

**Name of Work:** Consultancy Services for Preparation of Detailed Project Report for Construction of 2-lane Bridge for Connectivity of Chatham Island and Bambooflat in the Union Territory region of Andaman Nicobar Islands.

## Corrigendum No.1

Sl. No.	Clause No.	Description	Existing Provision	Modified Provision
1.	Enclosure –II	Team Leader cum Sr. Bridge Engineer	Desirable Qualification for <b>Team Leader cum Sr. Bridge Engineer</b> is post graduate in Civil Engineering (Highways/Bridge/ <b>Structures</b> /Traffic and Transportation/Soil Mechanics and foundation engineering/Construction Management/Transportation).	Desirable Qualification for <b>Team Leader cum Sr. Bridge Engineer</b> is post graduate in Civil Engineering (Highways/Bridge/ <b>Structures</b> ).
2.	Para 3.2.3 (vi)	(Form-T6)	The composition of the proposed Team to be submitted through INFRACON	The composition of the proposed Team and the task assigned to each of key personnel (Form-T6)
3.	Form-V	Tentative Quantities for SSI (Boring)	Cumulative Tentative Quantities (in m)	Cumulative Tentative Quantities (in no. of locations up to the required depth)
4.	Appendix 1 ToR	Engineering surveys and Investigations	Terms of Reference	Terms of Reference (As per Annexure A to this Corrigendum)
5.	General,4 (Primary Task) of the ToR General Background- (i),(ii)	Standard & code of practice Investigation for Bridge Structures	Terms of Reference	As above

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	(iii)] Detailed Design of bridges of the ToR			
6.	Supplement I	Additional point, (Primary tasks) 4.1 (v)	Terms of Reference	As above
7.	Supplement I	<b>Hydraulic model study</b>	Terms of Reference	As above
8.	Supplement I	Clause 4.1, 4.7, 4.11.1, 4.11.2, 4.11.2.1, 4.11.4.2, 4.12.1, 4.11.4.4	Terms of Reference	As above
9.	Clause 6.3 (d) of GCC	Mode of Billing and payment	The Client shall cause the payment of the Consultants in Para 6.4 (b) above as given in schedule of payment within thirty (30) days after the receipt by the Client of bills. Interests at the rate specified in the SC shall become payable as from the above due date on any amount due by, but not paid on, such due date.	The Client shall cause the payment of the Consultants in Para 6.3 (b) above as given in schedule of payment within thirty (30) days after the receipt by the Client of bills. Interests at the rate specified in the SC shall become payable as from the above due date on any amount due by, but not paid on, such due date.
10.	Clause 9.2.4 of SCC	Qualifications of Arbitrators	The sole arbitrator or the third arbitrator appointed pursuant to paragraphs (a) through (c) of Clause 8.2.1 hereof shall be an internationally recognized legal or technical expert with extensive experience in relation to the matter in dispute.	The sole arbitrator or the third arbitrator appointed pursuant to paragraphs (a) through (c) of Clause 9.2.1 hereof shall be an internationally recognized legal or technical expert with extensive experience in relation to the matter in dispute.
11.	Terms of Reference	<b>Clause 4</b>	Terms of Reference	Terms of Reference (As per Annexure A of this Corrigendum)
12.	Enclosure-II	Qualification and Experiences Requirement of	<b>Qualification and Experiences Requirement of Key Personnel</b> For all the key personnel, mentioned-	As above

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	Requirement of Key Personnel	For all the key personnel, mentioned- “Similar Capacity position: As mentioned in the input sheet of Infracon” The Consultants request the Client to provide the “input sheet” mentioned similar capacity positions as it is not available on the Infracon portal.																																																																																								
13.	Sr. no.1, 2, 3 of ToR  Back Ground, Objectives, Scope of Services of the tender documents	Terms of Reference	Terms of Reference (As per Annexure A of this corrigendum)																																																																																							
14.	Supplement I of ToR  Clause 11	Terms of Reference	As above																																																																																							
15.	Terms of Reference  Stage 4 Volume V	Terms of Reference	As above																																																																																							
16.	Clause 6.3 (b) of GCC  Mode of Billing and Payment (Payment Schedule)	<table><tr><th>S. No.</th><th>Item</th><th>Payment as % of Contract Value</th></tr><tr><td>1</td><td>On submission of Quality Assurance Plan and Inception Report</td><td>5 %</td></tr><tr><td>2</td><td>On submission of Draft Feasibility Study Report including Option Study Report</td><td>20 %</td></tr><tr><td>3</td><td>On Submission of Final Feasibility Study Report</td><td>10 %</td></tr><tr><td>4</td><td>On submission of Technical Schedules for PPP/EPC projects</td><td>10 %</td></tr><tr><td>5</td><td>On submission of Draft DPR</td><td>15 %</td></tr><tr><td>6</td><td>On approval of DPR</td><td>10 %</td></tr><tr><td>7</td><td>On completion of Project Clearances (20 %)</td><td></td></tr><tr><td></td><td>(i) Completion of 3a, 3A and 3D&amp;3G</td><td>10 %</td></tr><tr><td></td><td>(ii) Forest clearance and environmental Clearance</td><td>5 %</td></tr><tr><td></td><td>(iii) Utility Shifting</td><td>5 %</td></tr><tr><td>8</td><td>On Appointed Date of civil contract of All Packages*</td><td>10%</td></tr><tr><td></td><td>Total</td><td>100%</td></tr></table>	S. No.	Item	Payment as % of Contract Value	1	On submission of Quality Assurance Plan and Inception Report	5 %	2	On submission of Draft Feasibility Study Report including Option Study Report	20 %	3	On Submission of Final Feasibility Study Report	10 %	4	On submission of Technical Schedules for PPP/EPC projects	10 %	5	On submission of Draft DPR	15 %	6	On approval of DPR	10 %	7	On completion of Project Clearances (20 %)			(i) Completion of 3a, 3A and 3D&3G	10 %		(ii) Forest clearance and environmental Clearance	5 %		(iii) Utility Shifting	5 %	8	On Appointed Date of civil contract of All Packages*	10%		Total	100%	<table><tr><th>S. No</th><th>Item</th><th>Payment as % of contract value</th></tr><tr><td>1</td><td>Submission of final Inception Report</td><td>15%</td></tr><tr><td>2</td><td>Submission of final Alignment Report</td><td>10%</td></tr><tr><td>3</td><td>Submission of final Feasibility Report</td><td>5%</td></tr><tr><td>4</td><td>Submission of final Land Acquisition Report</td><td>10%</td></tr><tr><td>5</td><td>Submission of clearance proposals</td><td>5%</td></tr><tr><td>6</td><td>Submission of Draft DPR</td><td>10%</td></tr><tr><td>7</td><td>Approval of Final DPR</td><td>10%</td></tr><tr><td>8</td><td>Approval of Technical Schedules</td><td>5%</td></tr><tr><td>9</td><td>3D publication</td><td>10%</td></tr><tr><td>10</td><td>Clearance – Stage I Approval</td><td>5%</td></tr><tr><td>11</td><td>Clearance – Stage II/Final Approval</td><td>5%</td></tr><tr><td>12</td><td>Retention to be released after 3 years</td><td>10%</td></tr><tr><td></td><td>Total:</td><td>100%</td></tr><tr><td>13</td><td>Bonus on submission of draft 3A within 1 month of alignment finalization</td><td>2.5% bonus</td></tr><tr><td>14</td><td>Bonus on submission of draft clearance proposals within 1 month of alignment finalization</td><td>2.5% bonus</td></tr></table>	S. No	Item	Payment as % of contract value	1	Submission of final Inception Report	15%	2	Submission of final Alignment Report	10%	3	Submission of final Feasibility Report	5%	4	Submission of final Land Acquisition Report	10%	5	Submission of clearance proposals	5%	6	Submission of Draft DPR	10%	7	Approval of Final DPR	10%	8	Approval of Technical Schedules	5%	9	3D publication	10%	10	Clearance – Stage I Approval	5%	11	Clearance – Stage II/Final Approval	5%	12	Retention to be released after 3 years	10%		Total:	100%	13	Bonus on submission of draft 3A within 1 month of alignment finalization	2.5% bonus	14	Bonus on submission of draft clearance proposals within 1 month of alignment finalization	2.5% bonus
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17.	NIT	Clause 4 of NIT	Existing Provision		Modified Provision			
			Bid Document Publishing Date	:	29.08.2016 (1000 hrs)	Bid Document Publishing Date	:	29.08.2016 (1000 hrs)
			Bid Document Download / Start Date	:	29.08.2016 (1000 hrs)	Bid Document Download / Start Date	:	29.08.2016 (1000 hrs)
			Clarification Start Date	:	29.08.2016 (1000 hrs)	Clarification Start Date	:	29.08.2016 (1000 hrs)
			Clarification End Date	:	09.09.2016 (1700 hrs)	Clarification End Date	:	09.09.2016 (1700 hrs)
			Pre bid meeting	:	15.09.2016 (1400 hrs)	Pre bid meeting	:	15.09.2016 (1400 hrs)
			Bid Submission Start Date	:	29.08.2016 (0900 hrs)	Bid Submission Start Date	:	29.08.2016 (0900 hrs)
			Bid submission End Date	:	17.10.2016 (1500 hrs)	Bid submission End Date	:	26.10.2016 (1500 hrs)
			Opening Date of Technical Bid	:	17.10.2016 (1530 hrs)	Opening Date of Technical Bid	:	26.10.2016 (1530 hrs)
			Opening Date of Financial Bid	:	To be intimated after final evaluation of Technical bids	Opening Date of Financial Bid	:	To be intimated after final evaluation of Technical bids

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## **APPENDIX I**

**Annexure-A**

### **TERMS OF REFERENCE (TOR) (As Applicable and relevant to nature of assignment)**

**Consultancy Services for Preparation of Detailed Project Report for Construction of 2-Lane Bridge for Connectivity of Chatham Island and Bambooflat in the Union Territory region of Andaman Nicobar Islands.**

**Terms of Reference for Consultancy Services (TOR)**  
**(As Applicable and relevant to nature of assignment)**

**1. General**

- 1.1 The National Highways & Infrastructure Development Corporation Ltd. (NHIDCL) has been entrusted with the assignment of “**Consultancy Services for Preparation of Detailed Project Report for Construction of 2-Lane Bridge for Connectivity of Chatham Island and Bambooflat in the Union Territory region of Andaman Nicobar Islands**” NHIDCL now invites proposal from Technical consultants for carrying out detailed project report as per details given in **Annexure-1**.
- 1.2 National Highways & Infrastructure Development Corporation Ltd. will be the employer and executing agency for the consultancy services and the standards of output required from the appointed consultants are of international level both in terms of quality and adherence to the agreed time schedule.
- 1.3 Ministry has recently awarded works of consultancy services for construction of ROB for replacing level crossings in various states. In case a level crossing exists in a project reach, consultant is required to co-ordinate with those consultants and finalizes the alignment & configuration of road accordingly. However, if the same is not covered in the above assignment of DPR/feasibility study awarded by Ministry, the consultant under this assignment shall be responsible for preparing DPR for such level crossings.

**2. Objective**

- 2.1 The main objective of the consultancy service is to establish the technical, economical, and financial viability of the project and prepare detailed project reports for rehabilitation and upgrading of the existing road to <lanes> NH with paved shoulder configuration.
- 2.2 The viability of the project shall be established taking into account the requirements with regard to rehabilitation, upgrading and improvement based on highway design, pavement design, provision of service roads wherever necessary, type of intersections, rehabilitation and widening of existing and/or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis.
- 2.3 The Detailed Project Report would inter-alia include detailed highway design, design of pavement and overlay with options for flexible or rigid pavements, design of bridges and cross drainage structures and grade separated structures, design of service roads, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial viability analyses, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for international / local competitive bidding.
- 2.4 The DPR consultant should ensure detailed project preparation incorporating aspects of value engineering, quality audit and safety audit requirement in design and implementation.
- 2.5 The consultant should, along with Feasibility Report, clearly bring out through financial

analysis the preferred mode of implementation on which the Civil Works for the stretches are to be taken up. The consultant should also give cost estimates along with feasibility report/ detailed Project Report.

- 2.6 If at feasibility stage, employer desire to terminate the contract, the contract will be terminated after payment up to that stage.

### **3. Scope of Services**

- 3.1 As far as possible, the widening/improvement work to <lanes> with paved shoulders shall be within the existing right of way avoiding land acquisition, except for locations having inadequate width and where provisions of short bypasses, service roads, alignment corrections, improvement of intersections are considered necessary and practicable and cost effective. However bypasses proposals should also be considered, wherever in urban areas, improvement to <lanes> of the existing road is not possible. The Consultant shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition. Consultant shall also submit 3a, 3A and 3D draft notification for acquisition of land.
- 3.2 The Consultant shall study the possible locations and design of toll plaza, if applicable to the project. Wayside amenities required on tolled highway shall also be planned. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.
- 3.3 The general scope of services is given in the sections that follow. However, the entire scope of services would, inter-alia, include the items mentioned in the Letter of Invitation and the TOR. The Consultant will also make suitable proposals for widening/improvement of the existing road and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. The Consultants shall prepare documents for EPC/PPP contracts for each DPR assignment
- 3.4 All ready to implement ‘good for tender drawings and designs’ shall be prepared.
- 3.5 Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/ World Bank/JICA, etc.
- 3.6 *Wherever required, consultant will liaise with concerned authorities and arrange all clarifications. Approval of all drawings including GAD and detail engineering drawings will be got done by the consultant from the Railways. However, if Railways require proof checking of the drawings prepared by the consultants, the same will be got done by NHIDCL and payment to the proof consultant shall be made by NHIDCL directly. Consultant will also obtain final approval from Ministry of Environment and Forest for all applicable clearances. Consultant will also obtain approval for estimates for shifting of utilities of all types from the concerned authorities and competent authority within NHIDCL and its implementation agencies, as applicable. Consultant is*

*also required to prepare all Land Acquisition papers (i.e. all necessary schedule and draft 3a, 3A, and 3D, 3G notification as per L.A. act) for acquisition of land either under NH Act or State Act.*

- 3.7 The DPR consultant may be required to prepare the Bid Documents, based on the feasibility report, due to exigency of the project for execution if desired by NHIDCL.
- 3.8 Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.
- 3.9 The consultant shall prepare separate documents for BoT as well as EPC contracts at Feasibility stage / DPR stage. The studies for financing options like BoT, Annuity, EPC will be undertaken in feasibility study stage.
- 3.10 The consultant shall be guided in its assignment by the Model Concession/ Contract Agreements for PPP/ EPC projects, as applicable and the Manual of Specifications and Standards for two/ four/ six laning of highways published by IRC (IRC:SP:73 or IRC:SP:84 or IRC:SP:87, as applicable) (the "Manual") along with relevant IRC codes for design of long bridges.
- 3.11 The consultant shall prepare the bid documents including required schedules (as mentioned above) as per EPC/ PPP documents. For that it is suggested that consultant should also go through the EPC/PPP documents of ministry before bidding the project. The Consultant shall assist the NHIDCL and it's Financial Consultant and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the Project Highway and Bid Documents.
- 3.12 Consultant shall be responsible for sharing the findings from the preparation stages during the bid process. During the bid process for a project, the consultant shall support the authority in responding to all technical queries, and shall ensure participation of senior team members of the consultant during all interaction with potential bidders including pre-bid conference, meetings, site visits etc. In addition, the consultant shall also support preparation of detailed responses to the written queries raised by the bidders.

#### **4. General**

##### **4.1 Primary Tasks**

General Scope of Services shall cover but be not limited to the following major tasks (additional requirements for Preparation of Detailed Project Report for Hill Roads and Major Bridges are given in **Supplement I** and **II** respectively):

- i. *Review of all available reports and published information about the project road and the project influence area;*



- ii. *Environmental and social impact assessment, including such as related to cultural properties, natural habitants, involuntary resettlement etc.*
- ii (a). *Public consultation, including consultation with Communities located along the road, NGOs working in the area, other stake-holders and relevant Government departments at all the different stages of assignment (such as inception stage, feasibility stage, preliminary design stage and once final designs are concretized).*
- iii. *Detailed reconnaissance;*
- iv. *identification of possible improvements in the existing alignment and bypassing congested locations with alternatives, evaluation of different alternatives comparison on techno-economic and other considerations and recommendations regarding most appropriate option;*
- v. *traffic studies including traffic surveys and Axle load survey and demand forecasting for next thirty years;*
- vi. *Inventory and condition surveys for road;*
- vii. *Inventory and condition surveys for bridges, cross-drainage structures, other Structures, river Bank training/Protection works and drainage provisions;*
- viii. *Detailed topographic survey using mobile/ aerial LiDAR or equivalent technology*
- ix. *Pavement investigations;*
- x. *Sub-grade characteristics and strength: investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design and sub soil investigation;*
- xi. *Identification of sources of construction materials;*
- xii. *Detailed design of road, its x-sections, horizontal and vertical alignment and design of embankment of height more than 6m and also in poor soil conditions and where density consideration require, even lesser height embankment. Detailed design of structures preparation of GAD and construction drawings and cross-drainage structures and underpasses etc.*
- xiii. *Identification of the type and the design of intersections;*
- xiv. *Design of complete drainage system and disposal point for storm water*
- xv. *Value analysis / value engineering and project costing;*
- xvi. *Economic and financial analyses;*
- xvii. *Contract packaging and implementation schedule.*
- xviii. *Strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over- and underground) and the scheme for their relocation, trees to be felled, transplanted and planted and land acquisition requirements including schedule for*

*LA: reports documents and drawings arrangement of estimates for cutting/ transplanting of trees and shifting of utilities from the concerned department;*

- xix. To find out financial viability of project for implementation and suggest the preferred mode on which the project is to be taken up.*
- xx. Preparation of detailed project report, cost estimate, approval for construction Drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources.*
- xxi. Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings*
- xxii. Design of weighing stations, parking areas and rest areas.*
- xxiii. Any other user oriented facility en-route toll facility.*
- xxiv. Tie-in of on-going/sanctioned works of MORT&H/ NHAI/ other agencies.*
- xxv. Preparation of social plans for the project affected people as per policy of the lending agencies/ Govt. of India R & R Policy.*

- 4.2** While carrying out the field studies, investigations and design, the development plans being implemented or proposed for future implementation by the local bodies, should be taken into account. Such aspect should be clearly brought out in the reports and drawings.
- 4.3** The consultant shall study the possible locations and design of toll plaza, wayside amenities required and arboriculture along the highway shall also be planned.
- 4.4** The local and slow traffic may need segregation from the main traffic and provision of service roads and physical barrier including fencing may be considered, wherever necessary to improve efficiency and safety.

#### **4.5 Standards and Codes of Practices**

- 4.5.1** All activities related to field studies, design and documentation shall be done as per the latest guidelines/ circulars of MoRT&H and relevant publications of the Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS). For aspects not covered by IRC and BIS, international standards practices, may be adopted. The Consultants, upon award of the Contract, may finalize this in consultation with NHIDCL and reflect the same in the inception report.
- 4.5.2** All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC:71.

#### **4.6 Quality Assurance Plan (QAP)**

- 4.6.1** The Consultants should have detailed Quality Assurance Plan (QAP) for all field studies including topographic surveys, traffic surveys, engineering surveys and investigations, design and documentation activities. The quality assurance plans/procedures for different field studies, engineering surveys and investigation, design and documentation activities should be presented as separate sections like engineering surveys and investigations, traffic surveys, material geo-technical and sub-soil investigations, road and pavement investigations, investigation and design of bridges & structures, environment and R&R assessment, economic & financial analysis, drawings and documentation, preparation, checking, approval and filing of calculations, identification and tractability of project documents etc. Further, additional information as per format shall be furnished regarding

the details of personal who shall be responsible for carrying out/preparing and checking/verifying various activities forming part of feasibility study and project preparation, since inception to the completion of work. The detailed Draft QAP Document must be discussed and finalized with the concerned NHIDCL officers immediately upon the award of the Contract and submitted as part of the inception report.

- 4.6.2 It is imperative that the QAP is approved by NHIDCL before the Consultants start the field work.

#### **4.7 Review of Data and Documents**

- 4.7.1 The Consultants shall collect the available data and information relevant for the Study. The data and documents of major interest shall include, but not be limited to, the following:

- i. Climate
- ii. Road inventory
- iii. Road condition , year of original construction , year and type of major maintenance/rehabilitation works;
- iv. Condition of bridges and cross-drainage structures;
- v. sub-surface and geo-technical data for existing bridges;
- vi. Hydrological data, drawings and details of existing bridges;
- vii. Existing geological maps, catchment area maps, contour plans etc. for the project area
- viii. Condition of existing river bank / protection works, if any.
- ix. Details of sanctioned / on-going works on the stretch sanctioned by MoRT&H/other agencies for Tie-in purposes
- x. Survey and evaluation of locally available construction materials;
- xi. Historical data on classified traffic volume (preferably for 5 years or more);
- xii. Origin-destination and commodity movement characteristics; if available
- xiii. Speed and delay characteristics; if available;
- xiv. Commodity-wise traffic volume; if available;
- xv. Accident statistics; and,
- xvi. Vehicle loading behavior (axle load spectrum), if available.
- xvii. Type and location of existing utility services (e.g. Fibre Optical Cable, O/H and U/G Electric, Telephone line, Water mains, Sewer, Trees etc.)
- xviii. Environmental setting and social baseline of the project.

#### **4.8. Social Analysis**

The social analysis study shall be carried out in accordance with the MORT&H/World Bank/ADB Guidelines. The social analysis report will, among other things, provide a socio-economic profile of the project area and address in particular, indigenous people, communicable disease particularly HIV/AIDS poverty alleviation, gender, local population, industry, agriculture, employment, health, education, health, child labor, land acquisition and resettlement .

#### **4.9 Traffic Surveys**

All traffic surveys and studies will be completed in feasibility studies.

#### 4.9.1 Number and Location of Survey Stations

- 1 The type of traffic surveys and the minimum number of survey stations shall normally be as under, unless otherwise specifically mentioned.

Sl.NR.	Description	Number of Survey Stations
1.	Classified Traffic Volume Count	3
2.	Origin-Destination and Commodity Movement Characteristics	Minimum 2
3.	Axle Loading Characteristics	2
4.	Intersection Volume Count	All Major Intersections
5.	Speed-Delay Characteristics	Project Road Section
6.	Pedestrian/animal cross traffic count	All major inhabitations along the highway

- 2 The number of survey locations indicated in the table above are indicative only. The Consultants shall, immediately upon award of the work, submit to NHIDCL proposals regarding the total number as well as the locations of the traffic survey stations as part of inception report. Suitable maps and charts should accompany the proposals clearly indicating the rationale for selecting the location of survey Station
- 3 The methodology of collection and analysis of data, number and location of traffic survey stations shall be finalized in consultation with NHIDCL.

#### 4.9.2. Classified Traffic Volume Count Survey

1. Consultant shall make use of traffic survey done by Indian Highways Management Company Limited (IHMCL) using ATCC systems. If required, especially in cases where a particular stretch is not covered by IHMCL, DPR consultant should carry out classified traffic volume count survey using ATCC systems or equivalent technologies.
2. Consultant shall use ATCC systems that can meet the following accuracy levels after validation/ correction:

- (a) Classification of vehicles: better than 95%
- (b) Counting of vehicles: better than 98%

Before validation and correction, the ATCC system shall meet the following accuracy levels:

- (a) Classification of vehicles: better than 90%
- (b) Counting of vehicles: better than 95%

For verification of above accuracy levels, audit of raw ATCC shall be done on a sampling basis.

3. ATCC systems such as Pneumatic Tube Detector, Inductive Detector Loop, Video Image Detection, and Infrared Sensor or equivalent technologies shall be adopted.
4. The classified traffic volume count surveys shall be carried out for 7 days (continuous,

direction-wise) at the selected survey stations. The vehicle classification system as given in relevant IRC code may be followed. However, the following generalised classification system is suggested in view of the requirements of traffic demand estimates and economic analysis:

Motorised Traffic		Non-Motorised Traffic
2-Wheeler		Bi-Cycle
3-Wheeler		Cycle-Rickshaw
Passenger Car		Animal Drawn Vehicle (ADV)
Utility Vehicle (Jeep, Van etc.)		Hand Cart
		Other Non-Motorised Vehicle
Bus	Mini Bus Standard Bus	
LCV	LCV-Passenger LCV-Freight	
Truck	MCV : 2-Axle Rigid Chassis	
	HCV : 3-Axle Rigid Chassis	
	MAV	
	Semi Articulated	
	Articulated	

5. All results shall be presented in tabular and graphical form. The survey data shall be analysed to bring out the hourly and daily variations. The traffic volume count per day shall be averaged to show a weekly average daily traffic (ADT) by vehicle type. The annual average daily traffic (AADT) shall be worked out by applying seasonal factors.
6. The consultant shall compile the relevant traffic volume data from secondary sources also. The salient features of traffic volume characteristics shall be brought out and variations if any, from the traffic census carried out by the State PWD shall be suitably explained.

#### 4.9.3. Deleted

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#### **4.9.5. Axle Load Surveys**

1. Axle load surveys in both directions shall be carried out at suitable location(s) in the project road stretch on a random sample basis normally for trucks only (both empty and loaded trucks) for 2 normal days - (24 hours) at special count stations to be finalized in consultation with NHIDCL. However, a few buses may be weighed in order to get an idea about their loading behavior. While selecting the location(s) of axle load survey station(s), the locations of existing bridges with load restrictions, if any, should be taken into account and such sites should be avoided.
2. Axle load surveys shall normally be done using axle load pads or other sophisticated instruments. The location(s) of count station(s) and the survey methodology including the data formats and the instrument type to be used shall be finalized before taking up the axle load surveys
3. The axle load data should be collected axle configuration-wise. The number of equivalent standard axles per truck shall be calculated on the basis of results obtained. The results of the survey should bring out the VDF for each truck type (axle configuration, if the calculated VDF is found to be below the national average, then national average shall be used. Furthermore, the data from axle load surveys should be analyzed to bring out the Gross Vehicle Weight (GVW) and Single Axle Load (SAL) Distributions by truck type (axle configuration).
4. The Consultant shall ascertain from local enquiries about the exceptional live loads that have used the highway in the past in order to assess the suitability of existing bridges to carry such loads.

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#### **4.9.7 Pedestrian / animal cross traffic surveys:**

These may be conducted to determine if provision of viaduct for pedestrians/animals is necessary to improve the traffic safety.

#### **4.9.8 Truck Terminal Surveys**

The data derived from the O-D, speed-delay, other surveys and also supplementary surveys should be analyzed to assess requirements for present and future

development of truck terminals at suitable locations en route.

#### **4.10. Traffic Demand Estimates**

1. The consultants shall make traffic demand estimates and establish possible traffic growth rates in respect of all categories of vehicles, taking into account the past trends, annual population and real per capita growth rate, elasticity of transport demand in relation to income and estimated annual production increase. The other aspects including socio-economic development plans and the land use patterns of the region having impact on the traffic growth, the projections of vehicle manufacturing industry in the country, development plans for the other modes of transport, O-D and commodity movement behavior should also be taken into account while working out the traffic demand estimates.
2. The values of elasticity of transport demand shall be based on the prevailing practices in the country. The Consultants shall give complete background including references for selecting the value of transport demand elasticity.
3. It is envisaged that the project road sections covered under this TOR would be completed and opened to traffic after 3 years. The traffic demand estimates shall be done for a further period of 30 years from completion of two/four lane. The demand estimates shall be done assuming three scenarios, namely, optimistic, pessimistic and most likely traffic growth. The growth factors shall be worked out for five-yearly intervals.
4. Traffic projections should be based on sound and proven forecasting techniques. In case traffic demand estimated is to be made on the basis of a model, the application of the model in the similar situation with the validation of the results should be established. The traffic projections should also bring out the possible impact of implementation of any competing facility in the near future. The demand estimates should also take into account the freight and passenger traffic along the major corridors that may interconnect with the project. Impact of toll charges on the traffic estimates should be estimated.
5. The methodology for traffic demand estimates described in the preceding paragraphs is for normal traffic only. In addition to the estimates for normal traffic, the Consultants shall also work out the estimates for generated, induced and diverted traffic.
6. The traffic forecasts shall also be made for both diverted and generated traffic.
7. Overall traffic forecast thus made shall form the basis for the design of each pavement type and other facilities/ancillary works.

#### **4.11. Engineering Surveys and Investigations**

##### **4.11.1. Reconnaissance and Alignment**

1. The Consultants should make an in-depth study of the available land width (ROW) topographic maps, satellite imageries and aerial photographs of the project area,

geological maps, catchment area maps, contour plans, flood flow data and seismological data and other available relevant information collected by them concerning the existing alignment. Consultant himself has to arrange the required maps and the information needed by him from the potential sources. **Consultant should make efforts for minimizing land acquisition.**

2. The detailed ground reconnaissance may be taken up immediately after the study of maps and other data. The primary tasks to be accomplished during the reconnaissance surveys include;
  - i. *topographical features of the area;*
  - ii. *typical physical features along the existing alignment within and outside ROW i.e. land use Pattern;*
  - iii. *possible alignment alternatives, vis-a-vis, scheme for the construction of additional lanes parallel to the existing road;*
  - iv. *realignment requirements including the provision of bypasses, ROBs / Flyovers and via-duct for pedestrian crossings with possible alignment alternatives;*
  - v. *preliminary identification of improvement requirements including treatments and measures needed for the cross-roads;*
  - vi. *traffic pattern and preliminary identification of traffic homogenous links;*
  - vii. *sections through congested areas;*
  - viii. *inventory of major aspects including land width, terrain, pavement type, carriageway type, bridges and structures (type, size and location), intersections(type, cross-road category, location) urban areas (location, extent), geologically sensitive areas, environmental features;*
  - ix. *critical areas requiring detailed investigations; and,*
  - x. *Requirements for carrying out supplementary investigations.*
  - xi. *soil (textural classifications) and drainage conditions*
  - xii. *Type and extent of existing utility services along the alignment (with in ROW).*
  - xiii. *Typical physical features along the approach roads*
  - xiv. *Possible bridge locations, land acquisition problems, nature of crossings, likely length of approaches and bridge, firmness of banks, suitability of alignment of approach roads.*
3. The data derived from the reconnaissance surveys are normally utilized for planning and programming the detailed surveys and investigations. All field studies including the traffic surveys should be taken up on the basis of information derived from the reconnaissance surveys.
4. The data and information obtained from the reconnaissance surveys should be documented. The data analysis and the recommendations concerning alignment and the field studies should be included in the Inception Report. The data obtained from the reconnaissance surveys should form the core of the database which would be supplemented and augmented using the data obtained from detailed field studies and investigations.
5. The data obtained from the reconnaissance surveys should be compiled in the tabular as well as graphical (chart) form indicating the major physical features and the proposed widening scheme for NHIDCL comments. The data and the charts should also accompany the rationale for the selection of traffic survey stations.



#### 4.11.2. Topographic Surveys

1. The basic objective of the topographic survey would be to capture the essential ground features along the alignment in order to consider improvements and for working out improvements, rehabilitation and upgrading costs. The detailed topographic surveys should normally be taken up after the completion of reconnaissance surveys.
2. The carrying out of topographic surveys will be one of the most important and crucial field tasks under the project. Technologies which can meet the following accuracy levels shall be adopted. For land based surveys (a) Fundamental horizontal accuracy of 2 cm or better (b) Fundamental vertical accuracy of 2 cm or better (c) More than 50 points shall be measured per sq. m and for aerial based surveys (a) Fundamental horizontal accuracy of 5 cm or better (b) Fundamental vertical accuracy of 5 cm or better (c) More than 10 points shall be measured per sq. m. To establish accuracy, a check point survey using DGPS (for horizontal accuracy) and Auto Level (for vertical accuracy) shall be carried out to establish the fundamental horizontal and vertical accuracy. A minimum of 25 check points, or check points once every 4 km should be established, and these should be strictly different from any geo-referencing or control network points.
3. The following are the set of deliverables which should be submitted after completion of survey: (a) Raw DGPS data for the entire highway length and adjoining areas of interest (b) Point cloud data/ Data of points captured for the entire highway length and adjoining areas of interest (c) Topographic map of scale 1:1000 of the entire highway length and adjoining areas of interest (d) Contour map of 50 cm of entire highway length and adjoining areas of interest (e) Cross section of the highway at every 1 m in \*.dwg format.
4. For land based surveys, Mobile LiDAR (Light Detection and Ranging) or equivalent technology that can meet above requirements shall be adopted. For aerial based surveys, Aerial Mobile LiDAR (Light Detection and Ranging) or equivalent technology that can meet above requirements shall be adopted. In shadow areas such as invert levels below culverts, where LiDAR or equivalent technologies cannot survey accurately, traditional methods of Total Station/ Auto Level shall be used to complete the study.
5. In case of mobile LiDAR or equivalent technology, 360 degree panoramic images of the entire highway length and adjoining areas of interest shall be submitted. In case of aerial LiDAR or equivalent technology, ortho-images of the entire highway length and adjoining areas of interest shall be submitted.
6. The detailed field surveys would essentially include the following activities:
  - i. *Topographic Surveys along the Existing Right of Way (ROW): Carrying out topographic survey using LiDAR or equivalent technology along the existing road and realignments, wherever required and properly referencing the same with reference pillars fixed on either side of the centre-line at safe places within the ROW*
  - ii. *The detailed field surveys would essentially include the topographic surveys along the proposed location of bridge and alignment of approach road.*
  - iii. *The detailed topographic surveys should be carried out along the approach roads alignment and location of bridge approved by NHIDCL*
  - iv. *Collection/ Extraction of details for all features such as structures (bridges, culverts etc.) utilities, existing roads, electric and telephone installations (both O/H as well as underground), huts, buildings, fencing and trees (with girth greater than 0.3metre) oil and gas lines etc. falling within the extent of survey.*

7. The width of survey corridor will generally be as given under:

- i. *The width of the survey corridor should take into account the layout of the existing alignment including the extent of embankment and cut slopes and the general ground profile. While carrying out the field surveys, the widening scheme (i.e. right, left or symmetrical to the centre line of the existing carriageway) should be taken into consideration so that the topographic surveys cover sufficient width beyond the centre line of the proposed divided carriageway. Normally the surveys should extend a minimum of 30 m beyond either side of the centre line of the proposed divided carriageway or land boundary whichever is more*
- ii. *In case the reconnaissance survey reveals the need for bypassing the congested locations, the traverse lines would be run along the possible alignments in order to identify and select the most suitable alignment for the bypass. The detailed topographic surveys should be carried out along the bypass alignment approved by NHIDCL. At locations where grade separated intersections could be the obvious choice, the survey area will be suitably increased. Field notes of the survey should be maintained which would also provide information about traffic, soil, drainage etc.*
- iii. *The width of the surveyed corridor will be widened appropriately where developments and / or encroachments have resulted in a requirement for adjustment in the alignment, or where it is felt that the existing alignment can be improved upon through minor adjustments.*
- iv. *Where existing roads cross the alignments, the survey will extend a minimum of 100 m either side of the road centre line and will be of sufficient width to allow improvements, including at grade intersection to be designed.*

8. The surveyed alignment shall be transferred on to the ground as under:

- i. *Reference Pillar and Bench Mark / Reference pillar of size 15 cm X 15 cm X 45cm shall be cast in RCC of grade M 15 with a nail fixed in the centre of the top surface. The reference pillar shall be embedded in concrete upto a depth of 30cm with CC M10 (5 cm wide all around). The balance 15 cm above ground shall be painted yellow. The spacing shall be 250m apart, incase Bench Mark Pillar coincides with Reference Pillar, only one of the two need be provided.*
- ii. *Establishing Bench marks at site connected to GTS Bench marks at a interval of 250 metres on Bench mark pillar made of RCC as mentioned above with RL and BM No. marked on it with red paint.*
- iii. **Boundary Pillars-** *Wherever there is a proposal of realignment of the existing Highway and/or construction of New Bypasses, Consultant shall fix boundary pillars along the proposed alignment on the extreme boundary on either side of the project Highway at 50 m interval.*

#### 4.11.2.1 Longitudinal and Cross-Sections

The topographic surveys for longitudinal and cross-sections shall cover the following:

- i. *Longitudinal section levels along final centre line at every 1 m interval, at the locations of curve points, small streams, and intersections and at the locations of change in elevation.*
- ii. *Cross sections at every 1 m interval in full extent of survey covering sufficient number of spot levels on existing carriageway and adjacent ground for profile correction course and earth work calculations. Cross sections shall be taken at closer interval at curves.*
- iii. *Longitudinal section for cross roads for length adequate for design and quantity estimation purposes.*
- iv. *Longitudinal and cross sections for major and minor streams shall cover Cross section of the channel at the site of proposed crossing and few cross sections at suitable distance both upstream and downstream, bed level upto top of banks and ground levels to a sufficient distance beyond the edges of channel, nature of existing surface soil in bed, banks & approaches, longitudinal section of channel showing site of bridge etc. These shall be as per recommendations contained in IRC Special Publication No. 13 (Guidelines for the Design of Small Bridges and Culverts) and provisions of IRC:5 ("Standard Specifications & Code of Practice for Road Bridges, Section 1 – General Features of Design").*

*At feasibility study stage cross sections at 50m interval may be taken.*

#### **4.11.2.2 Details of utility Services and Other Physical Features**

1. The Consultants shall collect details of all important physical features along the alignment. These features affect the project proposals and should normally include buildings and structures, monuments, burial grounds, cremation grounds, places of worship, railway lines, stream / river / canal, water mains, sewers, gas/oil pipes, crossings, trees, plantations, utility services such as electric, and telephone lines (O/H & U/G) and poles, optical fibre cables (OFC) etc. The survey would cover the entire right-of-way of the road on the adequate allowance for possible shifting of the central lines at some of the intersections locations.
2. Consultant shall also map out sub-surface utilities. The following criteria shall be met by the process of sub-surface utility mapping: (a) Coverage and mapping of all sub-surface utilities within project RoW, especially those under additional carriageway width (b) Accurate mapping and resolution of all sub-surface utilities up to a depth of 4 m (c) Differentiation between sub-surface utilities such as live electric cables, metallic utilities and other utilities (d) Sub-surface utilities radargrams further processed into utility maps in formats such as PDF, JPEG and AutoCAD. To meet the accuracy levels, consultant shall use Ground Penetrating Radar, Induction Locator or equivalent technologies.
3. The information collected during reconnaissance and field surveys shall be shown on a strip plan so that the proposed improvements can be appreciated and the extent of land acquisition with L.A schedule, utility removals of each type etc.

assessed and suitable actions can be initiated. Separate strip plan for each of the services involved shall be prepared for submission to the concerned agency.

#### **4.11.3. Road and Pavement Investigations**

The Consultants shall carry out detailed field studies in respect of road and pavement. The data collected through road inventory and pavement investigations should be sufficient to meet the input requirements of HDM-IV.

##### **4.11.3.1 Road Inventory Surveys**

1. Detailed road inventory surveys shall be carried out to collect details of all existing road and pavement features along the existing road sections. The inventory data shall include but not limited to the following:
  - i. *Terrain (flat, rolling, mountainous);*
  - ii. *Land-use (agricultural, commercial, forest, residential etc ) @ every kilometer;*
  - iii. *Carriageway width, surfacing type @ every 500m and every change of feature whichever is earlier;*
  - iv. *Shoulder surfacing type and width @ every 500m and every change of feature whichever is earlier;*
  - v. *Sub-grade / local soil type (textural classification) @ every 500m and every change of feature whichever is earlier;*
  - vi. *Horizontal curve; vertical curve*
  - vii. *Road intersection type and details, at every occurrence;*
  - viii. *Retaining structures and details, at every occurrence;*
  - ix. *Location of water bodies (lakes and reservoirs), at every occurrence;*
  - x. *Height of embankment or depth of cut @ every 200m and every change of feature whichever is earlier.*
  - xi. *Land width i.e. ROW*
  - xii. *Culverts, bridges and other structures (type, size, span arrangement and location)*
  - xiii. *Roadside arboriculture*
  - xiv. *Existing utility services on either side within ROW.*
  - xv. *General drainage conditions*
  - xvi. *Design speed of existing road*
2. The data should be collected in sufficient detail. The data should be compiled and presented in tabular as well as graphical form. The inventory data would be stored in computer files using simple utility packages, such as EXCEL.

##### **4.11.3.2 Pavement Investigation**

###### **1. Pavement Composition**

- i. *The data concerning the pavement composition may be already available with the PWD. However, the consultants shall make trial pits to ascertain the pavement composition. The test pit interval will be as per Para 4 below.*
- ii. *For each test pit, the following information shall be recorded:*
  - *test pit reference (Identification number, location);*
  - *pavement composition (material type and thickness); and*
  - *subgrade type (textural classification) and condition (dry, wet)*

## **2. Road and Pavement Condition Surveys**

- i. *Detailed field studies shall be carried out to collect road and pavement surface conditions. The data should generally cover:*
  - *pavement condition (surface distress type and extent);*
  - *shoulder condition;*
  - *embankment condition; and drainage condition*

### **Pavement Condition**

- *cracking (narrow and wide cracking), % of pavement area affected;*
- *raveling, % of pavement area affected;*
- *potholing, % of pavement area affected;*
- *edge break, length (m); and,*
- *rut depth, mm*

### **Shoulder Condition**

- *Paved: Same as for pavement*
- *Unpaved: material loss, rut depth and corrugation,*
- *Edge drop, mm.*

### **Embankment Condition**

- *General condition; and*
- *extent of slope erosion*

- ii. *The objective of the road and pavement condition surveys shall be to identify defects and sections with similar characteristics. All defects shall be systematically referenced, recorded and quantified for the purpose of determining the mode of rehabilitation.*
- iii. *The pavement condition surveys shall be carried out using visual means. Supplemented by actual measurements and in accordance with the widely accepted methodology (AASHTO, IRC, OECD, TRL and World Bank Publications) adapted to meet the study requirements. The measurement of rut depth would be made using standard straight edges.*
- iv. *The shoulder and embankment conditions shall be evaluated by visual means and the existence of distress modes (cuts, erosion marks, failure, drops) and extent (none, moderate, frequent and very frequent) of such distress manifestations would be recorded.*
- v. *For sections with severe distresses, additional investigations as appropriate*

*shall be carried out to determine the cause of such distresses.*

- vi. *Middle 200m could be considered as representative sample for each one km. of road and incase all other things are considered similar.*

### **Drainage Condition**

- *General condition*
- *Connectivity of drainage turnouts into the natural topography*
- *Condition in cut sections*
- *Condition at high embankments*

The data obtained from the condition surveys should be analysed and the road segments of more or less equal performance may be identified using the criteria given in IRC: 81-1997.

### **3. Pavement Roughness**

- i. *The roughness surveys shall be carried out using Bump Integrator or similar instrument. The methodology for the surveys shall be as per the widely used standard practices. The calibration of the instrument shall be done as per the procedure given in the World Bank's Technical Publications and duly got authenticated by established laboratory/institution acceptable to the client*
- ii. *The surveys shall be carried out along the outer wheel paths. The surveys shall cover a minimum of two runs along the wheel paths for each directions.*
- iii. *The results of the survey shall be expressed in terms of BI and IRI and shall be presented in tabular and graphical forms. The processed data shall be analysed using the cumulative difference approach to identify road segments homogenous with respect to surface roughness.*

### **4. Pavement Structural Strength**

- i. *The Consultants shall carry out structural strength surveys for existing pavements using Benkelman Beam Deflection technique in accordance with the CGRA procedure given in IRC:81-1997 ("Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique").*
- ii. *It is suggested that the deflection surveys may be carried out as per the scheme given below:*
  - *mainline testing; and,*
  - *control section testing.*
- iii. *The deflection tests for the mainline shall be carried out at every 500 m along the road sections covered under the study. The control section testing shall involve carrying out deflection testing for each 100 m long homogenous road segment along the road sections. The selection of homogenous segment shall be based on the data derived from pavement condition surveys. The total length of such homogenous segments shall not be less than 100 m per kilometre. The deflection measurements for the control section testing should be at an interval*

*of not more than 10 m.*

- iv. *Test pits shall be dug at every 500 m and also along each homogeneous road segment to obtain pavement composition details (pavement course, material type and thickness) so as to be able to study if a correlation exists between deflection and composition. If so, the relationship may be used while working out the overlay thickness for the existing pavement.*
- v. *Benkelman Beam Deflection surveys may not be carried out for severely distressed sections of the road warranting reconstruction. The Consultants, immediately upon the award of the contract, shall submit to NHIDCL the scheme describing the testing schedule including the interval. The testing scheme shall be supported by data from detailed reconnaissance surveys.*
- vi. *In case, the Consultants wish to use any acceptable method(s) other than Benkelman Beam deflection technique for the evaluation of pavement strength, viz. Falling weight deflectometer method etc. details of such methods or innovative features for deflection testing using Benkelman Beam technique along with the methodology for data analysis, interpretation and the use of such data for pavement overlay design purposes using IRC or any other widely used practices, such as AASHTO guidelines, should be got approved by NHIDCL. The sources of such methods should be properly referenced.*

#### **4.11.3.3 Subgrade Characteristics and Strength**

- 1. Based on the data derived from condition (surface condition, roughness) and structural strength surveys, the project road section should be divided into segments homogenous with respect to pavement condition and strength. The delineation of segments homogenous with respect to roughness and strength should be done using the cumulative difference approach (AASHTO, 1993).
- 2. The data on soil classification and mechanical characteristics for soils along the existing alignments may already be available with the PWD. The testing scheme is, therefore, proposed as given under:
  - i. *For the widening (2/- Laning) of existing road within the ROW, the Consultants shall test at least three sub-grade soil samples for each homogenous road segment or three samples for each soil type encountered, whichever is more.*
  - ii. *For the roads along new alignments, the test pits for sub grade soil shall be @5km or for each soil type, whichever is more. A minimum of three samples should be tested corresponding to each homogenous segment.*
- 3. The testing for subgrade soil shall include:
  - i. *in-situ density and moisture content at each test pit*
  - ii. *Field CBR using DCP at each test pit*
  - iii. *Characterization (grain size and Atterberg limits) at each test pit and,*
  - iv. *Laboratory moisture-density characteristics (modified AASHTO compaction);*

- v. *Laboratory CBR (unsoaked and 4-day soak compacted at three energy levels) and swell.*
4. For problematic soils, the testing shall be more rigorous. The characteristics with regard to permeability and consolidation shall also be determined for these soils. The frequency of sampling and testing of these soils shall be finalized in consultation with the NHIDCL's officers after the problematic soil types are identified along the road sections.
5. The laboratory for testing of material should be got approved from NHIDCL before start of work.

#### **4.11.4 Investigations for Bridges and Structure**

##### **4.11.4.1 Inventory of Bridges, Culverts and Structures**

The Consultants shall make an inventory of all the structures (bridges, viaducts, ROBs, RUB and other grade separated structures, culverts, etc.) along the road under the project. The inventory for the bridges, viaducts and ROBs shall include the parameters required as per the guidelines of IRC-SP:35. The inventory of culverts shall be presented in a tabular form covering relevant physical and hydraulic parameters.

##### **4.11.4.2 Hydraulic and Hydrological Investigations**

1. The hydrological and hydraulic studies shall be carried out in accordance with IRC Special Publication No. 13 ("Guidelines for the Design of Small Bridges and Culverts") and IRC:5 ("Standard Specifications & Code of Practice for Road Bridges, Section I General Feature of Design"). These investigations shall be carried out for all existing drainage structures along the road sections under the study.
2. The consultant shall also collect information on observed maximum depth of scour.
3. In respect of major bridges, history of hydraulic functioning of existing bridge, if any, under flood situation, general direction of river course through structure, afflux, extent and magnitude of flood, effect of backwater, if any, aggradation/degradation of bed, evidence of scour etc. shall be used to augment the available hydrological data. The presence of flood control/irrigation structures, if affecting the hydraulic characteristics like causing obliquity, concentration of flow, scour, silting of bed, change in flow levels, bed levels etc. shall be studied and considered in design of bridges. The details of any future planned work that may affect the river hydraulics shall be studied and considered.
4. The Consultants shall make a desk study of available data on topography (topographic maps, stereoscopic aerial photography), storm duration, rainfall statistics, top soil characteristics, vegetation cover etc. so as to assess the catchment areas and hydraulic parameters for all existing and proposed drainage provisions. The findings of the desk study would be further supplemented and augmented by a reconnaissance along the area. All-important hydrological features shall be noted during this field reconnaissance.
5. The Consultants shall collect information on high flood level (HFL), low water



levels (LWL), high tide level (HTL), low tide level (LTL) where applicable, discharge velocity etc. from available past records, local inquiries and visible signs, if any, on the structural components and embankments. Local inquiries shall also be made with regard to the road sections getting overtopped during heavy rains.

6. Conducting Model studies for bridges is not covered in the scope of consultancy services. If Model study is envisaged for any bridge, requirement of the same shall be spelt out in the RFP documents separately indicating scope and time frame of such study. Salient features of the scope of services to be included for model study are given in the supplement- II Terms of Reference.

#### **4.11.4.3 Condition Surveys for Bridges, Culverts and Structures**

1. The Consultants shall thoroughly inspect the existing structures and shall prepare a report about their condition including all the parameters given in the Inspection pro-forma of IRC-SP: 35. The condition and structural assessment survey of the bridges / culverts / structures shall be carried out by senior experts of the Consultants.
2. For the bridges identified to be in a distressed condition based upon the visual condition survey, supplementary testing shall be carried out as per IRC-SP:35 and IRC-SP:40. Selection of tests may be made based on the specific requirement of the structure.
3. The assessment of the load carrying capacity or rating of existing bridges shall be carried out under one or more of the following scenarios:
  - i. *when the design live load is less than that of the statutory commercial vehicle plying or likely to ply on bridge;*
  - ii. *if during the condition assessment survey and supplementary testing the bridge is found to indicate distress of serious nature leading to doubt about structural and / or functional adequacy, and*
  - iii. *Design live load is not known nor are the records and drawings available*
4. The evaluation of the load carrying capacity of the bridge shall be carried out as per IRC-SP:37 (“Guidelines for Evaluation of Load Carrying Capacity of Bridges”). The analytical and correlation method shall be used for the evaluation of the load carrying capacity as far as possible. When it is not possible to determine the load carrying capacity of the bridge using analytical and correlation method, the same shall be carried out using load testing. The consultant has to exhaust all other methods of evaluation of strength of bridges before recommending taking up load testing of bridges. Road closure for testing if unavoidable shall be arranged by NHIDCL for limited duration say 12 hours or so.
5. Consultant shall carryout necessary surveys and investigations to establish the remaining service life of each retainable bridge or structure with and without the proposed strengthening and rehabilitation according to acceptable international practice in this regard.

#### **4.11.4.4 Geo-technical Investigations and Sub-Soil Exploration**

1. The Consultants shall carry out geo-technical investigations and sub-surface explorations for the proposed Bridges / Road over bridges/ tunnels/ viaducts/ interchanges etc., along high embankments and any other location as necessary for proper design of the works and conduct all relevant laboratory and field tests on soil and rock samples.
2. The deviation(s), if any, by the Consultants from the scheme presented above should be approved by NHIDCL.
3. However, where a study of geo-technical reports and information available from adjacent crossings over the same waterway (existing highway and railway bridges) indicates that subsurface variability is such that boring at the suggested spacing will be insufficient to adequately define the conditions for design purposes, the Consultants shall review and finalise the bore hole locations in consultation with NHIDCL's officers.
4. Geotechnical Investigations and Sub soil Explorations shall be carried out to determine the nature and properties of existing strata in bed, banks and approaches with trial pits and bore hole sections showing the levels, nature and properties of various strata to a sufficient depth below the level suitable for foundations, safe intensity of pressure on the foundation strata, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil etc. Geotechnical investigation and Sub-soil Exploration will be done as per IRC 78.
5. The scheme for the borings locations and the depth of boring shall be prepared by the Consultants and submitted to NHIDCL for approval. These may be finalized in consultation with NHIDCL.
6. The sub-soil exploration and testing should be carried out through the Geotechnical Consultants empanelled by MORT&H. The soil testing reports shall be in the format prescribed in relevant IRC Codes.
7. For the approach road pavement, bore holes at each major change in pavement condition or in deflection readings or at 2 km intervals whichever is less shall be carried out to a depth of at least 2 m below embankment base or to rock level and are to be fully logged. Appropriate tests to be carried out on samples collected from these bore holes to determine the suitability of various materials for use in widening of embankments or in parts of new pavement structure.

#### **4.11.5. Material Investigations**

1. The Consultants shall identify sources (including use of fly-ash/ slag), quarry sites and borrow areas, undertake field and laboratory testing of the materials to determine their suitability for various components of the work and establish quality and quantity of various construction materials and recommend their use on the basis of techno-economic principles. The Consultants shall prepare mass haul diagram for haulage purposes giving quarry charts indicating the location of selected borrow areas, quarries and the respective estimated quantities.

*“Environment friendly materials”*

“As per MORTH circular No. RW /NH-33044/53/2013-S&R(R) dated 20<sup>th</sup> November,

2013, alternative pavement materials and technologies for road construction shall be assessed and compared in the design stage. The alternative resulting in substantial reduction in GHG emission and with least life cycle cost shall be recommended for implementation.

Technical and economic feasibility of using industrial byproducts, recyclable and waste materials shall be assessed depending on their availability in the concerned region.

2. It is to be ensured that no material shall be used from the right-of-way except by way of leveling the ground as required from the construction point of view, or for landscaping and planting of trees etc. or from the cutting of existing ground for obtaining the required formation levels.
3. Environmental restrictions, if any, and feasibility of availability of these sites to prospective civil works contractors, should be duly taken into account while selecting new quarry locations.
4. The Consultants shall make suitable recommendations regarding making the borrow and quarry areas after the exploitation of materials for construction of works.
5. The Material Investigation aspect shall include preparation and testing of bituminous mixes for various layers and concrete mixes of different design mix grades using suitable materials (binders, aggregates, sand filler etc.) as identified during Material Investigation to conform to latest MoRT&H specification.

#### **4.12 Detailed Design of Road and Pavements, Bridges, Structures**

##### **4.12.1. General**

1. The Consultants are to carryout detailed designs and prepare working drawings for the following:
  - i. *High speed highway with divided carriageway configuration complete in all respects with service roads at appropriate locations;*
  - ii. *Design of pavement for the additional lanes and overlay for the existing road, paved shoulders, medians, verges;*
  - iii. *Bridges, viaduct/subways and other grade separated structures including ROB/RUBs etc.*
  - iv. *At-grade and grade-separated intersections, interchanges (if required);*
  - v. *ROB for railway crossings as per the requirement and the standards of the Indian Railways; and,*
  - vi. *Prepare alignment plans, longitudinal sections and cross-sections @ 50m intervals;*
  - vii. *Designs for road furniture and road safety/traffic control features;*
  - viii. *Designs and drawings for service road/under passes/overpass / cattle passes tree planting/fencing at locations where necessary / required*
  - ix. *Toll plazas and office-cum-residential complex for PIU (one for each civil contract package)*
  - x. *Short bypasses at congested locations*
  - xi. *Drainage design showing location of turnouts, out falling structures, separate drawings sheet for each 5 km. stretch.*
  - xii. *Bridges and structures rehabilitation plan with design and drawings*
  - xiii. *Traffic amenities (Parking Areas, Weighing Station and Rest Areas, etc.).*

- xiv. *Design of pavement for approach road*
- xv. *Design of river bank protection / training works. Innovative type of structures with minimum joints, aesthetically, pleasing and appropriate to the topography of the region shall be designed wherever feasible.*

#### **4.12.2. Design Standards**

1. The Consultants shall evolve Design Standards and material specifications for the Study primarily based on IRC publications, MoRT&H Circulars and relevant recommendations of the international standards for approval by NHIDCL.
2. The Design Standards evolved for the project shall cover all aspects of detailed design including the design of geometric elements, pavement design, bridges and structures, traffic safety and materials.

#### **4.12.3. Geometric Design**

1. The design of geometric elements shall, therefore, take into account the essential requirements of such facilities.
2. Based on the data collected from reconnaissance and topographic surveys, the sections with geometric deficiencies, if any, should be identified and suitable measures for improvement should be suggested for implementation.
3. The data on accident statistics should be compiled and reported showing accident type and frequency so that black spots are identified along the project road section. The possible causes (such as poor geometric features, pavement condition etc.) of accidents should be investigated into and suitable cost-effective remedial measures suggested for implementation.
4. The detailed design for geometric elements shall cover, but not be limited to the following major aspects:
  - i. *horizontal alignment;*
  - ii. *longitudinal profile;*
  - iii. *cross-sectional elements, including refuge lane (50m) at every 2kms.*
  - iv. *junctions, intersections and interchanges;*
  - v. *bypasses; and,*
  - vi. *service roads as and when require i.e built up area..*
5. The alignment design shall be verified for available sight distances as per the standard norms. The provision of appropriate markings and signs shall be made wherever the existing site conditions do not permit the adherence to the sight distance requirements as per the standard norms.
6. The consultants shall make detailed analysis of traffic flow and level of service for the existing road and workout the traffic flow capacity for the improved project road. The analysis should clearly establish the widening requirements with respect to the different horizon periods taking into account special problems such as road segments with isolated steep gradients.
7. In the case of closely spaced cross roads the Consultant shall examine different options such as, providing grade separated structure for some of them with a view

to reduce number of at-grade crossings, services roads connecting the cross-roads and closing access from some of the intersections and prepare and furnish appropriate proposals for this purpose keeping in view the cost of improvement, impact on traffic movement and accessibility to cross roads. The detailed drawings and cost estimate should include the provisions for realignments of the existing cross roads to allow such arrangements.

8. The Consultant shall also prepare design of grade separated pedestrian crossings (viaducts) for large cross traffic of pedestrians and / or animals.
9. The Consultant shall also prepare details for at-grade junctions, which may be adopted as alternative to the grade separated structures. The geometric design of interchanges shall take into account the site conditions, turning movement characteristics, level of service, overall economy and operational safety.
10. The Consultants shall prepare design and other details in respect of the parallel service roads in urbanized locations and other locations to cater to the local traffic, their effect of the viability of the project on commercial basis if service roads are constructed as part of the project and the implications of not providing the service roads.
11. The consultant shall prepare complete road and pavement design including drainage for new bypass option identified around congested town en-route.

#### **4.12.4. Pavement Design**

1. The detailed design of pavement shall involve:
  - i. *strengthening of existing road pavement and design of the new pavement if any, if the findings of the traffic studies and life-cycle costing analysis confirm the requirement for widening of the road beyond 2 lane undivided carriageway standard;*
  - ii. *pavement design for bypasses; and,*
  - iii. *design of shoulders.*
2. The design of pavement shall primarily be based on IRC publications.
3. The design of pavement shall be rigorous and shall make use of the latest Indian and International practices. **The design alternatives shall include both rigid and flexible design options. The most appropriate design, option shall be established on life-cycle costing and techno-economic consideration.**
4. For the design of pavement, each set of design input shall be decided on the basis of rigorous testing and evaluation of its suitability and relevance in respect of in-service performance of the pavement. The design methodology shall accompany the design proposals and shall clearly bring out the basic assumptions, values of the various design inputs, rationale behind the selection of the design inputs and the criteria for checking and control during the implementation of works. In other words, the design of pavement structure should take due account of the type, characteristics of materials used in the respective courses, variability of their properties and also the reliability of traffic predictions. Furthermore, the methodology adopted for the design of pavement shall be complete with flowcharts indicating the various steps in the design process, their interaction with

one another and the input parameter required at each step.

5. For the design of overlays for the existing 2-lane pavement, the strengthening requirement shall duly take into account the strength of the existing pavement vis-à-vis the remaining life. The overlay thickness requirements shall be worked out for each road segment homogenous with respect to condition, strength and sub-grade characteristics. The rehabilitation provisions should also include the provision of regulating layer. For existing pavement with acceptable levels of cracking, provision of a crack inhibiting layer should also be included.
6. Latest techniques of pavement strengthening like provision of geo-synthetics and cold/hot pavement recycling should be duly considered by the consultant for achieving economy.
7. The paved shoulders shall be designed as integral part of the pavement for the main carriageway. The design requirements for the carriageway pavement shall, therefore, be applicable for the design of shoulder pavements. The design of granular shoulder should take into account the drainage considerations besides the structural requirements.
8. The pavement design task shall also cover working out the maintenance and strengthening requirements and periodicity and timing of such treatments.

#### **4.12.5. Design of Embankments**

1. The embankments design should provide for maximum utilization of locally available materials consistent with economy. Use of fly ash wherever available within economical leads must be considered. In accordance with Government instructions, **use of fly ash within 100 km from Thermal Power Stations is mandatory.**
2. The Consultants shall carry out detailed analysis and design for all embankments of height greater than 6 m based on relevant IRC publications.
3. The design of embankments should include the requirements for protection works and traffic safety features.

#### **4.12.6. Design of Bridges and Structures**

1. The data collected and investigation results shall be analysed to determine the following:
  - i. HFL
  - ii. LWL
  - iii. LBL
  - iv. Erodibility of bed/scour level
  - v. Design discharge
  - vi. Linear waterway and effective linear waterway
  - vii. Likely foundation depth
  - viii. Safe bearing capacity

- ix. Engineering properties of sub soil
- x. Artesian conditions
- xi. Settlement characteristics
- xii. Vertical clearance
- xiii. Horizontal clearance
- xiv. Free board for approach road
- xv. Severity of environment with reference to corrosion
- xvi. Data pertaining to seismic and wind load
- xvii. Requirement of model study etc.

2. The Consultant shall prepare General Arrangement Drawing (GAD) and Alignment Plan showing the salient features of the bridges and structures proposed to be constructed / reconstructed along the road sections covered under the Study. These salient features such as alignment, overall length, span arrangement, cross section, deck level, founding level, type of bridge components (superstructure, substructure, foundations, bearings, expansion joint, return walls etc.) shall be finalized based upon hydraulic and geo-technical studies, cost effectiveness and ease of construction. The GAD shall be supplemented by Preliminary designs. In respect of span arrangement and type of bridge a few alternatives with cost-benefit implications should be submitted to enable NHIDCL to approve the best alternative. After approval of alignment and GAD the Consultant shall prepare detailed design as per IRC codes /guidelines and working drawings for all components of bridges and structures.
3. The location of all at-grade level crossings shall be identified falling across the existing level crossings for providing ROB at these locations. The Consultants shall prepare preliminary GAD for necessary construction separately to the Client. The Consultant shall pursue the Indian Railways Authorities or/and any statutory authority of State/Central Government for approval of the GAD from concerned Authorities.
4. GAD for bridges/structures across irrigation/water way channels shall be got approved from the concerned Irrigation/Water way Authorities. Subsequent to approval of GAD and alignment plan by NHIDCL the Consultants shall prepare detailed design as per IRC codes/guidelines for all components of the bridges and structures.
5. Subsequent to the approval of the GAD and Alignment Plan by NHIDCL and Railways, the Consultant shall prepare detailed design as per IRC and Railways guidelines and working drawings for all components of the bridges and structures. The Consultant shall furnish the design and working drawings for suitable protection works and/or river training works wherever required.
6. Dismantling/ reconstruction of existing structures shall be avoided as far as possible except where considered essential in view of their poor structural conditions/ inadequacy of the provisions etc.
7. The existing structures having inadequate carriageway width shall be

widened/reconstructed in part or fully as per the latest MoRT&H guidelines. The Consultant shall furnish the detailed design and working drawings for carrying out the above improvements.

8. Suitable repair / rehabilitation measures shall be suggested in respect of the existing structures as per IRC-SP:40 along with their specifications, drawings and cost estimate in the form of a report. The rehabilitation or reconstruction of the structures shall be suggested based on broad guidelines for rehabilitation and strengthening of existing bridges contained in IRC-SP:35 and IRC-SP:40.
9. Subsequent to the approval of the GAD and the alignment plan by NHIDCL, detailed design shall also be carried out for the proposed underpasses, overpasses and interchanges.
10. The Consultants shall also carry out the design and make suitable recommendations for protection works for bridges and drainage structures.
11. In case land available is not adequate for embankment slope, suitable design for RCC retaining wall shall be furnished. However, RES wall may also be considered depending upon techno-economic suitability to be approved by NHIDCL.

#### **4.12.7 Drainage System**

1. The requirement of roadside drainage system and the integration of the same with proposed cross-drainage system shall be worked out for the entire length of the project road section.
2. In addition to the roadside drainage system, the Consultants shall design the special drainage provisions for sections with super-elevated carriageways, high embankments and for road segments passing through cuts. The drainage provisions shall also be worked out for road segments passing through urban areas.
3. The designed drainage system should show locations of turnouts/outfall points with details of outfall structures fitting into natural contours. A separate drawing sheet covering every 5 km. stretch of road shall be prepared.

#### **4.12.8. Traffic Safety Features, Road Furniture and Road Markings**

The Consultants shall design suitable traffic safety features and road furniture including traffic signals, signs, markings, overhead sign boards, crash barriers, delineators etc. The locations of these features shall be given in the reports and also shown in the drawings.

#### **4.12.9. Arboriculture and Landscaping**

The Consultants shall work out appropriate plan for planting of trees (specifying type of plantation), horticulture, floriculture on the surplus land of the right-of way with a view to beautify the highway and making the environment along the highway pleasing. The existing trees / plants shall be retained to the extent possible. The Transplantation of trees shall also be proposed wherever feasible.

#### **4.12.10. Deleted**

#### **4.12.11. Deleted**



#### **4.12.12 Office-cum-Residential Complex for PIU-Deleted**

#### **4.12.13 Deleted**

### **4.13 Environment and Social Impact Assessment**

The consultant shall undertake the detailed environmental and social impact assessment in accordance with the standard set by the Government of India for projects proposed to be funded by MORT&H/NHAI. In respect of projects proposed to be funded by ADB loan assistance, Environmental Assessment Requirements, Environmental Guidelines for selected infrastructure projects, 1993 of Asian Development Bank shall be followed. Similarly, for projects proposed to be funded by World Bank loan assistance, World Bank Guidelines shall be followed.

#### **4.13.1 Environmental Impact Assessment**

Environment impact assessment or initial environment examination be carried out in accordance with ADB's Environmental Assessment Requirements of ADB 1998 guidelines for selected infrastructure projects 1993 as amended from time to time /World Bank Guidelines / Government of India Guidelines, as applicable

1. The consultant should carry out the preliminary environmental screening to assess the direct and induced impacts due to the project.
2. The consultant shall ensure to document baseline conditions relevant to the project with the objective to establish the benchmarks.
3. The consultant shall assess the potential significant impacts and identify the mitigation measures to address these impacts adequately.
4. The consultant shall do the analysis of alternatives incorporating environmental concerns. This should include with and without scenario and modification incorporated in the proposed project due to environment considerations.
5. The consultant shall give special attention to the environmental enhancement measures in the project for the following:
  - (a) Cultural property enhancement along the highways
  - (b) Bus bays and bus shelters including a review of their location,
  - (c) Highway side landscape and enhancement of the road junctions,
  - (d) Enhancement of highway side water bodies, and
  - (e) Redevelopment of the borrow areas located on public land.
6. The consultant shall prepare the bill-of-quantities (BOQ) and technical specifications for all items of work in such a way that these may be readily integrated to the construction contracts.
7. The consultant shall establish a suitable monitoring network with regard to air, water and noise pollution. The consultant will also provide additional inputs in the areas of performance indicators and monitoring mechanisms for environmental components during construction and operational phase of the project.
8. The consultant shall provide the cost of mitigation measures and ensure that environmental related staffing, training and institutional requirements are budgeted in project cost.

9. The consultant shall prepare the application forms and obtain forestry and environmental clearances from the respective authorities including the SPCBs and the MOEF on behalf of NHIDCL. The consultants will make presentation, if required, in defending the project to the MOEF Infrastructure Committee.
10. The consultant shall identify and plan for plantation and Transplantation of the suitable trees along the existing highway in accordance with IRC guidelines.
11. The consultant shall assist in providing appropriate input in preparation of relevant environment and social sections of BPIP.

#### **4.13.2 Social Assessment**

- 1 The consultant would conduct base line socio-economic and census survey to assess the impacts on the people, properties and loss of livelihood. The socioeconomic survey will establish the benchmark for monitoring of R&R activities. A social assessment is conducted for the entire project to identify mechanisms to improve project designs to meet the needs of different stakeholders. A summary of stakeholder discussions, issue raised and how the project design was developed to meet stakeholders need would be prepared.
  - 2 The consultant shall prepare Land Acquisition Plan and assist NHIDCL in acquisition of land under various Acts.
  - 3 The consultant would prepare Resettlement and Rehabilitation Plan and assess feasibility and effectiveness of income restoration strategies and suitability and availability to relocation sites. The resettlement plan which accounts for land acquisition and resettlement impacts would be based on a 25% socio-economic survey and 100 % census survey of project affected people which provides the complete assessment of the number of affected households and persons, including common property resources. All untitled occupants are recorded at the initial stages and identify cards will be issued to ensure there is no further influx of people in to the project area. All consultations with affected persons (to include list of participants) should be fully documented and records made available to NHIDCL.
- Assessment on the impact of the project on the poor and vulnerable groups along the project road corridor.
  - Based on the identified impacts, developing entitlement matrix for the project affected people.
  - Assessment on social issues such as indigenous people, gender, HIV/AIDS, labourers including child labour.
  - Implementation budgets, sources and timing of funding and schedule of tasks.
  - Responsibility of tasks, institutional arrangements and personnel for delivering entitlement and plans to build institutional capacity.
  - Internal and external monitoring plans, key monitoring indicators and grievance redress mechanism.
  - Incorporating any other suggestions of the NHIDCL, till the acceptance of the reports by the NHIDCL.

#### **4.13.3 Reporting Requirements of EIA**

- The consultant would prepare the stand-alone reports as per the requirement of the ADB/World Bank / NHIDCL, as applicable, with contents as per the following:
- Executive Summary
- Description of the Project
- Environmental setting of the project.
- Identification and categorization of the potential impacts (during pre-construction, construction and operation periods).
- Analysis of alternatives (this would include correlation amongst the finally selected alternative alignment/routing and designs with the avoidance and environmental management solutions).
- The public consultation process.
- Policy, legal and administrative framework. This would include mechanisms at the states and national level for operational policies. This would also include a description of the organizational and implementation mechanism recommended for this project.
- Typical plan or specific designs for all additional environmental items as described in the scope of work.
- Incorporating any other as per the suggestions of the ADB/ World Bank / MORT&H/NHIDCL, till the acceptance of the reports by the ADB/ World Bank / MORT&H/NHIDCL, as applicable.
- EMP Reports for Contract Package based on uniform methodology and processes. The consultant will also ensure that the EMP has all the elements for it to be a legal document. The EMP reports would include the following:
  - o Brief description of the project, purpose of the EMP, commitments on incorporating environmental considerations in the design, construction and operations phases of the project and institutional arrangements for implementing the EMP.
  - o A detailed EMP for construction and operational phases with recourse to the mitigation measures for all adverse impacts.
  - o Detailed plans for highway-side tree plantation (as part of the compensatory afforestation component).
  - o Environmental enhancement measure would be incorporated.
  - o Enhancement measures would include items described in the scope of work and shall be complete with plans, designs, BOQ and technical specifications.
  - o Environmental monitoring plans during and after construction including scaling and measurement techniques for the performance indicators selected for monitoring.
  - o The EMP should be amendable to be included in the contract documents for the works.
  - o Incorporating any other as per the suggestions of the ADB/ World Bank/ NHIDCL, till the acceptance of the reports by the ADB/ World Bank / NHIDCL as applicable.

#### **4.13.4 Reporting requirements of RAP**

Analysis on the resettlement plan be conducted based on ADBs Hand Book on Resettlement, A Guide to Good practice 1998 as amended time to time/ World Bank Guidelines / Government of India Guidelines, as applicable.

- Executive summary
- Description of project
- Objectives of the project.
- The need for Resettlement in the Project and evaluation of measures to minimize resettlement.
- Description and results of public consultation and plans for continued participation of PAPs.
- Definition of PAPs and the eligibility criteria.
- Census and survey results-number affected, how are they affected and what impacts will they experience.
- Legal and entitlement policy framework-support principles for different categories of impact.
- Arrangements for monitoring and evaluation (internal and external)
- Implementation schedule for resettlement which is linked to the civil works contract
- A matrix of scheduled activities linked to land acquisition procedures to indicate clearly what steps and actions will be taken at different stages and the time frame
- The payment of compensation and resettlement during the acquisition process
- An itemized budget (replacement value for all assets) and unit costs for different assets

## **5. Estimation of Quantities and Project Costs**

1. The Consultants shall prepare detailed estimates for quantities (considering designs and mass haul diagram) and project cost for the entire project (civil packages wise), including the cost of environmental and social safeguards proposed based on MoRT&H's Standard Data Book and market rate for the inputs. The estimation of quantities shall be based on detailed design of various components of the projects. The estimation of quantities and costs would have to be worked out separately for civil work Package as defined in this TOR.
2. The Consultants shall make detailed analysis for computing the unit rates for the different items of works. The unit rate analysis shall duly take into account the various inputs and their basic rates, suggested location of plants and respective lead distances for mechanized construction. The unit rate for each item of works shall be worked out in terms of manpower, machinery and materials.
3. The project cost estimates so prepared for NHIDCL /ADB/WB projects are to be checked against rates for similar on-going works in India under NHIDCL / World Bank/ ADB financed road sector projects.

## **6. Viability and Financing Options .**

1. The values of input parameters and the rationale for their selection for the economic and commercial analyses shall be clearly brought out and got approved by NHIDCL.
2. For models to be used for the economic and the commercial analyses, the calibration methodology and the basic parameters adapted to the local conditions shall be clearly brought out and got approved by NHIDCL.

3. The economic and commercial analyses should bring out the priority of the different homogenous links in terms of project implementation.

## **6.1. Economic Analysis**

1. The Consultants shall carry out economic analysis for the project. The analysis should be for each of the sections covered under this TOR. The benefit and cost streams should be worked out for the project using HDM-IV or other internationally recognized life-cycle costing model.
2. The economic analysis shall cover but be not limited to be following aspects:
  - i. *assess the capacity of existing roads and the effects of capacity constraints on vehicle operating costs (VOC);*
  - ii. *calculate VOCs for the existing road situation and those for the project;*
  - iii. *quantify all economic benefits, including those from reduced congestion, travel distance, road maintenance cost savings and reduced incidence of road accidents; and,*
  - iv. *estimate the economic internal rate of return (EIRR) for the project over a 30-year period. In calculating the EIRRs, identify the tradable and non-tradable components of projects costs and the border price value of the tradable components.*
  - v. *Saving in time value.*
3. Economic Internal Rate of Return (EIRR) and Net Present Value (NPV), “with” and “without time and accident savings” should be worked out based on these cost-benefit stream. Furthermore, sensitivity of EIRR and NPV worked out forth different scenarios as given under:

<i>Scenario – I</i>	<i>Base Costs and Base Benefits</i>
<i>Scenario - II</i>	<i>Base Costs plus 15% and Base Benefits</i>
<i>Scenario - III</i>	<i>Base Costs and Base Benefits minus 15%</i>
<i>Scenario - IV</i>	<i>Base Costs plus 15% and Base Benefits minus 15%</i>

The sensitivity scenarios given above are only indicative. The Consultants shall select the sensitivity scenarios taking into account possible construction delays, construction costs overrun, traffic volume, revenue shortfalls, operating costs, exchange rate variations, convertibility of foreign exchange, interest rate volatility, non-compliance or default by contractors, political risks and force majeure.

4. The economic analysis shall take into account all on-going and future road and transport infrastructure projects and future development plans in the project area.

## **6.2. Financial Analysis**

1. It is envisaged that the project stretch should be implemented on EPC/BOT basis, therefore, the Consultant shall study the financial viability of the project under a commercial format and under different user fee scenarios and funding options. The Consultants shall submit and finalize in consultation with the NHIDCL’s officers the format for the analysis and the primary parameters and scenarios that should be taken into account while carrying out the commercial analysis. The financial model so developed shall be the property of NHIDCL.

2. The Financial analysis for the project should cover financial internal rate of return, projected income statements, balance sheets and fund flow statements and should bring out all relevant assumptions. The sensitivity analysis should be carried out for a number of probabilistic scenarios.
3. The financial analysis should cover identification, assessment, and mitigating measures for all risks associated with the project. The analysis shall cover, but be not limited to, risks related to construction delays, construction costs overrun, traffic volume, revenue shortfalls, operating costs, exchange rate variations, convertibility of foreign exchange, interest rate volatility, non-compliance or default by contractors, political risks and force majeure.
4. The consultant shall suggest positive ways of enhancing the project Viability and furnish different financial models for implementing on BOT format.

#### 6.3 Payment Schedule

### 7. Time period for the service

1. Time period envisaged for the study of the project is indicated in **Annex-I to LOI**. The final reports, drawings and documentation shall be completed within this time schedule.
2. NHIDCL shall arrange to give approval on all sketches, drawings, reports and recommendations and other matters and proposals submitted for decision by the Consultant in such reasonable time so as not to delay or disrupt the performance of the Consultant's services.

### 8. Project Team and Project Office of the Consultant

1. The Consultants shall be required to form a multi-disciplinary team for this assignment. The consultants team shall be manned by adequate number of experts with relevant experience in the execution of similar detailed design assignments.
2. List of suggested key personnel to be fielded by the consultant with appropriate man-month of consultancy services is given in Enclosure I as per client's assessment.
3. A Manning Schedule for key personnel mentioned above is enclosed as Enclosure I along with broad job- description and qualification as Enclosure II. The information furnished in Enclosures I & II are to assist the Consultants to understand the client's perception about these requirements and shall be taken by the Consultants for the purpose of Financial Proposal and deployment schedule etc. in technical proposal to be submitted by them. Any deviation proposed may be recorded in the comments on TOR. All the key personnel mentioned will be evaluated at the time of evaluation of technical proposal. Consultants are advised in their own interest to frame the technical proposal in an objective manner as far as possible so that these could be properly assessed in respect of points to be given as part of evaluation criteria as mentioned in Data sheet. The bio-data of the key personnel should be signed on every sheet by the personnel concerned and the last sheet of each bio-data should also be signed by the authorized signatory of the Consultants.
4. The Consultants shall establish an office at the project site manned by senior personnel during the course of the surveys and investigations. All the project related office work shall be carried out by the consultant in their site office unless

there are special reasons for carrying out part of the office work elsewhere for which prior approval of NHIDCL shall be obtained. The address of the site office including the personnel manning it including their Telephone and FAX numbers will be intimated by the Consultant to NHIDCL before commencement of the services.

5. The Consultant shall maintain an Attendance Register to be signed by each individual key personnel at site as well as at Head Office. The Consultant shall furnish certificate that all the key personnel as envisaged in the Contract Agreement have been actually deployed in the Projects at the time of submission of their bills to the National Highways and Infrastructure Development Corporation Ltd from time to time.

## **9. Reports to be submitted by the Consultant to NHIDCL**

- 9.1 All reports, documents and drawings are to be submitted separately for each of the traffic homogenous link of the Project Road. The analysis of data and the design proposals shall be based on the data derived from the primary surveys and investigations carried out during the period of assignment. The sources of data and model relationships used in the reports shall be indicated with complete details for easy reference.
- 9.2 Project preparation activities will be split into six stages as brought out below. Preliminary design work should commence without waiting for feasibility study to be completed. Stage 3, 5 and 6 shall run in parallel with Stage 2 and 4

**Stage 1: Inception Report**

**Stage 2: Feasibility Report**

**Stage 3: LA & Clearances I Report**

**Stage 4: Detailed Project Report (DPR)**

**Stage 5: Technical Schedules**

**Stage 6: LA & Clearances II Report**

- 9.3 Consultant shall be required to complete, to the satisfaction of the client, all the different stages of study within the time frame indicated in the schedule of submission in para 10 pertaining to Reports and Documents for becoming eligible for payment for any part of the next stage.

## **10 Reports and Documents to be submitted by the Consultant to NHIDCL**

1. The Consultant shall submit to the client the reports and documents in bound volumes (and not spiral binding form) after completion of each stage of work as per the schedule and in the number of copies as given in Enclosure III. Further, the reports shall also be submitted in CD's in addition to the hardcopies as mentioned in Enclosure-III. Consultant shall submit all other reports mentioned specifically in the preceding paras of the TOR.
2. The time schedule for various submissions prescribed at s.l.no.1 above shall be strictly adhered to. No time-over-run in respect of these submissions will normally be

permitted. Consultant is advised to go through the entire terms of reference carefully and plan his work method in such a manner that various activities followed by respective submissions as brought out at Sl.No.1 above are completed as stipulated. Consultant is, therefore, advised to deploy sufficient number of supporting personnel, both technical and administrative, to undertake the project preparation activities in construction package (Section) simultaneously. As far as possible, the proposal should include complete information such as number of such persons, name, position, period of engagement, remuneration rate etc. The Consultant is also advised to start necessary survey works from the beginning so as to gain time in respect of various other activities in that stage.

### **STAGE 1**

#### **10.1 Quality Assurance Plan (QAP) Document**

1. Immediately upon the award, the Consultants shall submit four copies of the QAP document covering all aspects of field studies, investigations design and economic financial analysis. The quality assurance plans/procedures for different field studies, engineering surveys and investigation, design and documentation activities should be presented as separate sections like engineering surveys and investigations, traffic surveys, material geo-technical and sub-soil investigations, road and pavement investigations, investigation and design of bridges & structures, environment and R&R assessment, economic & financial analysis, drawings and documentation; preparation, checking, approval and filing of calculations, identification and traceability of project documents etc. Further, additional information as per format shall be furnished regarding the details of personnel who shall be responsible for carrying out/preparing and checking/verifying various activities forming part of feasibility study and project preparation, since inception to the completion of work. The field and design activities shall start after the QAP is approved by NHIDCL.
2. The data formats proposed by the Consultants for use in field studies and investigations shall be submitted within 14 days after the commencement of services and got approved by NHIDCL.

#### **10.2 Inception Report (IR)**

1. The report shall cover the following major aspects:
  - i. *Project appreciation;*
  - ii. *Detailed methodology to meet the requirements of the TOR finalised in consultation with The National Highways and Infrastructure Development Corporation Ltd officers; including scheduling of various sub activities to be carried out for completion of various stages of the work; stating out clearly their approach & methodology for project preparation after due inspection of the entire project stretch and collection/ collation of necessary information;*
  - iii. *Task Assignment and Manning Schedule;*
  - iv. *Work programme;*
  - v. *Performa for data collection;*
  - vi. *Design standards and proposed cross-sections;*
  - vii. *Key plan and Linear Plan;*
  - viii. *Development plans being implemented and / or proposed for implementation in the near future by the local bodies and the possible impact of such development*



- plans on the overall scheme for field work and design for the study;*
  - ix. *Quality Assurance Plan (QAP) finalised in consultation with NHIDCL;*
  - x. *Draft design standards; and*
2. The requirements, if any, for the construction of bypasses should be identified on the basis of data derived from reconnaissance and traffic studies. The available alignment options should be worked out on the basis of available maps. The most appropriate alignment option for bypasses should be identified on the basis of site conditions and techno-economic considerations. Inception Report should include the details regarding these aspects concerning the construction of bypasses for approval by NHIDCL.

## **STAGE 2:**

### **10.3 Feasibility Report**

1. The consultant shall commence the Feasibility Study of the project in accordance with the accepted IR and the report shall contain the following:
  - i. *Executive summary*
  - ii. *Overview of NHIDCL organization and activities, and project financing and cost recovery mechanisms*
  - iii. *Project description including possible alternative alignments/bypasses and technical/engineering alternatives*
  - iv. *Methodology adopted for the feasibility study*
  - v. *Socioeconomic profile of the project areas*
  - vi. *Indicative design standards, methodologies and specifications*
  - vii. *Traffic surveys and analysis*
  - viii. *Environmental screening and preliminary environmental assessment*
  - ix. *Initial social assessment and preliminary land acquisition/resettlement plan*
  - x. *Cost estimates based on preliminary rate analysis and bill of quantities*
  - xi. *Economic and financial analysis*
  - xii. *Conclusions and recommendations*
2. In view of para 1 above the consultant has to submit the following documents in six sets:
  - i. **Technical Specifications:** *The MORT&H's Technical Specifications for Road and Bridge works shall be followed for this study. However, Volume - IV: Technical Specifications shall contain the special technical specifications which are not covered by MORT&H Specifications for Roads and Bridges (latest edition / revision) and also specific quality control norms for the construction of works.*
  - ii. **Rate Analysis:** *This volume will present the analysis of rates for all items of works. The details of unit rate of materials at source, carriage charges, any other applicable charges, labour rates, and machine charges as considered in arriving at unit rates will be included in this volume.*
  - iii. **Cost Estimates:** *This volume will present the each item of work as well as a summary of total cost.*
  - iv. **Bill of Quantities:** *This volume shall contain the detailed Bill of Quantities for all items of works*
3. The basic data obtained from the field studies and investigations shall be submitted in a

separate volume as an Appendix to Feasibility Report.

4. The Final Feasibility Study Report incorporating comments, revisions and modifications suggested by NHIDCL shall be submitted within 15 days of comments from NHIDCL on draft feasibility study report.

### **STAGE 3:**

#### **10.4 Strip Plan and Clearances**

1. The Consultants shall submit the following documents:
  - i. *Details of the center line of the proposed widened NH along with the existing and proposed right-of-way limits to appreciate the requirements of land acquisition;*
  - ii. *The information concerning the area including ownership of land to be acquired for the implementation of the project shall be collected from the revenue and other concerned authorities and presented along with the strip plans;*
  - iii. *Strip plans showing the position of existing utilities and services indicating clearly the position of their relocation;*
  - iv. *Details for various clearances such as environment and forest clearances;*
  - v. *Separate strip plan showing shifting / relocation of each utility services in consultation with the concerned local authorities;*
  - vi. *The utility relocation plans should clearly show existing right-of-way and pertinent topographic details including buildings, major trees, fences and other installations such as water-mains, telephone, telegraph and electricity poles, and suggest relocation of the services along with their crossings the highway at designated locations as required and prepare necessary details for submission to the Service Departments;*
  - vii. *Detail schedules for acquisition of additional land and additional properties in consultation with the revenue authorities; and*
  - viii. *Land Acquisition Plan shall be prepared after digitization of cadastral / land revenue maps. The digitized map shall exactly match the original map, like a contact print, since the dimensions and area of plots, or the whole village is to be extracted from the map itself. An accuracy of 1mm or higher in a 1:1000 scale map shall be ensured, as this translates into an accuracy of 1 m or higher on ground.*
2. The strip plans and land acquisition plan shall be prepared on the basis of data from reconnaissance and detailed topographic surveys.
3. The Report accompanying the strip plans should cover the essential aspects as given under:
  - i. *Kilometre-wise Land Acquisition Plan (LAP) and schedule of ownership thereof and Costs as per Revenue Authorities and also based on realistic rates.*
  - ii. *Details of properties, such as buildings and structures falling within the right-of way and costs of acquisition based on realistic rates.*
  - iii. *Kilometre-wise Utility Relocation Plan (URP) and costs for relocation per civil construction package as per concerned authorities.*
  - iv. *Kilometre-wise account in regard to felling of trees of different type and girth and value estimate of such trees based on realistic rates obtainable from concerned District forest office.*
4. The strip plans shall clearly indicate the scheme for widening. The views and suggestions of the concerned State PWDs should be duly taken into account while working out the widening scheme (left, right or symmetrical). The widening scheme shall be finalised in consultation with NHIDCL

5. Kilometre-wise Strip Plans for section (Package) shall be prepared separately for each concerned agency and suggested by NHIDCL

#### **10.5 Land Acquisition Report**

1. The Land acquisition report shall be prepared and submitted for section (package). The report shall include detail schedules about acquisition of landholdings as per revenue records and their locations in a strip plan and also the costs as per district authorities. Details shall be submitted in land acquisition Performa to be supplied by NHIDCL. The land acquisition report shall be submitted in both Hind and English languages.
2. The land acquisition report should be prepared in consultation with affected persons, non-governmental organizations and concerned government agencies and should cover land acquisition and resettlement plan and costs of resettlement and rehabilitation of such affected persons. It should also include plan of compensating afforestation, its land requirement with specific locations and cost involved for undertaking all activities in this regard.

#### **10.6 Deleted**

#### **STAGE: 4**

#### **10.7 Draft Detailed Project Report (DPR)**

1. The draft DPR Submission shall consist of construction package-wise Main Report, Design Report, Materials Report, Engineering Report, Drainage Design Report, Economic and Financial Analysis Report, Environmental Assessment Report including Resettlement Action Plan (RAP), Package-wise bid Documents and Drawings.
2. The Report volumes shall be submitted as tabulated in para 10 above.
3. The Documents and Drawings shall be submitted for the Package and shall be in the following format:

#### **Reports**

- i. ***Volume-I, Main Report:*** This report will present the project background, social analysis of the project, details of surveys and investigations carried out, analysis and interpretation of survey and investigation data, traffic studies and demand forecasts designs, cost estimation, environmental aspects, economic and commercial analyses and conclusions. The report shall include Executive Summary giving brief accounts of the findings of the study and recommendations.

*The Report shall also include maps, charts and diagrams showing locations and details of existing features and the essential features of improvement and upgrading. The Environmental Impact Assessment (EIA) Report for contract package shall be submitted as a part of the main report.*

*The basic data obtained from the field studies and investigations and input data used for the preliminary design shall be submitted in a separate volume as an Appendix to Main*

*Report.*

- ii. **Volume - II, Design Report:** *This volume shall contain design calculations, supported by computer printout of calculations wherever applicable. The Report shall clearly bring out the various features of design standards adopted for the study. The design report will be in two parts. Part-I shall primarily deal with the design of road features and pavement composition while Part-II shall deal with the design of bridges, tunnels and cross-drainage structures. The sub-soil exploration report including the complete details of boring done, analyses and interpretation of data and the selection of design parameters shall be included as an Appendix to the Design Report.*

*The detailed design for all features should be carried out as per the requirements of the Design Standards for the project. However, there may be situations wherein it has not been possible to strictly adhere to the design standards due to the existing site conditions, restrictions and other considerations. The report should clearly bring out the details of these aspect and the standards adopted.*

- iii. **Volume - III, Materials Report:** *The Materials Report shall contain details concerning the proposed borrow areas and quarries for construction materials and possible sources of water for construction purposes. The report shall include details on locations of borrow areas and quarries shown on maps and charts and also the estimated quantities with mass haul diagram including possible end use with leads involved, the details of sampling and testing carried out and results in the form of important index values with possible end use thereof.*

*The materials Report shall also include details of sampling, testing and test results obtained in respect physical properties of subgrade soils. The information shall be presented in tabular as well as in graphical representations and schematic diagrams. The Report shall present soil profiles along the alignment.*

*The material Report should also clearly indicate the locations of areas with problematic soils. Recommendations concerning the improvement of such soils for use in the proposed construction works, such as stabilization (cement, lime, mechanical) should be included in the Report.*

- iv. **Volume - IV, Environmental Assessment Report including Environmental Management Plan (EMP) & Resettlement Action Plan (RAP):** *The Report shall be prepared conforming to the Guidelines of the Government of India, State Government and World Bank / ADB as appropriate for construction package.*

- v. **Volume - V, Technical Specifications:** *The MORT&H's Technical Specifications for Road and Bridge works shall be followed for this study. However, Volume IV: Technical Specifications shall contain the special technical specifications which are not covered by MOST Specifications for Roads and Bridges (latest edition / revision) and also specific quality control norms for the construction of works.*

- vi. **Volume - VI, Rate Analysis:** *This volume will present the analysis of rates for all items*

of works. The details of unit rate of materials at source, carriage charges, any other applicable charges, labour rates, machine charges as considered in arriving at unit rates will be included in this volume.

- vii. **Volume - VII, Cost Estimates:** This volume will present the contract package wise cost of each item of work as well as a summary of total cost.
- viii. **Volume - VIII, Bill of Quantities:** This volume shall contain the package-wise detailed Bill of Quantities for all items of works.
- ix. **Volume - IX, Drawing Volume:** All drawings forming part of this volume shall be 'good for tender drawings and designs'. All plan and profile drawings will be prepared in scale 1:250V and 1:2500H scale to cover one km in one sheet. In addition this volume will contain 'good for tender drawings and designs' the following:
  - Horizontal Alignment and Longitudinal Profile.
  - Cross-section @ 50m interval along the alignment within ROW
  - Typical Cross-Sections with details of pavement structure.
  - Detailed Working Drawings for individual Culverts and Cross Drainage Structures.
  - Detailed Working Drawings for individual Bridges, tunnels and Structures.
  - Detailed Drawings for Improvement of At-Grade and Grade-Separated Intersections and Interchanges.
  - Drawings for Road Sign, Markings, Toll Plazas, and other Facilities.
  - Schematic Diagrams (linear chart) indicating but be not limited to be following:
    - Widening scheme;
    - Locations of median openings, intersections, interchanges, underpasses, overpasses, bypasses;
    - Locations of service roads;
    - Location of traffic signals, traffic signs, road markings, safety features; and, Locations of toll plaza, parking areas, weighing stations, bus bays, rest areas, if any.
  - Drawings for toll plaza, Bus Bays, Parking areas, Rest areas, weighing stations etc. All drawings will be prepared in A2 size sheets. The format for plan, cross section and profile drawings shall be finalized in consultation with the concerned NHIDCL officers. The drawings shall also include details of all BM and reference pillars, HIP and VIP. The co-ordinates of all points should be referenced to a common datum, preferably GTS referencing system. The drawings shall also include the locations of all traffic safety features including traffic signals, signs, markings, crash barriers, delineators and rest areas, busbays, parking areas etc.
  - The typical cross-section drawings should indicate the scheme for future widening of the carriageway. The proposed cross-sections of road segment passing through urban areas should indicate the provisions for pedestrian movements and suitable measures for surface and sub-surface drainage and lighting, as required.

## **10.8. Final Detailed Project Report, Documents and Drawings (6 Sets)**

1. The Final package-wise DPR consisting of Main Report, Design Report, Drainage Design Report and Materials Report, incorporating all revisions deemed relevant following receipt of the comments from NHIDCL on the draft DPR shall be submitted as per the schedule given in Enclosure-III.

## **STAGE: 5**

### **10.9. Technical Schedules**

1. Civil Work Contract Agreement: A civil works contract agreement shall be submitted.

## **STAGE: 6**

### **10.10. LA & Clearances II Report**

1. Draft 3a, 3A, 3D notification shall be submitted by the consultant.
2. All the necessary project related clearances such as environment, forest and wildlife clearance from MOEF, Railways in respect of ROB/ RUBs, Irrigation Deptt and any other concerned agencies shall be obtained by the consultant. The final approvals shall be obtained and submitted to NHIDCL so that project implementation can straight away proceed without any hold up. For utility clearances, consultant shall prepare draft utility shifting estimates using the latest Schedule of Rates and obtain final approval from utility agency and NHIDCL.

### **11. Interaction with NHIDCL**

1. During entire period of services, the Consultant shall interact continuously with NHIDCL and provide any clarification as regards methods being followed and carryout modification as suggested by NHIDCL. A programme of various activities shall be provided to NHIDCL and prior intimation shall be given to NHIDCL regarding start of key activities such as boring, survey etc. so that inspections of NHIDCL officials could be arranged in time.
2. The National Highways and Infrastructure Development Corporation Ltd officers and other Government officers may visit the site at any time, individually or collectively to acquaint/ supervise the field investigation and survey works. NHIDCL may also appoint a Proof Consultant to supervise the work of the DPR consultant including inter-alia field investigation, survey work, Design work and preconstruction activities.
3. The consultant shall be required to send 3 copies of concise monthly Progress Report by the 5th day of the following month to the designated officer at his Head Quarter so that progress could be monitored by The National Highways and Infrastructure Development Corporation Ltd. These reports will indicate the dates of induction and de-induction of various key personnel and the activities performed by them. Frequent meetings with the consultant at site office or in Delhi are foreseen during the currency of project preparation.
4. All equipment, software and books etc. required for satisfactory services for this project shall be obtained by the Consultant at their own cost and shall be their property.

### **12. Payment Schedule**

1. The Consultant will be paid consultancy fee as a percentage of the contract values as per

the schedule given in the Draft Contract Agreement.

### **13. Data and Software**

1. The CD's containing all basic as well as the processed data from all field studies and investigations, report, appendices, annexure, documents and drawings shall be submitted to NHIDCL at the time of the submission of the Final Report. The data can be classified as follows:
  - i. ***Engineering Investigations and Traffic Studies:*** Road Inventory, Condition, Roughness, Test Pit (Pavement composition), Benkelman Beam Deflection, Material Investigation including test results for subgrade soils, Traffic Studies(traffic surveys), axle load surveys, Sub-soil Exploration, Drainage Inventory, Inventory data for bridge and culverts indicating rehabilitation, new construction requirement etc. in MS EXCEL or any other format which could be imported to widely used utility packages.
  - ii. ***Topographic Surveys and Drawings:*** All topographic data would be supplied in (x, y, z) format along with complete reference so that the data could be imported into any standard highway design software. The drawing files would be submitted in dxf or dwg format.
  - iii. ***Rate Analysis:*** The Consultant shall submit the rate analysis for various works items including the data developed on computer in this relation so that it could be used by the Authority later for the purpose of updating the cost of the project.
  - iv. ***Economic and Financial Analysis***
2. **Software:** The Consultant shall also hand-over to NHIDCL CD's containing any general software including the financial model which has been specifically developed for the project.
3. The CD's should be properly indexed and a catalogue giving contents of all CD's and print-outs of the contents (data from field studies topographic data and drawings) should be handed over to NHIDCL at the time of submission of the Final Report.
4. Consultant shall include editable soft copies of the final versions of all documents, including but not limited to the strip plan, plan & profile drawings, cross sections of right of way and details of structures as well as any cost workings.

## **SUPPLEMENT I**

Deleted



## SUPPLEMENT II

S.No.	Clause No. of TOR	<i>Additional points</i>
1	4.1	<b>For standalone bridge projects the scope of work shall include detailed design of approach road extending at least up to 2 km on either side of the bridge</b>
1.	4.11.4.2(6)	<p style="text-align: center;"><b>Model Studies for Bridges</b></p> <p><b>1. Objective</b></p> <p>Physical/ Mathematical Model study for detailed Hydraulic/ Hydrologic investigations regarding the proposed bridge for hydraulic design of the bridge and assessment and hydraulic design of required river training works.</p> <p><b>2. Methodology</b></p> <p><b>Physical/Mathematical Model</b> study shall be carried out at a reputed/recognized institution. The consultant will be responsible for identifying the institution, supplying Information /Documents /Data required for modal studies as indicated in para 4 below and coordinating the model study with the institution concerned</p> <p><b>3. Scope of Work</b></p> <p><b>3.1 Physical Model study</b></p> <p>Physical modeling with appropriate model scale for Hydraulic and Hydrologic Investigations to:</p> <ul style="list-style-type: none"> <li>i) Finalize span arrangement causing uniformity in flow distribution, and work out the alignment and orientation of river training works and bridge axis.</li> <li>ii) Provide information on estimated/observed maximum depth of scour.</li> <li>iii) Provide information on required river training works for proposed bridge</li> <li>iv) Provide hydraulic design for the bridge and the required river training works.</li> <li>v) Quantify the general direction of river course through bridge, afflux, extent and magnitude of flood, effect of backwater, if any, aggradation/degradation of bed, evidence of scour etc. shall be used to augment the available hydrological data. The presence of flood control/irrigation structures, if affecting the hydraulic characteristics like causing obliquity, concentration of flow, scour, silting of beds, change in flow levels, bed levels etc. shall be studied. and considered in Hydraulic design of proposed bridge. The details of any planned work in the immediate future that may affect the river hydraulics shall be studied and considered</li> </ul>

### **3.2 Mathematical Model study**

Mathematical modeling for detailed Hydraulic / Hydrologic investigations regarding the proposed new bridge to:

- i) Finalize the site/location of the proposed new bridge based on mathematical modeling.
- ii) Provide information on estimated/observed maximum depth of scour..
- iii) Provide information on required river training works for proposed bridge
- iv) Provide hydraulic design for the bridge and the required river training works.
- v) Quantify the general direction of river course through bridge, afflux, extent and magnitude of flood, effect of backwater, if any, aggradation/degradation of bed, evidence of scour etc. shall be used to augment the available hydrological data. The presence of flood control/irrigation structures, if affecting the hydraulic characteristics like causing obliquity, concentration of flow, scour, silting of bed, change in flow levels, bed levels etc. shall be studied and considered in Hydraulic design of proposed bridge. The details of any planned work in the immediate future that may affect the river hydraulics shall be studied and considered.

### **4. Information / Documents / Data required for Physical / Mathematical Model study**

- i) Plan layouts showing the locations of the proposed bridge as well as the existing bridges / barrages etc., in the vicinity of the proposed bridge with the chainages with respect to a standard reference marked on it.
- ii) High flood discharges and corresponding flood levels at the locations of the existing bridges in the vicinity of the proposed bridge.
- iii) General arrangement drawing (GAD) of the existing bridges showing number of spans, pier and well dimensions, founding levels, maximum scour level, the design discharge and the HFL, guide bund details. On this, the plan form of the river course with the bridge alignment may also be shown as far as possible.
- iv) General arrangement drawing (GAD) of the proposed new bridge showing number of spans, pier and foundation dimensions. On this, the plan form of the river course with the bridge alignment may also be shown as far as possible.

- v) River cross sections at 500m longitudinal spacing (maximum) up to a distance of 2 times the bridge total length on the upstream side and up to a distance equal to the bridge total length on the downstream with right bank and left bank clearly marked on it. At least one cross section to be provided at the location of the proposed bridge. At each cross section, the bed levels to be taken at a maximum lateral distance of 8 m in flow section and at 25 m in nonflow section respectively. The abrupt variations in the bed levels to be captured by taking measurements at closer locations both in longitudinal as well as lateral directions.
- vi) The cross sections, as far as possible, from high bank to high bank.
- vii) The longitudinal profile of the river along the length of the proposed alignment.
- viii) Size distribution of the river bed material and the bore log data at different locations at the site of the proposed bridge.

The series of annual peak flood of the river for at least 15 years period.

## SUPPLEMENT-III

### ADDITIONAL REQUIREMENT FOR SAFETY AUDIT

The use of checklists is highly recommended as they provide a useful “aide memoire” for the audit team to check that no important safety aspects are being overlooked. They also give to the project manager and the design engineer a sense of understanding of the place of safety audit in the design process. The following lists have been drawn up based on the experience of undertaking systematic safety audit procedures overseas. This experience indicates that extensive lists of technical details has encouraged their use as “tick” sheets without sufficient thought being given to the processes behind the actions. Accordingly, the checklists provide guideline son the principal issues that need to be examined during the course of the safety audits.

#### Stage F-During Feasibility Study

1. The audit team should review the proposed design from a road safety perspective and heck the following aspects

CONTENTS	ITEMS
Aspects to be checked	<ul style="list-style-type: none"><li>A. Safety and operational implications of proposed alignment and junction strategy with particular references to expected road users and vehicle types likely to use the road.</li><li>B. Width options considered for various sections.</li><li>C. Departures from standards and action taken.</li><li>D. Provision of pedestrians, cyclists and intermediate transport</li><li>E. Safety implications of the scheme beyond its physical limits i.e. how the scheme fits into its environs and road Hierarchy</li></ul>
A1 : General	<ul style="list-style-type: none"><li>➤ Departures from standards</li><li>➤ Cross-sectional variation</li><li>➤ Drainage</li><li>➤ Climatic conditions</li><li>➤ Landscaping</li><li>➤ Services apparatus</li><li>➤ Lay-byes</li><li>➤ Footpath</li><li>➤ Pedestrian crossings</li><li>➤ Access (minimize number of private accesses)</li></ul>
	<ul style="list-style-type: none"><li>➤ Emergency vehicles</li><li>➤ Public Transport</li></ul>

A2 : Local Alignment	<ul style="list-style-type: none"> <li>➤ Future widening</li> <li>➤ Staging of contracts</li> <li>➤ Adjacent development</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Visibility</li> <li>➤ New/Existing road interface</li> <li>➤ Safety Aids on steep hills</li> </ul>
A3 : Junctions	<ul style="list-style-type: none"> <li>➤ Minimise potential conflicts</li> <li>➤ Layout</li> <li>➤ Visibility</li> </ul>
A4 : Non-Motorised road users Provision	<ul style="list-style-type: none"> <li>➤ Adjacent land</li> <li>➤ Pedestrians</li> <li>➤ Cyclists</li> <li>➤ Non-motorised vehicles</li> </ul>
A5 : Signs and Lighting	<ul style="list-style-type: none"> <li>➤ Lighting</li> <li>➤ Signs/Markings</li> </ul>
A6 : Construction and Operation	<ul style="list-style-type: none"> <li>➤ Buildability</li> <li>➤ Operational</li> <li>➤ Network Management</li> </ul>

### Stage 1 – Completion of Preliminary Design

1. The audit team should review the proposed check the following aspects design from a road safety perspective and check the following aspects	
CONTENTS	ITEMS
Aspects to be checked	<p>A. Safety and operational implications of proposed alignment and junction strategy with particular references to expected road users and vehicle types likely to use the road.</p> <p>B. Width options considered for various sections.</p> <p>C. Departures from standards and action taken.</p> <p>D. Provision of pedestrians, cyclists and intermediate transport</p> <p>E. Safety implications of the scheme beyond its physical limits i.e. how the scheme fits into its environs and road hierarchy</p>
B1 : General	<ul style="list-style-type: none"> <li>➤ Departures from standards</li> </ul>

	<ul style="list-style-type: none"> <li>➤ Cross-sectional variation</li> <li>➤ Drainage</li> <li>➤ Climatic conditions</li> <li>➤ Landscaping</li> <li>➤ Services apparatus</li> <li>➤ Lay-byes</li> <li>➤ Footpaths</li> <li>➤ Pedestrian crossings</li> <li>➤ Access (minimize number of private accesses)</li> <li>➤ Emergency vehicles</li> <li>➤ Public Transport</li> <li>➤ Future widening</li> <li>➤ Staging of contracts</li> <li>➤ Adjacent development</li> </ul>
B2 : Local Alignment	<ul style="list-style-type: none"> <li>➤ Visibility</li> <li>➤ New/Existing road interface</li> <li>➤ Safety Aids on steep hills</li> </ul>
B3 : Junctions	<ul style="list-style-type: none"> <li>➤ Minimize potential conflicts</li> <li>➤ Layout</li> <li>➤ Visibility</li> </ul>
B4 : Non-Motorised road users Provision	<ul style="list-style-type: none"> <li>➤ Adjacent land</li> <li>➤ Pedestrians</li> <li>➤ Cyclists</li> <li>➤ Non-motorized vehicles</li> </ul>
B5 : Signs and Lighting	<ul style="list-style-type: none"> <li>➤ Lighting</li> <li>➤ Signs/Markings</li> </ul>
B6: Construction and Operation	<ul style="list-style-type: none"> <li>➤ Build ability</li> <li>➤ Operational</li> <li>➤ Network Management</li> </ul>

## Stage 2 – Completion of Detailed Design

1. The audit team should satisfy itself that all issues raised at Stage 1 have been resolved. Items may require further consideration where significant design changes

have occurred.

2. If a scheme has not been subject to a stage 1 audit, the items listed in Checklists B1 to B6 should be considered together with the items listed below.

CONTENTS	ITEMS
Aspects to be checked	<p>A. Any design changes since Stage 1.</p> <p>B. The detailed design from a road safety viewpoint, including the road safety implications of future maintenance (speed limits; road signs and markings; visibility; maintenance of street lighting and Central reserves).</p>
C1 : General	<ul style="list-style-type: none"> <li>➤ Departures from standards</li> <li>➤ Drainage</li> <li>➤ Climatic conditions</li> <li>➤ Landscaping</li> <li>➤ Services apparatus</li> <li>➤ Lay-byes</li> <li>➤ Access</li> <li>➤ Skid-resistance</li> <li>➤ Agriculture</li> <li>➤ Safety Fences</li> <li>➤ Adjacent development</li> </ul>
C2 : Local Alignment	<ul style="list-style-type: none"> <li>➤ Visibility</li> <li>➤ New/Existing road interface</li> </ul>
C3 : Junctions	<ul style="list-style-type: none"> <li>➤ Layout</li> <li>➤ Visibility</li> <li>➤ Signing</li> <li>➤ Lighting</li> <li>➤ Road Marking</li> <li>➤ T,X,Y-junctions</li> <li>➤ All roundabouts</li> <li>➤ Traffic signals</li> </ul>
C4 : Non-Motorized road users Provision	<ul style="list-style-type: none"> <li>➤ Adjacent land</li> <li>➤ Pedestrians</li> <li>➤ Cyclists</li> <li>➤ Non-motorized vehicles</li> </ul>
C5 : Signs and Lighting	<ul style="list-style-type: none"> <li>➤ Advanced direction signs</li> <li>➤ Local traffic signs</li> </ul>

	<ul style="list-style-type: none"> <li>➤ Variable message signs</li> <li>➤ Other traffic signs</li> <li>➤ Lighting</li> </ul>
C6 : Construction and Operation	<ul style="list-style-type: none"> <li>➤ Build ability</li> <li>➤ Operational</li> <li>➤ Network Management</li> </ul>

#### Annex-6

#### Payment Schedule

(Refer Clause 6.3)

S.No	Description	Week	Payment
1	On submission of Inception Report	4	10%
2	On Submission of Final feasibility report	12	20%
3	On Submission of draft preliminary project report	16	15%
4	On Submission of Draft Detailed Project Report and Bidding Documents	20	20%
5	On approval of Final Detailed Project Report and Bidding Documents	24	25%
6	On submission of required project clearances from the concerned agencies	26	10%
	<b>Total</b>		100%
<i>Note: Consultants have to provide a certificate that all the key personnel as envisaged in the Contract Agreement have been actually deployed in the projects. They have to furnish the certificate at the time of submission of their bills to NHIDCL from time to time.</i>			



**Enclosure-I****MANNING SCHEDULE****Package no. NHIDCL/Chatham-Bamboo Flat/DPR/2016**

SI. No	Key Personnel	Total Project Assignment(8 months)		
		At site (mm)	At design office	Total Time Period (mm)
1	Team Leader Cum Senior Highway	3.5	3.5	7
2	Senior Bridge Engineer	1	2	3
3	Highway cum Pavement Engineer	1.5	2	3.5
4	Material-cum-Geo-technical	3	2	5
5	Senior Survey Engineer	3	2	5
6	Traffic and Safety expert	1	2	3.5
7	Environmental Specialist	1	1.5	2.5
8	Quantity Surveyor/ Documentation	1	3.5	4.5
	Total	15	18.5	33.5

1. Consultants have to provide a certificate that all the key personnel as envisaged in the Contract Agreement have been actually deployed in the projects. They have to furnish the certificate at the time of submission of their bills to NHIDCL from time to time.
2. In case Tunnels are to be constructed, necessary input of Tunnel Experts shall be provided in addition to above mentioned Manpower requirement.

**Qualification and Experience Requirement of Key Personnel**  
**Team Leader cum Senior Highway Engineer**

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate in Civil Engineering or equivalent
	<b>Desirable</b>	<b>Post graduate in Civil Engineering (highways/structures/traffic and transportation/soil mechanics and foundation engineering/ Construction Management /Transportation)</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a)Total Professional Experience	Min. 20 years
	b) Experience in Highway projects	Min. 15 years in Planning, project preparation and design of <b>Highway projects</b> , including 2/4/6 laning of NH/SH/expressways. For hill roads, respective hill roads experience is required
	c) Experience in similar capacity (Either as Team Leader or in Similar capacity )	In Feasibility of two / Four/Six Laning works and DPR/IC/ Construction Supervision of Two/Four/six laning of major highway projects(NH/SH/Expressways)/ feasibility cum detailed project report of two/ four laning projects of minimum aggregate length of 80 km. For hill roads, respective hill roads experience is required.
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL***Highway cum Pavement Engineer*

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	<b>Degree in Civil Engineering</b>
	<b>Desirable</b>	<b>Masters in highway engineering/ Transportation Engineering</b>
<b>ii)</b>	<b>Experience</b>	
	a)Total Professional Experience	Min. 15 years
	b) Experience in Highway projects	Minimum 10 years experience in pavement design and maintenance of highways
	c) Experience in similar capacity	Pavement design for major highway projects (2/4/6 lane NH/SH/ Expressways) of minimum aggregate length of 80 km.
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of Proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL*****Sr Bridge Engineer***

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate in Civil Engineering or equivalent
	<b>Desirable</b>	<b>Masters in Bridge Engineering / Structural Engineering</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a)Total Professional Experience	Min. 15 years
	b) Experience in Bridge projects	Min. 10 years in project preparation and design of bridge projects.
	c) Experience in similar capacity	Bridge Engineer in highway design consultancy projects (2/4/6 lane NH/SH/ Expressways) involving design of minimum two major bridges (length more than 200 m)
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of Proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL*****Traffic and Safety Expert***

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate in Civil Engineering
	<b>Desirable</b>	<b>Masters in Traffic Engineering / Transportation Engineering / Transport Planning</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a) Total Professional Experience	Min. 10 years
	b) Experience in Highway projects	Min. 5 years on similar projects.
	c) Experience in similar capacity	Traffic Engineer in highway Projects (NH/SH/Expressways) involving 2/4/6 laning of minimum aggregate length of 80 km.
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of Proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL*****Material Engineer – cum – Geotechnical Engineer cum Geologist***

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate in Civil Engineering or M.Sc. Geology
	<b>Desirable</b>	<b>Masters in Foundation Engineering / Soil Mechanics / Phd in Geology /Geo Tech Engineering</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a) Total Professional Experience	<b>Min. 15 years</b>
	b) Experience in Highway Projects	<b>Min. 8 years on similar projects in design and/or construction</b>
	c) Experience in similar capacity	<b>Material cum Geo-technical Engineer on Highway projects (2/4/6 lane NH/SH/ Expressways) of minimum aggregate length of 80 km.</b>
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of Proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL***Senior Survey Engineer*

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate or equivalent in Civil Engineering or Diploma in Civil Engg or Diploma in Surveying
	<b>Desirable</b>	<b>Masters in Survey Engineering/ Surveying /Remote Sensing</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a) Total Professional Experience	Min. 15 years
	b) Experience in Highway projects	Min. 5 years on similar projects in project preparation and construction & thorough understanding of modern computer based methods of surveying
	c) Experience in similar capacity	Survey Engineer for projects preparation of highway project (NH/SH/Expressways) involving 2/4/6- laning of minimum aggregate length of 80 km.
<b>iii)</b>	<b>Age Limit</b>	<b>65 years on the date of submission of Proposal</b>

**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL***Environmental Specialist*

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	Graduate in Civil Engineering / Environment Engineering / Masters in Environment Science
	<b>Desirable</b>	<b>Post Graduate in Environmental Engineering</b>
<b>ii)</b>	<b>Essential Experience</b>	
	a) Total Professional Experience	<b>Min. 10 years</b>
	b) Experience in Highway Projects	Min. 5 years in environment impact assessment of highway projects (2/4/6 laning)
	c) Experience in similar capacity	Environmental Specialist in at least two highway projects (2/4/6 laning)
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of proposal</b>



**QUALIFICATION AND EXPERIENCE REQUIREMENT OF KEY PERSONNEL***Quantity Surveyor/Documentation Expert*

<b>i)</b>	<b>Educational Qualification</b>	
	Essential	<b>Graduate or equivalent in Civil Engineering / Certificate course from 'Institution of Quantity Surveying'</b>
	Desirable	
<b>ii)</b>	<b>Essential Experience</b>	
	a) Total Professional Experience	<b>Min. 15 years</b>
	b) Experience in Highway Projects	<b>Min. 5 years in Preparation of Bill of Quantities, Contract documents and documentation for major highway projects involving two/ four laning</b>
	c) Experience in similar capacity	<b>Quantity Surveyor / Documentation Expert in highway projects (NH/SH/Expressways) involving two/four/six laning of minimum aggregate length of 80 km.</b>
<b>iii)</b>	<b>Age Limit</b>	<b>70 years on the date of submission of proposal</b>

## Schedule for submission of Reports and Documents

Stage No.	Activity	No. of copies	Time Period in days from date of commencement
1	<b>Monthly Reports</b>	3	by 10 <sup>th</sup> day of every month
2	<b>Inception Report</b>		
	(i) Draft Inception Report including QAP document	3	21
	(ii) Inception Report including QAP document	3	30
3	<b>F.S. REPORT</b>		
	i) Draft Feasibility Study Report including option study report	4	75
	ii) Comments of client	1	90
	iii) Final Feasibility Study Report incorporating compliance of comments of Client.	4	<b>105</b>
4	<b>LA &amp; Clearances I Report</b>		
	i) Draft LA & Clearances I Report	4	90
	ii) Comments of client	1	<b>105</b>
	iii) Final LA & Clearances I Report incorporating compliance of comments of Client	4	120
5	<b>Detailed Project Report</b>		
	i) Draft DPR	4	<b>165</b>
	ii) Comments of client	1	195
	iii) Final DPR incorporating compliance of comments of Client	6	<b>210</b>
6	<b>Technical Schedules</b>		

	i) Draft Technical Schedules	4	<b>135</b>
	ii) Comments of client	1	<b>150</b>
	iii) Final technical schedule	6	<b>165</b>
<b>7</b>	<b>LA &amp; Clearances II Report</b>  <b>Approval of Project clearances</b> from concerned agencies e.g. from MOEF; Rly for approval of GAD and detail engineering drawing of ROB/RUB; Irrigation Dept.,  Land Acquisitions: 3(a), 3(A), 3(D) Notifications	6  Original letters from the concerned agencies and 5 photocopies of each.  3 copies each	<b>240</b>

