

TERMS OF REFERENCE

for

**Detailed Design and Construction Supervision of
Road and Bridges for Gelephu-Tareythang, Sarpang,
Bhutan**

March, 2025

1. INTRODUCTION AND BACKGROUND

Bhutan is a geographically small country situated between India and China. Inland connectivity challenges are substantial for landlocked countries like Bhutan. It lacks the scale of international trade volumes to sustain multiple trade corridors and, therefore, focus on select strategic routes.

The deepening relationship among Bangladesh, Bhutan, India, and Nepal on regional trade and transport is reflected by the increasing number of regional and bilateral connectivity agreements. However, although trade between them has been increasing over the years, opportunities for growth through regional trade remain largely untapped.

Low regional trade reflects the high cost of connectivity. Several factors account for the high cost, including inadequate transport and trade infrastructure, cumbersome regulations, manual processes, and protective tariffs and non-tariff barriers. The Trade Restrictiveness Index, which captures the trade policy distortions that each country imposes on its import bundle, shows South Asia with the greatest protection compared to any other region.

However, despite the region's large road, rail, and waterway networks, the degree of multimodal freight movement is limited at the national level, and even less for cross-border freight traffic. Each of the modes of transport has largely evolved separately, with only nascent efforts to facilitate multimodal transport operations. An effort will, therefore, be required to strengthen the road, waterway, and railway networks and develop freight markets that allow more efficient coexistence and interfaces between the transport modes. This also entails providing last-mile connectivity by improving congested and less-developed road sections connecting to international borders and other trade gateways.

To overcome some of these impediments to regional trade and connectivity, the Royal Government of Bhutan (RGoB), with the financial support from the World Bank, has conceived a project as a part of multi-phase program: Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS).

The objective of the proposed project is to increase the efficiency and resilience of trade and transport along selected corridors in Bhutan. The proposed project is expected to reduce trade and transport costs through (i) an increase in throughput at priority border points; (ii) a reduction in average travel time for vehicles along selected regional corridors; (iii) a reduction in annual fatalities on program corridors; and (iv) increase the number of people provided with improved climate resilient road access along regional corridors.

Many of the proposed activities are linked to the development of Gelephu and have strong regional relevance. For example, missing road links along the Southern East-West Highway (e.g. from Gelephu to Tareythang) are impeding regional development. The other set of project activities is directed at building resilience of digital infrastructure and developing the National Single Window (NSW), which will facilitate regional trade, which is especially important for Bhutan (representing 34% of GDP in 2019; trade with India accounts for 84% of total exports and 82% of imports). Gelephu could serve as a freight consolidation center on the southern border with links to industrial and manufacturing hubs (via the East-West highway), and a trade gateway with potential for multimodal connections to India and Bangladesh. While road transport dominates the modal mix carrying over 90 percent of

international trade, the Government intends to develop less carbon intensive modes, notably waterway and railway, which are exceptionally competitive for bulk cargo and could allow Bhutan to increase the export of minerals and boulders to its neighbors. As a part of the project, feasibility and masterplan studies for the Gelephu multimodal hub and airport, IWT and rail transport are envisioned.

The road link from Gelephu to Tareythang not only facilitates the airport, dry port and multimodal transport hub in Gelephu, but also is a part of the strategically important Samtse to Samdrup Jongkhar Highway running from east to west of the country. Gelephu and Tareythang are connected by a 45.4 km road now with a 3.0 m to 5.5m width and it takes about 2 hours to travel. The road traverses through mountainous terrain, often encountering steep inclines and declines, hair-pin bends and lacks proper sight distance at many curves. The first section (about 10 km) from Gelephu Town to the junction with the secondary road to Tareythang (near the eastern end of the existing Mau River bridge) is part of the National Highway, PNH5 to Trongsa.

An Initial Options and Scheme Definition (IOSD) study commissioned by the RGoB as a part of studies for its Gelephu Mindfulness City (GMC) initiative identified 3 possible alignments shown in Figure 1. The shortest alignment length is about 14.0 km which will need to be assessed and validated based on topographical, hydrological, geotechnical and other studies as a part of Detailed Design. The IOSD study was followed by a Preliminary Design, Feasibility Study, and Environmental and Social Impact Assessment (ESIA) based on the preliminary design. The current assignment is expected to benefit from these studies (but they do not substitute for the required surveys and field investigations) to develop detailed design and provide construction supervision support among other tasks.

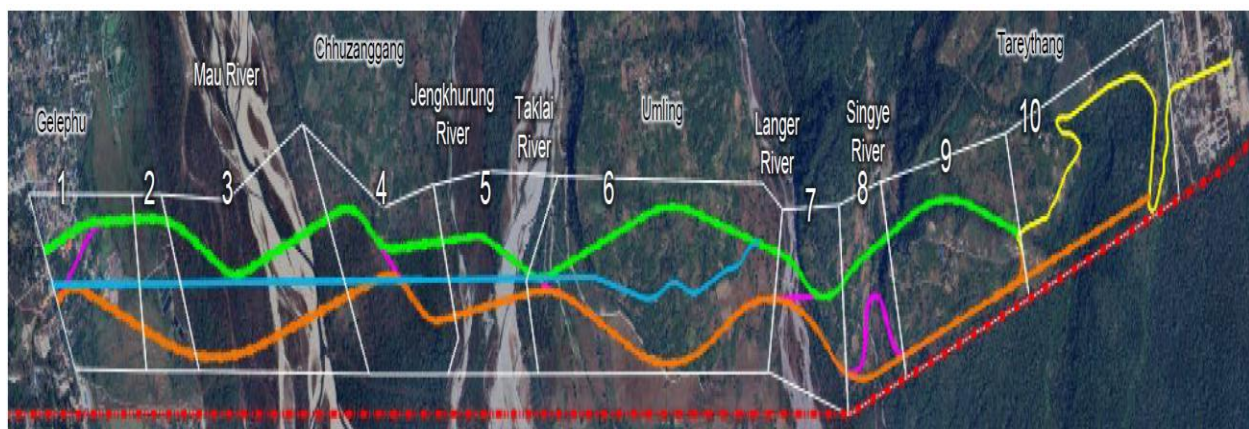


Figure 1: Candidate alignments with the southmost one being the shortest.

Being located on the floodplains, this will be a bridge-heavy road with over 3500m of bridge segments of different lengths, including about a 1000-meter-long bridge across Mau River. In addition to their usual functions, the bridges are expected to support the GMC development, be climate resilient, and also serve as underpasses for elephants and other wildlife.

Using a portion of ACCESS project financing from the World Bank, DoST would like to contract a qualified firm to render consulting services in conducting a comprehensive Detailed Project Report, construction supervision, and environmental and social risk management during construction. The services will be procured following the World Bank's Procurement Regulations for IPF Borrowers, February 2025.

2. OBJECTIVES OF THE ASSIGNMENT

The objective of this consultancy is to obtain the services described below (2.1 to 2.5) for a new road from Gelephu (26°52'13.57"N, 26°52'13.57"E) to Tareythang (26°48'39.00"N, 90°35'35.78"E)-namely, Gelephu-Tareythang (G-T) road in the Sarpang District of Bhutan which the Department has the plan to extend further to Panbang from Tareythang (about 80.0 Km). The new G-T road works will include (i) a seamless and safe integration of G-T road at both its terminal ends with the existing road and street system, including improvements to the intersecting street infrastructure; (ii) provision of short road connections from the new road to the existing settlements north of the selected alignment, facilitating access to these areas; and (iii) a bypass road connecting the eastern end of the new Mau River bridge with the PNH5 highway, to avoid the massive landslide and the existing narrow, low-level bridge, upstream from the project site.

The consultant, as part of the due diligence for the detailed design, will review and document all available engineering investigations, surveys, and testing data (topographical, geotechnical, geological, seismic, hydrological, hydraulic, river morphology etc.) including those carried out as part of the preliminary engineering and feasibility studies and the GMC Plan. Based on this review, the consultant will prepare and carry out remaining required surveys and field and laboratory testing required for detailed design and engineering. Specifically, the review will include the Feasibility Report, Preliminary Designs, Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP) Biodiversity Management Plan (BMP), and other survey data and information on the proposed project obtained from the Client (DoST) and other sources.

- 2.1. Detailed Surveys, Investigations, and Studies – e.g., topographical (if necessary), geotechnical, and hydrological surveys; seismic and geological studies; climate and climate resilience modeling, required for the design of road and bridges (including river training, erosion control, slope stabilization, road safety, and wildlife protection works).
- 2.2. Detailed Design of road and bridges and other ancillary structures and works.
- 2.3. Detailed Technical Specifications and Bill of Quantities (BoQ) for all items of work, incorporating the recommendations given in the ESIA, ESMP, BMP, along with the associated costs.
- 2.4. Updating or finalization of environmental and social risk management plans, based on the detailed design, including Resettlement Action Plan (RAP), Gender Action Plan (GAP), SEA/SH Action Plan (SAP), and Cultural Heritage Management Plan (CHMP) in compliance with the World Bank Environmental and Social Framework (ESF).
- 2.5. Procurement support to works contracts. Construction Works Supervision, including monitoring of ESMP and BMP and any relevant thematic E&S management plans during construction in compliance with the World Bank Environmental and Social Framework (ESF).

3. SCOPE OF SERVICES

The Scope of the services is to be divided into two phases;

Phase - I: The phase-I shall consist of Review of feasibility report, preliminary designs, ESIA reports, survey and other studies carried out for the project. Under this Phase, consultants are required to (i) validate the topographical survey and the DTM carried out during the previous studies; (ii) carry out detailed geotechnical survey and testing for the design of bridge foundation systems, retaining structures and other slope stabilization measures, and design of road pavements and embankments; (iii) carry out - hydrological surveys and hydraulic modeling and analysis , including a review of Mau river morphology, for the location and design of river training works, validation of the height and length of bridge spans; and the location, sizing and type of culverts and other drainage structures (iv) review the project site geology for faults and other features that could affect the seismic design for the bridges. The final product of this phase is detailed design of road and bridges, including preparation of drawings, detailed technical specifications and Bill of Quantities (BoQ), cost estimates, rate analysis for every item of work and works contracts procurement related support; preparation of addendum to ESIA and updated RAP are also included in this phase.

Phase-II: The Phase-II shall be the works contracts procurement support, construction supervision of the project works in addition to monitoring of Environmental and Social Management Plan (ESMP), Biodiversity Management Plan (BMP) and any relevant thematic E&S management plans during construction in compliance with the World Bank Environmental and Social Framework (ESF). This also includes the services during the DNP.

PHASE I TASKS

3.1. REVIEW OF REPORT, PRELIMINARY DESIGN, FEASIBILITY STUDY, ESIA REPORTS, SURVEY AND OTHER DATA ON THE PROPOSED PROJECT.

Familiarize itself with project rationale, relevant literature (previous studies will be made available by the client) from different available sources. Other envisaged tasks are:

3.1.1. Review of the Preliminary Design and Feasibility Study

The consultant will review the Preliminary Design and Feasibility Study report. They will verify and validate the relevant data collected during the preliminary design and feasibility study stage. The consultant will identify the data/information gaps and upon consultation with the employer, will prepare a detailed plan of additional surveys, investigations and studies required for the preparation of Detailed Project Report (DPR).

3.1.2. Review of ESIA reports including ESMP, BMP and other relevant thematic E&S management plans

The Consultant will review ESIA reports and other relevant reports and studies and identify any data gaps necessary to prepare the Detailed Design of the road and the bridges. This may include, but not limited to, additional biodiversity baseline survey to finalize the location of wildlife crossing and target species, additional consultation meetings with relevant authorities, NGOs and project affected communities.

3.1.3. Review and study of available survey data and information

Topographical Survey

Data from recent topographical survey (conducted by DoST) will be made available to the shortlisted consultants as part of the Request for Proposal (RFP) document. The consultant will validate that the topographical survey meets the following minimum requirements:

- ✓ Topographical survey covers 100-meter-wide strip on either side of the road center line with an additional coverage of 500 m upstream and 200 m downstream along rivers and known unstable/vulnerable sites intercepted by the alignment.
- ✓ The survey data is referenced to the coordinate points from the National Land Commission Secretariat (DRUKREF).
- ✓ Permanent benchmarks are established at an interval not exceeding 500m, with each traverse closed within this distance.
- ✓ For detailed design of bridges and culverts, the highest flood level (HFL), ordinary flood level (OFL) and low water level (LWL) are demarcated.

Topographic survey details commonly included in strip maps and site plans include the following elements:

- ✓ Trees, water bodies and other land features.
- ✓ Existing track/ road details (including national highways, secondary and local access roads) and boundary of government-owned land.
- ✓ Footprint of existing cross-drainage and other structures, existing access under the bridge, river training works and riverbank structure details
- ✓ Existing power line alignments and elevations (if buried) such as: high-tension poles, low-tension poles, transformers, sub stations, Streetlights poles, underground electrical supply, etc.
- ✓ Existing telecommunication alignments and elevations (if buried) such as: telephone lines, poles, cabinets, towers and underground lines
- ✓ Existing buildings and structures details such as: religious shrines, tangible cultural heritage, community building, governmental building, governmental building, residential building, boundary walls, etc.
- ✓ Existing or potential flood prone zones/ spots, low laying areas and river-bank cutting areas.

Additionally, the topographical maps/plans for bridges and river training works will include the following details;

- i. Flood lines on either side of the river in the entire area surveyed
- ii. Both banks of the river
- iii. River cross section at 25 m intervals, or less if required for modeling, analysis, and/or design; one cross section along the proposed bridge axis showing cross profile of 1m interval using suitable method
- iv. The angle and direction of skew if the bridge is proposed to be aligned skew
- v. Other information relevant to the design, construction and/or maintenance of the bridge.

Key task for the consultant includes;

- i. Acquiring the existing topographical survey data.
- ii. Review of the existing topographical survey data in accordance with the requirements mentioned above.
- iii. Identifying gaps in existing topographical survey data and additional requirements in the topographical survey data.
- iv. Conducting additional topographical surveys, if needed, in accordance with the requirements mentioned above. To expedite the survey process, it is recommended that the consultant deploy drones equipped with optical/Lidar cameras.
- v. Producing a Digital Terrain Model (DTM) and GIS-linked topographic shape files to facilitate the preparation of topographical strip maps in 1:1000 scale, 0.20 m contour interval and clearly showing the center-line of the selected road alignment and all the above-listed physical features.

Geotechnical Survey

Following field test results and data from recent Geotechnical Investigation (conducted by DoST) during the Feasibility and Preliminary design will be made available to the shortlisted consultants as part of the Request for Proposal (RFP) document. The consultant should review and carry out additional geotechnical investigations as detailed out in section 3.2.

- ✓ Data and field test results of boreholes
- ✓ Data and field test results of trial pits
- ✓ Data from Seismic refraction survey

Hydrological survey

Based on review of available information from DoST and other sources, the consultant shall identify data gaps and carry out additional investigations if required. The hydrological studies will feature the following;

- i. Catchment area of the river and its tributaries up to bridge site
- ii. Nature, size and quantities of debris carried by the river
- iii. Rainfall intensity, duration and frequency in the catchment

- iv. Existing bridge or other hydraulic structures across the river in the vicinity of the proposed bridge site with their details as much as possible
- v. General slope of the river from the critical point (origin) of the river up to bridge site and general slope of the catchment in both sides of the river
- vi. Cross sections covering 100m on either side. Beyond flood lines of the river at proposed bridge site, at about 500m. u/s and about 200m d/s. wherein HFL, LWL, LBL, area of the cross section, wetted perimeter and geological profile with silt factor of each strata (at proposed bridge site only) shall be indicated. (Horizontal and vertical scale of the cross section shall be the same.)
- vii. Bed slope of the river which must start from 100m up of the U/S cross section and end at 100 m. down of the d/s. cross section
- viii. Maximum discharge calculated by established formulas for different return periods and compared with historical peak discharges.
- ix. Peak design discharge for bridges estimated for a 1 in 200-year return period with stress testing for a 1 in 500-year flood. Peak design discharge for culverts and side/cross drains estimated for a 1 in 50 year return period.
- x. Velocity and depth of flow at the time of survey
- xi. Shifting of the river in the past at proposed bridge site and in its vicinity
- xii. River-bed degradation or aggradation (covering 500 m upstream and 500 m downstream)
- xiii. Use of river as migration corridor of wildlife and fisheries;
- xiv. Hydraulic data required for the location and design of river training/control works
- xv. The hydrological survey shall collect secondary data, preferably from the governmental sources, to determine the following
- xvi. Unit hydrograph for the catchment of River for bridge construction
- xvii. Size of the opening and location of cross drainage structure, that do not disturb the stream bed morphology and gradient, allowing free movement of aquatic and terrestrial;
- xviii. Minimize modification to the natural drainage pattern.

For hydrological data, the National Center for Hydrology & Meteorology (NCHM) should be consulted. After the selection of the proposed bridge site with alternatives and preparation of topographic maps, the Consultant shall discuss the collected hydrological and other data and decide the following points with the client for the final decision of the bridge site:

- i. Design discharge
- ii. Scour depth, Maximum Scour depth
- iii. A linear waterway needed to be provided
- iv. Anticipated soil condition for bridge foundation
- v. The most feasible proposed bridge site
- vi. River- training works and approach roads
- vii. Type of proposed foundation, substructure and superstructure
- viii. Wildlife crossing locations and structures.

The Consultant shall also carry out a detailed hydrological survey and study along the road alignments and identify catchment, discharge in drain, cross drainage, seepage area etc.

Seismological Study

The consultants shall collect and refer to the available data regarding the geological features and seismic records of the area. The consultant shall undertake a geological assessment of the project area and conduct a seismic vulnerability analysis of all structures and incorporate the findings into the design. While considering seismic forces on the bridge design, ICS¹, along with other international codes may be followed.

A materials survey will be conducted to determine the following:

- i. Suitable quarry site for boulder, sub-base/base/pavement aggregates, concrete aggregates, sand, fill materials;
- ii. Material to be transported from elsewhere;
- iii. Material to be imported from outside the country, their source and route of transport
- iv. Source of water for construction, location of boring if ground water to be used

The Consultant shall study the availability of construction materials like sand, gravel boulders, timber, etc., with their engineering properties, quantities and accessibility to the road works and bridge sites. The quarry site of materials with their available quantities should be shown on a sketch plan with reference to the bridge /road construction site. The Consultant will identify and locate temporary access roads to the construction staging areas for transporting equipment, materials, and supplies.

3.1.4. Identification of environment, climate induced hazards and disaster risks along road and bridges, and design the intervention to mitigate the risks

Based on the topographic survey, hydrological study, seismological study and review of technical and environmental and social impact assessments and management plans, the Consultant is to identify the environment, climate induced and disaster related risks which would affect the proposed road corridors and propose the measures to be incorporated to mitigate such risks into the road design documents. Some examples of mitigations may include but are not limited to drainage structure, wildlife crossing and fencing, noise barrier, vegetative cover/plantation/natural habitat conservation, avoiding the impacts on culture heritage, consideration of road design and materials, signage, pedestrian crossing, flood protection and slope stabilization works.

Once the proposed mitigations are approved by DoST, the following should be developed for each mitigation:

- i. Technical specifications and design
- ii. Location
- iii. Drawings
- iv. Timeline for construction
- v. Detailed cost estimates with rate analysis.

¹ The latest revision of ICS 91.120.25, Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi (or acceptable document followed by international best practice such as from Japan or California, US)

3.2. DETAILED GEOTECHNICAL INVESTIGATION FOR DESIGN OF ROAD AND BRIDGES.

3.2.1. Geotechnical Survey

For the design of bridges, pavements, retaining and other ancillary structures, following geotechnical tests, as a minimum, should be performed as per site requirements; the Consultant may propose alternative testing procedures, test frequency, and analytical methods, based on site conditions and best international practice:

- i. Sub-soil condition through pitting (1m x 1m x1m) and Dynamic Cone Penetration (DCP) tests at each 500m or wherever the soil type changes along the road alignment.
- ii. Sub-soil condition through 1m deep pitting and DCP test at each 5 m where a retaining wall of height more than 3 m is required.
- iii. Determine the properties of the soil and safe bearing capacity of the soil for the areas identified for the project through these tests.
- iv. Prepare soil profile along the road alignment through these tests.
- v. Identify, assess and prepare instability inventory maps (landslides, erosion, debris flow, scouring, toe erosion, creep, subsidence, land degradation, rock fall, planner failure, wedge failure, toppling etc.) within the study area and indicate the level of hazard posed by the instabilities. All the instabilities identified within the project area should be mapped on an appropriate scale. Furthermore, depicting cross sections of potential and existing unstable areas should be mapped on 1:500 scale maps with appropriate mitigation measures.
- vi. Survey, Identify, assess and prepare the slope map of the study area indicating the slope classification and level of hazards posed by the topography.
- vii. Stability of the cut slopes using appropriate stability analysis or through study, field surveys and investigation of materials at the site.
- viii. Survey, Identify, assess and prepare the geomorphologic maps for the instabilities.
- ix. Identify and assess the strength of geological materials by conducting necessary field and laboratory tests and analysis.
- x. Slope stability analysis of soil and rock slopes;
 - Depth and configuration of the failures.
 - Soil/rock classification, strength and density of soil/rock materials and the configuration of soil/rock strata, including basic geological indicators (e.g., Strike/dip) and other features such as fissures, faults, discontinuities etc.)
 - Groundwater table and surface/subsurface soil moisture conditions.
 - Analyze the stability of rock/soil slopes and determine if the excavated rock/soil faces are likely to fail (planar sliding along a discontinuity, wedge failure, or toppling failure).
- xi. Determine requirements for engineering structures such as retaining walls, Landscaping and complementary bioengineering applications along with detailed technical specifications, design, drawings, estimates and Bill of Quantities (BoQ).

3.2.2. Detailed Geotechnical Investigation

Detailed Subsurface exploration shall be carried out to acquire data for design of the bridges. The subsurface exploration shall, as a minimum, include the following (the Consultant, may propose alternative tests and test frequencies following best international practice):

i. **Test pits and auguring**

Test pits and auger-holes in the riverbed to a depth as required by the site condition or scouring criteria of the river shall be made and the required samples shall be taken for lab testing.

ii. **Bore-holes, field tests and laboratory tests**

The properties of the underlying soil are determined by field and laboratory tests of the soil samples obtained from the boreholes drilled to a depth as mentioned in the next paragraph. As far as possible, the locations of the boreholes shall be under each abutment and piers. Generally, the tests listed in Table 1 are conducted for determination of soil properties.

iii. **Depth of soil exploration**

The depth of soil exploration should be adequately done to inform the design of roads and bridges. An initial set of boreholes should be conducted along the final alignment to gain understanding of the ground condition. The final number and depth of ground investigations with boreholes at each pier and abutment location will then be determined for the final alignment and the preferred bridge type alternative for each location and its type of foundation (e.g., reinforced concrete piles, etc.) and has to be considerably deeper than the foundation depth in any soil type. Minimum of one bore hole should be drilled at the proposed foundation locations or its vicinity and its depth shall not be less than 60 meters from the surface unless confirmed refusal is encountered prior to achieving the prescribed depth.

iv. **Changes in soil strata**

During the boring, if there is any change of soil strata, the number of sampling of soils for different tests will be increased and the Consultant shall carry out the entire test required for each layer of soil. No additional payments will be made for such tests.

v. **Record of cores and labelling of the test samples**

The Consultants are required to properly secure the core in boxes with labels indicating the bore hole numbers, location with coordinates, their depth, color photographs of cores and hand over to the client for future reference. The Consultants shall take site photographs, videos or other documentation as appropriate for all site investigations, surveys and studies.

Table 1: Type of tests and sampling frequency

Sl. No	Type of Tests	Sampling Frequency
1	Undisturbed Soil Sampling	≥ 2 at each borehole
2	Standard Penetration Test	as required but the interval ≥ 1.5 m

Sl. No	Type of Tests	Sampling Frequency
3	Grain size analysis	≥2 at each borehole
4	Hydrometer analysis	≥2 at each borehole
5	Moisture content	≥2 at each borehole
6	Bulk and dry density	≥2 at each borehole
7	Unconfined compression test	≥2 at each borehole
8	Consolidation test	≥2 at each borehole
9	Direct shear test	≥2 at each borehole

3.2.4. Miscellaneous Studies/Investigations

If not covered by aforesaid, the Consultants shall perform other studies, explorations, tests surveys, calculations, etc. required to produce full and complete set of working drawings, specifications, bills of quantities, requirement of materials and complete cost estimates for the road and bridges including related works based upon which construction activities can be started to complete without further study and/or reference to them.

3.3. DETAILED DESIGN OF ROAD AND BRIDGES AND OTHER ANCILLARY STRUCTURES FOR ROADS AND BRIDGES.

It is expected that the consultant will establish a field design office in Bhutan with a significant part of data collection, analysis, and design work done locally in Bhutan. The intention is that the consultant will provide hands-on training to DoST engineers in road and bridge design.

3.3.1. Design of Bridges

- i. Based on the information collected and the results of the discussions mentioned above the consultants shall carry out detailed design of the bridges following the standard codes of practice, norms and guidelines. In addition, the designer shall consider general aesthetics and architectural perspectives of the bridges to be designed. Based on the additional data and information collected for detailed design, the consultant will review and confirm the final span arrangement and type of bridge, as compared to the recommended bridge design in the Preliminary Design and Feasibility Study. Refer Section 11 of this ToR for the preferred bridge types, span and others.
- ii. The Consultant shall prepare General Arrangement Drawing (GAD) and Alignment Plan showing the salient features of the bridges and structures proposed to be constructed along the road sections covered under the Study. The bridge cross-section (width) will conform to the design recommended in the feasibility report. The Consultants shall also design and make

suitable recommendations for protection works for bridges and river training works. The design of bridge shall also include design of approach road with proper geometric design to connect with existing road alignment including road safety provision.

The consultant will utilize hydraulic modeling software (e.g., HEC-RAS, various 2D modeling solutions) to inform design and to analyze scour potential at and near bridge substructure units (for example abutments, piers, and bents) given climate risks and incorporate climate resilience in the design.

- iii. The Consultant will provide for scour mitigation measures in design. And also develop a strategy for the movement or restriction of movement of water under the roadway embankment, in accordance with DoST standards and international best practices.
- iv. The Consultant shall produce a detailed quantity estimate of the bridge and all its accessories. They shall collect information on sources of materials and their lead distances and prepare rate schedules and cost estimates based on the standard norms followed by DoST² and other relevant ones and prevailing district rates.
- v. All activities related to field studies, design and documentation shall be done as per the latest guidelines, standard codes of practice and norms.
- vi. The Consultants shall work in close coordination with the reviewing experts entrusted by the Employer in every step of bridge design and supply the experts all the information they need within required duration.
- vii. The consultant shall make use of available forecast models to design climate resilient bridges and structures through various measures including materials selection and specification.
- viii. The design shall include the provision for installation of access to the bearing areas and major components of the bridge structure for the purpose of inspection and maintenance during the service life of the bridge. However, the access design provided shall not disturb overall aesthetics of the structure and should not compromise requirement of bridge design in accordance with standard code and guidelines.
- ix. The design shall include adequate river training structures on both the banks taking into consideration that the river would be trained appropriately within the given bridge span.
- x. The design shall include an approach road of suitable gradient and adequate turning radius with appropriate retaining structures on both banks. Moreover, there should be adequate drainage outlets (type and numbers) from the approach road.
- xi. The design shall include provisions for installation and conveyance of utilities such as water supply pipeline, telephone cables, television cables, power cables, closed-circuit television (CCTV) etc. as appropriate and deemed necessary by the study along the bridge.
- xii. The design shall include an appropriate lighting system on the bridge.
- xiii. The railing designed and provided should conform to international safety standards, be structurally sound, and visually aesthetic.
- xiv. The drawings should be done in an appropriate style and the scales suitably fixed so that they are easily readable at site or workshop by the naked eye. Except for general views, the drawing

² Guidelines for Rate Analysis, Bhutan

should preferably be made to scale of 1:50 and for showing minute details to 1:20 / 1:10 / 1:5 where necessary.

- xv. An adequate number of drawings should be produced to appropriately represent all the necessary details, views, etc.
- xvi. The detailed reinforcement schedule will be a part of the drawings.
- xvii. All drawings should be made to paper size – A3.
- xviii. Except for similar components, each different component shall have separate drawings in cross section, elevation and plan.
- xix. All drawing dimensions shall be in metric system (i.e., meter, cm and mm)
- xx. Technical Specifications (Specifications & Performance Requirements)
- xxi. The firm is required to prepare a detailed Technical Specifications for all items of work taking into consideration the relevant Code of Practices and the advancement in technology.
- xxii. Amongst others, the Technical Specifications shall include Occupational Health and Safety (OHS) as per the Notification Ref. No. MoIT/2020/20/112 dated 18th June 2020 of the Ministry and the subsequent Office Order Ref. No. DoST/CD/2/2019-2020/2506 dated 26th June 2020 of the Department.
- xxiii. The bridge designs must be verified/proof designed and then certified by the consultant firm.
- xxiv. The bridge design must allow for universal access including gender and diverse ability of the users' considerations.
- xxv. Design of wildlife passes/crossings and eco-friendly measures (refer to Section 3.3.10)

3.3.2. Design of road

The design of road shall follow Bhutan Standard to the extent possible, supplemented by established regional and international best practices. This shall include the following;

- i. Finetuning of the road alignment proposed by the Preliminary Design ensuring that it addresses local conditions and minimizes environmental and social impacts.
- ii. Design of the vertical and horizontal alignment for a 60 kmph design speed. Operational speed is to be determined by design stage and pre-opening road safety audit (through separate consultancy).
- iii. Design of highway cross-section including features such as but not limited to carriageway, roadside drains, ducts for utilities, shoulders, footpaths, cycle lanes and public transport facilities in accordance with the preliminary design and feasibility reports and according to the project needs.
- iv. Design of cut and fill slopes with a focus on erosion control and long-term durability. Consider bioengineering solutions where possible.
- v. Structural design of retaining structures (Gabion, Masonry, Plum concrete, RCC, Reinforced Earth, etc.).
- vi. Structural design of all RCC structures (including bridges, and underpasses).
- vii. Slope protection and Bioengineering.
- viii. Service lanes and bus bays wherever warranted.
- ix. Traffic calming measures where needed.
- x. Identification and design of road crossings for pedestrians and Vehicles from one side of road to another side.

- xi. Design of wildlife passes/crossings and eco-friendly measures (refer to Section 3.3.10).
- xii. Identification of roadside service area and its design.
- xiii. Identification of inclusive and accessible spaces for marketplace near the access roads connecting to the highway specifically for women entrepreneurs/traders. Propose plans for construction of marketplaces where feasible to be included in bidding documents.
- xiv. Public transport facilities, non-motorized transport facilities, pedestrian facilities, other road furniture to reach the project goals and curbside facilities.
- xv. Additional resilience measures, as needed, considering site conditions and climate forecast.
- xvi. Preparation of Design Drawings. Plan drawing should locate all other road structures such as cross drainages, animal crossings, slope protection works and other structures. Similarly, the cross-sectional drawings must be prepared for at least every 20 m interval for straight portion of road and closer for curves and bends reflecting all road structures such as pavement layers, drains, walls, cross slopes, cambers and other structures falling in that interval. The longitudinal section drawing must indicate all the required longitudinal parameters such as road gradient, vertical curve details, levels, and so on.
- xvii. Technical specification for each item included in the road design shall be prepared.
- xviii. Road alignment designed on Digital Terrain Model (DTM) shall be set out at the site while staking the central line and taking levels with verification of design. The consultant may use internationally recognized software for the road and bridge design. However, availing the software for the design purpose and any errors arising thereof during construction shall be the responsibility of the Consultant. All the coordinates in the drawings shall be in reference to the coordinate value acquired from the National Land Commission Secretariate, Bhutan.
- xix. Prepare drawing reports such earthwork quantities, coordinates for center line, left and right batter, stations and road edges.
- xx. Mass-balancing approach, especially for the last 5 kilometers of the road towards Tareythang. Mindful of balanced cut and fill and to the extent feasible, hill cutting is to be avoided for widening. Instead, the widening should be accomplished by well-drained retaining structures constructed on the valley side. This is particularly important for the last 5 kilometers of the road towards Tareythang. Safe spoil dump area needs to be identified for any unsuitable or excess material.

3.3.3. Design of Major Intersections, Terminal Road Connectivity, and Access/Bypass Roads

The Consultant shall conduct all appropriate traffic and other surveys, to obtain the required input variables to design the major intersections (traffic data from the surrounding traffic count stations will also be made available by DoST). The Consultants shall utilize one or more state of the art traffic modeling software packages (such as VISSIM, Synchro, Sim Traffic, or others) to model the existing condition and proposed options using the traffic volumes and turn movements forecasted at different points in time. The consultant will prepare and present short traffic simulation videos depicting options for each junction for the Employer to decide.

Other than the intersections at the Gelephu and Tareythang end points, all intermediate intersections will connect with the existing tertiary/local access roads by provision of interim road connections until the new GMC roads are constructed. These connections from the new road to the existing settlements

north of the alignment will facilitate access of existing residents and local governments (Gewogs) within GMC to the shorter route to Gelephu. The design of intersections shall be fully integrated with the road design and additional detailed drawings will be provided for each intersection, including road signs and markings, pedestrian crosswalks, and lighting. Further, the road intersections or take-offs from G-T road, provisions for flyover/underpass are to be considered to ensure smooth uninterrupted traffic.

At both terminal ends of the G-T road, the design will provide for a seamless and safe merger/integration with the existing road/street system, including improvements to the intersecting street infrastructure. This should include road extensions and terminal treatments (interchanges/roundabouts) to link the G-T road to the existing four-lane divided road connecting the dry port, airport, Gelephu town center and the planned road of Tareythang to Panbang.

Add the design of bypass road section from the eastern end of Mau bridge to the intersection of PNH5 and the existing secondary road to Tareythang (bypassing the slide and existing bridge). The location and design to conform to the GMC plan.

The detailed design will also include a bypass road section connecting the eastern end of the new Mau River bridge with the intersection of the PNH5, National Highway and the existing secondary road to Tareythang (bypassing the massive, active landslide and the existing low-level, narrow bridge upstream from the new G-T road alignment. The location and design of the bypass section (about 5-6 km) will conform to the GMC road and street plan, preferably utilizing the RoW of the existing secondary/district roads.

3.3.4. Design of Pavement

While designing the pavements, the Consultant shall consider standard universally accessible design guidelines³ considering users with diverse needs and ability, with the traffic and axle load data collected. Resilience measures are to be incorporated, as needed, considering site conditions and climate forecast at the project location.

The pavement design task shall also cover working out the maintenance and strengthening requirements and the periodicity and timing of such treatments.

As the current vehicle types and truck/axle loads are not representative of design year requirements, the design vehicle dimensions and truck/axle loadings should be based on future requirements (especially with respect to vehicle turning radii - for intersections, pavement/shoulder width, vertical/horizontal sight distance, and pavement thickness and surface type).

The detailed design will include a life cycle cost analysis of concrete vs, asphalt pavement, taking into account the availability of locally produced cement and the concurrent installation of plant and equipment for the construction of five concrete bridges. This analysis should also take into consideration the climate resilience aspects of the two pavement alternatives.

³ IRC:37-2018, *Guidelines for the Design of Flexible Pavements*, Indian Roads Congress, India; or *Guidelines for the Design of Flexible Pavements-2014 (2021 ed)*, DOR, Nepal; or *Road Note 31 (5th ed)*, TRL, UK

3.3.5. Design of Drainage Structures

While designing the drainage structures, the Consultant shall use a 1 in 50-year return period for estimating peak flows and use the data collected during the hydrological survey and determine the following;

- i. Type of surface and sub-surface drain
- ii. Type of the cross-drainage structure, including the use of arch culverts to maintain the stream morphology, gradient thus minimizing impact on aquatic life.
- iii. Structural design of culverts Size and location of road-side drainage and cross drainage structures (appropriate side drains and cross drainages such as pipe culverts)
- iv. Design of the water conduit/rainwater inlets/manholes to take storm water safely to the nearby natural stream
- v. Additional resilience measures, as needed, considering site conditions and climate forecast
- vi. Design of wildlife passes/crossings and eco-friendly measures (refer to Section 3.5)
- vii. The detailed drawings of each of these structures need to be produced.
- viii. The technical specification of each of the structures shall be prepared.

3.3.6. OFC and Ducting system design

The consultant will provide the technical design of the OFC ducting system and cables. The duct layout, including all access points, will be included in the relevant highway drawing sheets and also to be provided separately. The design will specify duct location within the road and bridge cross section. For OFC design and installation, the consultants will include the required specifications, service level agreements as per the adopted implementation approach in the final design and bid documents of the road.

3.3.7. Use of safe system approach

The Road should be safe for the design speed considered. This will include designing not only the traffic signs, markings, delineation and safety barriers but also incorporating measures for enforcement of traffic rules, speed management, gateway treatment (if applicable in the urban section), traffic calming (if applicable for urban section), educating road users, space to park unfit vehicles and identification of nearest post-crash treatment facility. In addition, the safety design should consider potential animal movement on the road, employing measures such as speed control, signage, roadside reflector to avoid or minimize wildlife vehicle crashes.

3.3.8. Climate resilient design

Given extreme climate and weather uncertainties in Bhutan, the consultant shall consider climate and weather resilience⁴ in all aspects during Feasibility and Detailed Design especially of bridge, drainage and retaining structures and road embankment. At a minimum, consider: (a) 1 in 200 return period for design of bridges and 1 in 50 for design of crossing, culverts, scour protection at all substructure units

⁴ Guidelines on Design, Construction and Maintenance of Road Infrastructure incorporating Climate-resilient Features- 2019, DOR, Bhutan.

and streambanks adjacent to abutments beyond that which is normally required by standard, (b) river training works, (c) additional freeboard to account for hydrologic and design flow uncertainty due to catchment area conditions and climate change, (d) design bridges, culverts, and approaches to withstand overtopping, (e) ensuring that all drainage structures are designed to be self-cleaning to the extent possible, and (f) oversizing large culverts to provide an additional factor of safety.

For the investigation and design process, preference shall be given to local guidelines supplemented by the relevant regional and international best practice⁵.

3.3.9. Value engineering study

A value engineering assessment of the road alignment and in particular the Mau River bridge and river training works preferably sub-contracted to a specialist value engineering consultancy. The value engineering shall include the sourcing of construction materials, the fabrication and installation methods of bridge components (e.g. box girders, type of foundation etc.).

The Consultant will carry out a value engineering analysis of the bridge and road designs to (i) identify cost-saving opportunities without compromising quality, functionality, or safety; (ii) optimize the design and construction processes; and (iii) improve the overall value of the project. The value engineering assessment will place special emphasis on the 1-km long Mau River bridge and the ancillary river training works, covering, *inter alia*, the design criteria and standards, sourcing of construction materials, and the fabrication and installation methods of bridge components (including both the super- and sub-structures).

The value engineering study will include, but not limited to:

- i. Review of existing design/engineering documents and cost estimates;
- ii. Identification of potential value engineering opportunities;
- iii. Analysis of cost-saving measures and their impact on project performance;
- iv. Development of value engineering proposals, including cost-effectiveness analyses; and
- v. Findings and recommendations to inform the detailed engineering.

Also, the value engineering study will assess design, material and construction technology choices such as:

- i. Use of reinforced earth for bridge abutments/approaches and slope protection works (in place of reinforced concrete or masonry).
- ii. Use of concrete pavements where vertical gradients exceed 6 percent; also compare concrete vs asphalt pavement using life cycle cost analysis for the entire project. As large concrete mixing/batching plants will be installed for bridge works, it could prove more cost effective to use concrete for road pavements as well (cement is locally produced vs asphalt is imported in Bhutan).

⁵ https://wii.gov.in/eia_bpg_guidance_document_2017 Guidelines on Design, Construction and Maintenance of Road Infrastructure incorporating Climate-resilient Features-2019, DOR, Bhutan.

- iii. Construction technology and methods adopted, such as type and size of foundations, the depth and span of bridge box girders, off-site vs. in-situ casting of bridge girders, elements, and so on. Climate resilience aspects such as selection of storm duration-intensity-frequency relationships and the storm return period (1 in 500 years vs. 1 in 200 years) for design of bridges and other drainage structures, and the implications for life-cycle costs.

3.3.10. Design of wildlife crossing structures and ecofriendly measures

The Consultant shall ensure wildlife crossing structures⁶, environmental risk mitigation measures and other eco-friendly measures are fully incorporated into the design based on the project ESIA, ESMP, BMP and international good practices. The different types of crossings should be proposed for different target species including Asian elephant, Gee's golden langur, amphibian/reptiles and others. These include species-specific dimensions of crossings, frequency of crossings, fencing requirements, additional road features, signage, etc. Examples include:

- i. Wildlife underpass: length, vertical clearance, openness index; guiding fences
- ii. Wildlife conflict mitigation measures, such as physical barrier, fences, elephant-proof trenches;
- iii. Culvert design should consider movement;
- iv. Overhead canopy crossings

For Asian elephant, preliminary design, ESIA and BMP suggest utilization of bridges to serve as elephant crossings. However, through review of existing E&S documents as well as collection and analysis of additional baseline data, additional wildlife crossing at the other location and by different form should be also considered and proposed as necessary to minimize the project impacts on wildlife movement.

The following international standards are proposed to design underpass/overpass structures and other eco-friendly measures to mitigate the impacts of the proposed road alignment on wildlife.

- i. Asian Development Bank, 2019. Green Infrastructure Design for Transport Projects: A Road Map to Protecting Asia's Wildlife Biodiversity.
- ii. Asian Elephant Transport Working Group, 2024, Handbook to mitigate the impacts of roads and railways on Asian Elephants.
- iii. Government of Nepal, 2022. Wildlife-friendly Infrastructure Construction Directives⁷.
- iv. Wildlife Institute of India, 2016. Eco-friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife.

3.4. PREPARATION OF BID DOCUMENTS INCLUSIVE OF DETAILED TECHNICAL SPECIFICATIONS AND BILL OF QUANTITIES (BOQ) FOR ALL ITEMS OF WORKS.

The bid documents shall be prepared based on the following:

- i. The civil works' quantities should be computed based on detailed plan profiles, design drawings and designed cross-sections following standard methods of measurement.

⁶ <https://www.adb.org/publications/green-transport-projects-asia-wildlife> https://conservationcorridor.org/wp-content/uploads/Asian-Elephant-Handbook_AsETWG_2024_web.pdf.

⁷ https://dnpwc.gov.np/media/rules/Wildlife-friendly_Infrastructure_Construction_Directives_2022.

- ii. The quantities of goods and works shall conform to the schedule and specifications⁸.
- iii. The rate analysis⁹ for civil engineering items shall follow the norms, official schedule of rates, and market prices for the year in which the cost estimate is prepared and updated in case of any delay in soliciting the Bids;
- iv. The costs shall be broken down into local and foreign currency components, direct cost, overheads, taxes, physical and price contingencies.
- v. The BoQ should be explicit covering all items of work. It should be as exhaustive as possible to avoid changes, additions, deletions and substitutions during execution and therefore the undesired disputes and claims.
- vi. The detailed technical and material specifications should be a part of the BoQ. One copy of the Technical Specifications shall be submitted to the client for its comments & suggestions before making the required number of copies.
- vii. The Consultant shall develop detailed Quality Assurance Plan (QAP) for the project.
- viii. Availability of materials may also be specified for those that are unique in features. As far as possible, the materials should be readily available in Bhutan.
- ix. Provide detailed market information for the selected procurement modality. Market information will include number of international contractors, name of contractors, notable similar experience, technical and financial capacity of these contractors.
- x. Propose suitable bidding modality (one stage/two stage), selection arrangements, requirements of initial selection/ pre-qualification for each package.
- xi. Rated criteria will be used during the bidding process for the works contracts. The consultant will propose appropriate rated criteria to be included in the bidding documents.

3.5. UPDATING AND FINALIZATION OF E&S MANAGEMENT PLANS IN COMPLIANCE WITH THE WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK (ESF) BASED ON DETAILED DESIGN.

The Consultant will update the following E&S deliverables in compliance with World Bank ESF and RGOB requirements;

- i. Updated ESMP: The Consultant will update the ESMP, prepared by DoST during the Project preparation, to ensure alignment with the Detailed Design. The updated ESMP will be part of the bidding document with cost estimates included. The updated ESMP will include works and activities as described in the Detailed Design, outline mitigation measures, define implementation roles and responsibilities, and specify requirements for training, reporting, and remedies.
- ii. Resettlement Action Plan (RAP): The draft RAP prepared by DoST during the Project preparation will be updated based on the detailed design. The objective of the RAP will be to describe and plan to mitigate any resettlement impacts (both physical and economic displacement) caused by land acquisition and restrictions on land use required for the construction and operation of the project. The RAP must include information about (a) the proposed project and its potential impacts on the displaced persons and other adversely affected

⁸ Guidelines for Rate Analysis, Bhutan

⁹ Bhutan Schedule of Rates-2024, MOIT

groups, (b) appropriate and feasible mitigation measures, and (c) the legal and institutional arrangements required for effective implementation of resettlement measures. The minimum elements of the RAP are detailed in Annex 1 of World Bank Environmental and Social Framework (ESF).

- iii. Resettlement Action Plan (RAP): The draft RAP, initially prepared by DoST during project preparation, will be updated based on the detailed design. The RAP aims to outline measures to mitigate resettlement impacts, including both physical and economic displacement, resulting from land acquisition and land use restrictions necessary for the project's construction and operation. The RAP must include: (a) an overview of the proposed project and its potential impacts on displaced persons and other affected groups; (b) updated socio-economic census of the PAPs and asset inventory; (c) appropriate and feasible mitigation measures, and (d) the legal and institutional arrangements required for the effective implementation of resettlement measures. The minimum elements of the RAP are detailed in Annex 1 of the World Bank's Environmental and Social Framework (ESF).
- iv. Gender Action Plan (GAP) and SEA/SH Action Plan (SAP): The GAP will have an initial assessment of gender gaps and priorities in the area. Based on findings on suitable areas for the marketplace and its potential design, the GAP will need to be updated. The SAP will include assessment of project-induced SEA/SH risks and mitigation measures. SEA/SH concerns and risks of the project activities include those related to resettlement/livelihood restoration in addition to the labor influx following the Bank's "Good Practice Note (GPN). The assessment will inform the; (a) approaches, methods, and action points for mainstreaming gender in the activities, which will inform the gender tag indicators of the project and will be captured in the GAP; (b) carry out an in-depth assessment of the SEA/SH related risks, assess the risk level and incorporate the necessary mitigation measures based on the risk level, which will be captured in the SAP.
- v. Cultural Heritage Management Plan (CHMP): Based on the detailed design and updated ESIA, the CHMP will be updated to map for additional tangible and intangible cultural heritage that may be covered by changes brought by the detailed design.
- vi. Capacity Building on E&S: Conduct initial comprehensive training sessions on E&S risk management, biodiversity and critical habitat species management, occupational health and safety (OHS), construction monitoring and auditing, stakeholder engagement, prevention and response to SEA/SH, management of Grievance Mechanism, implementation of RAP and livelihood restoration activities, occupational and Community Health and Safety, incident reporting procedures, and emergency preparedness and response procedures to PMU and implementation team and project workers prior to commencement of civil works, with follow-up training every 6 months as needed.
- vii. Contract clauses: The environmental and social clauses will be included in the bidding documents and contracts for the construction works, to ensure satisfactory environmental, social, health and safety performance of contractors. Such clauses should include any necessary penalties related to issues such as sexual exploitation and abuse (SEA) and sexual harassment (SH) by the contractor's and sub-contractor's workers, as well as the obligation for each project worker to sign codes of conduct on SEA/SH and OHS issues. The clauses will cover occupational health and safety (OHS) in communities affected by the construction and operation of the roads and other works, worksite health and safety. Labor camps/out of area

workers; HIV/AIDS & other STIs; child protection; gender equity and sexual harassment; labor rights and the employment of community members; and land, property and livelihood compensation.

PHASE II TASKS

3.6. CONSTRUCTION SUPERVISION OF ROAD AND BRIDGES INCLUDING MONITORING OF ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP), BIODIVERSITY MANAGEMENT PLAN (BMP) AND ANY RELEVANT THEMATIC E&S MANAGEMENT PLANS DURING CONSTRUCTION IN COMPLIANCE WITH THE WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK (ESF).

The role of the Consultant during supervision shall be as an “Engineer” to the contract using FIDIC General Conditions for construction supervision and contract administration ensuring full compliance with the design drawing, quality assurance and control as specified in the specification, and contract document. However, the Consultant shall seek and obtain the Client’s specific approval prior to undertaking actions that would incur additional costs and time:

- i. Issuing variation orders which have financial implications or are significant in quantities.
- ii. Revising the time for completion of the Works.
- iii. Approving any subcontracting of any part of the Works.
- iv. Fixing new rates or prices that are not in the Contract.
- v. Issuance of Taking Over Certificate. Issuance of Performance Certificate.
- vi. Any other as mentioned in the Contract Documents for works.

3.6.1. Procurement support

The consultant shall support DoST to – support bid evaluation process as requested by DoST, preparation of response against bidder queries, assist with negotiation, and support works contract finalization. To attract potential bidders internationally and locally, the consultant shall recommend the contract packages for the works. The consultant will also assist with organizing road shows to solicit interest in project civil works in selected international markets such as India, Thailand, Turkey, and Malaysia.

3.6.2. Pre-Construction Preparatory Tasks

The scope of the services during the pre-construction Phase shall include:

- i. Maintain, update, monitor, report on and, where applicable, administer the project’s risk management framework. Under the framework, while a risk is created, provide (i) a risk name, (ii) description of risk (iii) owner, (iv) set risk status (open, work in progress, closed, resolved),

- (v) set target resolution date, and (vi) note down resolution once resolved. During risk monitoring, update all the above inputs, as required.
- ii. Review and approve the Quality Assurance Plan (QAP) submitted by contractor as per contract specification to ensure the work quality for provisions of pavement and structures. QAP needs to outline, as of minimum, contract specific quality objectives, processes, responsibilities, and resources required to achieve and maintain the desired level of quality. QAP needs to be aligned with civil works contract specification.
- iii. Review and approve Environmental and Social Impact Assessments (ESIA), and Environmental and Social Management Plan (ESMP), Biodiversity Management Plan (BMP) and other specific E&S management plans such as OHS plans for compliance with World Bank Safeguard Policies submitted by contractor. The review should ensure adequate measures are in place to mitigate Gender-Based violence and sexual exploitation and abuse and other issues related to labor influx, in a manner consistent with the latest guidance from the World Bank, including the establishment of a functioning Grievance Redress Mechanism (GRM).
- iv. Review and approve the Environmental and Social Management Plan (C-ESMP) as per the Project ESMP and effectively implement it. The Supervision engineer serves as the representative of the Client to ensure E&S requirements are appropriately incorporated into the engineering design and bid documents, subsequently review, approve the C-ESMPs.
- v. Review Work Schedule, Mobilization Plan, Material Procurement Schedule and Manning Schedule proposed by the contractors. Scrutinize and approve the contractors' detailed work program including the resource planning.
- vi. Finalize the format and content of Progress Reports to be submitted to the Employer.
- vii. Finalize the content and format of laboratory test reports, Interim Payment Certificate, progress reports, monthly update of ESMP and other reports to be received from the Contractor as per the Contract.
- viii. Prepare a Supervision Manual which will lay out procedures to be followed during the execution of the works.
- ix. Scrutinize and approve construction methods proposed by the contractors with modifications, as necessary.
- x. Customize World Bank's GEMS app or develop an app on KoBo platform for monitoring of progress and compliance of E&S requirements. Upload data onto the app on weekly basis.

3.6.2 Construction Phase

The Consultant will work as 'The Engineer' for the contracts for roads and bridges. The scope of the services during the Construction Phase shall include but not limited to:

- i. Ensure that all works comply with the approved engineering designs and technical specifications, agreed schedule and budget, conditions of the contracts, standard engineering practice, and WB's safeguard policy.
- ii. Supervise and monitor construction of all project components. Interpret the Technical Specifications, where required.
- iii. Review, Scrutinize and Submit monthly financial and physical progress report to the Employer and the World Bank as per the requirement.

- iv. Perform site visits regularly in consultation with the client. During site visits, consultant's responsible personnel will:
 - a. examine the reality and the quality of the setting out of works and its adherence to the drawings; the consistency between the approved drawings, the works carried out and the quantities accounted for in the interim payment certificates.
 - b. ensure the quality of the works in conformity to QAP and the contract technical specifications,
 - c. examine the project management documents such as: work register, including the list of equipment used daily, relevant measurement books, calculation finches and shop drawings approved by the supervision team, minutes of site meetings, the topographical, geotechnical and every other intermediary task's acceptance reports, any other contractual documents and administrative orders, site correspondence and all correspondences between the contractor and the supervising consultant.
 - d. examine the site management aspects such as: the quantity and efficiency of the topographical and geotechnical teams' deliveries, the laboratory testing and the adequacy and availability of equipment, etc.
 - e. address any pre-dispute situations which are likely to result in a claim from the contractor or a site shut down.
 - f. do the checks and verifications to be carried out using appropriate methods and techniques including, but not necessarily limited to, e.g., site surveys, laboratory and site tests, measurements, photos and calculations to verify quantities based on statements and documents produced by the contractor and the supervising consultant.
 - g. recommend and execute further in-depth measures, if deemed necessary.
- v. Attend and certify all laboratory tests required on material and completed work as per the specifications.
- vi. Check and approve shop drawings submitted by the contractors.
- vii. Check the Performance Guarantee, Advance Payment Guarantee and insurance certificates submitted by the contractors for adequacy as well as ensure their timely renewal up to the duration required.
- viii. Monitor environmental and social safeguard requirements provisioned in ESIA, ESMP, BMP and specific E&S instruments. Scrutinize and approve the contractor's Environmental Management Social Action Management Plan (C-ESMP) as required under the project ESIA, and ESMP and BMP, and its monthly updates.
- ix. Review the Contractor's Code of Conduct for employees, and the remediation plans for any facilities required during the construction phase.
- x. Review and approve the location of camp sites to ensure they minimize disruption to local population, fauna and flora and water courses, and provide adequate drainage facilities and treatment of sewage and waste disposals.
- xi. Check and establish that the contractor mobilizes and supplies materials, equipment, construction machinery, workers and funds matching the timeline committed in their Bid and ensure that all such items remain on the contract until their release has been authorized.
- xii. Check line/ level, layout of construction to ensure conformity with the contract, propose any change in the plans, if required.

- xiii. Maintain detailed records of measurement of the completed works, quality test results, correspondence, detailed diaries, photographs, daily site records submitted by the contractors on ambient conditions and contractors' resources at the site and their use including other documents concerning relevant events and activities.
- xiv. Check, verify and certify interim payment certificates for progress payments, verify and certify the quantities for such certificates and recommend the Employer for payment with special emphasis on minimizing the time taken from receiving the interim certificates to disbursement against it.
- xv. Ensure timely offsetting of mobilization advance, deduction for retention, taxes, liquidated damages as well as repayment of retention to be included in the corresponding interim payment certificates.
- xvi. If any project activity is deviating from the targeted deadline as shown in the approved work program, identify and record the reasons for the delay and party responsible for the delay, and establish the mechanism to avoid such delay. When required, re-baseline the work program, keeping the original baseline alive. When required, use the proof of delay in rejecting or establishing any claim. Such deviation in targeted dateline should be immediately reported to the client.
- xvii. Attend third party inspections, as necessary, and provide certification on the quality of the supplies based on such inspections. Responsible to furnish necessary documents and clarification/justifications to Royal Audit Authority (RAA) or others for the activities executed during routine/annual auditing of the project.
- xviii. Provide necessary technical support to the Employer on its project management, including risk management, cost control, scheduling, monitoring and reporting.
- xix. Collate data and photographs of the work progress to manage project Management Information System (MIS) through Geo-Enabling initiative for Monitoring and Supervision (GEMS)¹⁰. Generate insights from data and include them in the progress report.
- xx. Undertake mapping throughout the construction period using openly available software such as Mapillary.
- xxi. Assess and make recommendations with all supporting documents, justifications to the Employer on the Contractor's claim for additional payment, Extension of Time and any other matters related to contract administration; and
- xxii. When the physical progress under a contract package reaches 80% of the initial contract value, prepare and submit a detailed progress report with updated cost of the packages, implementation schedules and substantiate any request related to additional funding, if such is needed to full completion of the project. At this stage, the Consultant shall also prepare the draft Completion Report for the respective packages in the format to be agreed by the Employer. The Completion Reports for each of the works' packages will be included in the consolidated Project Completion Report (PCR).
- xxiii. Conduct a Pre-Opening stage Safety Audit using the standard procedure in the region once the construction activities are completed and the road is ready to be opened for normal traffic. Address qualified audit findings.

¹⁰ GEMS software and training on GEMS will be provided to the consultant by the World Bank without any payment from the consultancy firm.

3.6.3 Supervision for the implementation of ESMP and BMP

The scope of the services during the Construction Phase to implement ESMP shall include but not limited to:

- i. Consultants shall ensure that the construction work method proposed by the Contractor are satisfactory with particular reference to the ESIA, ESMP, BMP, the regulatory requirement of environmental clearance from DOE; technical requirement of sound environmental standards of the project to ensure compliance to WB's Environmental and Social framework (ESF) and applicable WBG EHS guidelines; inspection of contractor's construction equipment; and safety of the construction works, property, personnel, and general public; the schedule of mitigation measures for adverse environmental impacts to be monitored by the Consultant.
- ii. Supervise the contractor(s) in the preparation of the contractor's environmental and social management plan (C-ESMP) following the project ESMP and BMP, review and approve the C-ESMP on behalf of the Client. Require contractors and subcontractors to prepare and implement an OHS Management Plan as part of the C-ESMP. The C-ESMP will include a periodic (quarterly) reporting format on E&S risk management based on which the contractor will report to the PIU on the related risk management issues. Subsequently, ensure implementation and monitoring of the C-ESMP by the contractor(s).
- iii. Design and undertake project performance monitoring and evaluation of the project in accordance with the Environmental and Social standard (ESS) of the ESF, relevant policy, guidelines and BMP and C-ESMP.
- iv. Prepare/update the Emergency Response plan of the Contractor to include provisions for pandemic (covid-19 and potential future ones) management.
- v. Monitor, facilitate and, where relevant, implement other social and gender related activities, including the HIV/AIDS, human trafficking, and road safety awareness campaign to the communities along the corridor and at labor camps.
- vi. The preparation of ESIA, ESMP and BMP, Resettlement Action Plan, Labor Management Plan, Stakeholder Engagement Plan, and any others as required under WB ESF and/ or national legislation for the improvement works will be provided by PMIU. However, the Consultant is expected to completely follow instructions from these documents to ensure that the specific findings and recommendations of these studies are fully integrated into the detailed design process, implementation schedule and work implementation procedure.
- vii. Assist the PMIU in managing/running the project GRM and stakeholder Engagement Plan (SEP) as outlined in the E&S documents. This will include the SEA/SH and workers' GRM as well, based on, respectively, the project SEA/SH Risk Mitigation and Action Plan and Labor Management Procedures (LMP). Ensure the smooth functioning of all GRMs in close coordination with the Contractors and PIU. Prepare periodic reports on behalf of the PIU on the status of the GRM and grievances submitted by the PAPs.
- viii. Assist the PIU in the implementation of the SEA/SH Risk Mitigation and Action Plan and Gender Action Plan.
- ix. As mass production of asphalt and its transportation is anticipated in the project area potential adverse impact on the environment and population needs to be evaluated and monitored

including recommending appropriate mitigation measures. Review and update the air quality monitoring, noise mitigation measures and waste management plan as and when required.

- x. Review the Contractors drawings, work plans, methodology etc. Check if the construction work zone safety measures are in place and are adequate, modify the plan and methodology if required.

3.6.4 Post-construction Phase

The scope of the Services during the post-construction Phase shall include:

- i. Inspect the works at appropriate intervals during Defects Notification Period (DNP) and issue instructions for rectification if any.
- ii. Prepare and submit to the Employer the final cost of executed works.
- iii. Ensure that the contractors' demobilization is as per the agreed Mobilization Plan, and the reviewed and approved remediation plans.
- iv. Check and certify As-Built Drawings prepared by the contractors before issuance of Taking-Over Certificates.
- v. At the completion of the works, assist the Employer in preparing a consolidated Project Completion Report (PCR) in the format as prescribed by the World Bank.

4. TECHNOLOGY TRANSFER

The Consultant shall consider the technology transfer as an important aspect during each stage of the project. If the Client so chooses, the Client's engineering staff shall be taken as trainee in field investigation, design and supervision related tasks. They shall be provided with working space and frequent interactions and guidance by the Consultant's key-experts.

One day workshop each on Geotechnical Investigation and Mitigation measures proposed, Road Design, and Bridges and other structure design shall be conducted for the officials of the client either in person or online.

The consultant will additionally conduct two additional knowledge sessions for DoST officials. The consultant should propose a long list of topics relevant to DoST for Client to discuss and agree on two depending on the need of the department.

DoST will provide venue of all the knowledge sessions. Other logistics and content are to come from the consultant.

In addition, for the bridge design work, the consultant shall invite the engineers from department (Bridge Division) to participate in the Design Process. This is to facilitate the transfer of know - how to the department. This will also enable engineers from the department to respond to clarification during the bidding process and during the time of construction.

5. DURATION OF SERVICES AND CONTRACT TYPE

The Five and half (5.5)-year service period is divided into two Phases:

- i. Phase-I: Lump-sum contract for Nine (9) months.
- ii. Phase-II: Time based contract for Fifty-Seven (57) months;

- a. Procurement support – 9 months
- b. Construction supervision support-36 months
- c. Supervision support during DNP-12 months

6. CONSULTANT'S TEAM

6.1. Key and non-key experts

The staff composition and their corresponding inputs in **Table 2** is the Client's estimate. The consulting firms are advised to assess their own requirements and propose their own staff composition and corresponding inputs for efficient deliveries as per the ToR. The Consultant may propose any additional staff as non-key experts.

For the Detailed Design part, the Consultant will be paid on a lumpsum basis with details elaborated in the RFP document. For the Construction Supervision and DNP related tasks, the payment shall be based on inputs.

Table 2: Estimated staff inputs from the Consultant

Composition of Consultant's team							
SL. No	Type of Experts	No	Estimated Inputs (Person-Months)				Remarks
			Phase-I (Design)	Phase-II (Supervision)	Phase-II (DNP)	Total	
Key Experts							
1	Team Leader/ Senior Highway Engineer (I)	1	4	24.0	1	29	K-1
2	Highway Engineer/ Deputy Team Leader	1	9	30.0	6	45	K-2
3	Senior Bridge Engineer (I)	1	9	18.0	0	27	K-3
4	Senior Environment Specialist (I)	1	1	2.0	0	3	K-4
5	Senior Biodiversity Specialist (I)	1	1	2.0	0	3	K-5
6	Senior Social Specialist (I)	1	4	12.0	0	16	K-6
7	Geotechnical Engineer (I)	1	4	18.0	0	22	K-7
8	Resident Engineer (I)	2	0	60.0	9	69	K-8
9	Value Engineering Expert	1	2	0.0	0	2	K-9
	Total	10	34	166	16	216	
Other Non-key Experts and Support Staff							
1	Geologist (I)	1	1	0.0	0	1	S-1
2	Structural Engineer (I)	1	9	12.0	0	21	S-2
3	Pavement Engineer (I)	1	1	6.0	0	7	S-3
4	Hydraulic Engineer/Hydrologist (I)	1	1	0.0	0	1	S-4
5	Materials/Quality Control Engineer (I)	1	3	30.0	0	33	S-5

Composition of Consultant's team							
SL. No	Type of Experts	No	Estimated Inputs (Person-Months)				Remarks
			Phase-I (Design)	Phase-II (Supervision)	Phase-II (DNP)	Total	
6	Assistant Resident Engineer	2	0	60.0	6	66	S-6
7	Environmental Specialist	1	2	24.0	1	27	S-7
8	Biodiversity Specialist	1	2	24.0	1	27	S-8
9	Occupational Health and Safety (OHS) Expert	1	1	24.0	0	25	S-9
10	Social Specialist (National)	1	2	12.0	0	14	S-10
11	Gender/GBV Specialist (National)	1	1	12.0	0	13	S-11
12	Gender/GBV Specialist (International)	1	1	2.0	0	3	S-12
13	Re-Settlement Specialist (International)	1	4	0.0	0	4	S-13
14	Procurement and Contract Management Expert(I)	1	3	6.0	0	9	S-14
15	Telecommunications Engineer	1	1	3.0	0	4	S-15
16	Senior Surveyor	1	2	6.0	0	8	S-16
17	Quantity Surveyor	1	5	30.0	3	38	S-17
18	Office Manager	1	6	36.0	0	42	S-18
19	CAD Operator	1	6	0.0	0	6	S-19
20	Technical support staff	3	9	90.0	12	111	S-20
21	Non-technical support staff	3	9	90.0	12	111	S-21
	Total	26	69	467	35	571	
	Total	36	103	633	51	787	

Note:

- i. *The consultant may propose any other experts as non-key experts or support staff, if necessary.*
- ii. *The home-based inputs of the expatriate experts (marked by "T" above) shall not exceed 20% of their corresponding total inputs.*
- iii. *Financial proposals should include all the logistics, investigations, rentals and other direct and indirect costs necessary to execute the services.*
- iv. *The number of experts proposed for different positions in Technical and Financial proposals should match.*

6.2. Qualifications and experiences of

The broad qualifications of the Key-personnel and their responsibilities are given below. The Technical Proposal should contain the CV of all personnel proposed. All the personnel shall be appropriately qualified and fit to travel for extended periods in rugged terrain. Though only the CV of key-personnel will be evaluated, the capacity of other staff shall also be monitored during task

execution. The detailed responsibilities shall be assigned by the Consultant to complete all the deliverables in a professional manner.

Key Experts:

6.2.1. Team Leader (I)/ Senior Highway Engineer (I)

- i. **Education:** Graduate in Civil Engineering, master's degree in Transportation Engineering, Civil Engineering, or in a related field; Relevant training in road design; Accredited Professional Engineer preferred. Additional relevant training on project management, contract management, procurement preferred.
- ii. **Experience:** 20 years of general experience in designing and supervision of highway projects. At least 10 years' experience in countries other than home country in leading highway design and construction projects. At least one project as Resident Engineer for a highway/bridge supervision project. At least one project with large bridge design or construction. Sound experience of procurement and contract management in projects funded by multilateral development partners. Excellent communication skills in English.

6.2.2. Highway Engineer/Deputy Team Leader

- i. **Education:** Graduate in Civil Engineering, preferably master's degree in Transportation Engineering, Civil Engineering, or in a related field; Relevant training in road design theory and software tools; Accredited Professional Engineer fellowship preferred.
- ii. **Experience:** 15 years of general experience in engineering including designing and constructing roads or highways. Over 10 years of specific experience in leading teams for design and construction of highways or roads in Bhutan. Experience in FIDIC-based contracts, managing contracts with international contractors, and projects funded by multilateral development partners will be an advantage.

6.2.3. Senior Bridge Engineer (I)

- i. **Education:** Graduate in Civil Engineering, with or master's degree in Bridge Engineering or Structural Engineering or in a related field. Training on common structural analysis and at least 2 design software packages will be an advantage. Relevant training or research on climate resilient design of bridges and other cross-drainage structures will be an advantage.
- ii. **Experience:** 15 years of general experience as Structural Engineer in bridge design. Specific experience of designing and construction-phase backstopping of over 5,000 m bridges, of which at least 3 different types from among RCC-girder, box-girder, cable-stay, and cable-suspension bridges. Prior experience of box-girder bridge design in a terrain similar to Bhutan is preferred. Substantial relevant experience in a country/country other than his/ her home country required.

6.2.4. Senior Environmental Specialist (I)

- i. **Education:** Graduate in Ecology, Forestry, Environmental Science or Engineering, or related field. Master's degree in Environmental Engineering, Environment Science or equivalent preferred.

- ii. **Experience:** 15 years of general experience in conducting EIA/ESIA for road projects. A minimum of 5 years of specific experience in leading EIA/ESIA and construction stage environmental monitoring for highway in countries other than Bhutan. Should have experience working with projects funded by international financing institutions. Relevant experience in a country/country other than his/ her home country required. Familiarity with WB ESF is required.

6.2.5. Senior Biodiversity Specialist (I)

- i. **Education:** Master's degree in Biodiversity, Wildlife, Ecology, Zoology, or a relevant discipline. Relevant research on elephant or tiger habitats in mountainous terrain will be advantageous.
- ii. **Experience:** 15 years of general experience as a Biodiversity Expert for infrastructure development projects. Specific experience in monitoring highway project impact on wildlife for at least 5 years. Should be familiar with WB ESS6 requirements and methodology. Experience in similar assignments in countries other than his/ her home country will be required.

6.2.6. Senior Social Specialist (I)

- i. **Education:** Graduate in Social Science or Sociology. Master's degree in Social Science, Sociology or equivalent preferred.
- ii. **Experience:** 15 years of general experience in conducting ESIA and RAP for road projects. A minimum of 5 years of specific experience in leading RAP and ESIA and construction stage social risk management and monitoring for highway or large infrastructure projects in countries other than Bhutan. Should have experience working with projects funded by international financing institutions. Relevant experience in a country/country other than his/ her home country required.

6.2.7. Geotechnical Engineer (I)

- i. **Education:** Graduate in Civil Engineering with a master's degree in Geotechnical Engineering. Special training on geotechnical investigation preferred.
- ii. **Experience:** 10+ years of general experience in sub-soil exploration, design of deep foundations of bridges and construction stage backstopping during bridge foundation construction. Specific experience of design and construction supervision of pile, well, or caisson foundation of at least 10 bridges. Experience of slope stability analysis in mountainous terrain is preferred. Substantial relevant experience of similar projects in country/countries other than his/ her home country required.

6.2.8. Resident Engineer (I)

- i. **Education:** Graduate in Civil Engineering, master's degree in Structural Engineering, Civil Engineering, highway engineering or in a related field; Relevant training in road design and structural analysis; Accreditation as Professional Engineering preferred.

- ii. **Experience:** 20 years of general experience in designing and supervision of highway and bridge projects. Over 10 years of specific experience as Team Leader or Resident Engineer in highway projects with at least one road project in mountain terrain comparable with Bhutan terrain. At least one project with considerable bridge work. Sound knowledge and experience of quality control and contract management. Ability to solve construction site issues to ensure progress necessary.

6.2.9. Value Engineering Expert(I)

- i. **Education:** Graduate in Civil Engineering with advanced degree in engineering business administration or a related field. Professional certification in Value Engineering or Project Management is highly recommended.
- ii. **Experience:** Minimum 10 years of general experience in value engineering of civil construction projects including highways and bridge projects. Should have sound and strong analytical and problem-solving skills. Should have experience of identifying cost saving opportunities of three infrastructure projects in countries other than home country. Sound knowledge in business models, economic analysis and strong communications skills is preferred.

Non-key Experts and Support Staff

6.2.10. Geologist (I)

- i. **Education:** Master's Degree in Geology, Applied Geology, Engineering Geology, Hydrogeology, Geochemistry, Geophysics, or related field and discipline. Geological Engineering and Geotechnical engineering will be preferred.
- ii. **Experience:** At least ten years general working experience with at least (3) three years specific experience in hazard and disaster studies, and geological assessment related work experience in highway and bridge construction projects in mountainous terrain near thrust fault zone will be preferred.

6.2.11. Structural Engineer (I)

- i. **Education:** Graduate in Civil Engineering, master's degree in Bridge Engineering or Structural Engineering or in a related field. Training on structural analysis /design software packages will be an advantage.
- ii. **Experience:** 15 years of general experience as Structural Engineer in bridge design and construction. Specific experience of designing and construction-phase backstopping of over 2,000 m of at least 3 different types from among RCC-girder, box-girder, and cable-suspension highway bridges. Experience of culvert and drainage structures design desired.

6.2.12. Pavement Engineer (I)

- i. **Education:** Graduate in Civil Engineering, preferably master's degree in Pavement, Highway, or relevant field. Training in Climate Resilient pavement design will be an advantage.

- ii. **Experience:** 10 years of general experience in design and construction of flexible and rigid pavements. Specific experience of designing over 200 km of flexible pavement. Experience of using geogrids, wet-mixed base, and modified bitumen will be an advantage. Thorough knowledge of construction materials properties in Bhutan is necessary.

6.2.13. Hydraulic Engineer/Hydrologist (I)

- i. **Education:** Graduate in Civil Engineering, preferably master's degree in River Hydrology/Hydraulics, or related field; relevant training in Hydrological Modelling or Climate Change preferred.
- ii. **Experience:** 12+ years of general experience in hydrological investigation for highway or hydropower projects; Specific experience of hydrological modelling for over 1,000 m of highway bridges in mountainous areas. Hydrological modelling experience for at least two projects.

6.2.14. Materials/ Quality Control Engineer (I)

- i. **Education:** Graduate in civil Engineering required; with master's degree in Geotechnical Engineering, Material Science, or related discipline. Experience in geotechnical investigation, laboratory testing, and construction materials for roads in Bhutan is necessary.
- ii. **Experience:** Over 10 years of general experience in operation and management of material testing laboratories for road and hydropower projects following IS or ASTM requirements.

6.2.15. Assistant Resident Engineer

- i. **Education:** Graduate in Civil Engineering; Relevant training in topographical survey, quality management, and road design software.
- ii. **Experience:** 10 years of general experience in construction supervision of road or hydropower projects with at least one project in mountain terrain comparable with Bhutan terrain. Sound knowledge and experience of quality control and contract management.

6.2.16. Environment Specialist

- i. **Education:** Graduate in Ecology, Forestry, Environmental Science or Engineering, or related field. Master's degree in Environmental Engineering, Environment Science or equivalent preferred.
- ii. **Experience:** 10 years of general experience in conducting EIA/ESIA for road projects with a minimum of 5 years of specific experience in leading EIA/ESIA and construction stage environmental monitoring for infrastructure development projects of comparable size and funded by multilateral development partners. Familiarity with Bhutan environmental laws and regulations is required.

6.2.17. Biodiversity Specialist

- i. **Education:** Master's degree in Biodiversity, Wildlife, Ecology, Zoology, or a relevant discipline. Relevant research on elephant or tiger habitats in mountainous terrain will be advantageous.
- ii. **Experience:** 10 years of general experience as a Biodiversity Expert for infrastructure development projects. Specific experience in monitoring highway or hydropower project impact on wildlife for at least 2 years. Should be familiar with ESS6 requirements and methodology. Knowledge and experience in Bhutan ecosystems and conservation activities especially on wildlife are required.

6.2.18. Occupational Health and Safety (OHS) Specialist

- i. **Education:** Master's degree in public health or relevant discipline. Adequate training on OHS adherence for civil works sites.
- ii. **Experience:** 10 years of general experience as an OHS Expert for infrastructure development projects. Specific experience in monitoring highway or bridge project impact on wildlife for at least 3 years as an OHS expert. Familiarity with Bhutan OHS laws and regulations are required.

6.2.19. Social Specialist (National)

- i. **Education:** Graduate in Social Science or Sociology. Master's degree in Social Science, Sociology or equivalent preferred.
- ii. **Experience:** 10 years of general experience as Social Specialist with a minimum of 5 years of specific experience in leading ESIA/ SIA for infrastructure development projects of comparable size and funded by multilateral development partners.

6.2.20. Gender/GBV specialist (National)

- i. **Education:** Graduate in Social Science or Sociology. Master's degree in Social Science, Gender Studies, International Development, Sociology or equivalent preferred.
- ii. **Experience:** 10 years of general experience as gender and/or GBV specialist. Minimum of 5 years of specific experience in implementing and monitoring interventions aimed at promoting gender equality and GBV prevention and response, particularly in large infrastructure development projects of comparable size and funded by multilateral development partners.

6.2.21. Gender/GBV Specialist (I)

- i. **Education:** Masters or equivalent in social studies, gender studies, public health, anthropology, sociology, or related field. Relevant training on gender aspects and GBV prevention.
- ii. **Experience:** Minimum 10 years of direct experience working in the area of GBV, with on-the-ground experience in ESIA (preferably GBV). Experience in providing high-level strategic and practical advice and technical support to donors, multilateral and community organizations, and policymakers on what works to prevent violence. Published knowledge of what works to address Gender-Based violence, based on global impact evaluation data. Direct experience in collecting and analyzing data related to GBV and internationally acknowledged methods for comparing GBV data across countries. An active member of

a global network working on GBV and/or have done work for such. Excellent writing skills in English and local languages are preferred.

6.2.22. Resettlement Specialist (I)

- i. **Education:** Graduate in Social Science or Sociology. Master's degree in Social Science, Sociology or equivalent preferred.
- ii. **Experience:** 10 years of general experience as Resettlement Specialist with a minimum of 5 years of specific experience in leading RAP for infrastructure development projects of comparable size and funded by multilateral development partners.

6.2.22. Procurement and Contract Management Expert (I)

- i. **Education:** At least Bachelor's degree, preferably in procurement, contract management, or a relevant field. Professional accreditation as an arbitrator preferred.
- ii. **Experience:** 20 years of relevant experience in Procurement and Contract Management. Excellent knowledge of World Bank procurement and contract policies, procedure, regulations and guidelines, and UNCITRAL model law on International Commercial Arbitration. At least 10 years' experience in countries other than home country in handling Contractor's claims in FIDIC based contracts.

6.2.23. Telecommunications Engineer

- i. **Education:** Graduate in the relevant field of Electronic Engineering or Electrical Engineering (focus on telecommunications).
- ii. **Experience:** 10 years of general experience in fiber network designs and implementations. Specific experience in defining specifications for ducting systems along road constructions.

6.2.24. Senior Surveyor

- i. **Education:** University Graduate in Surveying, Civil Engineering, or with at least 6-month professional training on topographical survey. Training on using drones for surveys will be an advantage.
- ii. **Experience:** 5 years of general experience in topographical survey or cadastral survey. 2 years of specific experience in leading topographic survey and mapping for highway or hydropower projects preferred.

6.2.25. Quantity Surveyor

- i. **Education:** Diploma in civil Engineering, bachelor's degree in civil engineering preferred. Training on quantity survey, relevant software or Microsoft Office Suite will be an advantage.
- ii. **Experience:** 5 years of general experience in analysis of unit rates, quantity estimation, and managing road construction projects; 2 years of specific experience in supporting design team or supervision team for infrastructure development project as Quantity Surveyor or Site Engineer will be an advantage.

6.2.26. Office Manager

- i. **Education:** University graduate. Training on Microsoft Office Suite will be an advantage.

- ii. **Experience:** 2 years of general experience in supporting a team of multi-disciplinary professionals of different countries in an office environment. Specific experience of typing reports, managing finances and field logistics will be an advantage.

6.2.27. CAD Operator

- i. **Education:** Diploma in Architecture or Civil Engineering, training in AutoCAD or Auto Civil or other relevant drafting software will be an advantage.
- ii. **Experience:** 5 years of general experience in computer-aided drafting of design drawings, working drawings, structural drawings, architectural drawings, etc. for road and bridges in different formats.

The Consultant may propose any other expert as a non-key expert. It will include in its proposal the full costs for such non-key experts and support staff (secretaries, translators, drivers, etc.), and activities necessary for the professional operation of the project team. Costs shall include administrative and technical support from the Consultant's head office and field trips, including travels to Bhutan and consultative sessions

7. REPORTING AND DOCUMENTS REQUIREMENT

Reports required to be submitted by the Consultant during the course of their services are as follows:

7.1. Phase-I

Report	Broad content	Timing (starting from the Commencement Date)	Submission condition	Employer's response
Inception Report	<ul style="list-style-type: none"> ▪ Approach and methodology ▪ Activity schedule broken down to weeks showing: <ul style="list-style-type: none"> ▫ Each component of the TOR with its completion matching the Delivery Milestones ▫ Expert inputs matching the Delivery Milestones and showing home-based or field inputs ▪ Highlight any immediate actions needed. ▪ Reason of selection of specific norms and standards intended to be used in design and construction supervision 	Within 6 weeks	<ul style="list-style-type: none"> ▪ 2 hard copies ▪ 1 soft copy ▪ Slide presentation in a hybrid meeting. 	Within 2-weeks either accept or ask for revision

Report	Broad content	Timing (starting from the Commencement Date)	Submission condition	Employer's response
	<ul style="list-style-type: none"> ▪ Critical review of all prior studies and data provided by the Employer. 			
Geotechnical Investigation Report	<ul style="list-style-type: none"> ▪ All bore logs for bridges ▪ Interpretation of result 	Within 4 months	<ul style="list-style-type: none"> ▪ Bored out cores arranged in labelled boxes ▪ 3 hard copies ▪ 1 soft copy 	Within 2-weeks either accept or ask for reinterpretation of results
Draft Detailed Design Report	<ul style="list-style-type: none"> ▪ Detailed design of road alignments, road embankment, pavement layers, culverts, drainage, wildlife underpasses and other structures ▪ Detailed Design of bridges including all structural and architectural details for the selected option ▪ Incorporation of ESIA, ESMP and BMP provisions in design, cost estimate, Bid Documents ▪ Resettlement Action Plan ▪ Architectural, and structural drawings of the road, bridges, and other structures ▪ Ducting System Specifications ▪ General and Particular Technical Specifications ▪ Bid Document through editing appropriate template from the World Bank ▪ BoQ and Cost Estimates 	Within 6 months	<ul style="list-style-type: none"> ▪ 3 hard copies ▪ 1 soft copy ▪ Slide presentation in a hybrid meeting. 	Within 2-weeks either accept or ask for revision
Final Detailed Design Report	<ul style="list-style-type: none"> -Finalized version of content in draft report including final bid documents -Final digital models of all the bridges shall have to be submitted 	Within 9 months	<ul style="list-style-type: none"> ▪ 10 hard copies, an editable soft copy, and a PDF soft copy: 	Acknowledge

Report	Broad content	Timing (starting from the Commencement Date)	Submission condition	Employer's response
			<ul style="list-style-type: none"> ▪ Separate report for each bridge. ▪ Separate report for animal underpasses and multi-cell box culverts and animal underpasses. ▪ Separate report for major intersections. ▪ combined report 	

7.2. Phase-II

Report	Broad content	Timing (starting from the Commencement Date)	Submission condition	Employer's response
Supervision Manual	<ul style="list-style-type: none"> ▪ Procedures to be followed by construction supervision staff of the Consultant 	Before the Contractors are on board	<ul style="list-style-type: none"> ▪ 2 hard copies ▪ 1 soft copy. 	Acknowledge
Draft Completion Report	<ul style="list-style-type: none"> ▪ Quantities executed vs provisioned, Change Orders, Contractor's claims and their status, 	When Physical progress of a package reaches 80%	<ul style="list-style-type: none"> ▪ 2 hard copies ▪ 1 soft copy. 	Acknowledge
Contract Completion		At completion	<ul style="list-style-type: none"> ▪ 10 hard copies 	Acknowledge

Report	Broad content	Timing (starting from the Commencement Date)	Submission condition	Employer's response
on Report		n of a package	▪ 1 soft copy.	
Monthly Progress Report	<ul style="list-style-type: none"> ▪ Progress as per TOR ▪ Log of communication. ▪ Monitoring reports on E&S performance of contractors and subcontractors ▪ Specific highlights, if needed ▪ Key actions ahead (next month) to ensure timely completion of the project 	Within 7 th of each consecutive calendar month	<ul style="list-style-type: none"> ▪ 2 hard copies ▪ 1 soft copy. 	Observations
Special Highlight Report	Investigation, data, and their analysis as required	As and when required by the Employer	▪ 2 hard copies	Acknowledge

8. GENERAL OBLIGATIONS

8.1. To be provided by the Consultant

During the study, the Consultant shall provide all the facilities for their staff and other logistical requirements on their own to fulfill its obligations. These will also include support staff and office facilities, office equipment and supplies, required equipment and materials for field data collection, vehicles, communications and insurance for its staff as required. The Consultant will set out the phase wise requirements in the technical proposal and provide the financial cost estimates for these in their financial proposal. For the client to avail all the services, the consultant shall set up the offices at project sites, Thimphu and wherever deemed necessary by the client at its own cost.

8.2. To be provided by the Employer

The Employer will provide the Consultant with all previous Feasibility Study, Conceptual Design, Draft ESIA, Draft ESMP, RAP reports and data relevant to the services. The Employer will provide access to the existing facilities and information required for the study and provide assistance where the Consultant, for the purpose of executing these services, needs to coordinate with other RGoB agencies, and other stakeholders. The Employer will facilitate the consultant to participate in all stakeholder consultation events.

If the Employer chooses to send Employer’s engineering staff on secondment to the Consultant team as trainee, the remuneration, accommodation, transportation and other logistics of such trainee engineers will be borne by the Employer.

9. IMPLEMENTATION MODALITY

The Terms of Reference (ToR) for the contract has been developed to be implemented in two (2) phases of the project and the consultant shall quote financial proposals for both the phases separately. The financial proposal of the both the phases shall be combined to evaluate the financial proposal to determine the Most Advantageous Proposal of the Consulting Services.

After the selection, the Phase-I (Lump Sum) and the Phase-II (Time Based) contract shall be signed between DoST and the consultant. However, the Phase-II (Time Based) contract will be effective subject to fulfillment of the effectiveness conditions which may include:

- 9.1. Approval of the construction of the Project from DoST project stakeholders.
- 9.2. Availability of financial resources for the execution of Phase-II deliverables.
- 9.3. Any other conditions DoST may consider necessary for the continuation of the services under Phase-II.

10. SELECTION PROCEDURE

The Consultant will be selected following the Quality and Cost-Based Selection (QCBS) method as set forth in the World Bank Procurement Regulations for IPF Borrowers, Sixth Edition, February 2025.

11. Key features of the bridges

11.1. Gelephu Bridge

Bridge Name:	Gelephu Bridge
Span of the bridge:	Approximately 80 m
Loading class:	Envelope of class 70R and class A (wheeled) as per IRC 6
No. of lanes:	4 lanes
Carriageway width:	15.00 meters
Footpath:	3.00 meters
Total width	Minimum of 20.95 m
Railings:	Suitable railing with drainage outlet

Lighting:	Appropriate lighting system
Bridge Type:	RC Multicellular Box Culvert
Approach road:	Approach road with smooth curve and transition on both the banks

11.2. Mau River Bridge

Bridge Name:	Mau Bridge
Span of the bridge:	Approximately 1005 m (As recommended in Preliminary Design Report and Feasibility Study Report)
Loading class:	Envelope of class 70R and class A (wheeled) as per IRC 6
No. of lanes:	4 lanes
Carriageway width:	15.00 meters
Footpath:	3.00 meters
Total width	Minimum of 20.95 m (as recommended Preliminary Design Report and Feasibility Study Report)
Railings:	Suitable railing with drainage outlet
Lighting:	Appropriate lighting system
Bridge Type:	PSC box girder (refer Preliminary Design Report and Feasibility Study Report attached as annexure)
Approach road:	Approach road with smooth curve and transition on both the banks

11.3. Jengkhurung and Taklai Bridge

Bridge Name:	Jengkhurung and Taklai Bridge
Span of the bridge:	Approximately 780 m (As recommended in Preliminary Design Report and Feasibility Study Report)
Loading class:	Envelope of class 70R and class A (wheeled) as per IRC 6
No. of lanes:	2 lanes
Carriageway width:	7.50 meters
Footpath:	3.00 meters

Total width	Minimum of 12.15 m (as recommended Preliminary Design Report and Feasibility Study Report)
Railings:	Suitable railing with drainage outlet
Lighting:	Appropriate lighting system
Bridge Type:	PSC box girder (refer Preliminary Design Report and Feasibility Study Report attached as annexure)
Approach road:	Approach road with smooth curve and transition on both the banks

11.4. Langer Bridge

Bridge Name:	Langer Bridge
Span of the bridge:	Approximately 300 - 380 m (as recommended in Preliminary Design Report and Feasibility Study Report)
Loading class:	Envelope of class 70R and class A (wheeled) as per IRC 6
No. of lanes:	2 lanes
Carriageway width:	7.50 meters
Footpath:	3.00 meters
Total width	Minimum of 12.15 m (as recommended Preliminary Design Report and Feasibility Study Report)
Railings:	Suitable railing with drainage outlet
Lighting:	Appropriate lighting system
Bridge Type:	PSC box girder (refer Preliminary Design Report and Feasibility Study Report attached as annexure)
Approach road:	Approach road with smooth curve and transition on both the banks

11.5. Singye River Bridge

Bridge Name:	Singye Bridge
Span of the bridge:	Approximately 380 m (as recommended in feasibility study)

Loading class:	Envelope of class 70R and class A (wheeled) as per IRC 6
No. of lanes:	2 lanes
Carriageway width:	7.50 meters
Footpath:	3.00 meters
Total width	Minimum of 12.15 m (as recommended Preliminary Design Report and Feasibility Study Report)
Railings:	Suitable railing with drainage outlet
Lighting:	Appropriate lighting system
Bridge Type:	PSC box girder (refer Preliminary Design Report and Feasibility Study Report attached as annexure)
Approach road:	Approach road with smooth curve and transition on both the banks