

## E EXECUTIVE SUMMARY

### E.0 BACKGROUND

Manipur is one of the eight North Eastern States in India. The geographical area of the state 22,327 sq km constitutes less than 0.70% of the entire country. It lies between latitude of 23°83'N – 25°68'N and longitude of 93°03'E – 94°78'E. The State capital, Imphal is located at an elevation of 790 m above mean sea level. Geographically the state is bounded on all sides by ranges of hills and particularly land locked.

### E.1 THE PROJECT

The Project Road starts in Imphal city, first 10 km section has already been undertaken by MORTH for upgrading to 4 lane carriageway and 6 km from start is already upgraded and remaining 4 km section has been sanctioned for upgradation to 4-lane and is in advance stage of Implementation. The project start has been considered beyond the first 10 km at km 330+000. The project concerns upgrading about 95.411 kilometers of existing National Highway 39 in the State of Manipur. The project corridor starts from Lilong village at its Km 330+000 and ends at Moreh (Myanmar Border) at its km 425+411. The road runs through plain terrain upto Pallel (36 kms) and remaining road section passes through hilly/rolling terrain (from Pallel to Moreh). The corridor traverses through agriculturally rich area for first 30 kilometers length but with fair to poor surface condition. In addition to the NH 39 corridor, the study also includes development of state highway route between Wangjing (Km 350+000 on NH 39) to Khudengthabi (Km 417+000 on NH 39), which is an alternate route to NH 39 between Wangjing and Khudengthabi serving the population along the alternate state highway corridor. A map of the project road corridors are given in Figure 1.1 in Chapter 1.

### E.2 CORRIDOR SECTIONS

Considering the nature of traffic, geometric features as observed during the preliminary visits, NH 39 corridor can be divided into four broad sections as given below in Table 1 to describe the project road features.

Table E-1 Project Road Sections – NH39

| Section No.  | Section  | Length (km) |
|--------------|--|-------------|
| 1            | Lilong Village – Thoubal (From Km 330 to Km 342+600) | 12.60       |
| 2            | Thoubal – Pallel (From 342+600 to Km 365+900)        | 23.30       |
| 3            | Pallel – Khudengthabi (From Km 365+900 to Km 417)    | 51.10       |
| 4            | Khudengthabi – Moreh (From Km 417 to Km 425+411)     | 8.411       |
| Total Length |  | 95.411      |

Alternative State Highway Alignment: As part of the project, possible alternative alignments were studied and it is found that there is an alternative alignment existing on western side of the project corridor which starts from Wangjing town and finally merges with the project corridor near Khudengthabi village.

The said alternate alignment takes off from the project corridor from Wangjing town at its km 350+000 and follows the existing Major District Road (MDR) up to Heirolk town. There from the alternative alignment takes right turn and passes adjacent to the Heirolk Military camp on a track for a length of 0.5 kilometers to join the track on hill section. Further the track passes through several villages in hilly terrain and merges with another major district road which connects Tengupoal on NH 39 and Hariyam village where there is a bituminous road for its full length.

### E.3 SOCIO ECONOMIC PROFILE

The total population of Manipur is 2,570,390 as per census of 2011 with 32% living in urban areas. The decadal growth rate of population in Manipur in the last decade is 18.6%. The population density in the state range from 32 to 992 persons per sq. km with a state average of 122 persons per sq. km. The project corridors pass through Thoubal and Chandel districts which have a population density of 818 and 43 persons per sq. km respectively.

The state economy has been growing at an annual growth rate of 5.9% during 2005 to 2012 and per capita income at the rate of 3.9% during the same period in real terms. The state per capita income at current prices in 2011 was Rs.36085. Agriculture is the main stay with 60% of population dependent on that and contributing 27% to net state domestic product. There is large potential in horticulture and sericulture development in the state. The manufacturing sector contribution is minimal in the net state domestic product at 4.3%.

Vehicle growth has been significantly high in the state in the recent past with an overall growth rate of 10% between 2004 and 2011 with cars, two wheelers, trucks and buses growing at 8.6, 10.3, 6.6 and 5.6 percent respectively.

### E.4 BASE YEAR TRAFFIC AND TRAFFIC PROJECTIONS

The base year traffic (AADT) obtained from the traffic surveys at four locations on the project corridor is given below:

Table E-2: Annual Average Daily Traffic (AADT)-Normal Traffic on NH 39

| Section No. | Car/Jeep/Van | Two Wheeler | Three Wheeler | Bus | Goods Vehicles | Total Fast Vehicles | Slow Moving Vehicles | Total PCU |
|-------------|--------------|-------------|---------------|-----|----------------|---------------------|----------------------|-----------|
| 1           | 8829         | 6531        | 5674          | 207 | 772            | 22013               | 413                  | 20012     |
| 2           | 1294         | 771         | 347           | 36  | 241            | 2689                | 249                  | 2746      |
| 3           | 1142         | 16          | 14            | 3   | 151            | 1326                | 0                    | 1470      |
| 4           | 1201         | 1584        | 1714          | 4   | 179            | 4682                | 89                   | 4125      |

The traffic level is high in the first section and is moderate in the remaining sections. No traffic survey was carried out on the alternate state route as most of the route is not motorable at present.

In the absence of historical traffic data on the project corridor, the vehicle registration growth in the project influence area and economic parameters such as net state domestic product, per capita income and population were analysed to estimate vehicle growth elasticity in relation to these parameters and was adopted for traffic projection. The traffic growth rates adopted for traffic projection is given in Table 3.

**TableE-3: Summary of Recommended Growth Rates for Project Road**

| Vehicle Type | 2013-18 | 2018-23 | 2023-28 | 2028-33 | 2033-38 |
|--------------|---------|---------|---------|---------|---------|
| Car/Van/Jeep | 7.2     | 6.4     | 5.8     | 5.0     | 4.0     |
| 2 Wheeler    | 9.0     | 8.0     | 6.5     | 5.6     | 4.0     |
| 3 Wheeler    | 6.5     | 5.8     | 5.2     | 4.5     | 3.6     |
| Bus          | 5.0     | 4.3     | 4.0     | 3.4     | 3.4     |
| All Trucks   | 5.5     | 5.0     | 4.5     | 4.0     | 3.5     |
| LCV          | 6.1     | 5.5     | 5.0     | 4.4     | 3.9     |

The opening up of trade opportunities with Myanmar and the south east Asian countries through Myanmar has a lot of potential for trade through Moreh as it is the main land route between India and Myanmar. The trade potential assessed based on various available studies and projections were used to assess the traffic potential in the coming years along the project corridor as described in Chapter 6. For the traffic estimation a total of 800 trucks per day (import and export together) and an induced passenger traffic of 865 passenger vehicles is considered by 2022 and considering the trade growth projections in the long term, this traffic is anticipated to grow at 8% per annum for the first 10 years from 2022 and 6% per annum for the following 10 years. The traffic projection summary at 5 years interval for each section of NH 39 corridor (unconstrained) is given in Table 4.

**Table E-4: Year wise AADT Projections for NH 39 Sections in PCU**

|      | Section 1 | Section 2 | Section 3 | Section 4 |
|------|-----------|-----------|-----------|-----------|
| 2013 | 20012     | 2746      | 1470      | 4125      |
| 2018 | 31812     | 5253      | 2928      | 7182      |
| 2023 | 45898     | 9656      | 6061      | 12213     |
| 2028 | 60599     | 12910     | 8259      | 16186     |
| 2033 | 70550     | 15823     | 10286     | 19327     |
| 2038 | 78894     | 18638     | 12273     | 22202     |

**Traffic Estimate for alternate State Highway Route:** This route is a track for most of its length and is currently not motorable during rainy season and rest of the year most of its length being track is used by only four wheel drive vehicles. Once the road is developed, it is expected to carry traffic similar to other roads with the population and activity along the road corridor. The population of the villages along

the road corridor is about 18,553 as of 2011 census. The project corridor is estimated to have a population of 28,000. The trip generation per capita (passenger vehicle km) was worked out for each passenger vehicle type from the state vehicle registration data, average annual vehicle km and occupancy. Using this per capita trip generation and population, likely passenger vehicle volumes are calculated. In case of goods vehicle, both this approach and based on consumption expenditure, average value of goods, population and per capita income, goods vehicle trip generation was estimated. The traffic on alternate route thus estimated for opening year (Chapter 6) is given in Table 5. The AADT in PCU in opening year is 933 which grows to a PCU of 2250 over the 20 year design period.

Table E-5: Projected Traffic along the State Highway Alignment in Opening Year

| Vehicle category | Traffic estimated to realize in the opening year (2018) |
|------------------|---|
| Car/Jeep/Van     | 572   |
| Two Wheeler      | 181   |
| Three Wheeler    | 42  |
| Bus              | 25  |
| LCV              | 48  |
| Trucks           | 17  |

## E.5 ENGINEERING SURVEYS AND INVESTIGATIONS

The pavement condition survey indicate that only 24% of road length is in good condition, 45% in fair and 31% of length in poor condition. Broad variation in pavement thickness was observed along the project road. However the pavement composition of the existing pavement is generally same composed of bituminous layers, WMM or WBM base and Sub-base. The Bituminous layer varies from 40 mm to 180 mm: Base course varies from 80 mm to 470 mm and sub-base varies from 130 mm to 390 mm. From the pavement composition it is clear that there is no uniform drainage layer in plain/low laying areas.

The laboratory investigations of subgrade indicate that the existing subgrade varies and generally consists of SM, SC, MH, MI and ML soil types along the road. The soaked CBR values of existing subgrade varies from 2.45% to 14.95% at 97% of MDD. The average CBR for four homogenous sections are in the order of 3.6, 3.1, 9.4 and 6.4 respectively.

There are 3 major bridges, 12 minor bridges, 1 pedestrian underpass, 118 box/slab culverts and 192 pipe culverts on the NH 39 corridor. The condition assessment indicate the 3 major bridges, 10 minor bridges, 1 pedestrian underpass can be retained and rest needs reconstruction. Along the alternative state highway Route from Wangjing to Khudengthabi passes through the mountain ridge from Heirok to Khudengthabe and there are requirement of 5 minor bridges and some cross drainage structures. There are 19 pipe culverts and 4 slab culverts on this section which are all in bad condition and all are recommended for reconstruction.

## E. 6 ENGINEERING ALTERNATIVES AND PAVEMENT DESIGN

The improvement proposals for the different road sections recommended is given below:

**Table E-6: Recommendation for Lane Configuration**

| Sl.No | Homogenous Section Details  | Recommendation on Capacity Augmentation                           |
|-------|---|---|
| 1     | HS 1: Lilong to Thoubal (km 330 to km 342+600) on NH 39                                   | 4 Lane with Paved shoulder and service road on built up location. |
| 2     | HS 2: Thoubal to Pallel (km 342+600 to km 365+900) on NH 39                               | 2 Lane with paved shoulder and service road on built up location. |
| 3     | HS 3: Pallel to Khudangthabi (365+900 to km 417) on NH 39                                 | 2 Lane with Paved shoulder.                                       |
| 4     | HS 4: Khudangthabi to Moreh (km 417 to km 425+411) on NH 39                               | 2 Lane with Paved shoulder.                                       |
| 5.    | Alternative state highway Alignment from Wangjing to Khudangthabi (km 0+000 to km 58+506) | Two Lane Configuration  |

The projected cumulative standard axles on the NH 39 sections for a 20 year design period range from 5.87 to 19.3 CMSA. For pavement design minimum design traffic of 25 CMSA for Lilong to Pallel (HS 1& HS 2) and 20 CMSA from Pallel to Morehare recommended. For the alternativestate highway alignment minimum design traffic of 10 CMSA is recommended. Based on the pavement condition and the need to provide embankment heights as per standards and raising at sections with overtopping situation, the NH 39 project road section from km 330+000 to km 425+411 is recommended for reconstruction.

**TableE-7: New/Widening Pavement Thickness**

| Design MSA | Road Sections with 20 year Design Life              | CBR (%) | BC | WMM | CTB | CTSB |
|------------|---|---------|----|-----|-----|------|
| 25         | Lilong to Thoubal                                   | 7       | 50 | 100 | 115 | 250  |
| 20         | Thoubal to Pallel                                   | 7       | 50 | 100 | 115 | 250  |
| 20         | Pallel to Khudengthabi                              | 10      | 50 | 100 | 90  | 250  |
| 20         | Khudengthabi to Moreh                               | 10      | 50 | 100 | 90  | 250  |
| 10         | Alternative alignment from Wangjing to Khudengthabi | 10      | 40 | 100 | 80  | 250  |

### Major Bridges:

(1) Lilong Bridge at Km 330+150 is PSC I-girder type superstructure with well foundations. Condition survey shows that this bridge is of structurally sound and hydraulically functioning good. The bridge also meet the carriageway requirement of 2lane improvement even though the total width of the bridge is less than that required. Considering these parameters, this bridge is proposed to be retained with minor repair and rehabilitation.

(2) Trouble bridge, at Km 341+780, is PSC I-girder type superstructure with well foundations. Condition survey shows that this bridge is of structurally sound and hydraulically functioning good. This bridge also meet the carriageway requirement of 2lane improvement even though the total width of the bridge is less than that required. Considering these parameters, this bridge is proposed to be retained with minor repair and rehabilitation

(3) Pallel Bridge at Km 365+500- A new 2 lane bridge is under construction along the realignment of the existing road. During inventory it is observed that super structure casting is in progress..

#### Minor Bridges:

Minor bridges at Km 334+330,347+600, 348+150,349+900,352+800 are RCC solid slab type and minor bridges at Km 336+100, 344+240 are RCC T girder bridges. These bridges fall in 4 lane improvement stretch of the project corridor. Condition survey shows that these bridges are of structurally sound and hydraulically functioning well except the bridges at Km 336+100 and 348+150 are structurally distressed hence these can be reconstructed. Remaining bridges are structurally sound, hence these can be widened to 12.0m and a new 2 lane bridge is proposed parallel to the existing bridge.

Minor bridges at Km409+000 and 412+230are solid slab bridges which fall in 2 lane improvement with paved shoulder. These bridges are structurally sound so they are widened to 12.9m concentrically. (Refer Annex 7.1)

Bridge at chainage 407+450 is stone abutment with foundation on rock with bailey super structure; Separate DPR had been submitted for this bridge and construction is being taken up and is therefore not in the scope of the present study and project.

Bridge at Km 428+150 is RCCgirder bridgeand is structurally sound and comes in 2 lane improvement of the project and as it is meeting the 2 lane carriage way width, it is retained. Bridge at Km425+411 is across Menarriver with RCC abutment with bailey type super structure is on the international border and hence not included in the scope of the project.

#### Vehicular and Pedestrian Underpasses:

There is one PUP in the approach of Thoubal Bridge, which is structurally sound and is proposed to be widened to meet the requirement for the improvement to 4 lanes. Three new VUPs are proposed along the project road, chainages and the span arrangements are given below.

Table E-8: Details of New VUP on Existing Road

| Sl. No | Design chainage | Proposed span (m) | Type of structure | Road Crossing | Structure Type |
|--------|-----------------|-------------------|-------------------|---------------|----------------|
| 1      | 341+825         | 1x5.5x2.5         | RCC Box           | 2 lane        | PUP            |

|   |         |              |         |        |     |
|---|---------|--------------|---------|--------|-----|
| 2 | 342+450 | 1x20.0 x 5.5 | RCC Box | 4 lane | VUP |
| 3 | 360+050 | 1x20.0 x 5.5 | RCC Box | 2 lane | VUP |

Culverts:

Summary of improvement proposal for pipe and box culverts along the project road for mail alignment and alternate route are given in Tables below:

TableE-9: Summary of Culvert improvement proposal on NH 39

| Culvert Type          | Existing | Retained | Reconstruction |
|-----------------------|----------|----------|----------------|
| Pipe Culverts         | 192      | 0        | 192            |
| SLAB/BOX/ARCH culvert | 118      | 0        | 118            |

TableE-10: Summary of Culvert proposal in Alternate State Highway Alignment

| Culvert Type          | Existing | Retained | Reconstruction | New and Reconstruction |
|-----------------------|----------|----------|----------------|------------------------|
| Pipe Culverts         | -        | 0        | -              | 140                    |
| SLAB/BOX/ARCH culvert | -        | 0        | -              | 40                     |

**E. 7 COST ESTIMATES**

Cost estimates were prepared for 2 lane sections and four lane sections separately and separate cost estimate has been prepared for alternative route and the summary is given below:

Table E-11: Cost Estimates for NH 39 Sections

| Bill. No. | Description   | Km 330+000 to Km 342+930 | Km 342+930 to Km 425+411 | Km 330+000 to Km 425+411 |
|-----------|---|--------------------------|--------------------------|--------------------------|
|           |   | 4Lane Portion            | 2Lane Portion            | Total Project Cost       |
| 1         | SITE CLEARANCE AND DISMANTLING                        | 20,766,662               | 35,596,587               | 56,363,249               |
| 2         | EARTHWORK   | 118,695,75               | 1,706,538,639            | 1,825,234,384            |
| 3         | GRANULAR SUB-BASE AND BASE COURSE                     | 242,323,401              | 1,050,995,838            | 1,293,319,239            |
| 4         | BITUMINOUS COURSE                                     | 305,753,888              | 865,304,877              | 1,171,058,765            |
| 5         | CULVERTS  | 104,822,099              | 400,784,904              | 505,607,003              |
| 6         | BRIDGES (Underpasses, Vaiduct, Minor & Major Bridges) | 438,623,086              | 214,184,009              | 652,807,095              |
| 7         | JUNCTIONS, TOLL PLAZA                                 | 168,379,055              | 57,664,265               | 226,043,320              |
| 8         | DRAINAGE AND PROTECTIVE WORKS                         | 415,672,608              | 532,391,608              | 948,064,216              |
| 9         | TRAFFIC SIGN, MARKING & OTHER APPURENANCES            | 47,675,228               | 74,349,944               | 122,025,172              |
| 10        | MISCELLANEOUS   | 15,094,727               | 216,351,560              | 231,446,287              |
| 11        | MAINTENANCE , REPAIRS & REHABILITATION                | 21,931,154               | 10,709,200               | 32,640,355               |



|    |  |                      |                      |                      |
|----|--|----------------------|----------------------|----------------------|
| 12 | ELECTRICAL ITEMS   | 38,625,000           | 22,700,000           | <b>61,325,000</b>    |
|    |  |                      |                      |                      |
|    | <b>Total(Civil Cost)2015-2016=</b>   | <b>1,938,362,653</b> | <b>5,187,571,431</b> | <b>7,125,934,084</b> |
|    |  |                      |                      |                      |
|    | <b>Cost per KM (INR Crores/Km) =</b>   | <b>14.99</b>         | <b>6.29</b>          | <b>7.47</b>          |
|    | Labour Welfare Cess at 1%  | 19,383,627           | 51,875,714           | 71,259,341           |
|    | Add physical contingency at 2.8%   | 54,274,154           | 145,252,000          | 199,526,154          |
|    | Agency Charges at 3%   | 58,150,880           | 155,627,143          | 213,778,023          |
|    | Quality Control at 0.25%   | 4,845,907            | 12,968,929           | 17,814,835           |
|    | Road Safety at 0.25%   | 4,845,907            | 12,968,929           | 17,814,835           |
|    | Supervision at 3%  | 58,150,880           | 155,627,143          | 213,778,023          |
|    | Price escalation @ 5% per annum (3 year construction with 30:40:30 disbursement at a total of 10%) | 193,836,265          | 518,757,143          | 712,593,408          |
|    | Utility shifting (Provisional sum)   |                      |                      |                      |
|    | EMP and Environmental Monitoring   |                      |                      |                      |
|    | Land Acquisition and Resettlement  |                      |                      |                      |
|    |  |                      |                      |                      |
|    | <b>Total Project Cost (2015)</b>   | <b>2,331,850,272</b> | <b>6,240,648,432</b> | <b>8,572,498,703</b> |
|    | <b>Total Project Cost (2015) in Rs. Crores</b>   | <b>233.19</b>        | <b>624.06</b>        | <b>857.25</b>        |
|    | <b>Length (Km)</b>   | <b>12.93</b>         | <b>82.48</b>         | <b>95.411</b>        |
|    | <b>Cost per KM (INR Crores/Km )</b>  | <b>18.03</b>         | <b>7.57</b>          | <b>8.98</b>          |
|    |  |                      |                      |                      |
|    | Total Project Cost in USD @ INR 58/USD   | 40,204,315           | 107,597,387          | 147,801,702          |
|    | Cost per KM (USD Million/km)   | 3.11                 | 1.30                 | 1.55                 |

Table E-12: Cost Estimates for Alternative State Highway Route

| Sl. No. | Description  | Km 0+000 to Km 58+506 |
|---------|--|-----------------------|
|         |  | Project Cost          |
| 1       | <b>SITE CLEARANCE AND DISMANTLING</b>                            | <b>35,744,749</b>     |
| 2       | <b>EARTHWORK</b>   | <b>1,616,734,559</b>  |
| 3       | <b>GRANULAR SUB-BASE AND BASE COURSE</b>                         | <b>516,916,030</b>    |
| 4       | <b>BITUMINOUS COURSE</b>   | <b>571,335,245</b>    |
| 5       | <b>CULVERTS</b>  | <b>216,067,090</b>    |
| 6       | <b>BRIDGES (Underpasses, Vaiduct, Minor &amp; Major Bridges)</b> | <b>223,600,522</b>    |
| 7       | <b>JUNCTIONS, TOLL PLAZA</b>                                     | <b>98,936,545</b>     |
| 8       | <b>DRAINAGE AND PROTECTIVE WORKS</b>                             | <b>943,655,103</b>    |
| 9       | <b>TRAFFIC SIGN, MARKING &amp; OTHER APPURENANCES</b>            | <b>82,382,350</b>     |
| 10      | <b>MISCELLANEOUS</b>   | <b>195,895,584</b>    |
| 11      | <b>MAINTENANCE , REPAIRS &amp; REHABILITATION</b>                | <b>-</b>              |
| 12      | <b>ELECTRICAL ITEMS</b>  | <b>33,090,000</b>     |
|         |  |                       |
|         | <b>Total(Civil Cost)2015-2016=</b>                               | <b>4,534,357,776</b>  |
|         |  |                       |
|         | <b>Cost per KM (INR Crores/Km) =</b>                             | <b>7.64</b>           |
|         | Labour Welfare Cessar 1%   | 45,343,578            |
|         | Add physical contingency at 2.8%                                 | 126,962,018           |



|  |  |                      |
|--|--|----------------------|
|  | Agency Charges at 3%   | 136,030,733          |
|  | Quality Control at 0.25%   | 11,335,894           |
|  | Road Safety at 0.25%   | 11,335,894           |
|  | Supervision at 3%  | 136,030,733          |
|  | Price escalation @ 5% per annum (3 year construction with 30:40:30 disbursement at a total of 10%) | 453,435,778          |
|  | Utility shifting (Provisional sum)   |                      |
|  | EMP and Environmental Monitoring   |                      |
|  | Land Acquisition and Resettlement  |                      |
|  |  |                      |
|  | <b>Total Project Cost (2015)</b>   | <b>5,454,832,405</b> |
|  | <b>Total Project Cost (2015) in Rs. Crores</b>   | <b>545.48</b>        |
|  | <b>Length (Km)</b>   | <b>59.359</b>        |
|  | <b>Cost per KM (INR Crores/Km )</b>  | <b>9.19</b>          |
|  |  |                      |
|  | Total Project Cost in USD @ INR 58/USD   | 94,048,835           |
|  | Cost per KM (USD Million/km)   | 1.58                 |

## E. 8 ECONOMIC ANALYSIS

An economic analysis has been carried out for the project road sections. On the benefit side, vehicle operating cost savings and travel time savings are quantified and included in case of NH 39. In case of villages along the Alternative State Highway Route, it provides a shorter direct route along the main travel corridor and based on the road network access in the area it is assessed that upto 10% reduction in travel distance can be realized and a 5% reduction in distance is considered in the analysis.

The results of economic analysis using HDM-4 model for the project road are summarized in Table xx. The results indicate that the project development option have a rate of return well above the opportunity cost of 12%.

**Table E-13 Results of Economic Analysis**

| Description of Option        | EIRR (%) | NPV (INR Million) |
|------------------------------|----------|-------------------|
| Imphal – Moreh Section       | 17.0     | 3161.58           |
| Additional Alternative Route | 13.0     | 232.45            |

*Note: EIRR – Economic Internal Rate of Return; NPV – Net Present Value*

Sensitivity analyses were also carried out to investigate the robustness of the economic viability of the project to cost over-runs and benefit reductions. The cases analysed are (1) Case I-Base Cost and Base Benefits, (2) Case II - Increase in Capital Costs by 15 % and Base Benefits, (3) Case III -Base Cost and Decrease Benefits by 15 % and, Case IV -Increase Capital Costs by 15 % & Decrease Benefits by 15 %.

The results of the sensitivity analyses for the road corridors are given in Table 9.8. As shown, either with an increase in capital costs by 15 percent or a reduction in benefits by 15%, both project corridors still has an EIRR of above 12 percent but with a combination of both an increase in cost and decrease in benefits of the

magnitude of 15% will result in EIRR falling marginally below 12%. Considering the larger trade related economic impact for the north eastern region in case of Imphal-Moreh section and the project area economic development with new access in case of Alternate Route which are not captured in the economic analysis, the acceptable EIRR threshold could be lowered to 10% and even in the worst case scenario, EIRR is above 10% and therefore the project is considered economically viable. Based on the economic analysis of the project options, as well as on the engineering and traffic assessment, the proposed project is recommended for implementation.

Table E-14. Sensitivity Analysis Results

| Sensitivity | Imphal – Moreh Section |         | Additional Alternative Route |          |
|-------------|------------------------|---------|------------------------------|----------|
|             | EIRR                   | NPV     | EIRR                         | NPV      |
| Case I      | 17.0                   | 3161.58 | 13.0                         | 232.45   |
| Case II     | 17.0                   | 3959.76 | 13.0                         | 449.43   |
| Case III    | 17.0                   | 2926.78 | 13.0                         | 332.19   |
| Case IV     | 14.0                   | 1246.76 | 10.0                         | (739.97) |