



## TERMS OF REFERENCE

### Consultancy Services for conducting Preliminary Surveys, Assessments and Feasibility Study for the proposed Thinadhoo - Kaadedhdhoo link project in Gaafu Dhaalu. Atoll, Maldives

#### 1. Background

Maldives is an archipelago of 1,190 low-lying coral islands in the Indian Ocean spread over an area of 90,000 km<sup>2</sup>, stretching 860 km with a population of approximately 515,000 distributed over 187 islands. The land area, which covers about 26 geographic atolls, is grouped into 18 administrative atolls and three cities.

Located in the southern region of the Maldives, Huvadhoor or Gaafu Atoll stands out with its distinctive geography and is often recognized as the second largest atoll in the country, spanning two administrative districts; Gaafu Dhaalu Atoll and Gaafu Alif Atoll (refer to Figure 1). Gaafu Dhaalu Atoll, with Thinadhoo as its administrative capital, comprises 10 inhabited islands or districts and is equipped with two domestic airports, namely Kaadedhdhoo and Faresmaathodaa. Beyond its geographic significance, Gaafu Dhaalu Atoll showcases substantial potential to evolve into a key economic hub in the southern Maldives.

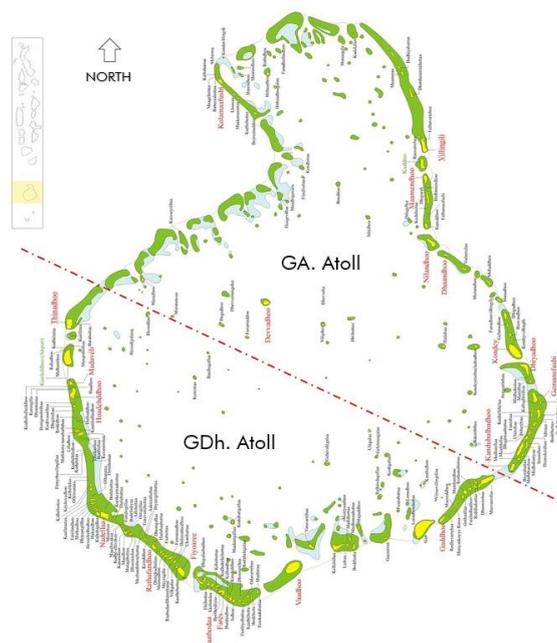
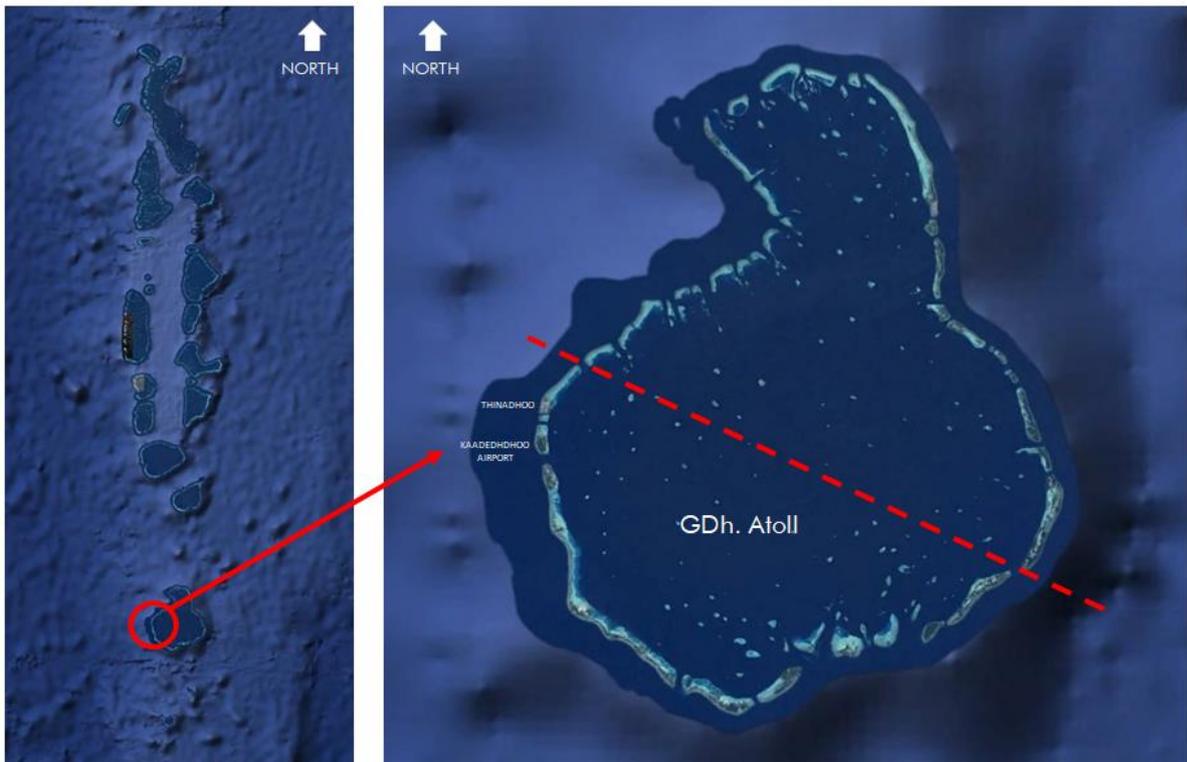


Figure-1: Map of Huvadhoor Atoll, Maldives



The unique geographical and demographic characteristics poses major development challenges for the Maldives including in areas such as transport connectivity and infrastructure development as well as the provision of basic social services and access to equitable economic opportunity.

In recent years, governments have made changes in its policies to address many of the above issues and thus have invested heavily in transport infrastructure development. The most significant of it is the completion of China-Maldives Friendship Bridge which now physically links Male' City to Velana International Airport at Hulhule' and residential island of Hulhumale'. Additionally, the ongoing construction of Thila-Male' bridge, designed to connect the entire Greater Male' region, underscores the commitment to enhancing connectivity. Consequently, there is a recognized need to establish physical links between other islands of Maldives. The government aims to realize its vision by initiating the implementation of bridge links to connect the islands of Gdh.Thinadhoo and Gdh.Kaadedhdhoo (Figure 2).



Map of Maldives

Map of Gdh. Atoll of Maldives

Figure-2: Map of Gaafu Dhaalu Atoll, Maldives



## 2. Objectives

The primary objective of the project is to establish an efficient and a safer land link between the islands of Gdh. Thinadhoo and Gdh. Kaadedhdhoo, resulting in reduced transfer times for goods and passengers by sea. The specific objective of this assignment is to conduct a feasibility study, evaluating the viability of the project and identify the optimum alignment option for the link. The anticipated total length of the proposed link is estimated to be around 3-3.5 km, with the exact length pending confirmation after determining the potential options for the bridge landing points upon completion of this exercise. The comprehensive design of the proposed link may extend beyond the bridge itself to include associated highway link road, coastal, and shore protection elements if required.

The project site encompasses harbours and navigation channels, in addition to an operational domestic airport. Within close proximity to the project site are operational resort islands, necessitating regular arrivals and departures of tourists to and from Kaadedhdhoo airport. Serving as the capital of Gaafu Dhaalu Atoll and the most densely populated island in Huvadhoo Atoll, the island of Thinadhoo holds a central position in the project's context. The geographical placement of the islands where the proposed link is envisaged can be visualized in Figure 3.



Map of Maldives

Map of Thinadhoo and Kaadedhdhoo Airport –  
located on the western rim of Gaafu Dhaalu Atoll

Figure-3: Map of Gaafu Daalu Atoll showing the location of Gdh. Thinadhoo island and Kaadedhdhoo Airport, where the link has been proposed



Ministry of Construction and Infrastructure

Male', Republic of Maldives

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On behalf of the Government of Maldives, the Ministry of Construction and Infrastructure (MCI) will serve as the Implementing Agency for the project. Implementing Agency will be the lead agency in coordinating with the stakeholders and beneficiaries during the pre-construction and construction phase of the project. Implementing Agency shall also provide support in getting any necessary information to achieve compliance to the necessary local laws and regulations.

### 3. Scope of Services

Government of Maldives now seeks the assistance of a qualified and competent consulting firm with ample experience, to conduct preliminary survey, assessments and feasibility study on the construction of the bridge, highway link road including any integral shore protection structures (hereinafter collectively to be referred as the “Project”) for the envisioned Thinadhoo - Kaadedhdhoo bridge in Gaafu Dhaalu Atoll.

The Consultant is tasked with conducting a comprehensive feasibility study, collaborating with the Employer and relevant stakeholders. This involves exploring various alignment alternatives to ascertain the most economically viable, technically feasible, and environmentally sound solution for the proposed link. It is imperative to ensure that the bridge alignment avoids conflicts with current and future marine traffic in and around harbours, as well as vessels enroute to nearby islands. Moreover, it is essential that the profiles ensure sufficient clearance for navigation channels, enabling unhindered passage for marine vessels. This entails maintaining a height well below the Obstacle Limitation Surface of existing Kaadedhdhoo Airport runway and any prospective expansions, ensuring seamless navigation while adhering to aviation safety regulations.

The detailed scope of work outlined in this Terms of Reference (TOR) includes, but is not limited to, the following:

#### a) Preliminary Surveys and Assessments

All preliminary surveys and assessments required by the Consultant to determine suitable bridge alignment alternatives and to thoroughly assess the feasibility of the selected optimum proposal should be conducted. The Consultant, in collaboration with the Employer, will determine the extent and coverage of the surveys to ensure a thorough assessment to finalize the alignment of the proposed link. The initial steps of the survey involve conducting a reconnaissance survey and undertaking a comprehensive desk review prior to proceeding with detailed on-site surveys. This comprehensive approach ensures a thorough understanding of the surveyed area, facilitating effective planning and decision-making. The following surveys and assessments, while not exhaustive, are deemed sufficient to study the feasibility of the proposed alignment for the proposed link:

##### a. Topographic Survey

- All necessary physical features, crucial for determining the optimum alignment solution of the link, are to be surveyed.



- Surveys should be carried out in reference to the existing Permanent Station Marks (PSMs) established in each island.
- Surveys and the resulting maps should be completed to international and local standards.
- All distances used in the surveys should be in metric unit system and all angles should be in degrees, minutes and seconds.

*b. Bathymetric Survey*

- All necessary underwater features of the sea bed, crucial for determining the optimum alignment solution of the link, are to be surveyed.
- Contours of the seabed in both deep and shallow waters along the proposed alignment are to be mapped.
- Survey and the resulting maps should be completed to international and local standards.
- All distances used in the surveys should be in metric unit system and all angles should be in degrees, minutes and seconds.

*c. Geotechnical Study*

- Undertake an extensive literature review incorporating existing studies on the geotechnical properties of soil within and around the project site, drawing insights from analogous projects.
- Perform an initial evaluation of the soil condition, utilizing visual or fundamental soil investigation methods such as trial pits, complemented by insights from existing studies at the proposed landing points and pier locations in order to ascertain the physical characteristics of the soil. An intensive site investigation is not expected to be conducted at this stage of the project.
- The report should describe the methodology employed for estimating preliminary geotechnical parameters, along with the proposed values and assumptions utilized for the preliminary design of pile foundations across the entire site.

*d. Hydrological Study*

- A literature review encompassing existing studies for the islands, inclusive of historical and current rainfall data from the MET office is to be conducted. The review should also include any available data on historical and current flooding associated with storm surges, along with any existing hydrological surveys.
- An intensive hydrological survey is not expected to be conducted at this stage of the project.
- The report should describe the methodology employed for estimating impacts of flooding on the bridge landing locations resulting from the introduction of the proposed bridge. Additionally, it should detail the proposed values and assumptions used for the preliminary estimation of the drainage requirements.

*e. Hydrodynamic Study*

- Undertake an extensive literature review of the coastal region of the islands, drawing insight from similar projects. Integrate current, tide, and wave data from existing studies on the hydrodynamic characteristics of the coastal environment within the project site.



- Assess the impact of waves, tides, currents and storm surges on the proposed link based on existing studies. An intensive hydrodynamic modelling of the project site is not expected to be conducted at this stage of the project.
- The report should describe the methodology employed for estimating preliminary hydraulic parameters, including proposed values and assumptions utilized for the preliminary design of the proposed link throughout the entire site.

*f. Initial Environmental Examination and Socio-Economic Study*

- A literature review is to be undertaken of existing studies on the potential impact of the proposed bridge alignment on coral and marine habitat.
- Identify marine protected areas (MPAs) and assess sensitive sites such as breeding or nursery grounds of protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles).
- Assess and analyse environmental mitigation measures that will have a financial and technical impact on the project in terms of methodology required for works execution or related activities.
- Assess and analyse socio-economic benefits of the connectivity project. The study must include impacts on the environment and the economic activities at the islands.
- Assess the possibility of encroachment on privately owned or land assigned on long term lease basis both within the proposed bridge alignment and landing points.
- Collection of demographic data related to the project. This should include existing population data as per both island council register and published census records, household data, etc.
- At this stage of the project, an Environmental Impact Assessment (EIA) is not expected to be conducted for any segment of the assignment.

*g. Transportation Study*

- A study to analyse the impact of the proposed link on marine and land traffic flow. This includes evaluating the current and potential future traffic demands/ changes and influences resulting from the development of the new link.
- Accessibility and availability of (public) transport to nearby islands, including the number of travellers and its impact due to the proposed link.

*h. Utility Survey and Condition Assessment Study*

- Identify the locations of existing utility services and facilities, sub-sea cables, and upcoming expansion plans through collaboration with utility service providers and island councils.
- Collection of data related to power supply system of the islands including power generation capacity, transformers, available loads from distribution boxes etc.
- Identification of structures along the alignment that may necessitate a condition assessment, and propose necessary modifications that may be required for the structures, such as quay walls, shore protection structures, etc.



## b) Feasibility Study

The aforementioned surveys and studies are to be synthesized to examine the technical and economic feasibility of the proposed alignment. The goal is to identify and choose the most optimal solution among possible alignment alternatives.

In collaboration with the Employer, a thorough review of all existing project documentation should be conducted, aiding the government in finalizing both functional and aesthetic requirements of the proposed link. The Consultant is tasked with developing an optimum conceptual design for the link, encompassing alignment alternatives, types, and options, to be presented as preliminary concept. Stormwater drainage at the bridge landing locations should be assessed, details on dredging, reclamation, and shore protection works should also be prominently studied. While it is recommended to explore a minimum of three alignment alternatives to allow the consultant to determine the best alignment, the focus of this assignment is solely on studying the conceptual aspects of the optimal solution. The presented option will include a thorough analysis of its respective pros and cons, including the construction method and preliminary cost estimate. The salient features of the proposed link, including the width and number of lanes as per international standards, and a confirmation of the total length of the proposed link/ bridge will be made during this phase, with stakeholder consultations playing a crucial role in the decision-making process. The finalization of bridge landing points, access points, approach roads and considerations for embankments or filling will be contingent on this concept design.

This comprehensive approach ensures thorough finalization of all essential components, aligning with the Employer or stakeholder expectations and environmental considerations. The essential features of the proposed link are to be determined in the course of this assignment. However, anticipated salient features of the link include:

- Bridge
- Highway link road
- Carriageway
- Sidewalks
- Drainage
- Road Lighting
- Road Marking
- Sign boards and safety features
- Handrails and crash barriers
- Utility corridor; for current services as well as for future expansion
- Fiber optic backbone network for communications
- CCTV & speed cameras

The emphasis throughout this process is on comprehensive consultation, analysis, and informed decision-making to ensure a well-rounded and well-informed feasibility study.



At the end of the feasibility study, the following should be finalized:

- Present the optimum solution for the proposed link with an analysis of its respective pros and cons.
- Presentation of the methodology flow of the optimum solution and its selection, which includes the methodology (philosophy) of the design of the bridge.
- Determine the technical and economic/ financial feasibility of the optimum solution chosen.
- Type of highway link and its components, proposed structural scheme of the bridge (including all other elements considering variations in shallow and deep areas).
- Establishment of the final alignment, with conceptual plan and profile of the link and span arrangement based on the preliminary design layout.
- The Consultant should make a preliminary estimate of the required material volume, encompassing reclamation, if any and highway link road pavement, as part of the project assessment. If sand is required, the volume and methodology, borrow areas for sourcing sand, whether through dredging using a cutter suction dredger or Trailing Hopper Suction Dredger (THSD), should be clearly discussed.
- The proposal should include a construction methodology with details on the availability, potential locations, sizes, and specifications of temporary land for casting yards and gantries, taking into account the preferences of the Employer and local authorities.
- Maintenance requirements or features and frequencies of the various components of the bridge should be clearly assessed.

#### **4. Duration of Services**

The period of total engagement will be 45 (forty-five) days from the date of signing the Contract Agreement. Commencement of Consultancy work will start upon signing the contract agreement.

#### **5. Requirements of the Consultancy Team**

All engineering work shall be performed by experienced personnel, and the Consultant shall use the necessary tools, instruments and equipment to perform the engineering work in a professional manner and in accordance with accepted engineering practices. The scope of works listed above broadly requires competencies in civil, structural, mechanical or electrical engineering, surveying, environmental science and economics or finance.

The Consultant is required to submit comprehensive CVs for each proposed key staff member as a minimum requirement. The list of key expertise required for consulting services is outlined below, though not exhaustive. Consultants are encouraged to propose additional personnel as necessary to guarantee the successful fulfilment of the assignment.



**a) Key Staff and Roles and Responsibilities**

#	Expertise or Position	Minimum Educational Qualification	Expected Tasks	General Experience (years)	Specific Experience (years)
1	<b>Project Manager/ Team Leader</b>	Minimum Bachelor's Degree in Civil Engineering, Project Management or related field to the assignment.	<p>a. Focal point of the consultancy team, to coordinate with the Employer and the stakeholders during all matters of the assignment.</p> <p>b. The Team Leader shall have extensive knowledge and experience in planning, administration, preparation of feasibility studies.</p> <p>c. Overall coordination of the Consultant's team of experts and any other matters related to the smooth execution of the consulting services contract.</p> <p>d. Overall responsibility for management and the project liaison with the Employer, and all authorities concerned with matters relevant to the proposed project, reporting of project progress, and coordination of work carried out.</p> <p>e. Responsible for provision of Feasibility Study and any other information necessary, assessing the</p>	10	7



			<p>requirements, organization of personnel, review of surveys and obtaining Employers' approval.</p> <p>f. Responsible for all progress reporting, and advice to the Employer on all matters of the assignment.</p>		
2	<b>Bridge Engineer/ Structural Engineer</b>	Minimum Bachelor's Degree in Civil Engineering/ Structural Engineering/ Highway Engineering or related field to the assignment.	<p>a. Preparation of technical feasibility study for the proposed link.</p> <p>b. Review and assessment of all available data and information related to the current and future transportation links in and around the area.</p> <p>c. Current cargo and passenger traffic flow analysis, future projections, both land and marine.</p> <p>d. Study masterplans, land use plans, zoning plans and available right of way (ROW) of the roadways to finalize the alignment alternatives and landing points that best aligns with the requirements of the local and national authorities.</p> <p>e. Aesthetics of the bridge is to be considered when finalizing the bridge concept (features and condition of all exposed surfaces due to</p>	10	7



			<p>temporary works, after the construction to be highlighted and discussed).</p> <p>f. Review and assessment of all available data and information related to the bridge to provide the Employer with a functional and aesthetical design concept.</p> <p>g. Provide project traffic survey and forecasting for the complete link and at the landing locations.</p> <p>h. Preliminary design of pavement of the bridge and highway link road.</p> <p>i. Resolve the bottle necks at the landing points/ approach roads and assign intersections, proper horizontal and vertical curves.</p>		
3	<b>Civil Engineer</b>	Minimum Bachelor's Degree in Civil Engineering/ Transportation Engineering or related field to the assignment.	<p>a. Review the current and historic rainfall data available for the region to determine various risk scenarios based on pertinent aspects such as overall risk of failure of drainage structures.</p> <p>b. Develop a drainage design solution that ensures no flooding</p>	10	7





4	<b>Surveyor (Land &amp; Marine)</b>	Bachelor's degree in Surveying or related field to the assignment.	a. Preparation of surveys, topography including aerial maps, bathymetry etc.	10	7
5	<b>Environmental Specialist</b>	Bachelor's degree in Environmental Science/ Environmental Engineering or related field to the assignment.	a. Preparation of Initial Environmental Examination Assessment and Socio-Economic Study. b. Identification of the relevant stakeholders, including government, NGOs, private sector, local communities, and other entities, liaise and conduct community consultation.	10	7
6	<b>Economic &amp; Financial Specialist</b>	Bachelor's degree in Economics / Business Administration/ Finance or related field to the assignment.	a. Preparation of economic and financial feasibility study. b. Prepare a Cost-Benefit Analysis for the project.	10	7

Throughout this consultancy assignment, there may arise a need to enhance the team by including additional support staff, specialists, and advisers to ensure the successful fulfilment of the outlined objectives. Consequently, it is essential to duly consider and make adequate provisions for such supplementation. The contributions of key personnel towards compiling the deliverables should be clearly outlined in the reports.

The Consultants shall ensure that experts are adequately supported and equipped. In particular he/ she shall ensure that there are sufficient administrative, computing and secretarial provision to enable experts to concentrate on their primary responsibilities. The Consultant shall meet the full costs for the supply of the teams including all travels, remuneration, insurance, emergency medical aid, facilities and all else necessary for the competent operation of the teams. The Consultants will provide their own office space, if required for the project team.



## 6. Deliverables

The Consultant is responsible for completing and submitting the following deliverables. All final reports and documents should be submitted in English in 1 (one) electronic copy. Draft reports and documents may be submitted to the Employer electronically. All reports and documents will be submitted in Draft and in logical sequence. The Employer will review the reports and documents and provide comments to the Consultant. These details are not exhaustive and may be expanded as needed for a comprehensive design study of the bridge:

### a) *Inception Report*

Inception report is to be submitted within two weeks after the date of commencing the services. The Inception Report shall specify the detailed methodology, staffing schedule and work schedules with key milestones as per the scope of works assigned in section 3 and the inputs required from MCI, Government of Maldives to deliver the services.

### b) *Weekly Progress Reports*

Weekly progress reports are to be delivered on 1<sup>st</sup> day of each week comprising of up-to-date progress information, photographs of surveys and any other details as agreed with the Employer.

### c) *Preliminary Survey & Assessment Report*

A report shall be submitted for the surveys mentioned in section 3a and must be submitted for approval well ahead of submitting the feasibility report. The report should be to an acceptable standard with a separate section for each of the surveys and studies mentioned above and should include Title Page, Table of Contents, Executive Summary, Background, Objectives, Methodology, Results/ Discussions, Conclusions and Recommendations, and Appendices. It should be accompanied by soft copies of all raw files such as AutoCAD files, images, etc. The following details are to be noted:

- i. Topographic and Bathymetric Survey raw data should be submitted in AutoCAD Civil 3D and in XYZ format. Geo-referenced aerial maps should be inserted to the background and aligned to the survey.
- ii. The survey should be aligned to any existing or future land use plans indicating plots given for current and future development at the landing locations.
- iii. Details and analysis of all the surveys and assessments mentioned in section 3, under surveys and assessments including any additional surveys conducted, along with findings, conclusions, or recommendations are to be submitted.
- iv. Details of the geotechnical, hydrological, hydrodynamic studies and utility survey and condition assessment study conducted are to be presented and discussed in separate sections of the report.
- v. Initial Environmental Examination and Socio-Economic Assessment section of the report should include a description of the community consultation process involving the local council, NGOs, utility companies, local fishermen, town offices, police, vessels frequently using the navigation channels, resort/ dive operators, and the community etc. Meeting minutes documenting the discussions and outcomes should be attached to the report.



- vi. Land requirement for Right of Way (ROW) or for any other facilities as part of the project should be identified and reported in the feasibility study. Special/ protected areas declared under the Council or EPA or any written law (if any) within the project ROW are to be discussed.
- vii. Report should include the survey, study and assessment methodology, details of instruments and devices, software, equipment used, and personnel involved in the data collection with analysis and detailed procedure used along with photographs.

*d) Feasibility Report*

The feasibility study should be divided primarily into two main sections; technical feasibility and economic feasibility. It should be to an acceptable standard and should include Title Page, Table of Contents, Executive Summary, Background, Objectives, Methodology, Results/ Discussions, Conclusions and Recommendations, and Appendices. The report shall address the following, but not limited to:

- i. A discussion on the technical and economic/ financial feasibility of the proposed link with justifications.
- ii. A detailed description of the chosen optimum bridge alignment concept, along with preliminary costing, clearly highlighting the bridge landing locations with justifications.
- iii. The report should include a description of the type of bridge chosen with an explanation of major components of the bridge; deck, piles, girders, piers, abutment and bearings.
- iv. Optimum bridge alignment option is to be superimposed on geo-referenced aerial images, topographic and bathymetric survey map.
- v. Conceptual drawing of the plan and profile of the proposed link should be presented to scale.
- vi. Proposed methods for construction; both permanent and temporary works for the project.
- vii. Proposed construction schedule of the project and the estimated duration for construction.
  - i. The preliminary design methodology, including details of instruments, software, equipment, and personnel involved in the preparation of the design.
- viii. A preliminary cost estimate that includes a detailed breakdown of all elements included in the bridge and highway link road and other components in the design.

It is not the intention of this document to completely specify all detailed services required during survey and design phases of the project, however, any additional services which are not specifically mentioned here, but which are required to complete the project in every respect and in accordance with the intent, technical specification for safe use and guaranteed performance, shall be deemed to be covered under the scope of work. Consultants may at the time of submission of the final proposals suggest any changes to the TOR to cover additional services that may be required with a separate cost proposal.

Furthermore, the Consultant shall consider the technology transfer as an important aspect of this project. The Consultant shall provide the opportunity to the staff of the Employer to be involved in the working team of Consultants' during the survey and feasibility study phase of the project for their capacity development wherever possible. If requested by Employers' staff, the Consultant shall brief and demonstrate the survey and assessment procedures.



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## 7. Payment Conditions and Schedule

Payment to the Consultant will be disbursed upon the successful completion and submission of the specified outputs, following the schedule outlined below and adhering to the sequence provided.

#	Description	Amount Payable
1	Upon submission of the <b>Inception report</b> (Output 1) and acceptance of the same by the Client	20% of the contract amount
2	Upon submission of the <b>Preliminary Survey &amp; Assessment Report</b> (Output 2) and acceptance of the same by the Client	30% of the contract amount
3	Upon submission of the <b>Feasibility Report</b> (Output 3) and acceptance of the same by the Client	50% of the contract amount