			  ○ Perlithang Khatoed Chiwog
			  ○ Gewog G.A.O
			• Gewog Office Driver

		• Gelephu Thromde	• Former Prime Minister of Bhutan
21 July 2024	Visual observations, consultations	• Namkhaling Demkhong, Gelephu Thromde	• Community Member

22 July 2024	Visual observations, consultations	• Thimphu	• National Land Commission Representatives
			  ○ Chief land Registrar
			  ○ Land Registrar
			  ○ Survey Engineer
			• Survey Engineer

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated

		• Thimphu	• Dean of Student Affairs, College of Natural Resources, Royal University of Bhutan
			• NGO Representatives
			  ○ Civil Society Organizations' Authority (CSOA)
			  ○ Tarayana Foundation – Rural Transformation
			  ○ RENEW – Gender Based Violence/Domestic Violence
			• RSPN

30 August 2024	Workshop on Land Acquisition and R&B Project	• Gelephu Thromde Office	• Thrompon of Gelephu Thromde • Direct – National Land Commission (NLC) • DoST officials and local support team
31 August 2024	Key Informant Interviews (KIIs) and Consultations	• Gelephu Thromde Office and Samtenling Gewog Office, Gelegphu Gewog Office	• Representatives of Jampeling Demkhong, Namkhaling Demkhong, Samtenling Gewog • Village representative - Non-Formal Education (NFE) • Instructor, Facilitator – Early Child Care Development • Community Service Centre executive • NGO representative – Kidney Foundation
01 September 2024	KIIs and Consultations	• Gelephu Thromde Office	• General Surgeon, Clinic Nurse at Gelephu Regional Referral Hospital • Chief Forestry Officer
02 September 2024	KIIs and Consultations	• Chhuzanggang Thromde Office and Hospital, Umling Gewog and Tareythang Gewog	• Principal at Chhuzanggang Primary School • Healthcare workers in hospital at Chhuzanggang Gewog • Principal of middle secondary school and Range Office, Royal Manas National Park • Gewog/Block Administrative Office, Community Forest and Principal of school
03 September 2024	KIIs	• Regional Labor and Human Resource Office, Gelephu	• Labor Officer and Employment Counsellor • Superintendent of Police, (SSP, Division V, Royal Bhutan Police, Gelephu) • Sarpang Judicial Representatives
27 September	Stakeholder Meeting	• Gelephu Thromde Hall • Umling RNR Hall • Gelephu HSS	• Dr. Lotay Tshering (Governor) • Elected officials of the Local Governance (Gewogs and Thromde) • Landowners

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
14 October 2024	KII	• Tarayana Foundation, Thimphu	• Ms. Sonam Pem (Executive Director, Tarayana Foundation)
15 October 2024	Consultations, visit to the entrepreneurs processing unit, KIIs	• Gelephu Thromde	Government organizations (Trade, Revenue and Customs, Industry) • Ms. Nidup Zangmo, Customs Inspector, RRCO, MoF • Ms. Tshering Choeda, Senior Customs Officer, RRCO, MoF • Ms. Yeshi Choden, Assistant Revenue Officer, RRCO, MoF • Ms. Tshering Lhamo, Dy. CTO, RoICE, MoICE
		• Gelephu Thromde	Private entities • Mr. Yeshi Dorji, Taxi Association member • Mr. Kencho Tashi, Taxi Association member • Mr. Deepark Muklia, Exporter, NRDCL • Mr. Som Bahadur, Prioprietor of Leo Trading (large license holder) • Mr. Lobzang Tshering, CEO of DPCCPC (construction firm (large license holder) • Ms. Chimmi Delkar, CEO of GWI (wood industry with medium license holder)
		• Gelephu Thromde	Bhutan Chamber of Commerce and Industry (BCCI) and Clearing Agents • Mr. Suresh Rai (Business Promotion Officer, BCCI) • Ms. Parbati Pourel (Gelephu Clearing Agent) • Ms. Sangay Bidha (Clearing and forwarding agent) • Mr. Gang Ram Ghalley (Logistic of worker loaders)
		• Gelephu Thromde	Women Traders in Gelephu • Ms. Kezang Dema, Proprietor, (general trader with medium size license)

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
			• Ms. Sharan Kumari Gurung, Proprietor, (construction with small size license) • Ms. Yeshi Dorji, Proprietor, (Agro business with small size license) • Ms. Chimi Dema, Chairperson, (agri-food business with small size license)
		• Gelephu Thromde	Tashi Info Comm Pvt Ltd, Bhutan Telecom Limited and Thromde • Mr. Pawan Kumar Chhetri (Regional Manager, Tashi InfoComm Pvt Ltd) • Mr. Jigme Wangchuk (Regional Director, Bhutan Telecom Limited) • Ms. Kezang Choden, ICTO, Gelephu Thromde
16 October 2024	Consultations and KIIs	• Gelephu Thromde	RENEW and Department of Youth and Sport in Gelephu • Ms. Ambika Neopany, Teacher-RENEW volunteer, Ministry of Education/RENEW • Ms. Geeta Darnal, Center Manager, RENEW Community Service Center, Gelephu • Mr. Chandra Bahadur, Manager, Program and Youth Coordination Division, Youth Center, DYS • Ms. Dechen Dema, Administrative Officer, Program and Youth Coordination Division, Youth, DYS, MoESD
		• Gelephu Thromde • Gelephu ECCD	District Agricultural Regional Agricultural Marketing and Cooperatives Office (RAMCO), Livestock and early learning center (private) • Dr. Thukten Chophel (Mr.), District Vet., Department of Livestock • Mr. Yonten Kafley, Sr. EDMO, RAMCO

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
			• Ms. Sacha Wangmo, Agricultural Extension Supervisor), Department of Agriculture • Mr. Pema Dorji Tamang, DBO Department of Agriculture Private • Mr. Jamtsho, Founder/President, Bhutan Early Childhood Development Association • Ms. Dechen Lhamo, Center Director, Gelephu ECCD
17 October 2024	KII	• Gelephu	Royal Bhutan Police, Gelephu • Col. Chogyel Dukpa (Mr.), SSP, RBP • Lieut. Pranita Pradhan (Ms.), 10, WCPC, RBP
18 October 2024	KII	• Trade Office, Thimphu	Trade • Mr. Sangay Chophely, Trade Officer of Department of Trade (Bhutan Trade Fin Net Engineer
18 October 2024	KII	• BYDF Office, Thimphu	Bhutan Youth Development Fund (Bhutan YDF) • Ms. Roma Pradhan (Sr. Programme Coordinator, Bhutan YDF)
18 October 2024	Consultation	• NCWC office, Thimphu	National Commission for Women and Children Office, Ministry of Education & Skills Development, Thimphu • Reena Thapa (Chief Programme Officer, NCWC) • Kinley Dorji, Dy. (Chief Program Officer, NCWC) • Sonam Darjay (Program Officer, NCWC)
19 October 2024	Consultation	• MoIT, Thimphu	NSW Steering Committee, GovTech, and PMU and PIU of MoIT • Mr. Pema Rabgay,Project Coordinator, PMU, MoIT • Mr. Thinley Dorji, PIU, MoIT • Mr. Sangay Pelzang, ICT Officer, Gov. Tech

Date Period	Engagement Activity/Topic	Location	Stakeholder Participated
			• Ms. Tshering Lhamo, Project Manager, PMU, MoIT • Mr. Tashi Phuntsho, World Bank • Ms. Erisha Singh Suwal, World Bank • Mr. Mokandas, World Bank
18 October 2024	KIIs	• BAOWE Head Office, • New YDF Building, Below DNP Office • Thimphu	Bhutan Association of Women Entrepreneurs (BAOWE) • Ms. Damchae Dem (CEO/Founder, BAOWE) Ms. Namgay Wangmo (Finance Officer, BAOWE)
22nd October 2024	KIIs	• RENEW Micro Finance, Thimphu	RENEW Micro Finance • Ms. Tshering Euden, Dy. CEO • Ms. Lhayul Pemo, Operation Officers
23rd October 2024	KII	• Virtual	Exporter based in Dagana exports from Gelephu, Private woman exporter • Ms. Sangay Zam
24th October 2024	KII	• CSI Market, Thimphu	Druksell and CSI Market, Thimphu • Mr. Sonam Chophel, founder/proprietor
31st October 2024	KII	• Virtual	• Exporter based in Dagana exports from Gelephu, Private woman exporter
31st October 2024	KII	• CSI Market, Thimphu	Green Bhutan Waste Management and SHE-cycle solutions, women led CBO on waste management • Ms. Chogyal Lhamo

The key discussion points from stakeholder consultation are summarized in ***Table 14.4*** below.

Table 14.4 Key Discussion Points from Stakeholder Consultation

S. No.	Stakeholder Group	Key Points Discussed
1	Women above 18 years of age	• General project awareness. • Access to services. • Socioeconomic profile of women and girls in the impact area. • Gender norms and attitude in the community.
2	Adolescent girls (15-18 years of age)	• General project awareness. • Facilities in the impact area. • Access to services. • Education and work. • Gender norms and attitude in the community.
3	Men and boys above 18 years of age	• General project awareness. • Socio-Economic Profile of Women and Girls in the impact area. • Gender norms and attitude in the community. • Compensation.
4	Cultivators/Agricultural Labor/Land Users	• General project awareness. • Occupational profile in the impact area. • Average annual incomes. • Landholding patterns and average landholding. • Agricultural production patterns. • Information on land users. • Water harvesting structures. • NGOs/CBOs working in the social study area. • Common property resources. • Compensation. • Emotional attachment to family land.
5	Vulnerable population	• General project awareness • Other infrastructure and/or development projects in the impact area. • Level of engagement with vulnerable groups. • Landlessness in the impact area. • Cultivation and agricultural patterns, including sharecropping practices. • Daily wage labor work and prevalence and incomes. • Migration trends.
6	Women (general consultations)	• General project awareness. • Other infrastructure and/or development projects in the impact area. • Landownership among women, inheritance, ownership patterns. • Bank accounts and type of ownership. • Access to technology. • Literacy levels among women.

S. No.	Stakeholder Group	Key Points Discussed
		• Livelihoods and occupational patterns among women. • Concerns regarding safety and opinions of stakeholders. • Compensation.

14.3 FEEDBACK FROM CONSULTATIONS

Feedback from the stakeholder consultation is summarized in ***Table 14.5*** below, including responses from DoST. Additional MOM from consultations and FGDs have been provided in ***Appendix L***.

Table 14.5 Feedback from Stakeholder Consultation

S. N.	Issue/Concern/Demand Raised	Response/Action
1.	Disclosure about the Project and project details	• Detailed Roads and Bridges Project related information was provided, ensuring that the current project information was differentiated from the larger GMC plan.
2.	Existing compensation mechanisms and valuation methods	It was clarified that the compensation rates that will be provided will be based on: • Like-for-like land either within the village, Gewog or Dzongkhags, if available (in line with the Land Act of Bhutan 2007); • Compensation at replacement cost. This will be defined by a market valuation study; • Livelihood restoration support; and • Options for resettlement to designated sites identified by the relevant government authorities.
3.	Suggestions on whether the communities should sell their lands in anticipation of higher land rates due to the upcoming project	• It was shared that lands shall not be sold since the project has immense potential and the people will lose in the longer run if they sell of their lands right away.
4.	Resettlement options and locations for communities that will be affected	• It was shared that resettlement options and locations are being identified and will be in the same Gewog as much as possible.
5.	Further clarifications on compensation	• Existing compensation norms entail land compensation from within the same local government jurisdiction but in GMC, land compensation can be given from any of the 20 Dzongkhags of Bhutan. • New sites will be allotted based on the value of the land. • Monetary compensation will be based on assessed market value and not based on the existing (PAVA) compensation rates which was set based on land value in 2022 and does not reflect the value of land in GMC at this moment. • Tokenization system is also being developed which would be another compensation modality. • Cultivated land compensation will be based on calculation of projected production value for a particular number of years until the new site becomes productive. • Structures/ houses will be compensated after thorough evaluation of its value and then either monetarily or a new structure of similar typology will be built in the new location. Relocation will only be done after the new location is made liveable. • Principle of the acquisition is to give fair compensation and will make sure no one is impacted negatively. • Exceptional cases or the outliers will be addressed separately by the task force. • Such consultations will be held continuously as and when there are major breakthroughs in capital works so that everyone remains informed of what is happening. It was further shared that compensation will be done appropriately, fairly and swiftly. Compensation will be carried out based on the value of the land and adequate consideration will be made to protect the interest of the landowners in view of farming practices.

S. N.	Issue/Concern/Demand Raised	Response/Action
6.	Discussions on consideration of exceptional cases for benefits under the land acquisition and resettlement process	It was disclosed that exceptional cases, for instance if only a portion of landholding falls under the proposed site, semipermanent houses and similar will be considered on a case-to-case basis. Other responses included: • No specific intervention currently required for semipermanent houses where families have been living for a long time, but as GMC grows, there will be a guideline endorsed that will set the minimum standards that everyone will have to abide by and that there will be adequate support coming their way to help the families attain those standards. • If the remaining portion of land is deemed useful/beneficial for the landholder, they shall retain the land, but if the remaining portion of land is found to be not beneficial, the entire plot will be compensated. • In the event that a portion of my land falls in the road plans, clubbing the remaining portion of land to an adjacent land which belongs to a relative will present a host of legal problems in the future and may not be allowed. • Land acquisition works is an important part of any urban planning, it won't be one-size-fits all, acquisition will be based on a case-by-case basis and on the principles of fair compensation.
7.	Question around any consideration for the emotional attachment that one might have to their land which has been handed down over generations	• Compensation will be done appropriately, fairly and swiftly. It will be difficult to entertain issues of emotional attachment with their ancestral land.
8.	Concerns regarding low supply of water especially during the winter season	• Action pending. This will however be considered based on the ESIA management plan implementation.
9.	Queries regarding whether Chuzhing (wet land) will be compensated with chuzhing	• Compensation shall be carried out based on the value of the land more than any other factor. Adequate consideration will be made to protect the interest of the landowners, with particular consideration to keep their farming practices.
10.	Concerns regarding human-wildlife conflict, specially about the elephant destruction of crops	• The ESIA has assessed the human-wildlife conflict conditions in the Project area and proposed measures to address this issue.
11.	Queries regarding local employment opportunities due to the Project	• It was reported that employment will be based on merit. However, based on ESIA management plans, local employment will be prioritised.
12.	Discussions and concerns regarding labor influx and limited human resources for handling the added burden on health facilities with the Project related developments in the area	• The ESIA management plans have requirements such as health checkups for workers migrating to the project site. Moreover, engagement with health units has also been identified.
13.	General concerns regarding the high prevalence of alcoholism in the impact area	• This is linked to the overall development in the social study area with increased employment opportunities and therefore increased engagement in other livelihood opportunities which may decrease alcohol addiction.
14.	Willingness to participate in, and faith in the development of the larger GMC vision	• The Project is thankful for the support of the communities in believing in the Government's larger vision of GMC for the nation's future and development.

14.4 DISCLOSURE

DoST, MoIT will disclose the ESIA Executive Summary in Bhutanese and ESIA on its website. The World Bank also discloses these documents on its external website.