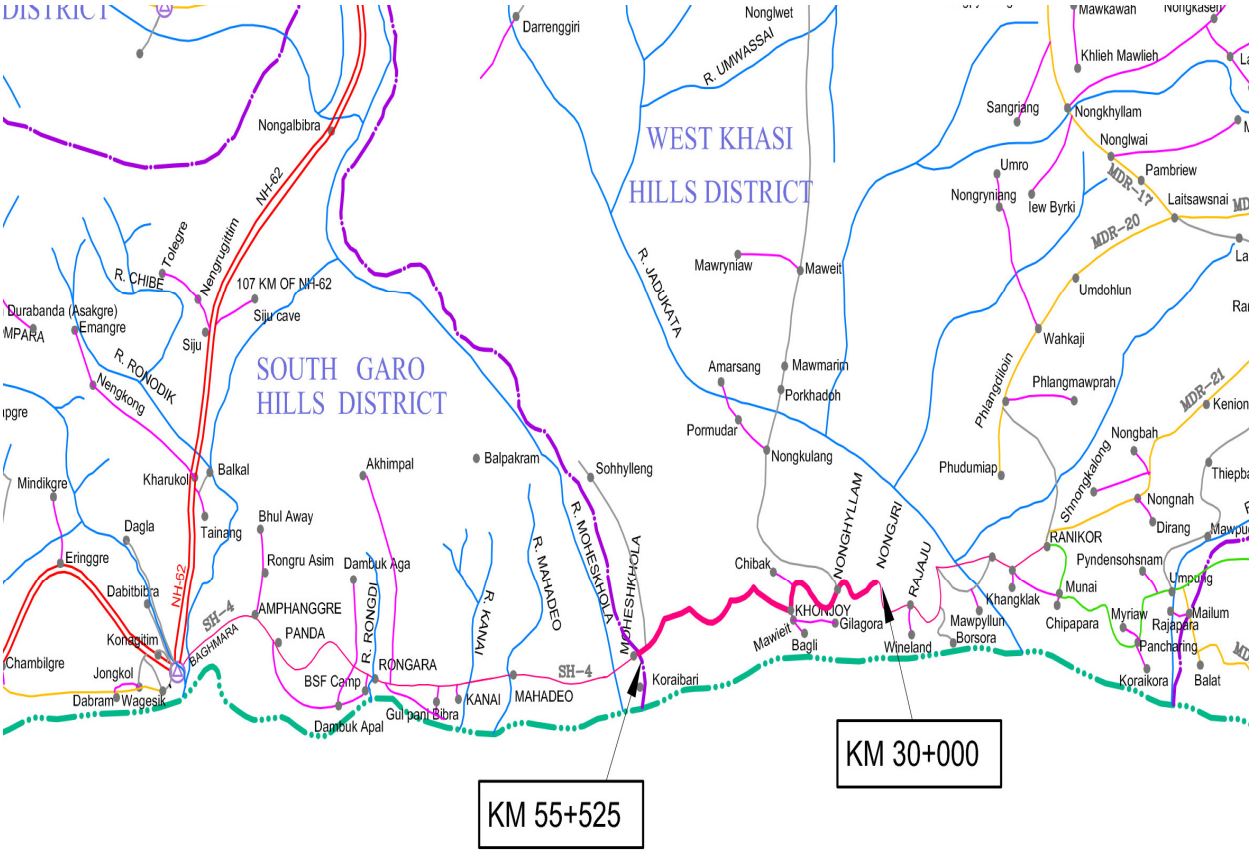
NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

Consultancy Services for Preparation of Detailed Project Report for Development of Nongjri-Maheshkhola- road from Km 31+700 to Km 59+270 (Design Chainage – From Km30+000 to Km 55+525) in Meghalaya to 2-Lane Standards



DETAILED PROJECT REPORT

Nongjri (Km 30+000) – Maheshkhola (Km 55+525)

Volume I: Main Report

HOLTEC CONSULTING PVT. LTD.

Holtec Centre, A Block, Sushant Lok
Gurgaon 122001, Haryana, India
Phone: + 91-124-2385095, 2385096
Fax: + 91-124-2385114, 2385116*
www.holtecnet.com

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Executive Summary

CHAPTER-1

EXECUTIVE SUMMARY

BACKGROUND

Transport plays a vital role in the economic and social development of a country. The demand for inter-city freight transport in India is expected to double every 12 years while the demand for passenger transport is expected to double every eight or nine years. Since 1950, the system of State Highways has expanded over eight-fold. This rapid expansion of road network was made possible through speedy access to available resources for construction of single or intermediate lane state and district roads, with thin and structurally deficient pavements. As a result the arterial road system has become grossly congested with poor pavement condition. We are faced with many capacity related problems as traffic on arterial routes is growing at 10-12% per annum. With such high growth of traffic, congestion becomes inevitable and loss due to accidents also increases. Additional capacity has to be created by widening the roads to multi-lane standards and/or by strengthening the existing pavement crust. The Government of India aims at improving and developing the road infrastructure of the Ranikor-Nonghyllam-Maheshkhola-Baghmara Road in the State of Meghalaya, Government of India.

Ranikor-Nonhyllam-Maheshkhola-Baghmara Road is important State Highway passing in Meghalaya and providing connectivity Ranikor to Baghmara. Portion of Ranikor-Nonhyllam-Maheshkhola-Baghmara passes through the towns and the habited areas. With the fast development of the State, the land-use has added tremendous problems to the movement of traffic – passenger as well as freight services. Existing facility needs to be augmented to 2-Lane for fast movement of the traffic and ease and comfort to the commuters.

The Govt of India and in Govt of Meghalaya,(Public Works Department, Meghalaya) has decided to take up the development of the existing Ranikor-Nonhyllam-Maheshkhola-Baghmara Road for(Km 139) to 2-lane State Highway standards.

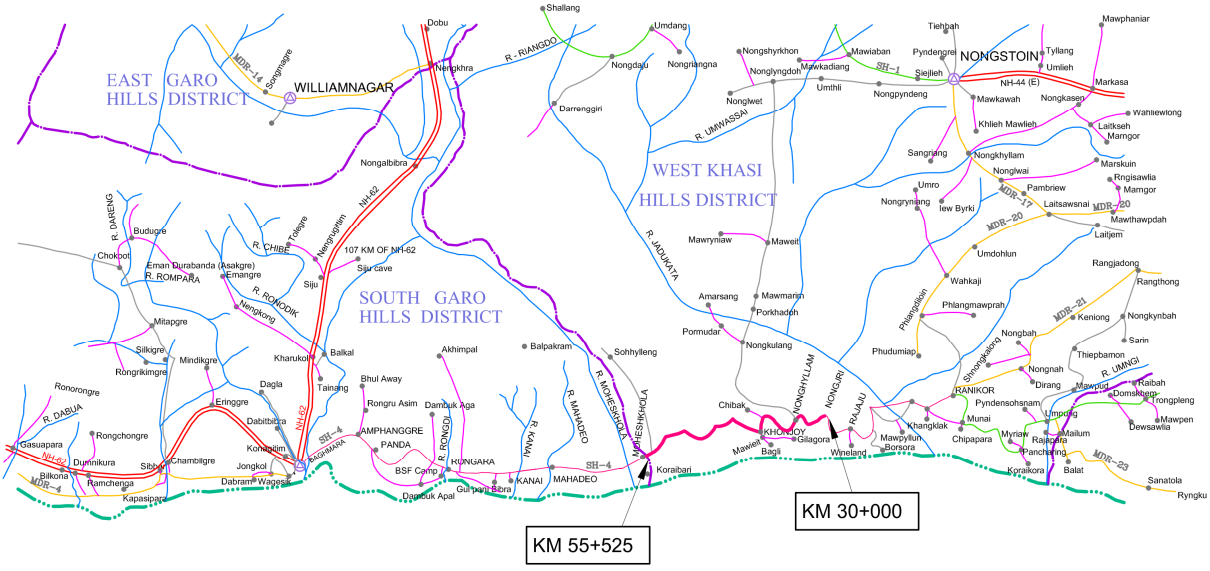
The Government of Meghalaya,Public Works Department, Meghalaya Government of India called for consultancy assignment for preparation of Detailed Project Report which should expressively give all the requirements for development of the project and its facilities as well as to assess the financial requirements in a clear and practicable manner. The consultancy assignment has been awarded to Holtec Consulting Private Limited, Gurgaon for preparation of Detailed Project Report for upgradation of the project Highway.

Salient Features of the Consultancy Assignment

• Name of the Project	Preparation of Detailed Project Report for Development of Ranikor – Nonghyllam – Maheshkhola – Baghmara road from 0 to 139 in Meghalaya to 2-Lane Standards.
• Name of Employer	Chief Engineer, Ministry of Road Transport and Highways and Chief Engineer (NH), Public Works Department, Meghalaya
• Name of Consultant	Holtec Consulting Private Limited, Gurgaon, Haryana
• Contract Award	Agreement dated. 18 February 2010
• Consultant's Services	Preparation of Detailed Project Report

Project Road

The Project Road for the development is shown in the fig below



The existing road, Km 31+700 (Design Chainage – 30+000) to Km 59+270 (Design Chainage – 55+525), starts at Village Nongjri and terminates at Maheshkhola. It passes through villages, Built-up areas as well as forest areas.

- **Start Point** :
  - Nongjri
  - Km of Project Road 31.700(Survey Chainage)/30.00 (Design Chainage)
- **End Point**
  - Maheshkhola
  - Km of 59.270 (Survey Chainage) / 55.525 (Design Chainage)
- **Length Of Project Road**
  - Length as per existing chainage is 27.570 Km
  - Length as per Design chainage is 25.525 Km
  - Road features of this report are based on the design chainages
  - Survey and Investigation data is based on existing chainages
- **Project Influence Area**
  - Project Road: SH 4 (from km 30 to 55.525)
  - SH 4 : South direction and across Meghalaya
- **Major Roads Connectivity:**
  - Shillong Road
  - Borsora Town
  - Nong Kulang Town
  - Tura – Dhudhnoi road
- **Major Intersections / Junction Points**
  - Junction of SH 4 at Starting of the project road with the road to Shillong Km 0.00

- Junction of SH 4 with road to Borsora at Km 18.300
- Junction of SH 4 with road to Nong Kulang at Km 27.760

- **Towns and Villages**

The Project Road connects the following villages and towns:

Sn.	Name of Habitation	Location (Km) (Designed Chainage
		From
1	Khonjoy	37.660
2	Maheshkhola	55.500

- **Terrain**

  - Hilly and steep mountainous terrain

- **Land Use**

  - Passes through hill forest area with some villages / towns en-route

Meteorological Features

The region experiences heavy rainfall.

The area is windy.

Weather experiences low temperature.

Road Geometrics

The elements of road geometrics of this road are poor.

It has sharp curves which need improvement.

It has number of stretches with steep gradients which require short re-alignment and/or relocation.

Rivers En route

The Project Road crosses many Streams / Rivers en-route. There are 13 major stream crossings (Major / Minor Bridges)

Condition of Existing Road

- Road width is of single lane standard
- Condition of the Road Pavement is Poor.
- Shoulders have been damaged or mostly washed away
- Retaining walls are in satisfactory condition but may get damaged during widening operation
- Breast walls will be relocated due to widening
- Drainage is unsatisfactory Road side drains are damaged, blocked, filed with debris, non-existing, etc
- CD structures are mostly choked or blocked (fully or partially)

- Many culverts are found to be having inadequate waterway.
- There are no major slide and sinking areas :
- Road safety structures are inadequate
- Road marking non-existing
- Sign boards are in inadequate number
- Crash barriers not existing
- Parapet walls are damaged

Alignment of Existing Road

Project road in general, follows the natural line of communication.

It provides connectivity to regional villages/towns.

The geometric standard of the project road is poor.

Horizontal alignment has curves which need improvement to bring to the National Highway Standard.

The vertical gradient is by and large within the specified standard. Some portions require regrading.

DESIGN PACKAGES

With the approval of PWD, Meghalaya, the Road Project is divided into six packages as shown in the table below:

Package	Design Chainage		Length(Km)
	From (Km)	To (Km)	
I	0+000	30+000	33+250
II	**30+000**	**55+525**	**25+525**
III	55+525	79+680	24+155
IV	81+100	96+000	14+763
V	96+000	112+300	16+300
VI	112+300	129+385	17+085
Total(Km)			**131+078**

This report concentrates upon Package-II i.e. from Km 30+000 to Km 55+525.

ALIGNMENT DESIGN

Alignment Plan

The proposed road will follow the existing alignment except the New construction due to Short Realignment / relocation, and curve improvement. The alignment is designed in a manner that the newly constructed structures are integrated in the Alignment Plan.

Alignment Concept Plan

The Concept Plan for development of the project is divided into three distinct parts.

PACKAGE II

	Name of Work	Remarks (Chainage : Km 30.000 to Km 55.525)
1	Widening	7.1 km
2	New-Construction	6.22 km
3	Box-Cut	11.380 km
4	Built-up	0.825 km

Alignment Drawings

The Proposed Road will follow the existing alignment except the following due to up-gradation works:

- New construction due to Short Realignment / relocation and curve improvement
- Strengthening, widening and regarding

ROADWAY DESIGN

2-Lane

- Road is designed for Roadway width of 10.000 m
- Preliminary design is on the basis of the alignment survey. It will be fine tuned based on detailed topographical data and cross-sections.
- Preliminary alignment plans along with road profile of the proposed road are attached in the Volume IV (a) – Drawings: Road Works.
- Preliminary design follows the standards specified in IRC:SP:48 1998.
- Design Speed is : Ruling : 40 Km/hr; Minimum : 30 Km/hr
- The speed and radius of curvature in village / town are modified lowered to avoid heavy cutting, relocation of settlement, environmental and social problems etc.
- Some stretches, particularly the village / towns will be amended to accommodate within the available space.
- Consequent to improvement of geometric some box-cut are incorporated.
- Space / hill face between the realignment closer to existing road, the space or features between the two will be knocked off

Design Categories

Roadway of 10.00 m consists of the following categories:

- Widening of Existing Single Lane Road to Double Lane.
- New construction at short realignment /relocation for geometric improvement.

Road Stretches

The road stretches are given in the Plan and Profile drawings.

Design Factors

The roadway design factors are tabulated below

• Total road width	:	10.000 m
• Earthen Shoulder hill side (including drain)	:	1 x 1.5 m
• Earthen Shoulder Valley side	:	1 x 1.5 m
• Angle of Hill cutting		Average 60°
• Average height of cutting	:	10.0 m
• Soil classification of hill cutting	:	Attached
• ROW	:	24.000 m
• Length	:	25.525 Km

TRAFFIC DESIGN

Homogeneous Sections

Homogenous sections are the sections of the project road having similar traffic and travel characteristics. Major intersections / settlements are also considered as nodes for identification for various homogenous sections. The project road was divided in to three homogeneous sections the details are tabulated below:

Homogenous Sections of the Project Road

Section	Stretch	Approximate Length (Km)
1	SH-4 Km 0.00 – Km 28.315	28.315
2	SH-4 Km 28.315 to Km 56.170	27.855
3	SH-4 Km 56.170 to Km 129.385	73.215

Classified Traffic Volume Count

In order to assess the variation of traffic levels and traffic composition over the week, traffic surveys were conducted continuously for one-week duration. The survey was carried out 24 hrs for one week. The traffic count was carried out at three count station. The details of PCU and CVPD of the count stations are tabulated below:

S. No	Traffic Count Location		PCU	CVPD
	Survey Chainage	Design Chainage		
1	Km 15.310	Km 14.460	590	179
2	Km 39.80	Km 37.660	456	138
3	Km 137.664	Km 129.385	1196	204

Details of PCU in the subject stretch is as per the table below:-

Sl.No.	Type of Vehicle	Average Traffic (UP & DOWN)	Percentage (%)	Equivalency Factor	PCU
1	Two Wheeler	85	30.69	0.5	42.5
2	Three Wheeler	0	0.00	1	0
3	Car/Jeep/Taxi	76	27.44	1	76
4	Mini Bus	0	0.00	1.5	0
5	Bus (full)	4	1.44	3	12
6	Light Commercial Vehicle (LCV)	44	15.88	1.5	66
7	Two Axle Truck	68	24.55	3	204
	Total (1 to 7)	**277**	**100**		400.5
				Say (At 2011)	**400**
				At 2018 (assuming 7.5% growth)	**663**
				Say	**700**

For pavement design the below mentioned factors were also considered

Traffic Growth Rate

Growth rate of 7.5% is adopted.

Traffic Design Life

Traffic Design Life of 15 years is adopted.

Construction Period

Three years of construction period is adopted.

CBR

S. no	Location	CBR value
1	Homogeneous Section I	8 %
2	Homogeneous Section II	8%
3	Homogeneous Section III1	8%

PAVEMENT DESIGN

Based on above factors the pavement design adopted for homogenous sectors is detailed below:

Design Proposal From Km 30 to Km 55.525

For Km 30.000 to Km 55.525 Flexible pavement design comes as under :

BC : 40 mm
WMM : 150 mm
CTSB : 200 mm

Earthen Shoulder : 2 x 1.50 metre

Pavement : in 7m width

Shoulders

- Keeping in view the Traffic Volume and its growth in 15 years, it is proposed to provide Earthen Shoulder 2 x 1.5 m
- Earthen Shoulder on Valley side includes crash barrier, parapet wall, etc.
- Earthen Shoulder on hill side includes road side drain.

Pavement Design

Flexible pavement for 10 MSA and 8% CBR has been proposed.

DESIGN OF CULVERTS

Existing Culverts

- The condition survey of existing culvert was carried out
- CD structures are mostly choked or blocked (fully or partially)
- Many culverts are found to be having inadequate waterway.
- The pipe culverts are constructed of NP-2 class

It is proposed to reconstruct the culverts providing adequate water way, providing inlet and outlet chutes wherever required.

New Culverts

At some locations it is observed that culverts have not been provided at the locations of natural water course. The valley side has been eroded due to non availability of culverts at such locations new culverts have been proposed.

The details are tabulated below:

PACKAGE II

Km 30 to Km 55.525					
S. no	**Type of Culvert**	**Size of Culvert**	**Reconstruction (Nos)**	**New Construction (Nos)**	**Total**
1	**SRHP**				
		1 x 1.0	62	17	**79**
		1 X 1.2	62	26	**88**
2	**DRHP**				
		2 x 1.0	0	2	**2**
3	**RCC Box Culvert**				
		3 x 3	2	2	**4**

Km 30 to Km 55.525					
S. no	**Type of Culvert**	**Size of Culvert**	**Reconstruction (Nos)**	**New Construction (Nos)**	**Total**
		4 x 2	1	0	**1**
		6 x 3	6	1	**7**
	Total		**133**	**48**	**181**

PRELIMINARY STUDY AND DESIGN OF BRIDGES

Summary of Bridges

Sn.	Type of Bridge	Widening	Retention	New Construction	Reconstruction (CL will not shift)	Total No. of Bridges.
1	Minor	0	0	12	0	12
2	Major	0	0	1	0	1
	Total No. of Bridges	0	0	13	0	**13**

Conclusion : Total number of Existing Bridges on the road **Nongjri**(Chainage 30.00 km) – **Maheshkhola**(Chainage 55.525 km) are **13** in numbers. The detail of chainages, Type of bridges, Width, Existing condition and proposal of all the above said bridges have been given in attached list.

Category of Bridges

The Road Sector has higher requirement of Bridges and Drainage structures due to heavy rainfall, foothill location and hills / plain terrain. The bridges are (a) existing bridges (b) bridges recently constructed, (c) bridges with standards and specifications not matching to 2-lane highways, (d) new bridges and (e) rehabilitation of old bridges.

Study

Consultant have carried out our visual examination and evaluation of the data made available by the Client as well as data collected by local enquiry that the design parameter arrived at are appropriate.

Desk Study

We undertook a desk study of available data on topography, rainfall, top soil characteristic, vegetation cover, et., so as to assess hydraulic parameters for all existing and proposed drainage provision.

Condition Survey of Existing Bridges

The details of the condition survey of existing bridges are placed in Volume-I : Main Report - Annexures.

General Study of Bridges

This includes the data based on general enquiry, visual inspection, analysis of available data, and historical background in order to make assessment of hydrological behavior and design

parameters. The hydrological and hydraulic study has been carried out in accordance with IRC Special Publication No. 13 (Guidelines for the design of small bridges and culverts). IRC: 5-1998 (Standard Specification & Code of Practice for Road Bridges, Section 1: General Feature of design), etc.

Details of Proposals

Designed details are placed in Volume-II : Bridges and contain the followings :

- Salient Features
- Typical Photographs
- Hydraulic study
- Preparation of Location Plan
- Preparation of General Arrangement Drawings (GAD)

Based on the above, the parameters have been identified for carrying out the study for aiming at the design parameter of the bridges.

DRAINAGE DESIGN

Inadequate drainage on a hill road causes softening of the sub-grade and renders it too weak to take the load of the moving traffic. Roadside drains are therefore necessary on a hill road.

In the existing road drainage is unsatisfactory road side drains are damaged, blocked, filled with debris, non-existing, etc

Following categories are adopted in the proposal

i) Rectangular RCC Covered Drains (for towns/ villages)
ii) Lined Drains (V-shaped) in open area

The proposed Drains category wise are tabulated below

Package II (Km 30 to Km 55.525)

S.No	Type of Drain	Length In running Km	Remarks
1	Rectangular RCC Covered Drain	0.825 (both sides)	Provided in Built-up town areas
2	V-Shaped Lined Drain	18.129	Provided in soils & soft rock portions

SLOPE PROTECTION WORKS

Requirement

- Hill road is formed mostly by cutting into the hill and thereby disturbing natural stability of slopes
- Water course along the slopes cause erosion affecting road stability
- Soil movement along slope tends to disturb the road formation. All these have to be effectively countered to obtain a stable road by provision of structures to act as retaining, restraining and protective structures
- Safety of traffic also needs structures to be provided on the road
- This is achieved by construction of

- Retaining walls
- Breast walls
- Parapet walls
- Railings
- Edge stones
- Toe walls

- Landslide Area: There is no major Landslide area / Sinking location on this road.

Summary of Slope Protection Works

Package-II : Nongjri to Maheshkhola

S. No	Type of Structure	New Construction (m)
1	**Breast Wall**	
	3.00 m height (R.R)	200
	4.00 m height (R.R)	400
	5.00 m height (R.R)	500
	6.00 m height (R.R)	600
	Total	**1700**
2	**Retaining wall**	
	1.50 m height (R.R)	740
	2.50 m height (R.R)	340
	3.00 m height (R.R)	140
	4.00 m height (R.R)	300
	6.00 m height (R.R)	720
	Total	**2240**

BUS BAYS / STOPS

2 Nos. Bus Bays / Stops have been proposed in Town / Village areas

LAND ACQUISITION PLAN

Land Acquisition is required as per the table below:

Total Land Required	61.26 Ha
Land available	10.62 Ha
Land to be acquired	50.63 Ha

UTILITIES SHIFTING ; RELOCATION

Utility shifting has been done and an approximate estimate of Rs. 2 Crore has been proposed for the same.

TREES CUTTING

Based on physical survey a total of 5500 number of trees are to be cut.

AFFORESTATION

Provision of aforestation has been made in the Cost Estimate.

LAND AND LIFT OF MATERIALS

Quarry for road metal (Stone) and sand have been identified. Details are placed in annexure to Volume-I : Survey & Investigations.

PRELIMINARY ENVIRONMENT IMPACT STUDY

It has been carried out and is placed at Chapter-8 of this Report.

Report contains the project details, base data, Environmental Impact Assessment and Environmental Mitigation Measures

COST ESTIMATE

BOQ and Cost Estimate has been worked out.

SoR 8th Revision (01-10-2019) for NH circle Meghalaya, Shillong has been used for preparation of cost estimate.

Lead and lift has been added.

1.5 years construction period has been considered.

Rate analysis has been worked out.

Details are placed in Volume-3 : Cost Estimate

Abstract / Summary of cost is attached with the Report.

Abstract of Estimated Cost for Road Ranikor - Maheshkhola - Baghmara to 2-Lane Standards (Km 30.000 to 55.525) - Package-II				
S.No	**Item of Work**	**Amount (Rs)**	**Amount (Cr.)**	**Cost (Crores)/Km**
1	Site Clearance	7376620	**0.74**	0.03
2	Earth work	577852052	**57.79**	2.26
3	Bases and sub Bases (Non Bituminous)	288427225	**28.84**	1.13
4	Bituminous Works	104917150	**10.49**	0.41
5	Protection Works Rwalls / Bwalls/ Toe Walls	349448005	**34.94**	1.37
6	Culverts	143821218	**14.38**	0.56
7	Bridges	253056852	**25.31**	0.99

Abstract of Estimated Cost for Road Ranikor - Maheshkhola - Baghmara to 2-Lane Standards (Km 30.000 to 55.525) - Package-II				
S.No	**Item of Work**	**Amount (Rs)**	**Amount (Cr.)**	**Cost (Crores)/Km**
8	Major Junctions and Minor Junctions	14856337	**1.49**	0.06
9	Drains	52156898	**5.22**	0.20
10	Traffic Signs and marking	71214490	**7.12**	0.28
11	Truck laybyes	0	**0.00**	0.00
12	Cost of Bus stops/bays	5198303	**0.52**	0.02
A	**Construction Cost (Rates adopted from current October'2019 SOR for National Highway Circle, Meghalaya are inclusive of GST @12% (1 to 12))**	**1868325150**	**186.83**	**7.32**
	Cost of GST @ 12%	200177694.7		
B	**Construction Cost (Excluding GST)**	**1668147455.548**		
	Cost Inflation for the year 2019-20 @ 4.65% based on WPI on B	86877119.48		
C	**Cost of Utility Shifting**			
	PHED Shifting	9823200	0.98	
	MePDCL Shifting	3504253.2	0.35	
D	**Estimated Civil Cost/ Cost Put upto Tender**	**1,76,83,52,028.23**	**176.84**	**6.93**
	GST @ 12% of D	212202243.4	**21.22**	
	Contingencies at 2.8% of D	49513856.79	**4.95**	
	Agency Charges @3% of D	53050560.85	**5.31**	
	O&M cost for last 5 years after construction @ 2.5% of D	44208800.71	**4.42**	
	Supervision @ 3% of D	53050560.85	**5.31**	
	Price Escalation @ 5% per year for 1 year on D	88417601.41	**8.84**	
E	**Total Project Civil Cost**	**2,26,87,95,652.22**	**226.88**	**8.89**
F	Land Acquisition Cost	697378325	69.74	
G	Forest Clearance & Environmental cost	50000000	5.00	
H	**Total Non Civil Cost (F+G)**	**747378325**	**74.74**	**2.93**
I	Total Project Cost(E+H)	3,01,61,73,977.22	**301.62**	**11.82**

Recommendations and Conclusions

Strengthening, widening and improvement of the project road to 2-lane standard specification will not pose any major issue and is recommended for acceptance.

Chapter – 2
Project Description

CHAPTER - 2

PROJECT APPRECIATION

BACKGROUND

Transport plays a vital role in the economic and social development of a country. The demand for inter-city freight transport in India is expected to double every 12 years while the demand for passenger transport is expected to double every eight or nine years. Since 1950, the system of State Highways has expanded over eight-fold. This rapid expansion of road network was made possible through speedy access to available resources for construction of single or intermediate lane state and district roads, with thin and structurally deficient pavements. As a result the arterial road system has become grossly congested with poor pavement condition. We are faced with many capacity related problems as traffic on arterial routes is growing at 10-12% per annum. With such high growth of traffic, congestion becomes inevitable and loss due to accidents also increases. Additional capacity has to be created by widening the roads to multi-lane standards and/or by strengthening the existing pavement crust. The Government of India aims at improving and developing the road infrastructure of the Ranikor-Nonhyllam-Maheshkhola-Baghmara Road in the State of Meghalaya, Government of India.

Ranikor-Nonhyllam-Maheshkhola-Baghmara Road is important State Highway passing in Meghalaya and providing connectivity Ranikor to Baghmara. Portion of Ranikor-Nonhyllam-Maheshkhola-Baghmara passes through the towns and the most habited areas. With the fast development of the State, the land-use has added tremendous problems to the movement of traffic – passenger as well as freight services. Existing facility needs to be augmented to 2-Lane for fast movement of the traffic and ease and comfort to the commuters.

The Govt of India and Govt Meghalaya,(Road Public works Department,Meghalaya) has decided to take up the development of the existing Ranikor-Nonhyllam-Maheshkhola-Baghmara Road for(Km 139) to 2-lane state Highway standards.

The proposed highway section falls in the State of Meghalia and is given in the following drawings attached.

Drg. No. HOL/RMB/DDRP/10558/ALI-01	Road Map of Maghalaya.
Drg. No. HOL/RMB/DDRP/10558/ALI-02	Project road Location
Drg. No. HOL/RMB/DDRP/10558/ALI-03	Alignment Plan of Project Road
Drg. No. HOL/RMB/DDRP/10558/ALI-04	Line Plan of Project Corridor

The Government of Meghalaya,Public Works Department,Meghalaya GoI called for consultancy assignment for preparation of Detailed Project Report which should expressively give all the requirements for development of the project and its facilities as well as to assess the financial requirements in a clear and practicable manner. The consultancy assignment has been awarded to Holtec Consulting Private Limited, Gurgaon for preparation of Detailed Project Report for upgradation of the project Highway.

Holtec consulting Private Limited has prepared and submitted this Draft Detailed Project Report.

Salient Features of the Consultancy Assignment

• Name of the Project	Preparation of Detailed Project Report for Development of Ranikor-Nonhyllam-Maheshkhola-Baghmara Road from KM 0to Km 139 in Meghalaya to 2-Lane Standards
• Name of Employer	Chief Engineer, Government of Meghalaya, Public Works Department, Meghalaya.
• Name of Consultant	Holtec Consulting Private Limited, Gurgaon, Haryana
• Contract Award	Agreement dated.7 January 20011
• Work Order	PW/CE/SARDP/10/2010/12 7 JAN 2011
• Consultant's Services	Preparation of Detailed Project Report
• Value of Contract	Rs. 6131467.00/-
• Date of Start	28 January 2011
• Period of Completion	8 Months from the Date of start.

Objective of the Assignment

The objective of the consultancy services is to prepare a detailed project report covering widening of existing highway to 2-lane standards, which shall, inter-alia, include construction of elevated road, bypasses/re-alignments, construction/reconstruction of bridges, Grade separators and cross drainage structures, retaining walls, breast walls, provision of road safety measures.

• Survey and Investigations.
• Detailed Engineering Design and Project Report.
• Economics Analysis.
• Contract Packaging and Implementation Schedules.
• Computerized inventory and digitized maps.

We will demonstrate the efficacy of coordinated effort of the Department and the Consultant for achieving high quality project.

Scope of Services

These are specified in the TOR and are summarized as under :

- Collection of General data of Project.
- Topographic Survey.
- Traffic Survey and Assessment.
- Material investigations.
- Pavement investigations.
- Geo-technical investigations and sub-soil exploration.
- Hydaulic Analysis.
- Strip plan.
- Identification of homogeneous Sections and junctions.
- Concept Plan.
- Detailed Design of Road works.
- Detailed Design of bridges,culverts and flyovers.
- Provision of laybys, Parking, Bus Stop, ROB / RUB.
- Environmental and Social impact.
- Estimation of quantities and project cost.

- Economic Analysis.
- Contract Packaging and Implementation Schedules.

Schedule of Services

- Submission of Inception Report: 15 days. from the date of start.
- Submission of Draft Report: 120 days. from the date of approval of Inception report
- Submission of Final Report. 60 days. from the date of approval of Draft Report

Submission of Reports

- Stage – 1 : Inception Report.
- Stage – 2 : Draft Project Report
- Stage – 3 : Detailed Project Report (DPR)

Inception Report has been submitted on 29 June 2011.

Draft Detailed Project Report is prepared and submitted on 16 December 2011.

LOCATION STUDY OF THE PROJECT ROAD

Project Country: India

Project State: Meghalaya

Location of India: India occupies a strategic position in Asia, looking across the seas to Arabia and Africa on the west and Burma, Malaysia and the Indonesian Archipelago on the east. Geographically, the Himalayan ranges keep India apart from the rest of Asia. India lies to the north of the equator between 8° 4' and 37° 6' north latitude and 68°7' and 97°25' east longitude. It is bounded on the southwest by Arabian Sea and on the southeast by the Bay of Bengal. On the north, northeast and northwest lie the Himalayan ranges.

Project District:

- **Nongjri to Maheshkhola : Km 25.525 (West Khasi Hills District)**

Following are the notable points of this sector:

1) The State of Meghalaya has no link with through Rail, Water or Air transportation but has to depend upon the Road transport for the State, as these road East and West Khasi Hills district through Ranikor and Maheshkhola.

2) These road is through an approach road (from km 42.00 (old) (Lailad) and from km (45.00 km) Rajaju for a length of 3.0 km, which is one of the International Border Trade and Commerce Centre of India and Bangladesh, Land Custom Station is also set up in Barsora to provide better infrastructure for there.

3) Chera Gaon, which is also an International Trade and Commerce Centre of India and Bangladesh links from km 55.00 (Nonghyllam) of these road (5.00 km).

4) It is very important corridor for export of natural resources like Coal, Lime Stones etc, Agricultural/ Forest/ Horticulture products like maize, Rice, Potato's, vegetables, Bamboos, Fireweed, Timbers etc. it also exports to Bangladesh with fresh potential in Commerce activities like Farming and Fishery etc.

5) It will provide Trade and Commerce between India and Bangladesh to bring lot of revenue for both the strategic and the Central Govt.

6) It is also very important for the static point of view for both internal and external security.

7) It is also very important raise to the standard of the people by providing them better and faster means of communication and Transport to facilitate economical development, increase of job opportunities and indirectly help in removing the problems of the reason which is extremism and insurgency.

8) These road is main lifeline of the people living in area of Ranikor, Rajaju, Nonghyllam, Nongjiri, Khonjoy, Rangandai, Ganganagar, Maheshkhola and many small villages for this area. There is no other connectivity to either District H.Qs or State H.Qs.

9) The road alignment passes through mostly mountainous terrain, Soil erosion takes place every year during monsoon season disrupting movement of traffic for several days causing great hardship to the people living in these areas. The International Trade Centre at Barsora and Chera Gaon has to be closed, incurring heavy lose of revenue to the State and Central Govt.

10) The existing road pavement and Cross Drainage works (Culverts and Bridges) were constructed, designed basically of Other District Road (ODR) for single land semi permanent in nature. the superstructure of some Bridges and Culverts like track ways, decking, wheel guards, railing etc are of timbers which last only for few months. Permissible load is only 9 Tons. Frequent repairing of Timber Bridges and Culverts is to be carried out which disturbs the flow of Traffic.

The entire length from Nongjri to Maheshkhola is deficient in many aspects span as existing single lane pavement in dilapidate condition, poor geometrics and sub standards curves/ gradients. Permanent bridges already constructed and under construction are of 2 lane specification and are in good condition. Balance bridges to be constructed for 2 lane specifications.

Project Road

The project road is between km 31.700 (Nongjri) to km 59.270 (Maheshkhola) in Meghalaya State.

The project road is 27.57 kms in length of proposed Ranikor-Nonhyllam-Maheshkhola-Baghmara Road.

Project Location:

- Country : India
- State : Meghalaya
- Road Name : Ranikor-Nonhyllam-Maheshkhola-Baghmara Road
- Project Road Length : 27.5 kms

Project Country: India

Project State : Meghalaya.

Name of the State **:** Meghalaya
State Capital **:** Shillong

Area : 22429 Sq.km

Inter State Border : Bangladesh, Assam,

No. of Districts : 7

No. of autonomous Dist Councils : 3

No. of Sub Divisions : 8

No. of R.D Blocks : 39

Major festivals : Wangala, Nongkrem Dance.

Major Dances : Nongkrem Dance.

Other Statistics:

- Population (20011) 2.702.000
- Languages Khasi, Garo,English.
- Literacy (2010) 62.4 %
- Per Capita in Rs 15932
- Roads length 8371

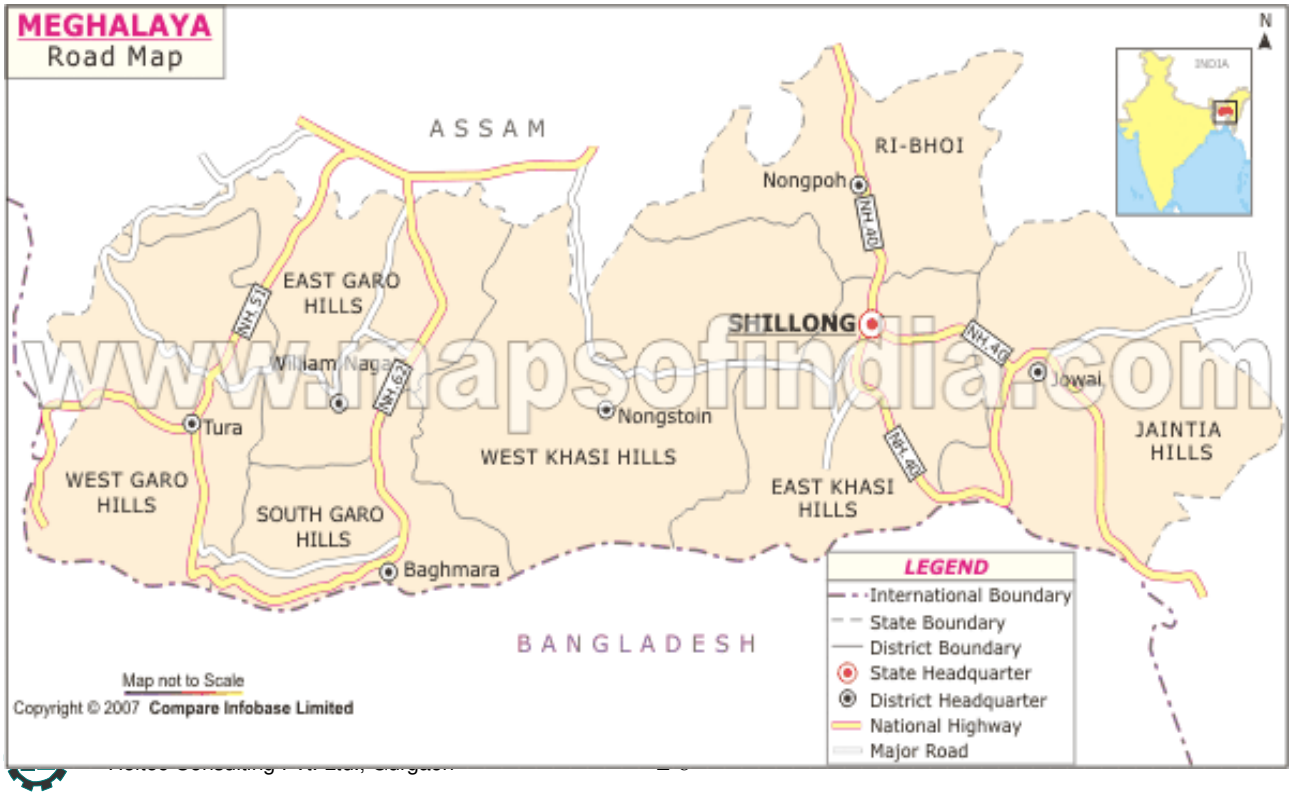
The state of Meghalaya is situated in the north-eastern part of India. The state capital is Shillong which is located at an altitude of 1496 mts. above sea level.

Meghalaya is located between Latitude 20° 1' N & 26° 5' N and Longitude 85° 49' E & 92° 52' E. The total area covered by the state is 22,429 Sq. Km and the total forest area is 8510 sq. km.

The highest point is the Shillong peak which is at a height of 1965 m above seas level.

The State is bounded on the North by Goalpara, Kamrup and Nowgong districts of Assam, on the East by Karbi Anglong and North Cachar Hills Districts of Assam, and on the South and West by Bangladesh.

The Location Map of Meghalaya.



Land: Meghalaya is a mountainous region, which is a small State of the Indian. Meghalaya is a hilly strip in the eastern part of the country about 300 km long (east-west) and 100 km wide, with a total area of about 8,700 sq mi (22,720 km^2). Meghalaya was formed by carving out two districts from the state of Assam: the United Khasi Hills and Jaintia Hills, and the Garo Hills on 21 January 1972. Prior to attaining full statehood, Meghalaya was given a semi-autonomous status in 1970.

Terrain: Meghalaya's terrain consists more of rolling hills and less of steep climbs. There are beautiful meadows with fringes of pine forests everywhere. Meghalaya, one of the smallest states in India, occupies the plateau and rolling hills between Assam and Bangladesh. The area is made of the oldest rock-formations. Meghalaya consists of the Garo, Khasi and Jaintia hills along with their outliers formed by the Assam ranges. Meghalaya Plateau's elevation varies between 150 meters to 1961 meters above sea level. The Plateau is highly dissected and has irregular terrain in the western and northern side. The southern side is marked by a continuous escarpment with steep slopes. The broken hills and ranges in the north are not of a well defined boundary.

Meghalaya: Road in Hilly Terrain

Climate: Meghalaya climate depends upon its altitude, the more high the altitude is, the more cooler and soothing is the climate. This is why Khasi and Jaintia hills have a very soothing climate where you can rejuvenate from your worldly pleasures amidst the nature's magnanimous beauty.

The region of Meghalaya where the temperature is too hot and humid in summers are Garo hills. The climate of Meghalaya is so in this region because of the low altitude of the place. On the other hand, Shillong experiences low temperature because of high altitude..

Flora and Fauna: Meghalaya is a treasure trove of Nature, with its richly varied and dense endemic, exotic and cultivated flora. Nature, in its generous abundance, had bestowed on Meghalaya a unique array of vegetation, ranging from tropical and sub-tropical to temperate or near temperate. This is due to the diverse topography, varied and abundant rainfall and differential climatic and edaphic conditions of the State, within small regions.. Biotic factors have also played an important role, at places decisive. It is said that about 50% of the total number of mammal genera found in the entire Indian sub-continent can be seen in Meghalaya and its adjoining states in the North-East. Out of the above, nine genera of mammals, such as Tupaia, Rhizomys, Cannomys, Chiropodomys, Micromys etc occur only in Meghalaya and its adjacent areas.

People: The word "*Meghalaya*" literally means *The Abode of Clouds* in Sanskrit and other Indic languages.
The Khasi, Jaintia, Bhoi, War collectively known as the **Hynniewtrep** people predominantly inhabit the districts of East Meghalaya, also known to be one of the earliest ethnic group of settlers in the Indian sub-continent, belonging to the Proto Austroloid Monkhmer race.

Social Life: The staple food of Meghalaya's people is rice. They also take fish and meat. Like the other tribes in the North-East, the Khasis also ferment rice-beer, and make spirit out of rice or millets by distillation. Use of rice-beer is a must for every ceremonial and religious occasion. The Khasis, the Jaintias and the Garos have a matrilineal society. Descent is traced through the mother, but the father plays an important role in the material and mental life of the family. While, writing on the Khasi and the Jaintia people, David Roy observed, '*a man is the defender of the woman, but the woman is the keeper of his trust*'. No better description of Meghalayan matrilineal society could perhaps be possible. In the Khasi society, the woman looks after home and hearth, the man finds the means to support the family, and the maternal uncle settles all social and religious matters. Earlier in the conservative Jaintia non-Christian families, however, the father only visits the family in the night and is not responsible for the maintenance of the family.

Administration: The Capital of Meghalaya is Shillong. Meghalaya is divided into 7 districts .

All Executive Authority of the State formally vests in the Governor. In actual practice, however, he acts as the Constitutional Head of the State Government. Every act or decision of the Governor is impressed to be taken in his name. Every such act or decision is based on a decision taken by the Council of Ministers or under the authority of a Minister except in so far as the Governor is by or under the Constitution required to exercise his function on any of them in his decision. The executive power of the State Government is exercised by the Council of Ministers with the Chief Minister as its head. The Chief Minister is appointed by the Governor. The other Ministers are appointed by the Governor on the advice of the Chief Minister. The Council of Ministers is collectively responsible to the State Legislative Assembly.

The Council of Ministers consist of Ministers who are members of the Cabinet and Ministers of States. The Cabinet, which consists of the Ministers appointed as its members, determines the policy of the Govt. and gives direction. The Ministers who are not members of the Cabinet attend meetings of the Cabinet when matters concerning their Departments are considered by the Cabinet, if so desired by the Cabinet.

Connectivity: Road Network in the state has been managed quite efficiently and covers the state conveniently. National Highway 40 is an all-weather road running through the state. The road connects Shillong with Guwahati, which in turn is connected to other major cities in rest of the country.

Meghalaya Road Network :

It consists of 8371 kms road length with road density 36.4 sq km as of 2007-08

Road Category	Length (kms)
National Highway	810
State highways	137
Major District roads	1219
Other District Roads	5205
Total	8371
No of Districts	7

Project Road : Ranikor-Nonhyllam-Maheshkhola-Baghmara

- The initial road sector traverses towards in the East direction ending at km 59.270.
- The list of the habitations along the road are presented in Table given below
- Chainages are not defined on the ground.Approximate chainages/Kms are mentioned below.

Lists of Habitats

Place	Chainage in Kms
Nongjiri	32
Khonjoy	34
Bacali	36
Maheshkhola	60

General Project Area

Nongjri-Maheshkhola is 27.570 Kms long

This sector is Single Lane Road with comparatively good geometric standards.

This stretch was constructed by BRO as emergency requirement. Due to the difficulty in supervision and execution, the grades and formation width at various stretches are not conforming to the standard. Improvement works have been done under NH Scheme.

- It passes through geographical feature which is classified as hilly terrain.
- The hills are of recent origin with rocky areas comprising of soft and rocks.
- The average annual rain fall in the south west is about 400 cm. The maximum rain fall occurs over the Southern slope of the khasi Hills over Cherrapunjee (Sohra) and Mawsynram (situated on SH-4) which received the heaviest rainfall in the world of 1392 cm.

- No rail way line crosses the present project road..
- At present the road is single-lane corridor (Roadway 5 to 7 m wide)
- The Project aims at making it 2-lane.
- The average carpet width of the existing road is between 3.2 m to 4.5 m.

- The ROW is not defined on the ground.
- Horizontal Alignment: At places, the geometric of the existing road alignment does not confirm to the National Highways Standards of the hill roads as per IRC-SP-48 1996.
- Vertical Alignment: The vertical profile of the road is fair and meets the National Highway Standards except certain stretches.
- Camber / Crossfall / Superelevation: The project road needs well-defined Camber / Crossfall / Superelevation.

Problems and Challenge Areas

Based on the ground study, reconnaissance & survey and the data collected the consultant have gained appreciation of the technical and project management problems and have insight of the challenge areas of the project. The general appreciation of the thrust areas are described in the following paragraph.

Accessibility:

Meghalaya is situated in the north-eastern region of India, between the Brahmaputra valley in the north and the Bangladesh in the south. It extends for about 300 kilometres in length and about 100 kilometres in breadth. The state was created in 1972 from the Khasi, Jaintia, Garo districts of Assam, which were formerly small kingdoms inhabited by separate tribal groups. The state of Meghalaya (the abode of clouds) is geographically known as the "Meghalaya Plateau" or the "Shillong Plateau". The area is made of the oldest rock-formations. Meghalaya consists of the Garo, Khasi and Jaintia hills along with their outliers formed by the Assam ranges. It is the detached north-eastern extension of the Peninsular India. Part of it lies buried

under the alluvium deposited by the Ganga-Brahmaputra system of rivers. This gap is known as Malda gap (between Raj Mahal hills/Chhota Nagpur and the Shillong Plateau). Meghalaya Plateau's elevation varies between 150 meters to 1961 meters above sea level. The highest point of the entire state is the Shillong peak whose elevation is about 1965m above sea level. It is bounded on the south and southwest by Bangladesh and on all other sides by the state of Assam. The area is 22,429 square kilometres. The capital is the hill town of Shillong. Shillong, the capital of Meghalaya is located at an altitude of 1496 metres above sea level. Shillong, which was made Assam's capital in 1874, remained so till January 1972, following the formation of Meghalaya. The capital city derives its name from the manifestation of the creator called Shyllong. Meghalaya is a region of great scenic beauty; a panorama of lush, undulating hills, fertile valleys, 250 species of orchids, meandering rivers, waterfalls, sparkling mountain streams and lakes. Meghalaya is known for its natural beauty and the simple lifestyle of its tribal people. Meghalaya also receives limelight on account of Cherrapunjee, the wettest place on earth, which is only 56 kms. away from Shillong. Meghalaya has a single-chamber Legislative Assembly of 60 seats. The state sends three members to the Indian national parliament: one to the Rajya Sabha (upper house) and two to the Lok Sabha (lower house). The state has seven administrative districts. These are :

Cross Drainage Works: The existing culverts are old and narrow structures having different structural and construction composition. These need rehabilitation / reconstruction / special repairs.

Seismic effect: The entire state of Meghalaya is earthquake prone and falls under seismic Zone V with reference to IRC-6. All structures need to be designed with seismic effect as per stipulations in IRC-6.

Plantation: There is thick growth of vegetation along the Project road.

Stone for Road Construction: While extracting stones for WMM, the quality material should be selectively chosen. If these quarries are used for the complete road, lead for the whole road may be substantial.

Water: In general, water available in the area has been found suitable for use in the road construction work. However, water is not available at all places and has to be transported from the local water points to the construction sites.

Work force: Mostly local people are agriculturists. Road construction requires tradesmen of sorts, skilled labourers and unskilled labourers. Manpower may need to be brought from other part of the country. It requires planning and organisation for recruitment, training, induction and maintenance including provision of campage, food supplies, medical, welfare activities, etc. Independent facilities are necessitated to cater for the increased workforce.

Contractors: Local contractors are not capable to work for big job.A badly damaged road is shown below.

GENERAL DATA COLLECTION DURING GROUND RECONNAISSANCE ON ROAD RANIKOR-NONGHYLLAM-MAHESHKHOLA-BAGHMARA

1.	Details of route vis-à-vis topography of the area, heather plain, rolling or hilly	Hilly
2.	Length of the road along various alternatives	25.525 km (Designed Chainage: From Km 30+000 to Km 55+525)
3.	Bridging requirements number, length	Minor and Major bridges: 13 nos.
4.	**Geometrics Features:**	
	a) Gradient that are feasible, specifying the extent of deviations called for	Mountainous and Steep
	b) Curves hair-pain bends, etc	Nil
	c) Railway crossing	Nil
	d) Ground constraints	Significant
5.	Existing means of surface travel-mule path, jeep track, earthen cart tracks, railway lines, waterway, etc	Vehicular Traffic
6.	Right-of-way available, bringing out constraints on account of built-up area, monuments, and other structures	a) EROW =7-9m carriage way width=3.60m Shoulder width including parapet and side drain=3.85m b) There is no monuments and other important historical structures along the existing road
7	**Terrain and Soil Conditions**	

Sn	**Sector**	**Terrain**	**Classification of Hills**	**Traffic Count Station**
1	Nongjri to Maheshkhola Km 31.700 to km 59.270	Hilly and rolling	Hard and SMB 80% and 60%	Bacally at Km 36.00

	7.1)	Geology of the area	Rocky / SMB
	7.2)	Nature of soil, drainage conditions and nature of hill slopes	a) Poor soil up to Maheshkhola (31.700 to 59.270 km) thereafter good soil of CBR 7% (60 to 139.0 km) b) Drainage condition is poor. c) Hill slope is stable varying from 10 degree to 80 degree.
	7.3)	**Road length passing through:-**	
		i) Mountainous terrain	Significant
		ii) Steep terrain	Significant
		iii) Rocky stretches with indication of the length in loose rock stretches	Significant and no loose rock stretch
		iv) Areas subject to avalanches and snow drifts	NA
		v) Areas subjected to inundation and flooding	Nil
		vi) Areas subjected to sand dunes including location of dunes	NA
		vii) Areas of poor soils and drainage conditions	Nil
		viii) Areas with very poor sub-soil strength, e.g. marshes	Nil
		ix) Areas of high salinity or wet saline soil	Nil
	7.4)	Cliffs and gorges	Significant
	7.5)	Drainage characteristics of the area including susceptibility to flooding	Nil
	7.6)	General elevation of the indicating maximum and minimum heights negotiated by main ascents and descents in hill sections	Not yet assed
	7.7)	Total number of ascents and descents in hill sections	Not yet assed
	7.8)	Disposition and location of sand dunes	NA
	7.9)	Vegetation-extent and type	Thick and very rapid growth
8.	**Climate condition:-**		
	8.1)	Temperature-monthly	Moderate April is the hottest month when the mean maximum temperature

		maximum and minimum readings	is 33 degree Centre grade and the mean maximum is 22 degree Centre grade. Jan is the coldest month and recorded the mean maximum of 24 degree Centre grade and the mean minimum is 12 degree Centre grade.
	8.2)	Rainfall data-average annual, peak intensities, monthly distribution (to the extent available)	More than 75% of rainfall occurs during the period of six months (April-Sep).The average annual rainfall in the area is 400 cm. The wettest place of the world Mawsynram falls on this road between Mawngap and Ranikor and highest rainfall is 1392 cm due to the rain-shadow effect.
	8.3)	Snowfall data-average annual, peak intensities , monthly distribution (to the extent available)	NA
	8.4)	Wind Direction and velocities	(a) South-West in monsoon (b) North – East in winter. (c) Velocity - Normal
	8.5)	Visibility	Normal
	8.6)	Exposure to sun	Normal
	8.7)	Water table and its variation between maximum and minimum	NA
	8.8	History of unusual between maximum and minimum	Not yet occurred
9.	**Facilities Resources**		
	9.1)	Landing ground in case of hilly stretches	Tura (120.00 km fro end of project road)
	9.2)	Dropping zones in case of hilly stretches	- do -
	9.3)	Foodstuffs	Normal
	9.4)	Labour-local availability and need for import	Locally Labours available and imported Labour are required for skill work
	9.5)	Construction material timber, bamboo, sand, stones, shingle, etc. with extent of their availability, leads involved and availability of easy access	a) Stones are available in road side old quarries at km 9.80 and from km 40.0 to 41.0 km with easy access road b) Sand are also available in river bed near Ranikor, Maheshkhola and Baghmara through easy access roads
	9.6)	Availability of water, especially in arid zones	Water is available along the project road in Nallah/ Stream through out the year for road construction work and drinking water being provided by PHED of Meghalaya state
	9.7)	Availability of local contractors	Local contractors are not available for big works
10.	Value of land – agriculture land, irrigated land, built-up land, forest land, etc.		These aspects will be accessed during land acquisition process
11.	Approximate construction cost of various alternatives.		Rs. ……. crore / km as accessed on NH-40 (Part-II) road
12.	Access points indicating possibility of induction of equipment.		a) Ranikor- through IBB road b) Baqli- through IBB road c) Baghmara-through NH-62 and NH-51
13.	Period required for construction		At least 5 years
14.	Strategic considerations		a) Vehicles carrying coals are plying on the road between km 12.0 to 30.00 being coal field area which causes damages of road surface. b) Some places Indo-Bangladesh border are not fenced resulting unauthorized peoples crossing borders frequently and doing smuggling and crime. c) There is no Telephonic communication facilities in border villages / town.
15.	Recreational potential		No recreational facilities are available in the village / towns situated on project road
16	Important villages, town and		Ranikor, Nolikota, Mawpyllun, rajaju, Nonghyllam, Nongiri, Khonjoy,

.	marketing centre connected		baqli, Maheshkhola, Mahadeo, Rongra, Dambuk, Panda, Amphanggire and Baghmara
17.	**Economic Factors:**		
	i)	Population served by the alignment	Not yet accessed
	ii)	Agricultural and economic potential of the area	a) The coal quarried from the coal area will be easily transported. b) Easily transportation of Kaju, bananas, Tejpati and Rubber. c) Visit of National park at Balpakram by visitors/ Tourist. d) Easy moment of BSF personnce on border areas.
	iii)	Marketing centre	Ranikor, nonghyllam, Nongin ,Khonjoy, Maheshkhola and Baghmara
18.	Other major developmental projects being taken up in the area, e.g. railway project hydro-electric projects, railway projects, dams, reservoirs, mining/ agricultural projects, etc		Nil
19.	Crossing with Railway Lines and other existing Highways		Nil
20.	Location of existing or proposed utilities along the alignment		Electric poles and water supply pipes are existing along the project road and all details will be ascertained during detailed survey
21.	Necessity of by-passes for towns and villages		No Bypass has been proposed to Bypass the existing Villages/ Towns
22.	Position of ancient monuments, burial grounds, religious structures, hospitals and schools		Not affected any structures during construction / development of project road
23.	Ecology and environmental factors		No negative impact
24.	Aspects needing co-ordination with other administrative authorities		a) Co-operation required with Meghalaya state department of agriculture Horticulture, Electric telecommunication, revenue, PWD, Forest, local Village headman and BSF during Land acquisition and road construction activities. b) Ministry of Road Transport and Highways and Meghalaya state PWD for providing schedule of rate for preparation of estimate.
25.	Traffic counts from existing records		Traffic count survey was not done by Meghalaya state PWD

Data Collection

In addition to the discussion and study of map, reports and other details, general survey of the project road including (a) general data collection (b) compilation of salient features (c) evaluation of features of re-alignment of sub-sector and major problems likely to be encountered.

Data Collection during Reconnaissance

Survey has been conducted by the Team. In order to capture salient physical features of the road, these data are taken on the basis of the general reconnaissance only. It will be fine-tuned and properly connected with the detailed survey data at subsequent stage. The remarks given in the Table will be analysed at our end and fine tuned. The general data collection during reconnaissance is given below :

- Road start and end point
- Road length
- Towns / Villages
- Road Width
- Road geometry.
- Road surface condition

- Homogeneous sections
- Drainage
- Pavement
- Shoulder
- CD Works
- Gradient
- Retaining Walls
- Breast Walls
- Major Bridges
- Minor Bridges
- Junctions
- Traffic Study

Road start and end point

Project road start at Nongjri (Existing Km 31.700) and ends at Maheshkhola (Existing Km59.270).

Existing road pavement width condition:

Sn	Road sub sector	Road land (m)			Condition	New proposals	Remarks
		Carriage way width (m)	Shoulder both side including parapet walls and side drains (m)	Road way width (m)			
1	Nongjri to Mahehkhola (Km 31.700 to Km 59.970)	3.50	4.70	8.20	Poor	Concrete Road with paved shoulder and lined drains	Concrete pavement consider for following reasons : (a)_Poor Soil. (b) Heavy equipment plying on the road. © High rain fall (d) Coal quarries falling along the road alignment. (e) CBR value. (f) Stone quarries (g) In adequate existing of cross drainage work.

On going work by State PWD:

1) Sector: Nongjri to Maheshkhola

a) Some Bridges / Culverts Sanctioned under NLCPR (None Lapsable Central Pool Resources) Schemes by the Ministry of Development of NE region work is in progress.

b) Some Bridges (31/1, 31/2, 35/1 and 35/2) constructed by fund provided by NABARD (National Bank for Agriculture and Rural Development) money granted under rural infrastructure development fund to set up construction of road Bridges.

c) The Modified/ Revised estimate for replacement of SPT/ BUG Bridges of 13 nos. on this road sector had been submitted to DONER by Planning Department vide their letter no. PLR-129/ 2007/62 dated 03.10.2008 and sanction awaited.

d) RCC Hume pipes culverts have been procured and stacked on road side for replacement of weak and damaged culverts and road sectors. Tenders for Construction of HP Culverts called by state PWD, Shillong and acceptance is awaited/ under issue.

Road Length; Total road length is approx 27.570 km.

Road surface condition The Road surface has cracks, mosaic, reveling, uneven, bump foundation and has sunk / failed at many places in the road stretch stated to be due to lack of maintenance funds. Photos below show the real picture of project road.

Gradient : The existing gradients of the project road are steep in certain stretches.

Chapter – 3
Survey & Investigations

CHAPTER-3

SURVEY AND INVESTIGATIONS

Data Collection, Surveys and Investgation have been carried and for the following :

- Traffic Volume Survey
- Road Inventory Data Sheet
- Inventory and Condition Survey for Bridges
- Pavement Condition Survey
- Inventory and Condition Survey For Culverts
- Detail Of Villages / Towns
- Detail of Junctions / Link Road / Access / Approach Roads / Stair Cases
- Ponds
- Site for Disposing Extra Excavated Earth
- Memorial Stone
- Coal Mining Area
- Play Ground
- Boundary / Fencing
- Retaining And Breast Walls
- Lined Drain
- Details of Ascending and Descending
- Soil Classification of Hill Slope
- Detail Of Test Pit Dug

Details of the above have been placed annexed in separate volume to the Report.

Chapter – 4

Design Standards and Specification

CHAPTER - 4

INDICATIVE DESIGN STANDARDS & SPECIFICATIONS

DESIGN PHILOSOPHY

Road sector Nongjri to Maheshkhola is being improved to 2-lane National Highway Standard / Specifications. The Project Road will have two lane carriageway facilities. The design philosophy that will be followed embodies the following:

- The facility should be of National Highway standards
- The facility must meet the needs for development activities in the region.
- Travel should be safe, with in-built engineering features
- The facility should be aesthetically pleasing and should not be visually intrusive
- The facility should meet the environmental conditions

Design Standards for the highway requirements have been framed for following items for providing the desirable level of service and safety. For this Project it is proposed to follow Design Standards given in IRC Standards, Codes, Guidelines and Special Publications besides MORTH circulars and specifications as applicable to National Highways and the Concession Agreement stipulations in this respect. In the absence of any definite provisions on any particular issue, the following standards shall be referred to in that order.

- Bureau of Indian Standards
- American Association of State Highway and Transport Officials (AASHTO)
- American Society of Testing Materials(ASTM)
- British Standards
- Any other National or International Standard as considered suitable

In case certain provisions are not available and uncertainties exist, these will be discussed with Meghalaya PWD (NH) / MORTH and consensus reached.

SPECIFICATIONS

The material to be used in the Project work (including facilities there on) shall conform to MORTH Specifications for Road & Bridge Works 4th Rev. 2001. Where these specifications are silent in regard to certain specifications for the material in question, in that case, specifications under Bureau of Indian Standard/AASHTO/ASTM/BS shall apply in that order. But where these specifications are silent, the specifications for the material in question shall be got designed from the Consultant.

GEOMETRIC DESIGN STANDARDS

For this Project Highway, Geometric Design Standards as per
IRC:73-1980 shall be generally followed.
IRC-SP-19-2001: Manual for survey, investigations and preparation of road projects.
IRC:52: Recommendations about the Alignment survey and Geometric Design of Hill Roads (Second Revision).
IRC:-SP-48-1998: Hill Road Manual

DESIGN PARAMETERS

Terrain Classification:

Terrain as pertinent to the road structure is classified as given in the following table;

Terrain Classification

Terrain	Cross Slope (%)
Rolling	1>0 upto25
Mountainous	>25 upto 60
Steep	> 60

This Road Corridor is generally in mountainous terrain with stretches on steep mountainous terrain.

Design Speed:

Road Classification	Mountainous Terrain		Steep Terrain	
	Ruling	Minimum	Ruling	Minimum
National / State Highway	50 km/hr	40 km/hr	40	30

The ruling design speed should generally be the criterion for correlation of the various design features.

Minimum design speed should be adopted in sections where site conditions or economic do not permit a design based on the ruling design speed. This will be adopted in consultation with the client.

Cross Section Elements:

- **Right of Way (ROW)**

  IRC: 73-1980 Table-3 recommends the following land width for National Highway:

ROW Width

Sn	Road Classification	Mountainous and steep Terrain	
		Open areas	Built-up areas
		Normal	Normal
1	National Highways	24m	20m

The existing ROW along the project road is not uniform. The width of ROW is not defined in the road. ROW of 24/20 will be maintained. However there are stretches where the ROW has been encroached. It would require restoration to 24/20m width.

- **2-Lane Carriageway:**

Total road width	:	10.00 meter
Carriageway	:	7.000 m
Earthen Shoulder Hill side (including Drain)	:	1.50
Earthen Shoulder Valley side (including parapet)	:	1.50

- **Cross-slope**

Each carriageway shall have cross slope of 2.50 per cent
The earthen shoulder shall have a slope of 3.5 per cent.

- **Stopping Sight Distance:**

Sufficient stopping distance is made available for drivers to stop their vehicles when faced with an unexpected obstruction in the carriageway. The safe stopping sight distance, overtaking sight distance as recommended in the manual is as below:

Minimum recommended Sight Distances

Speed (Km/h)	Safe Stopping Sight Distance (m)	Intermediate Sight Distance (m)
20	20	40
25	25	50
30	30	60
35	40	80
40	45	90
50	60	120

- **Horizontal Alignment:**

  - **Super elevation**

No super elevation is proposed when its value obtained is less than the road camber e.g. Radii beyond which super elevation is not proposed are as mentioned below:

Radius Beyond which super elevation not required

Design speed (km/hr)	Radius (m)					
	Proposed as per IRC 73	4%	3%	2.5%	2%	1.7
20		50	60	70	90	10
25		70	90	110	140	150
30		100	130	160	200	240
35		140	180	220	270	320
40		180	240	280	350	420
50		280	370	450	550	650

- **Radius**

Radii for horizontal curves corresponding to ruling minimum and absolute minimum design speeds are as given below:

Minimum Radius for National Highways / State Highways

Steep Terrain	
Ruling Min Radius (m)	**Absolute Minimum Radius (m)**
50	30

There will be corresponding speed limit in case the radius is less than the above due to hill physical features and economic consideration.

Hair-Pin Bends

Hair-pin bends where unavoidable, may be designed either as a circular curve with transition at each end, or as a compound circular curve. The following criteria should be followed normally for their design

a)	Minimum design speed -	20 km/h
b)	Minimum roadway width at apex	
	i. National / State Highways	11.5m for double-lane 9.0m for single-lane
c)	Minimum radius for the inner curve	- 15.0 m
d)	Minimum length of transition curve	- 15.0 m
e)	Gradient	
	Maximum	- 1 in 40 (2.5%)
	Minimum	- 1 in 200 (0,5%)
f)	Super-elevation	- 1 in 10 (10%)

At hair-pin bends, the full roadway with will be surfaced

Widening of Pavement at Curves

At sharp horizontal curves, it is necessary to widen the carriageway to facilitate safe passers of vehicle. Extra width to be provided on horizontal curve is given below (refer clause 6.8.5 of IRC : SP: 48: 1998).

Radius of Curve (m)	Upto 20	21 to 40	41 to 60	61 to 100	101 to 300	Above 300
Extra width(m) 2 Lane	1.5	1.5	1.2	0.90	0.60	Nil

Wherever the radius is less than the specified minimum design speed, the transition curve, super elevation and pavement widening will be introduced. This will minimize the intrusion of vehicles on to adjacent lanes, tend to encourage uniformity of speed and increase vehicle speed at the curves.

- **Transition Length**

Transition length is given in Table below:

Transition Length of Curve
As per IRC: SP: 48-1998

Curve Radius (m)	Design Speed Km/h				
	50	40	30	25	20
	Transition length - metres				
15				NA	30
20				35	20
25			NA	25	20
30			30	25	15
40		NA	25	20	15
50		40	20	15	15
55		40	20	15	15
70	NA	30	15	15	15
80	55	25	15	15	NR
90	45	25	15	15	
100	45	20	15	15	
125	35	15	15	NR	
150	30	15	15		
170	25	15	NR		
200	20	15			
250	15	15			
300	15	NR			
400	15				
500	NR				

NA-Not Applicable
NR- Transition not required

- **Vertical Alignment:**

Codal Provisions

The gradients to be maintained in the design are as per following guidelines :

Codal Reference	Clause No.
IRC : SP-48 – 1998, Hill Road Manual	12.2.1
IRC : 52-2001, Recommendations about Alignment Survey and Geometric Design of Hill Roads	6.9.1.3

Gradients for Different Terrain

SL. No	Terrain	Ruling gradient	Limited gradient	Exceptional gradient
1	Steep terrain up to 3,000 m height above mean sea level	6 % (1 in16.7)	7 % (1 in 14.3)	8 % (1 in 12.5)

Gradients upto the ruling gradient may be used as a matter of course in design (Ref. Clause No. 6.9.1.4 of IRC-SP: 48 – 1998).

The limiting gradients may be used where the topography of a place compels this course or where the adoption of gentler gradients would add enormously to the cost. In such cases, the length of continuous grade steeper than the ruling gradient should be as short as possible. (Ref. Clause No. 6.9.1.5 of IRC-SP: 48 – 1998).

Exceptional gradients are meant to be adopted only in very difficult situations and for short lengths not exceeding 100 m at a stretch. Successive stretches of exceptional gradients must be separated by a minimum length of 100 m having gentler / flatter gradient (Ref. Clause No. 6.9.1.6 of IRC-SP: 48 – 1998).

Vertical Curves

Minimum length of Vertical Curve (As per IRC: SP: 48-1998)

Design speed km/h	Maximum grade change (percent) not requiring a vertical curve	Minimum Length of vertical curve (m)
35	1.5	15
40	1.2	20
50	1.0	30

The actual length for the vertical curve shall however be provided as per IRC: 73–1980

- **GEOTECHNICAL DESIGN**

Earth Embankment

i) The fill material, compaction and other requirements shall conform to IRC: 36-1970. Where these specifications are in variance with the MORT&H specifications, the later shall govern and accordingly followed.

ii) Side slope of 2:1 is provided

Side Slopes Formation in Cutting

The following values are adopted as per IRC: SP: 48:1948 Clause 7.4.

Side Slope in Cutting

Sn	*Item*	*Slopes of Cutting*
1	Ordinary Soil / Heavy Soils	1 : 1 to ½ : 1
2	Ordinary / Soft Rock	¼ : 1 to 1/8 : 1
3	Hard rock	80^0 to 90^0 to Horizontal

(Explanation: The slope 1: 1 signifies 1 in the horizontal direction and 1 in the vertical)

ROAD FURNITURE

Km Stones

Km Stones, 200m stones and 5th km stones shall be provided as per codal provisions.

Road Signs:

All signs shall be placed on the valley side of the road. Where extra emphasis is warranted, they may be duplicated on the right hand side as well as per IRC: 67-1977. The extreme edge of the sign shall be not less than 2 m from the edge of the carriageway.

Road Marking:

Provisions shall be made for center line marking with thermo-plastic paint as per IRC: 35-1970.

Safety Barriers:

Guardrail shall be provided on approaches to bridges and high embankments.

BRIDGES & CULVERTS

- All Cross- Drainage structures shall be classified as culverts, minor bridges & major bridges depending on the length of the structure as per IRC standards. Structures up to 6m length fall into the category of culverts, more than 6m but up to 60m in length as minor bridges and beyond 60m length as major bridges.

- For bridge on 2-lane SH the carriageway width shall be 10.90m The deck width including carriageway footpath and crash barrier/railing is required to be kept 12.00m for 2-lanes.

- The bridge components shall be designed at least with 2-lanes of class 'A' loading or one lane of class 70R loading.

- SH-4 (Ranikor to Baghmara) falls under Zone-V of seismic zone as provided in IRC: 6-2000.

- The list of IRC codes given below but not limiting to shall be referred during formulation of the design and drawings of bridges.

List of IRC Codes

IRC: 5-1998	Standard Specification & Code of practice for Road Bridges. Section – I General Features of Design (Seventh Revision)
IRC: 6-2000	Standard Specification & Code of practice for Road Bridges. Section – II Loads & Stresses (Fourth Revision)
IRC: 18-2000	Design Criteria for Prestressed Concrete Road Bridges (Post- Tensioned Concrete) (Third Revision)
IRC: 21-2000	Standard Specification & Code of practice for Road Bridges. Section – III Cement Concrete Plain & Reinforced (Second Revision)
IRC: 22-2008	Standard Specification & Code of practice for Road Bridges. Section – VI Composite Construction (First Revision)
IRC: 24-2010	Standard Specification & Code of practice for Road Bridges. Section – V Steel Road Bridges (Second Revision)
IRC: 45-1972	Recommendations for Estimating the Resistance of soil below the maximum Scour Level in the Design of Well Foundations of Bridges.
IRC: 73-1980	Geometric Design standards for Rural (Non-Urban) Highways.
IRC: 78-2000	Standard Specification & Code of practice for Road Bridges.

	Section – VII Foundation & Substructure (First Revision)
IRC: 83-1999 Part-I	Standard Specification & Code of practice for Road Bridges. Section – IX Bearings, Part-I Metallic Bearings (First Revision)
IRC: 83-1987 Part-II	Standard Specification & Code of practice for Road Bridges. Section – IX Bearings, Part-II Elastomeric Bearings
IRC: 89-1997	Guidelines for Design & Construction of River training & control works for road bridges.
IRC:SP:33-1989	Guidelines on supplemental Measures for Design, Detailing & Durability of Important Bridge Structures.

Design loads

- **Dead Loads:**

Apart from all the actual dead loads, irrespective of the type of wearing coat and crash barrier proposed, the structure shall be designed to allow for

- Wearing coat load = 2 kN/m^2.
- RCC crash barriers P1 type as per IRC: 6 -2000

- **Live Loads:**

The bridges shall be designed to carry one lane of Class 70R for every two lanes or one lane of Class A for each lane.

- **Seismic Effects:**

(i) Basic horizontal seismic co-efficient - As per zone V
(Table 5 & fig 11 of IRC: 6–2000)

(ii) Importance Factor
- 1.50 (For major bridges)
- 1.00 (for minor bridges)

Reinforcement detailing of structures shall conform to the provisions of IS 13920

(iii) Soil Foundation factor β = 1.2 for foundations

- **Loading due to Crash barrier:** As per Table 3 of IRC: 6 – 2000

- **Temperature Effect:**

(i) Temperature stresses to be worked out as per Clause 218 of IRC: 6 – 2000.

For design of structure the temperature range to account for temperature effect shall be:

In the present case t = +/- 25^0 C

(ii) The superstructures shall also be designed for effects of distribution of temperature across the deck depth. For calculation of thermal forces effect of 'E' value of concrete should be taken as 50% of the instantaneous value as to account for effects of creep on thermal strains.

- **Differential Settlement:** 6 mm with instantaneous E value of concrete. This will be deemed to cover lifting of superstructure also.

PAVEMENT DESIGN

Design for new pavement has been carried out in accordance with the latest version of IRC: 37-2001.

DRAINAGE

- An effective drainage system for drainage of road shall be designed as per stipulations of IRC SP: 42-1994.

- The road side channel will be rectangular V-shaped of adequate capacity to carry 100% surface runoff of drainage area of highway ROW. It will be drained to the nearest available natural water course. We propose to adopt section R.C.C covered drain in built-up area. This will be lined drain to drain out in the open field or to the defined outfall points. V shaped unlined drain will be adopted in the hard rock hill sections V shaped lined drain will be provided in soil and soft rock sections.

- The superstructure of bridges shall be drained with suitable drainage spouts.

TRAFFIC SAFETY MEASURES

The design layout and materials chosen for the safety barrier shall suitably blend with the surrounding and shall further conform to MOSRT&H circulars and shall be finalized in consultation with and approved by PWD.

TECHNICAL SPECIFICATIONS

- In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the codes, standards and specifications of IRC, MORT&H guide lines and official publications as applicable to National Highways, AASHTO, ASTM, BS or any other international standards in that order. Where even these are silent, the construction and completion of the works shall conform to sound Engineering practice as approved by the Engineer.

- The material to be used in the Project work (including facilities there on) shall conform to MORT&H Specifications for Road & Bridge Works 4th Rev. 2001. Where these specifications are silent in regard to certain specifications for the material in question, in that case, specifications under Bureau of Indian Standard/AASHTO/ASTM/BS shall apply in that order. But where these specifications are silent, the specifications for the material in question shall be got approved from the Independent Consultant.

Chapter – 5
Traffic Survey and Analysis

CHAPTER - 5

TRAFFIC SURVEY AND ANALYSIS

INTRODUCTION

Project Road provides important link between Ranikor, Nonghyllam, Maheshkhola and Baghmara of Meghalaya. The road serves as important link for transportation of men and materials including agriculture produce, forest and mineral wealth of the State to various centers of agricultural/industrial/ markets and to feed stock and raw material for various industries.

Homogeneous Sections

Homogenous sections are the sections of the project road having similar traffic and travel characteristics. Major intersections / settlements are also considered as nodes for identification for various homogenous sections.

There is some variation in traffic flow characteristics on the project corridors due to the presence of towns and other settlements. Based on the traffic movement pattern ensuring minimum variation in traffic level within such sections, initially the total road length has been divided into three homogenous sections as given below :

Homogenous Sections of the Project Road

Section	Stretch (Design Chainage)	Approximate Length (Km)
1	SH-4 Km 0.00 – Km 28.315	28.315
2	SH- 4 Km 28.315 – Km 56.170	27.855
3	SH-4 Km 56.170 - Km 129.385	73.215

Analysis

The collected data were analysed to get total daily traffic for the number of days during which Classified Traffic Volume Survey at each count station. The data analysis was calculated in terms of hourly traffic volumes, total PCU's values, traffic composition, Average Daily Traffic (ADT) and mode wise distribution of traffic. The analysis is represented in the form of Bar Charts, Pie Charts and other various graphical forms.

Factors for Seasonal Variation

The seasonal variation in traffic occurs due to various reasons such as higher traffic during harvest and festival seasons, lower traffic during rainy season etc. Estimation of seasonal variation factors requires time series traffic count data on a monthly basis.

Seasonal variation factor, which is the ratio of the traffic for a particular month of the year to the average monthly traffic for that year, was not available. Seasonal correction factor, which is used to moderate the traffic observed in any month of the year to AADT by multiplying the observed traffic with the factor, is the inverse of the seasonal variation factor. In absence of time series data, it was decided to obtain data for the district. The data suggests the month of February as an average month.

A seasonal correction factor of 1.2 is applied to arrive at AADT.

Traffic Surveys

Traffic Survey Locations for Classified Volume Count

Station	Section	Location (Survey Chainage)	Remarks
1	SH-4 Km 0.00 – Km 28.315	Km -15.310 Near Lailad	7 Days
2	SH- 4 Km 28.315 – Km 56.170	Km 39.800 Near Khongjoy	7 Days
3	SH-4 Km 56.170 - Km 129.385	Km 137.664 Near Bhagmara	7 Days

Classified Traffic Volume Count

In order to assess the variation of traffic levels and traffic composition over the week, traffic surveys were conducted continuously for one-week duration. The survey was carried out 24 hrs for one week using the structured proforma given in the SP: 19 - 21.

The traffic was broadly grouped into Fast Moving Vehicles and Slow Moving Vehicles. Further the fast moving vehicles have been classified into Cars/Jeeps, Two wheelers, three wheelers, Buses (Mini & Full), Trucks and Agricultural Tractors. Slow Moving Vehicles are Cycles, Cycle Rickshaws and Animal Drawn Vehicles.

The surveys were conducted using well-trained enumerators, under the supervision of Traffic and transportation professionals. These surveys were normally conducted during dry weather conditions.

The primary objectives of the traffic count were to:

- Determine the motorised and non-motorised traffic volumes along the corridor.
- Determine Average Daily Traffic
- Determine the distribution of traffic during peak and non-peak hours.
- Establish the mode wise distribution.
- Determine the current traffic pattern on the project road

Traffic Volume counts was carried out for both directions separately. Two enumerators in three shifts were deployed and an experienced supervisor was kept in charge of each location. Three locations were identified,

Traffic Count Period

The traffic surveys were conducted in the month of July 2011

Recommended PCU values for different Types of Vehicles

Sn	Vehicle Type	Equivalency Factor
	Fast Vehicles	
1	Motor Cycle or Scooter	**0.50**

2	Car/Jeep, Van/Taxi or auto-rickshaw	**1.00**
3	Agricultural Tractor, LCV	**1.50**
4	Truck or Bus	**3.00**
5	Truck -Trailer, Agricultural Tractor-Trailer Unit	**4.50**
	Slow Vehicles	
6	Cycle	**0.50**
7	Cycle Rickshaw	**2.00**
8	Hand Cart	**3.00**
9	Horse -Drawn Cart	**4.00**
10	Bullock/Camel Cart	**8.00**

Different classes of vehicles which were obtained from the field surveys were converted into Passenger Car Units (PCU's) by using the PCU factors given in IRC:64-1979 "Guidelines for Capacity of Roads in Rural Areas".

Data Tabulation and result interpretation

The survey data collected have been tabulated hourly at three locations.

The tabulations also give traffic in Passenger Car Units (PCU's) per day for the survey locations. The survey data attached as under:

Daily Traffic Count	Station No.1 Km 15.310	
Daily Traffic Count	Station No.2 Km 39.800	
Daily Traffic Count	Station No.3 Km 137.664	
ADT and CVPD	Station Km 15.310	Annexure-1
ADT and CVPD	Station Km 39.800	Annexure-2
ADT and CVPD	Station Km 137.664	Annexure-3

ANALYSIS OF TRAFFIC VOLUME

Traffic volume count survey has been carried out for location for seven days X 24 hours. Seasonal variation of 20% is added to achieve the Design Traffic Volume. Variation is based on the high volume during tourist season.

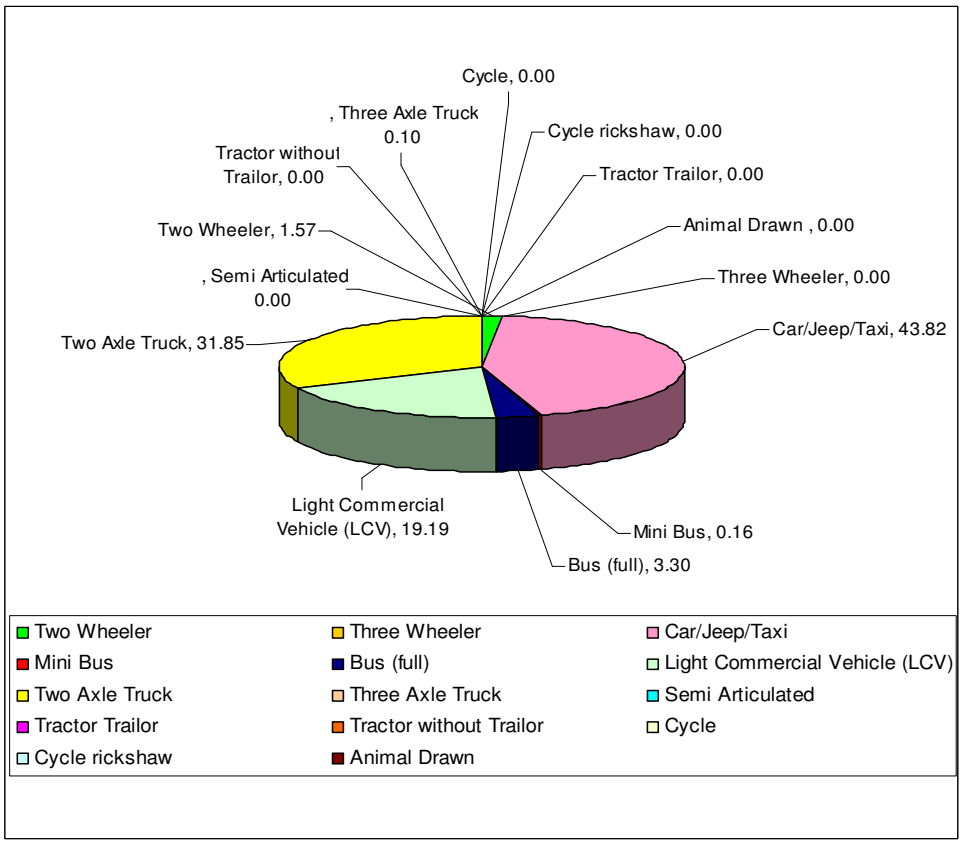
Sn	Traffic Count Location		PCU	CVPD
	Survey Chainage	Designed Chainage		
1	Km 15.310	14.490	590	95
2	Km 39.800	36.660	456	138
3	Km 137.664	129.385	1196	204

Traffic Composition:

The Graphical Average Traffic Composition for the count station is detailed under:

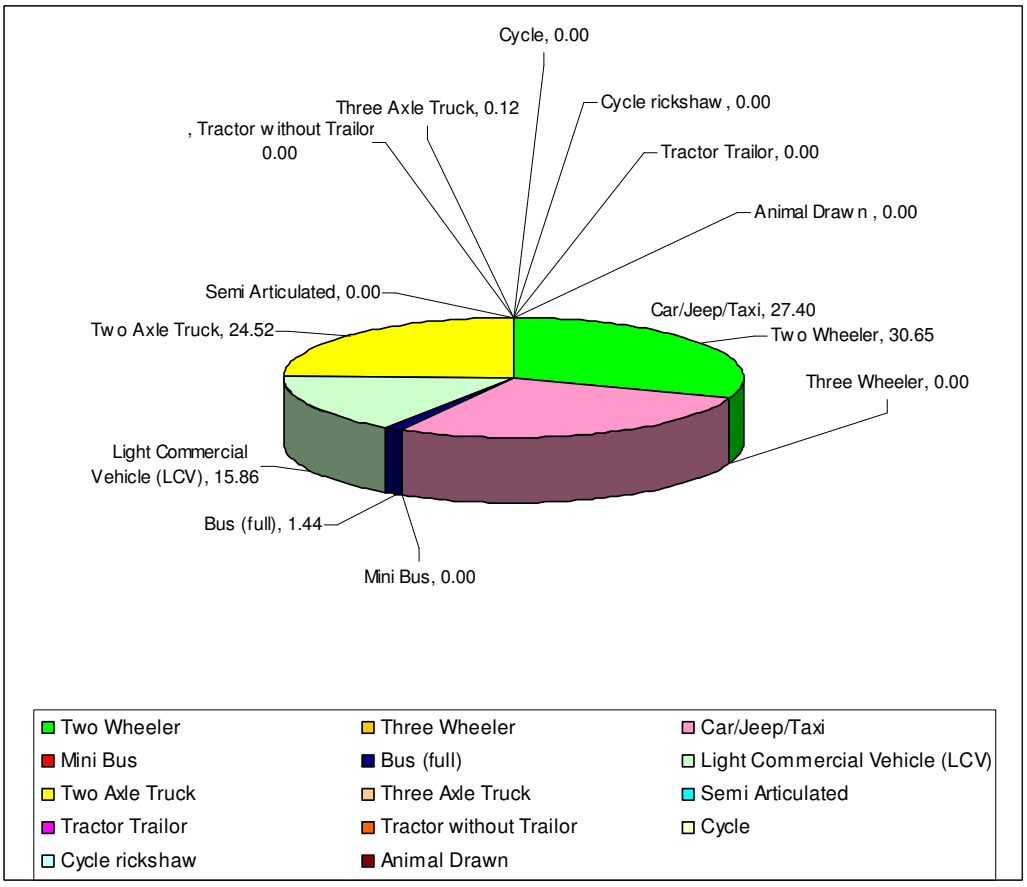
Km 15.310 (Survey Chainage) Count Station-1

Graphical Representation of Average Traffic			
Sl.No.	**Type of Vehicle**	**Average Traffic (UP & DOWN)**	**Percentage (%)**
1	Two Wheeler	5	1.57
2	Three Wheeler	0	0.00
3	Car/Jeep/Taxi	143	43.82
4	Mini Bus	1	0.16
5	Bus (full)	11	3.30
6	Light Commercial Vehicle (LCV)	63	19.19
7	Two Axle Truck	104	31.85
8	Three Axle Truck	0	0.10
9	Semi Articulated	0	0.00
10	Tractor Trailor	0	0.00
11	Tractor without Trailor	0	0.00
12	Cycle	0	0.00
13	Cycle rickshaw	0	0.00
14	Animal Drawn	0	0.00
	Total (1 to 14)	**327**	**100.00**



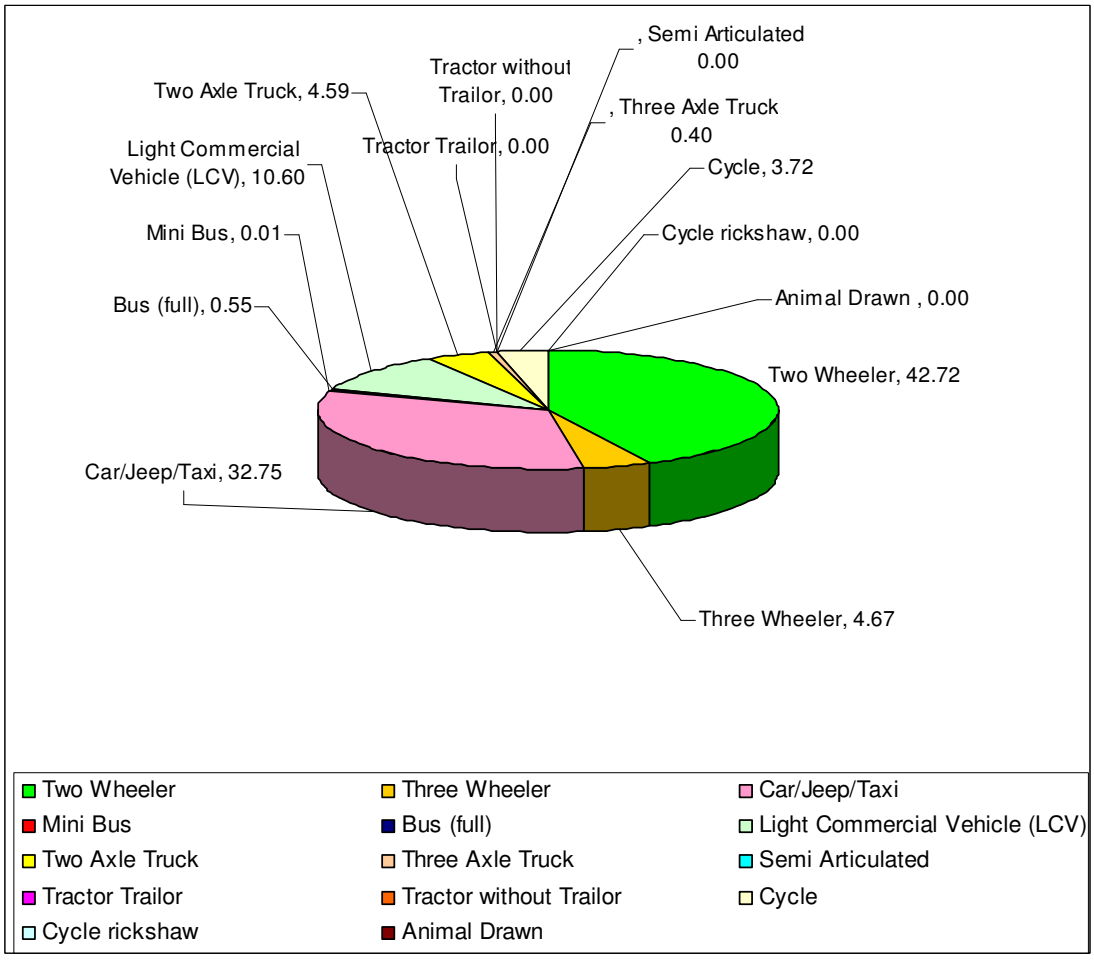
Km 39.800(Survey Location) Count Station 2

Sl.No.	Type of Vehicle	Average Traffic (UP & DOWN)	Percentage (%)
1	Two Wheeler	85	30.65
2	Three Wheeler	0	0.00
3	Car/Jeep/Taxi	76	27.40
4	Mini Bus	0	0.00
5	Bus (full)	4	1.44
6	Light Commercial Vehicle (LCV)	44	15.86
7	Two Axle Truck	68	24.52
8	Three Axle Truck	0	0.12
9	Semi Articulated	0	0.00
10	Tractor Trailor	0	0.00
11	Tractor without Trailor	0	0.00
12	Cycle	0	0.00
13	Cycle rickshaw	0	0.00
14	Animal Drawn	0	0.00
	Total (1 to 14)	**277**	**100.00**



Km 137.664(Survey Location) Count Station-3

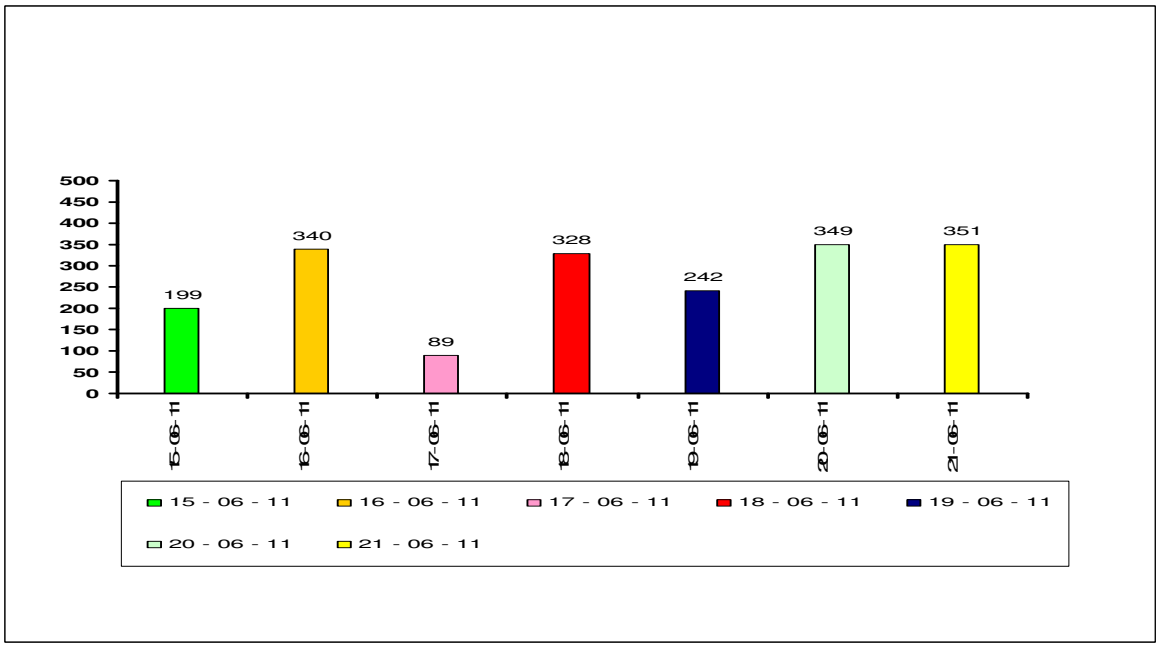
Sl.No.	Type of Vehicle	Average Traffic (UP & DOWN)	Percentage (%)
1	Two Wheeler	540	42.72
2	Three Wheeler	59	4.67
3	Car/Jeep/Taxi	414	32.75
4	Mini Bus	0	0.01
5	Bus (full)	7	0.55
6	Light Commercial Vehicle (LCV)	134	10.60
7	Two Axle Truck	58	4.59
8	Three Axle Truck	5	0.40
9	Semi Articulated	0	0.00
10	Tractor Trailor	0	0.00
11	Tractor without Trailor	0	0.00
12	Cycle	47	3.72
13	Cycle rickshaw	0	0.00
14	Animal Drawn	0	0.00
	Total (1 to 14)	**1264**	**100.00**



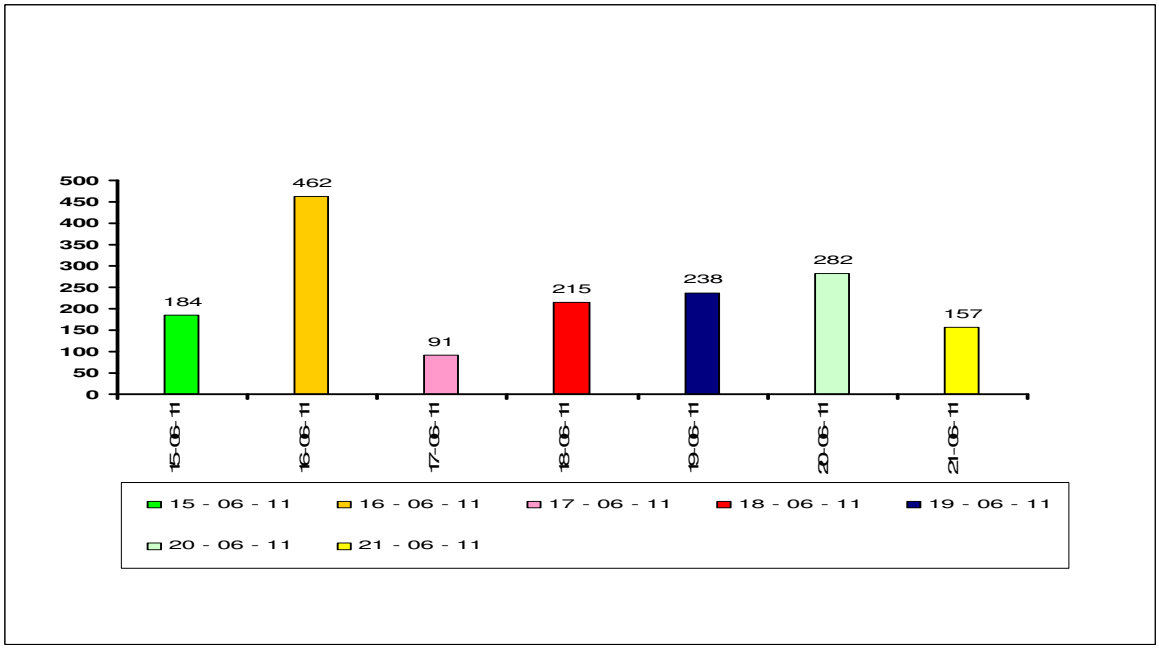
Daily Variation of Traffic:

The Daily Variation of Traffic for three count stations is detailed under:

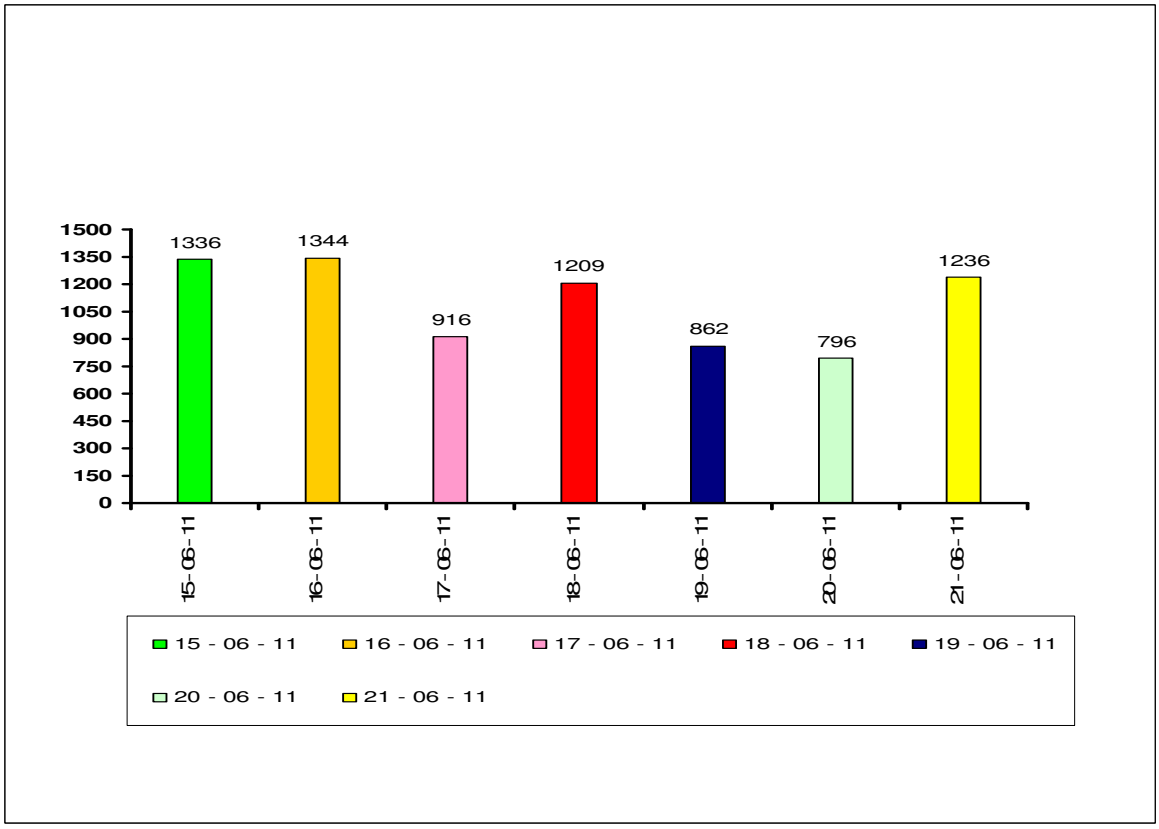
Km 14.190 Near Lailad



Km 37.660 Near Knongjoy



Km 129.385 Near Baghmara



Summary of Analysis

Traffic Volume at Km 14.490

- Total PCU : 590
- Total PCU Up (Towards Nonghllam) : 311
- Total PCU Down (Towards Ranikor) : 279
- Total CVPD : 179
- Total CVPD Up (Towards Nonghllam) : 95
- Total CVPD Down (Towards Ranikor) : 84
- The percentage of the passenger vehicles is much higher than the commercial vehicles.
- Passenger cars and two wheelers form a major portion of the passenger vehicles.

Traffic Volume at Km 37.660

- Total PCU : 456
- Total PCU Up (Towards Maheshkhola) : 231
- Total PCU Down (Towards Nonghyallam) : 225
- Total CVPD : 138
- Total CVPD Up(Towards Maheshkhola) : 70
- Total CVPD Down (Towards Nonghyallam) : 68

- The percentage of the passenger vehicles is much higher than the commercial vehicles.
- Passenger cars and two wheelers form a major portion of the passenger vehicles.

Traffic Volume at Km 129.385

- Total PCU : 1196
- Total PCU Up (Hnahthial to Hrangchal Kawn) : 574
- Total PCU Down (Hrangchal Kawn to Hnahthial) : 622
- Total CVPD : 204
- Total CVPD Up (Hnahthial to Hrangchal Kawn) : 101
- Total CVPD Down (Hrangchal Kawn to Hnahthial) : 103

- The percentage of the passenger vehicles is much higher than the commercial vehicles.
- Passenger cars and two wheelers form a major portion of the passenger vehicles.

Travel Pattern & Composition

Travel Pattern

An understanding of the travel pattern is key to transportation planners, researchers, engineers and policy analysts. The travel patterns relates to the changes in directionality, purpose, mode and time of the trip. Traffic counts, which directly measure volumes, are a more accurate measure of traffic pattern on specific facilities.

The traffic scenario at all the three Section is influenced by the local traffic. Cars and 2-wheelers form an important means of traffic in this region. As observed from the figures shows the hourly variation at the count location, traffic is more during the morning hours

Traffic Composition

Table gives composition of traffic in each of the traffic survey locations in percentages.

Typical Composition of Traffic

Count Station N0. 1

Table – A

Vehicles	Km 0.000 to Km 28.315Km	
	Vehicles	Percentage
Two wheelers/Cars and light vehicles	148	45.12
Buses	13	3.96
LCV/2 Axle/3 Axle/ Semi Articulated	167	50.92
Total	328	100
Percentage of fast moving vehicles	100	
Percentage of slow moving vehicles	0.00	

Count Station N0. 2

Table – B

Vehicles	Km 28.315 to Km 56.170	
	Vehicles	Percentage
Two wheelers/Cars and light vehicles	161	58.12

Buses	4	1.44
LCV/2 Axle/3 Axle/ Semi Articulated	112	40.43
Total	277	100
Percentage of fast moving vehicles	100	
Percentage of slow moving vehicles	0.00	

Count Station N0. 3

Table – C

Vehicles	**Km 56.170 to Km 129.385**	
	Vehicles	**Percentage**
Two wheelers/Cars and light vehicles	1013	80.46
Buses	7	0.56
LCV/2 Axle/3 Axle/ Semi Articulated	192	15.25
Cycle / Annimal Drawn Vehicles	47	3.73
Total	1259	100
Percentage of fast moving vehicles	96.37	
Percentage of slow moving vehicles	3.73	

From traffic volume counts supplemented by Table-A, B, C the following observations can be made,

(i) There are large numbers of 2-wheelers using the road (40-50%). Slow moving traffic contribution is minimal

(ii) The Traffic is dominated by the passenger vehicles (cars and two wheelers).

(iii) The heavy vehicle traffic is very minimal as compared to the passenger traffic.

Traffic Design:

- Traffic Volume (2010)

The Project Road is designed for the following traffic.

S.No	Section	ADT (PCU)	CVPD
1	Km 0.000 to Km 28.315	590	179
2	Km 28.315 to Km 56.170	456	138
3	Km 56.170 to 129.385	1196	204

- **Traffic Growth Rate**

Growth rate of 7.5% is adopted.

Chapter – 6

Preliminary Design and Drawings

CHAPTER – 6

PRELIMINARY DESIGN AND DRAWINGS

PRELIMINARY DESIGN AND DRAWINGS

Designing the Project is covered under the following headings:

6.(a) Alignment Study
6.(b) Roadway Design
6.(c) Pavement Design
6.(d) Culverts
6.(e) Bridges
6.(f) Drainage
6.(g) Junction / Intersections
6.(h) Truck Lay byes
6.(i) Slope Protection Works
6.(j) Road Safety, Road Side Furniture and Miscellaneous Works

Work Content

Project Design covers following distinct parts of the Project:

- Strengthening and widening to 2-Laning of existing SH-4.
- Realigning of steep gradient stretches
- Short realignment to improve road geometries.
- Rehabilitation of landslide/sinking areas.
- Drainage system including CD works
- Road safety structures

Project Road

- **Start Point** : Nongjri (Design Ch.30.00/ Existing Ch. 31.700)
- **End Point** : Maheshkola (Design Ch. 55.525/ Existing Ch. 59.270)
- **Length** : - Designed Length : Km 25.525
  - Existing Length : Km 27.570

6. (a) ALIGNMENT STUDY

Approach

Alignment study is the most important part of the Project. It is a derivation of the comprehensive study of various technical facets of the project road. It also takes into account the development works to be undertaken. After study of these aspects, the changes or amendments to the alignment are incorporated to define the development corridor for engineering design.

2-Laning Km 30 – Km 55.525

The existing road stretch is single lane road with town/village portions widened. The existing road length is Km 31.700 to Km 59.270. The road length after design comes to Km 0.000 to Km 129.385.

The project road is to be strengthened and widened to 2-lane standard and specifications. The route alignment is examined for upgradation works to meet the desired standard

Studies

Following studies have been carried out as part of survey and investigations. These have been applied for engineering for alignment finalisation:

- Road inventory
- Inventory of culverts
- Inventory of Bridges & other Structures
- Road condition Survey
- Bridge Condition Survey
- Pavement investigation: Composition
- Alignment Survey
- Road Bad / damaged pavement – Impact on alignment
- Initial Environmental Screening
- Resettlement / Social issues
- Utility Services Survey

General Study of Existing Corridor

Existing Road Alignment

The Project Road is very old line of communication in this area and has served the region for connecting places.

The alignment is serving the connectivity places. No additional detouring for additional places is contemplated.

The existing road alignment has poor geometrics standard. There are sharp curves, steep gradients and narrow road width.

Condition of carriageway (pavement) is poor and at many places completely damaged.

Shoulders of road are more or less non-existent.

Drainage system is damaged and non-functional.

Villages Connectivity

The Project Road connects the following villages and towns:

Sn.	Name of Habitation	Location (Km)
1	Khonjoy	37.660
2	Maheshkhola	56.170

Terrain

The road passes through hilly area.

Meteorological Features

The region experiences heavy rainfall.

The area is windy.

Weather experiences low temperature.

Road Geometrics

The elements of road geometrics of this road are poor.

It has sharp curves which need improvement.

It has number of stretches with steep gradients which require short re-alignment and/or relocation.

Road Condition

The road condition of the existing road is poor. It is to be taken care of during up-gradation work.

- Pavement is in very poor condition
- Shoulders are damaged and more or less non-existent
- Drainage system is not functional

Rivers En route

The Project Road crosses the following Streams / Rivers enroute:-

Sn	Location (Km) (Designed Chainage)	Name of Stream / River	Proposal	Ventway Proposed (No x Span length) (m)
1	30.425	Hill Stream	New construction u/s side	1x12
2	38.562	Khonjoy	New construction u/s side	1x24
3	41.825	Hill Stream	New construction u/s side	1x12
4	43.155	Hill Stream	New construction u/s side	1x10
5	43.325	Hill Stream	New construction u/s side	1x16

6	47.185	Hill Stream	New construction d/s side	1x30
7	49.08	Hill Stream	New construction u/s side	1x10
8	49.496	Hill Stream	New construction u/s side	1x10
9	51.085	Hill Stream	New construction d/s side	1x12
10	51.25	Hill Stream	New construction u/s side	1x10
11	54.236	Hill Stream	New construction d/s side	1x10
12	54.5	Hill Stream	New construction d/s side	1x12
13	55.485	Maheshkhola	Widening is not possible (New construction in u/s side)	2x38.5

Drainage

Drainage system (existing) is not satisfactory.

Project Packages

With the approval of PWD (NH), Meghalaya, construction of the Project will be divided into five packages as under :

Package	Design Chainage		Length(Km)
	From (Km)	To (Km)	
I	0+000	30+000	33+250
II	**30+000**	**55+525**	**25+525**
III	55+525	80+500	23+705
IV	80+500	112+300	31+800
V	112+300	129+385	17+085
Total(Km)			**131+365**

ALIGNMENT DESIGN : IMPACT OF UP-GRADATION WORKS

Study has been carried out for the development and up-gradation works of the projects which are likely to impact the alignment of the road corridor and change in the present centerline. The status of up-gradation works which are likely to impact the road alignment are as under:

- Impact of Narrow Corridor
- Impact of Geometric improvement.
- Impact of Relocation of utilities
- Impact of bypasses

The above aspects are likely to impact the road corridor and the present centerline. These are discussed as under :

- **Impact of Narrow Corridor**

Existing road is narrow. It is proposed to be brought to 2-Lane standard and specifications.

- **Impact of Geometric Improvement**

The existing road follows the natural line of communication (LOC) and has served the region. At places, it has sharp curves, sub-standard curvature, steep gradients, inadequate sight distance, inadequate super-elevation, no transition in between curves etc.

More so the centre line of the road will shift with the widening of the road in its full stretch. In order to widening such stretches, the alignment survey of the entire road has been carried out and plotted. The survey drawing is placed on the design on the route to the satisfaction of IRC standards. Portions with steep gradients are designed for regrading and/or short relocation. The stretches requiring short realignment (New construction) are shown in the strip plan placed in Chapter No seven (7).

- **Impact of relocation of utility services**

  Relocation of utility survey is not a major issue on the road. There is no location which warrants change/amendment to the route alignment

- **Impact of Bypasses and Short Realignment**

  No bypass is proposed. Short realignments and small relocation are necessitated for geometric improvement.

Alignment Plan

The Proposed Road will follow the existing alignment except the following up-gradation works:

- New construction due to Short Realignment / relocation
- New Construction due to curve improvement

Proposed alignment design is shown in the Plan and Profile volume.

- Strengthening, widening and Regrading
- New construction due to Geometric Improvement

Design of Alignment

Detailed topographical Survey has been carried out.

The design of Plan and Profile is based on detailed survey data. These are placed in drawing volume.

The summary of design is as under :

	Name of Work	Remarks (Chainage : Km 30.000 to Km 55.525)
1	Widening	7.1 km

2	New-Construction	6.22 km
3	Box-Cut	11.380 km
4	Built-up	0.825 km

6. (b) ROADWAY DESIGN

2-Lane

- Road is designed for Roadway width of 10.000 m
- Preliminary design is on the basis of the alignment survey. It will be fine tuned based on detailed topographical data and cross-sections.
- Preliminary alignment plans along with road profile of the proposed road are attached in the Volume IV (a) – Drawings: Road Works.
- Preliminary design follows the standards specified in IRC:SP:48 1998.
- Design Speed is : Ruling : 40 Km/hr; Minimum : 30 Km/hr
- The speed and radius of curvature in village / town are modified lowered to avoid heavy cutting, relocation of settlement, environmental and social problems etc.
- Some stretches, particularly the village / towns will be amended to accommodate within the available space.
- Consequent to improvement of geometric some box-cut are incorporated.
- Space / hill face between the realignment closer to existing road, the space or features between the two will be knocked off

Design Categories

Roadway of 10.00 m consists of the following categories:

- Widening of Existing Single Lane Road to Double Lane.
- New construction at short realignment /relocation for geometric improvement.

Road Stretches

The road stretches are given in the Plan and Profile drawings placed in Drawing volume.

Design Factors

The roadway design factors are tabulated below

• Total road width	:	10.000 m
• Earthen Shoulder hill side (including drain)	:	1 x 1.5 m
• Earthen Shoulder Valley side	:	1 x 1.5 m
• Angle of Hill cutting		Average 60°
• Average height of cutting	:	10.0 m
• Soil classification of hill cutting	:	Attached
• ROW	:	24.000 m
• Length	:	129.385 Km

Drawings

The Typical Cross sections of roadway are placed in the Drawing Volume and Technical Schedule Volume.

Hill Cutting Slope

Formation width (Roadway width) is achieved by hill side cutting. Hill soil/rock identification has been carried out. The soil classification is placed as under :

Soil Classification
Road Sector From Km 31.700 (Nongjri) To Km 59.270 (Maheshkhola)

S/no	Location in km (Survey Chainage)		Soil classification in %				Soil	Angle of side slope	Remarks
	From	To	OS/ SMB	SR	HR	Total			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	31.700	34.000	60	35	05	100	SMB	50	-do-
2	34.000	36.000	80	20	-	100	SMB	45	-do-
3	36.000	39.000	-	15	85	100	HR	20	Left side
4	39.000	39.300	**Rolling**						Khonjoy
5	39.300	40.690	05	15	80	100	HR	35	Left side
6	40.690	40.720	**Gap of Khonjoy River**						-
7	40.720	41.200	80	20	-	100	SMB	25	Right side
8	41.200	41.230	**Saddle**						Near Khonjoy Dispensary
9	41.230	41.400	60	30	10	100	SMB	45	Left side
10	41.400	41.880	-	20	80	100	HR		Right side
11	41.880	41.940	**Saddle**						Near Junction of Bagli
12	41.940	43.150	80	15	05	100	SMB	60	Left side
13	43.150	44.200	-	15	85	100	HR	15	-do-
14	44.200	50.000	80	15	05	100	SMB	50	Left side
15	50.000	56.000	80	20	-	100	SMB	45	Right side
16	56.000	58.000	85	15	-	100	SMB	45 degree	-do-
17	58.000	59.080	15	80	05	100	SR	65 degree	Left side
18	59.080	59.195	**PLAIN**						**EMBANKMENT**
19	59.195 to 59.270	**Gap Of Maheshkhola Bridge**							

6. (c) PAVEMENT DESIGN

Homogeneous Sections:

Sn	Section	Terrains	Classification of Hill Formation	Traffic Count Station (Designed Chainage)
1	Nonjri to Maheshkhola Designed Chainage : 30.00 – 55.525	Hilly and rolling	Hard and SMB 80% and 60%.	Ch. 37.660

Basis of Homogenous Section

Traffic Scenario

- The traffic on the sector is limited due to poor condition of road pavement and geometrics.
- Limited connectivity of the road sectors result in low flow of traffic.
- The road section from 13th Km to Nonghyllam 29th KM) is infested with heavy coal mining. It is congested and has high volume of local traffic for coal mining.
- Connecting roads in above sector blocks the main axis.
- Heavy vehicle in other sub sectors are less.
- Mostly taxis and trucks for coal transportation are using the road.
- There is potential of increase in traffic ones the road is rehabilitated/upgraded.

Road Condition

- It is a single lane hill road passing through thick jungle area.
- The road passes mostly through hard rock area.
- The pavement condition is poor and has to be reconstructed, widened and strengthened.
- Road geometry is poor with practically no camber/cross fall.
- Bridges are in poor condition.
- Many bridges are non-existence.
- Culverts are inadequate in number. Most of the culverts are block, choked.
- There are two slide zones one is developed as stone quarry area.
- Road safety structures are highly inadequate.

Traffic Volume Count

Traffic Volume Count Survey is carried out at locations specified hereunder :

Name of Location	Road	Count (Survey Chainages) (Km)	Designed Chainage	Traffic)
Lailad, Meghalaya	SH-4	15.310	14.490	Ranikor to Nonghyllam
Khongjoy, Meghalaya	SH-4	39.800	37.660	Nonghyllam to Maheshkhola
Baghmara, Meghalaya	SH-4	137.664	129.385	Maheshkhola to Baghmara

Design Traffic Volume

Section No	Section Designed Chainage)	ADT(PCU)	CVPD
1	Km 0.00 to Km 28.315	590	179
2	Km 28.315 to Km 56.170	456	138
3	Km 56.170 to Km 129.385	1196	204

Section-2 : Pavement design 2-Laning of SH 4, Km 28.315– Km 56.170

Design Traffic Volume

Total PCU	456
Total PCU UP	231
Total PCU Down	225
Total CVPD UP	70
Total CVPD Down	68
Total CVPD	138

Laning Design

Category A-i:- 2-Lane New Road with earthen shoulder on short realignments

Category A–ii**:** 2- Lane strengthening Widening and regrading road wit earthen shoulder

Category-I is for New Road construction.

Category–II: is for strengthening widening and regrading of the existing road portion. In actual implementation, the existing pavement will be fully damaged or regraded for widening and gradient correction. The residual road will be utilized as sub-grade

Therefore the pavement will be new carriageway for the entire stretch.

Traffic Growth Rate

Growth rate of 7.5% is adopted.

Traffic Design Life

Traffic Design Life of 15 years is adopted.

Construction Period

Three years of construction period is adopted.

CBR

CBR on average basis is 8%.

Design Proposal From Km 30.00 to Km 55.525

For Km 30.00 to Km 55.525 Flexible pavement comes as per Design No. 2 as under :

BC : 40 mm
DBM : 150 mm
CTSB : 200 mm

Earthen Shoulder : 2 x 1.50 metre

Pavement : in 7m width

Shoulders

Keeping in view the Traffic Volume and its growth in 15 years, it is proposed to provide Earthen Shoulder 2 x 1.5 m

Earthen Shoulder on Valley side includes crash barrier, parapet wall, etc.

Earthen Shoulder on hill side includes road side drain.

6. (d) CULVERTS

Sector-I has facility of casting of Hume Pipes. Therefore, it was decided in the meeting with the PWD, Meghalaya to adopt design as under :

PACKAGE II (Nongjri to Maheshkhola)

Km 30 to Km 55.525					
S. no	**Type of Culvert**	**Size of Culvert**	**Reconstruction (Nos)**	**New Construction (Nos)**	**Total**
1	**SRHP**				
		1 x 1.0	62	17	**79**
		1 x 1.2	62	26	**88**
2	**DRHP**				
		2 x 1.0	0	2	**2**
3	**RCC Box Culvert**				
		3 x 3	2	2	**4**
		4 x 2	1	0	**1**
		6 x 3	6	1	**7**
	Total		**133**	**48**	**181**

Package – II : Culverts on SH-4 for the road sector from Km 30 to Km 55.525

Details of the Culverts are as under

PACKAGE II

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
1	32.46	30.76	Slab	1 x 1.00	Fair	1x1.0m SRHP	
2	33.25	31.545	Slab	1 x 0.60	Fair	1x1.0m SRHP	
3	34.61	32.81	Slab	1 x 1.00	Fair		1x1.0m SRHP
4	34.74	32.92	Slab	1 x 1.00	Fair	1x1.0m SRHP	
5	35.07	33.175	Slab	1 x 2.00	Fair		2x1.0m DRHP
6	35.305	33.34	Slab	1 x 1.00	Fair	1x1.0m SRHP	
7	35.41	33.445	Slab	1 x 1.00	Fair	1x1.0m SRHP	
8	35.48	33.525	Slab	1 x 1.00	Fair	1x1.0m SRHP	
9	35.62	33.655	Slab	1 x 2.00	Fair		2x1.0m DRHP
10	36.215	34.22	Slab	1 x 1.00	Fair	1x1.0m SRHP	
11	36.43	34.42	Slab	1 x 1.00	Fair	1x1.0m SRHP	
12	36.47	34.47	Slab	1 x 1.00	Fair	1x1.0m SRHP	
13	36.61	34.58	Slab	1 x 1.00	Fair	1x1.0m SRHP	
14	37.13	35.1	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
15	37.42	35.38	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
16	37.49	35.45	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
17	37.86	35.83	Slab	1 x 1.00	Fair	1x1.0m SRHP	
18	38.01	35.97	Slab	1 x 1.00	Fair	1x1.0m SRHP	
19	38.05	36.01	Slab	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
20	38.15	36.1	Slab	1 x 1.00	Fair	1x1.00m SRHP	
21	38.24	36.195	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
22	38.41	36.365	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
23	38.73	36.675	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
24	38.78	36.73	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
25	38.88	36.825	Slab	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
26	38.93	36.882	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
27	39.02	36.965	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
28	39.11	37.05	Slab	1 x 0.90 dia	Fair	1x1.0m SRHP	
29	39.35	37.25	HP	1 x 1.00	Fair	1x1.0m SRHP	
30	39.39	37.29	HP	1 x 1.00	Fair		1x1.0m SRHP
31	39.47	37.34	HP	1 x 0.90 dia	Fair	1x1.0m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
32	39.56	37.425	Slab	1 x 1.00	Fair	1x1.0m SRHP	
33	39.68	37.54	Slab	1 x 1.00	Fair	1x1.0m SRHP	
34	40.05	37.92	HP	1 x 1.00	Fair	1x1.0m SRHP	
35	40.12	37.985	Slab	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
36	40.17	38.035	HP	1 x 0.90 dia	Fair	1x1.0m SRHP	
37	40.47	38.332	HP	1 x 0.90 dia	Fair	1x1.0m SRHP	
38	40.52	38.375	HP	1 x 0.90 dia	Fair	1x1.0m SRHP	
39	40.57	38.415	HP	1 x 2.50	Inadequate		1x3.0x3.0
40	40.74	38.64	HP	1 x 0.90 dia	Fair		1x1.0m SRHP
41	40.795	38.688	HP	1 x 0.90 dia	Fair	1x1.0m SRHP	
42	40.81	38.7	Slab	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
43	40.9	38.795	Slab	1 x 1.00	Fair		1x1.0m SRHP
44	40.97	38.855	HP	1 x 1.00	Fair	1x1.0m SRHP	
45	41.32	39.15	Slab	1 x 1.00	Fair	1x1.0m SRHP	
46	41.83	39.662	Slab	1 x 1.00	Fair	1x1.0m SRHP	
47	41.95	39.79	Slab	1 x 1.00	Fair		1x1.0m SRHP
48	41.985	39.815	HP	1 x 1.00	Fair	1x1.0m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
49	42.045	39.88	HP	1 x 5.70	Fair	1x6x3 Box culvert	
50	42.14	39.97	HP	1 x 1.00	Fair	1x1.0m SRHP	
51	42.2	40.02	HP	1 x 1.00	Fair		1x1.0m SRHP
52	42.26	40.065	Slab	1 x 1.00	Fair	1x1.0m SRHP	
53	42.28	40.08	HP	1 x 1.00	Fair	1x1.0m SRHP	
54	42.34	40.135	HP	1 x 0.60	Fair	1x1.0m SRHP	
55	42.475	40.265	Slab+HP	1 x 1.00	Inadequate	1x1.20m SRHP	
56	42.65	40.44	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
57	42.835	40.625	HP	1 x 1.00	Inadequate	1x1.20m SRHP	
58	43.435	41.21	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
59	43.55	41.33	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
60	43.64	41.415	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
61	43.74	41.52	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
62	43.8	41.58	-do-	1 x 0.60	Inadequate	1x1.20m SRHP	
63	43.97	41.755	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
64	44.01	41.79	-do-	1 x 1.00	Inadequate		1x1.20m SRHP

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
65	44.21	42	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
66	44.375	42.13	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
67	44.465	42.225	-do-	1 x 1.00	Inadequate		1x1.20m SRHP
68	44.67	42.37	-do-	1 x 1.00	Inadequate	1x1.20m SRHP	
69	44.825	42.56	-do-	1 x 1.00	Inadequate		1x1.20m SRHP
70	44.875	42.595	HP	1 x 0.90 dia	Fair		1x1.0m SRHP
71	44.99	42.69	Slab	1 x 1.00	Fair		1x1.20m SRHP
72	45.075	42.745	-do-	1 x 1.00	Fair	1x1.20m SRHP	
73	45.185	42.855	-do-	1 x 1.00	Fair	1x1.20m SRHP	
74	45.31	42.97	Wooden cul	1 x 5.50	Inadequate	1x6x3 Box culvert	
75	45.385	43.045	Slab	1 x 1.00	Fair		1x1.0m SRHP
76	45.42	43.07	Wooden cul	1 x 3.00	Fair		1x3.0x3.0
77	45.82	43.5	Slab	1 x 1.00	Fair	1x1.0m SRHP	
78	45.9	43.585	-do-	1 x 1.00	Fair	1x1.0m SRHP	
79	45.965	43.645	Wooden cul	1 x 2.90	Inadequate	1x3.0x3.0	
80	46.145	43.82	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
81	46.24	43.91	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
82	46.45	44.12	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
83	46.53	44.185	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
84	46.58	44.23	HP	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
85	46.79	44.43	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
86	46.86	44.485	HP	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
87	46.99	44.63	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
88	47.09	44.72	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
89	47.82	45.28	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
90	48.075	45.51	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
91	48.355	45.8	HP	1 x 0.90 dia	Inadequate		1x1.00m SRPH
92	48.42	45.855	HP	1 x 0.90 dia	Inadequate		1x1.00m SRPH
93	48.44	45.882	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
94	48.645	46.115	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
95	48.855	46.22	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
96	48.925	46.295	wooden	1 x 6.00	Inadequate	1x6x3	
97	48.97	46.38	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
98	49.025	46.435	HP	1 x 0.90 dia	Inadequate		1x1.00m SRPH

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
99	49.07	46.475	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
100	50.12	47.45	HP	1 x 0.90 dia	Inadequate	1x1.00m SRPH	
101	50.22	47.55	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
102	50.26	47.58	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
103	50.275	47.595	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
104	50.315	47.645	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
105	50.45	47.75	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
106	50.58	47.798	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
107	50.695	47.915	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
108	50.94	48.125	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
109	51.38	48.45	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
110	51.49	48.535	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
111	51.855	48.83	HP	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
112	51.94	48.92	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
113	52.015	48.99	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
114	52.04	49.052	Slab	1 x 1.00	Inadequate		1x1.20m SRHP

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
115	52.18	49.165	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
116	52.315	49.225	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
117	52.36	49.28	HP	1 x 0.90 dia	Inadequate	1x1.0m SRHP	
118	52.505	49.39	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
119	52.57	49.48	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
120	52.73	49.67	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
121	52.9	49.83	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
122	53	49.935	Wooden Cul	1 x 5.60	Inadequate	1x6x3	
123	53.03	49.965	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
124	53.075	50.02	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
125	53.23	50.15	Slab	1 x 2.50	Inadequate	1x3.0x3.0	
126	53.295	50.218	HP	1 x 0.90 dia	Inadequate	1x1.0m SRPH	
127	53.4	50.29	HP	1 x 0.90 dia	Inadequate	1x1.0m SRPH	
128	53.48	50.355	HP	1 x 0.90 dia	Inadequate		1x1.0m SRPH
129	53.54	50.418	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
130	53.63	50.475	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
131	53.86	50.695	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
132	54	50.83	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
133	54.035	50.87	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
134	54.16	50.95	Wooden Cul	1 x 5.90	Inadequate	1x6x3	
135	54.54	51.36	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
136	54.63	51.445	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
137	54.77	51.545	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
138	54.785	51.573	HP	1 x 0.90 dia	Inadequate		1x1.0m SRPH
139	54.88	51.66	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
140	54.9	51.677	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
141	55.175	51.805	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
142	55.225	51.86	Slab	1 x 0.60	Inadequate		1x1.0m SRHP
143	55.39	52.005	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
144	55.41	52.02	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
145	55.59	52.135	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
146	55.618	52.16	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
147	55.72	52.252	Slab	1 x 0.60	Inadequate	1x1.0m SRHP	
148	55.765	52.29	Slab	1 x 0.60	Inadequate		1x1.0m SRHP

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
149	55.788	52.32	Slab	1 x 0.50	Inadequate	1x1.0m SRHP	
150	55.82	52.355	Slab	1 x 0.50	Inadequate	1x1.0m SRHP	
151	55.9	52.43	Slab	1 x 0.50	Inadequate		1x1.0m SRHP
152	55.99	52.518	Slab	1 x 0.50	Inadequate	1x1.0m SRHP	
153	56.06	52.575	Slab	1 x 0.50	Inadequate		1x1.0m SRHP
154	56.105	52.618	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
155	56.135	52.655	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
156	56.275	52.76	Wooden Cul	1 x 4.30	Inadequate	1x6x3 Box culvert	
157	56.33	52.83	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
158	56.365	52.855	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
159	56.53	53.02	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
160	56.57	53.06	Wooden Cul	1 x 4.00	Inadequate	1x4x2	
161	56.66	53.145	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
162	56.81	53.238	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
163	56.87	53.29	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
164	56.975	53.34	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
165	57.06	53.42	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	

S.No	Location		Existing Types of Culvert (HP/Slab/Box/Arch)	Span Arrangement & Vent Height Exixting Culvert	Condition	Proposed	
	Existing	Proposed				Reconstruction	New
166	57.095	53.46	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
167	57.16	53.515	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
168	57.335	53.685	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
169	57.474	53.82	wooden	1 x 6.00	Inadequate		1x6x3 Box culvert
170	57.527	53.875	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
171	57.64	53.98	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
172	57.765	54.108	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
173	57.96	54.265	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
174	57.995	54.33	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
175	58.06	54.395	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
176	58.445	54.745	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
177	58.545	54.815	Slab	1 x 1.00	Inadequate		1x1.20m SRHP
178	58.555	54.83	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
179	58.57	54.85	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
180	58.765	55.02	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	
181	58.86	55.125	Slab	1 x 1.00	Inadequate	1x1.20m SRHP	

6.(e) PRELIMINARY STUDY AND DESIGN OF BRIDGES

Summary of Bridges

Sn.	Type of Bridge	Widening	Retention	New Construction	Reconstruction (CL will not shift)	Total No. of Bridges.
1	Minor	0	0	12	0	12
2	Major	0	0	1	0	1
	Total No. of Bridges	0	0	13	0	**13**

Conclusion : Total number of Existing Bridges on the road **Nongjri – Maheshkhola** Starting from **Nongjri** (Chainage 30.00 km) and ends at **Maheshkhola** (Chainage 55.525 km) are **13** in numbers. The detail of chainages, Type of bridges, Width, Existing condition and proposal of all the above said bridges have been given in attached list.

Category of Bridges

The Road Sector has higher requirement of Bridges and Drainage structures due to heavy rainfall, foothill location and hills / plain terrain. The bridges are (a) existing bridges (b) bridges recently constructed, (c) bridges with standards and specifications not matching to 2-lane highways, (d) new bridges and (e) rehabilitation of old bridges.

Visual Examination

Consultant have carried out our visual examination and evaluation of the data made available by the Client as well as data collected by local enquiry that the design parameter arrived at are appropriate.

Desk Study

We undertook a desk study of available data on topography, rainfall, top soil characteristic, vegetation cover, et., so as to assess hydraulic parameters for all existing and proposed drainage provision. The finding of the desk study is further supplemented and augmented by a reconnaissance along the area. All important features are noted during field reconnaissance and ground surveys.

Condition Survey of Existing Bridges

The details of the condition survey of existing bridges are placed in Chapter No.11, Annexure.

General Study of Bridges

This includes the data based on general enquiry, visual inspection, analysis of available data, and historical background in order to make assessment of hydrological behavior and design parameters. It is to lead to the conclusion with respect to:

Terrain
Rainfall and runoff
Cloud burst or such factor
Gorge / Cliff
Discharge
Velocity of flow
Scour condition
Bed slope
Stream configuration
Stability of banks

The hydrological and hydraulic study has been carried out in accordance with IRC Special Publication No. 13 (Guidelines for the design of small bridges and culverts). IRC: 5-1998 (Standard Specification & Code of Practice for Road Bridges, Section 1: General Feature of design), etc.

Formulation of Proposals

It is carried out on the basis of the following items :

- Location study
- Topographical survey
- Stream condition
- Peak flood condition
- Deck level / adequacy
- Adequacy of span
- Road, Geometric of the approaches
- Adequacy of design for smooth and comfort to the traffic
- Bridge / Road width matching to the traffic requirement and futuristic assessment
- Protection work

Details of Proposals

Designed details are placed in Volume-II : Bridges and contain the followings :

- Salient Features
- Typical Photographs
- Hydraulic study
- Preparation of Location Plan
- Preparation of General Arrangement Drawings (GAD)

Based on the above, the parameters have been identified for carrying out the study for aiming at the design parameter of the bridges.

6. (f) DRAINAGE DESIGN

Drainage System

It consists of the following works to ensure proper and adequate drainage to avoid damage to road and its components

- CD works including Culverts and Bridges

- Road side Drains
- Pavement Surface Drainage
- Catch water Drains / Intercepting Drains
- Chutes
- Catch pits

Culverts and Bridges

Theses are described in separate sub sections as under:

Culverts	Details in Chapter-6, sub-Chapter 6 (d)
Bridges	Details in Chapter-6, Sub-chapter 6 (e)

Road Side Drains

Following category is adopted

i) Rectangular RCC Covered Drains (for towns/ villages)
ii) Lined Drains (V-shaped) in open area

Requirement of Drains

The requirement has been work out and is given here under:

Summary of Drain

Package I (Km 30 to Km 55.525)

S.No	Type of Drain	Length In running Km	Remarks
1	Rectangular RCC Covered Drain	0.825 (both sides)	Provided in Built-up town areas
2	V-Shaped Lined Drain	18.129	Provided in soils & soft rock portions

Pavement Surface Drainage

It includes the disposal of all water present on the surface of the pavement and formation width. It is achieved by providing the following:

- Cross fall towards the valley side at re-entrants
- Camber to drain in the road side drains at straight reaches
- Shoulders are to be well-drained

For this design we have adopted:

- Road surface cross fall / camber -2.5%
- Shoulders -3.5%

Catch water Drains / Intercepting Drains

These are provided in landslide and sinking areas on hill slops to intercept water flowing from upper reaches and guide such flow into culverts. There are no such hazardous areas. However, these would be taken into consideration while constructing the rehabilitation of such areas.

Chutes

Lined Chutes have been provided to lead the discharge to the natural drainage channel. These are forming the part of the drawings of the culverts.

Catch pits

Catch pits are provided as part of the culverts with the purpose to channelise the flow from road side drains as well as the catch water/ intercepting drains. These form part of the culvert.

JUNCTIONS/INTERSECTION

Major Junctions

The road has four major Junctions.

Sn	Location	Type of Junction	Name of Road
NIL			

Minor Junctions

The details of the Minor Junctions are as under :

Sn	Location	Type of Junction	Side	Name of Road
1	37.996	1.100	R.S/L.S	market road
2	38.395	1.152	L.S	ODR.
3	38.545	1.430	L.S	To River
4	38.700	1.935	R.S	Chibak Village
5	39.010	2.807	L.S	To River
6	39.158	2.925	L.S	ORD.
7	39.705	3.043	L.S	Baghi Road
8	43.117	3.185	R.S	Bolkut Village
9	54.490	3.437	L.S	Ganganagar
10	55.265	3.750	R.S	Soling Village
11	55.337	4.525	L.S	IBB Road

6.(h) TRUCK LAYBYES

Proposed Truck Laybyes are as under :

Sn	Location (Designed Chainage)	Description
NIL		

6. (i) SLOPE PROTECTION WORKS

Requirement

- Hill road is formed mostly by cutting into the hill and thereby disturbing natural stability of slopes
- Water course along the slopes cause erosion affecting road stability
- Soil movement along slope tends to disturb the road formation. All these have to be effectively countered to obtain a stable road by provision of structures to act as retaining, restraining and protective structures
- Safety of traffic also needs structures to be provided on the road
- This is achieved by construction of
  - Retaining walls
  - Breast walls
  - Parapet walls
  - Railings
  - Edge stones
  - Toe walls
- Landslide Area: There is no major Landslide area / Sinking location on this road.

Summary of Slope Protection Works

Package-II : Nongjri to Maheshkhola

S. No	Type of Structure	New Construction (m)
1	**Breast Wall**	
	3.00 m height (R.R)	200
	4.00 m height (R.R)	400
	5.00 m height (R.R)	500
	6.00 m height (R.R)	600
	Total	**1700**
2	**Retaining wall**	
	1.50 m height (R.R)	740
	2.50 m height (R.R)	340
	3.00 m height (R.R)	140
	4.00 m height (R.R)	300
	6.00 m height (R.R)	720

S. No	Type of Structure	New Construction (m)
	Total	**2240**

Chapter – 7
Land,Utilities and Tree Cutting

7.(a) LAND ACQUISITION PLAN

The land requirement is marked in the Land Plans and placed in the following drawings

1	Land Plan	HOL/RMB/DDPR/10558/LP-01 to 130

The land requirement is worked out on the following conditions

- Length of road is 25.525 Kms
- Road corridor out will be 24 m
- New construction for bypass is for full corridor width of 24 m. it is taken as 9 m for center line on valley side and 15 m from centre line on hill side.
- In short realignment portions for improvement works is based on 9 m from center line on valley side and 15m from center line on the hill side. In case of jetty ledges of the hill creating box cut will be knocked off, resulting requirement of land wider than the corridor width. Same is marked in the land plan.
- In view the non availability of ROW, the existing road width is tentatively taken as the available land for calculating balance land requirement.
- Land share of government and Private is 50 : 50
- Total Land required are as per the table below

Total Land Required	61.26 Ha
Land available	13.12 Ha
Land to be acquired	48.14 Ha

7.(b) UTILITY SHIFTING : RELOCATION

i) Electrical Utility

Sr. No	Type of Utility	Unit	Quantity
A	**ELECTRICAL UTILITIES**		
A1	Shifting of 11KV lines from Nongjri to Maheshkhola		
(i)	GI Pole 14.5 m (HD) long	Nos.	17
(ii)	GI Pole 9.5 m long	Nos.	25
(iii)	ACSR Weasel Conductor	kms	5.52
(iv)	GI Wire 8 SWG (for cradle guard)	kg	765
(v)	GI Stay wire 7/14 SWG	Nos.	120
A2	Shifting of LT lines from Nongjri to Maheshkhola		
(i)	GI Pole 9.5 m long	Nos.	8

Sr. No	Type of Utility	Unit	Quantity
(ii)	GI Pole 8.0 m long	Nos.	15
(iii)	ACSR Squirel Conductor	kms	2.76
(iv)	GI Wire 8 SWG (for cradle guard)	kg	770
(v)	GI Stay wire 7/10 SWG	kg	360

ii) PHED Utility

Sr. No	Type of Utility	Unit	Quantity
B	**Water/Sewage pipeline**		
B1	Water supply pipeline(Public Health Engineering Dept., PHED)		
a	Labour charge for taking out GI pipe including fitting fixing GI specials complete as per specificaiton and as per directed		
(i)	Khonjoy-A WSS: 40 mm Dia	meters	245
(ii)	Rangdongai WSS; 40 mm Dia	meters	180
(iii)	Rangdongai WSS; 15 mm Dia	meters	200
(iv)	Chimasora-Maheshkhola comb. WSS: 25 mm Dia	meters	215
(v)	Chimasora-Maheshkhola comb. WSS: 25 mm Dia	meters	190

7.(c) TREES CUTTING

A total of 5500 numbers of trees are to be cut.

Chapter –8
Preliminary Environmental Screening and Environmental Assessment

CHAPTER – 8

Preliminary Environmental Screening and Environmental Assessment

Preliminary Environmental Screening and Environmental Assessment

- Initial environmental screening has been carried out
- Finding and recommendation are as under:
- There are no negative Impact on the environment
- There is no major dislocation of permanent settlements
- Dumping of the spoils and extra cut material is provided
- There is no requirement of borrow areas for soils
- Drainage pattern of the CD works has been retained. Additional waterway has been provided for improving the drainage system.
- Road side drain has been provided for full length of the present road for improvement drainage
- Chutes and catch pits have been provided for management of water environment
- The ambience of the air quality is not disturbed
- Controlled rock cutting measures have been provided
- There is no historical monument requiring relocation
- Mitigation measures during construction period are part of the project.
- Slope protection measures have been adopted
- Water harvesting structures are provided to make available water for construction operations.

Preamble

This chapter presents the identification and appraisal of various environmental impacts during construction and operation of proposed widening and strengthening of existing road. Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly by the proposed project and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed actions. The details of criteria opted for impacts assessment are as per described hereunder:

Processes that may create risk to the environment are considered and analyzed in terms of key potential environmental impacts. Actual and foreseeable events, including operational and typical events are discussed in this chapter.

The environmental impacts may include all those that are beneficial or adverse, short or long term (acute or chronic), temporary or permanent, direct or indirect and local or regional. The adverse impacts may include all those leading to harm to living resources, damage to human health, hindrance to other activities, impairment of quality for use, reduction of amenities, damage to cultural and heritage resources, and damage to physical structures.

In order to minimize the adverse impacts of the proposed road project, avoidance and mitigation measures are formulated and implemented as part of the project design. Avoidance and mitigation of negative impacts involve the reduction and magnitude of the impacts through:

- Alternatives during design, site clearance, construction and operation phases of the road project to avoid adverse impacts, and
- Additional mitigation measures for unavoidable negative impacts on natural, socio-economic and cultural environment.

Impacts during Construction Phase

Construction phase mainly include the following activities;

- Acquisition of additional land;
- Clearing of ROW;
- Leveling of required portion of ROW;
- Construction or strengthening/widening of new or existing culverts, bridges etc;
- Strengthening and widening of 2 lane road with paved shoulders;
- Commissioning of camp site with hot mixing/Batching plant;
- Transportation of man and materials;
- Transportation of equipments/machinery; etc
- Rehabilitation of Coal Mining holes, pits and shafts
- 24 m wide corridor

Land Use pattern

The land requirement is worked out on the following conditions

- Length of road is 25.525 Kms
- Land Plans are placed in Volume-IV (a) : Drawings – Road Work.
- Road corridor out will be 24 m in open areas and 20 m in the built-up areas.
- New construction for bypass is for full corridor width of 24 m. it is taken as 9 m for center line on valley side and 15 m from centre line on hill side.
- In short realignment portions for improvement works is based on 9 m from center line on valley side and 15m from center line on the hill side. In case of jetty ledges of the hill creating box cut will be knocked off, resulting requirement of land wider than the corridor width. Same is marked in the land plan.
- In view the non availability of ROW, the existing road width is tentatively taken as the available land for calculating balance land requirement.
- Land share of government and Private is 50 : 50
- Land required is as per the table below

Total Land Required	61.26 Ha
Land available	13.12 Ha
Land to be acquired	48.14 Ha

Physiography and Topography

Proposed project of widening and strengthening of existing road is confined to existing ROW and design will consider the improvement of roadside drainage conditions through the improvement of cross-drainage structures. Providing Roadside Drain through out the length of road, providing chutes on the upstream and downstream side of Culvert to channelise water and avoid erosion, Catch water intercepting drains have been proposed in the land slide areas .Design of the cross drainage structures will follow IRC Guidelines (IRC, 1995).

Impact on the physiography and topography of the area would be insignificant.

Biological Environment

During construction of the project road, as first step, vegetation in the form of trees, shrubs and grasses present in ROW and additional land proposed to be acquired will be cleared.

About 93 trees (of equal to and more than 60 cm girth) are proposed to be cut. For cutting of tress, forest clearance as applicable will be taken under the Forest Conservation Act, 1980 as amended, thereof.

There will be no significant loss of bio-diversity since no rare/endangered plant or animal species is going to be eliminated due to the proposed upgrading of project road. There will be no loss of animal habitat and the aquatic ecology will not be damaged, as structures will be provided on the water bodies crossed by project road.

The loss of trees at least during the construction phase is likely to produce some negative impacts. Following measures are suggested:u

- Careful and proper planning should be done for re-plantation of trees during design and right at the commencement of construction and the phase wise removal of growing trees will mitigate the negative impacts; and
- Compensatory plantation should be started during construction phase parallel to the construction activities.

Soil Environment

a. Loss of Productive Soil

The area along the project road is mostly non agriculture land. Therefore, no loss of productive soils is anticipated due to acquisition of land.

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b. Soil Erosion

During the upgrading of the project, some trees, shrubs and grasses will need to be cleared along the project road, which may pose some soil erosion problem during first few rains. Therefore, suitable mitigation measures will need to be implemented to prevent the soil erosion problem.

c. Contamination of Soil

During the construction of the project road, the contamination of the soil will be negligible. Further, the contractor shall initiate measures to minimize waste generation from all construction activities. At construction sites, the vehicles and equipment will be maintained properly and refueled only at fueling areas, without any spillage.

d. Compaction of Soil

During construction phase, at some places, soil in the adjoining productive lands beyond the ROW may be compacted by the movement of construction vehicles, machinery and equipment.

Terrain along the project road is hilly. To prevent any compaction of soil in the adjoining productive lands beyond the ROW, the movement of construction vehicles, machinery and equipment will be restricted to the corridor.

As the land requirement on permanent basis is very small as compare to total area hence impacts on soil during construction phase would be insignificant with the following mitigation

measures:

- Re-plantation of trees;
- Good engineering & construction practices;
- Slope stabilization in on hills by retaining wall and breast wall;
- Turfing on slides areas
- Providing mild slopes, not flat nor steep slope; etc

These steps will efficiently mitigate the potential soil erosion problem and by the time the road starts operating, the ecosystems will restore itself Rainfall is very heavy and there is a rapid growth of vegetation which will also help in stablisation of slopes.In case soils erosion is found suitable measures should be taken to control the soil erosion.

To avoid the soil contamination, at the wash down and re-fueling areas, "oil interceptors" shall be provided. Unusable debris shall be dumped in nearest landfill sites.

Quarries

For construction of road, aggregate will be procured from nearest quarry approved by Mizoram State Pollution Control Board in their respective jurisdiction.During operation of quarry followings measures will be adopted.1) The over burden will not be pushed into the valley.Over burden will be utilized for repair of bad stretches of existing road during monsoon,quarry spalls will be utilized for G.S.B

.Quarry operation and closure plans will be prepared.
After extraction of stone to the full capacities, quarries will be closed after adopting mitigation measures like turfing of slopes, providing gabion toe wall to avoid slide and retain earth spoil
Providing of Breast wall as per requirement

Providing drainage channels like catch water drains.

Turfing the steep slopes.

Drainage Pattern

Drainage pattern of the CD works has been retained. Additional water way has been formed improving the drainage system Roadside drain has been proposed for full length of present road for improved drainage. Chutes and catch pits have been provided for efficient management of water flow. About 906 culverts will be provided in this stretch which shall be sufficient for cross drainage and maintaining the natural flow of water.

The performance of a pavement shall be improved considerably and adequate precautions shall be taken to avoid the accumulation of water on the pavement structure. Side drains and cross drains will be properly integrated so that water from these drains shall cross the road underneath through culverts at appropriate locations.

It is evident from the details given above that there is likely no significant impact on existing drainage system along the road. However following mitigation measures shall be taken into consideration:

- The contractor shall ensure that construction debris does not find its way in to the minor drainage channels, which may get clogged;
- Extra culverts are proposed to accommodate the drainage requirement along the alignment;
- Drainage arrangements will be provided in respect of site conditions in the form of drainage

layer and sub-surface drains in the full width of formation or below the shoulder so as to keep the pavement well drained at locations where these are required; and

- Good engineering and construction practiced shall be followed.

Water Environment

Water requirement for the project road will be on temporary basis and meet through existing water sources available at places along the road.Water harvesting structure will be constructed at suitable locations to augment supply of water for construction purpose. Check dam will be created in the river to maintain the supply of the water for construction. No local water supply (public water supply, community hand pumps & bore wells and public wells) will be used for construction purposes. Separate sources of water for construction purpose will be identified along the project road. Therefore, impact is anticipated as insignificant, reversible and for short duration only.

Widening activities may temporarily deteriorate surface water quality during rains in terms of turbidity along the road. However, this impact will be observed only up to first few rains. Therefore, no significant impact is anticipated on water quality due to construction of project road.

Following mitigation measures are suggested to mitigate any adverse impacts during construction phase:

- Construction camps should be located away from water bodies and basic sanitary facilities should be provided to the labour camps;
- Provision shall be made for proper drainage along the road;
- Good engineering practices to be followed to avoid the clogging of water channels along the project road; and
- Water to be used for construction shall have separate source other than public supply.

Ambient Air Quality

During construction phase, there will be two main sources of air emissions i.e. mobile sources and fixed sources. Mobile sources are mostly vehicles to be involved in construction activities while emissions from fixed sources include diesel generator sets, construction equipments/machinery (*e.g.* compressors), excavation/grading activities and hot mix plant.

Certain amount of dust and gaseous emissions will be generated during the construction phase from excavation machine and road construction machines. Pollutants of primary concern include Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM). However, suspended dust particles may be coarse and will be settled within a short distance of construction area. Therefore, impact will be temporary and restricted within the closed vicinity of the construction activities along the road only.

Generation of exhaust gases is likely due to movement of heavy machinery for clearance of the ROW for construction. High levels of HC and NOx are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact will be localized only and it can spread down wind depending on the wind speeds and directions.

Considerable amount of emissions of carbon monoxide (CO), unburned hydrocarbon, sulfur di-oxide, particulate matters, nitrogen oxides (NOx), etc, will be generated from the hot mix plants(2 nos.).

Following distance for establishment of Hot mix plant should be maintained as per details given

below

Sn.	Distance from	Distance
1.	Municipal Corporation Limits	5 Km
2.	Class A Town & Cities Limits	2 Km
3.	Other Town & Cities Limits	1 Km
4.	Village Lal Dora / Phirni	500 Mts.
5.	Wild life Sanctuary / Zoo	500 Mts.
6.	National Highway *	500 Mts.
7.	State Highway * / Scheduled Road	300 Mts.
8.	Residential Area (15 Pucca Houses)	300 Mts.
9.	Educational Institute / Historical/Religious Places/ Protected Monuments	300 Mts.

The emissions standards for hot mix plants for SPM is 150 mg/Nm^3 with no smoke visible from the plant.

Following measures should be undertaken for prevention of air pollution by Hot Mix Plant:

- A suitable dust control system for the dryer and mixer to contain/recycle permissible fines in the mix should be provided. It should be capable of preventing the exhaust of fine dust into atmosphere from both ends of the dryer drum by creating adequate negative pressure.
- The plant should have centralized control panel/cabine capable of pre-setting controlling/synchronizing all operations, starting from feeding of cold aggregates to the discharges of hot mix to ensure proper mixing. It should have adequate water scrubbing mechanism to completely remove/control the dust coming out of the drier with proper provision of re-circulation system for the scrubber water.
- Bitumen must be mixed with aggregate as soon as it is heated and dried and second time lifting of the dried aggregate for proper batching should be avoided.
- All roads/vehicular movement areas at site of Hot Mix Plant should be pucca/ stabilized with stone aggregates and regular sprinkling of water be ensured so that no dust is generated with vehicular movement.
- Hot Mix Plant must have proper stack heights for the discharge of its scrubbed flue gases and bitumen heating system with proper platform and port holes as per the CPCB/ Uttar Pradesh Pollution Control Board norms.
- Fine dust arrested by water scrubber and collected in the re-circulation water tank should be collected and filled in a pit to be covered with fresh earth. This exercise should be repeated as and when dust is removed from re-circulation tank.

Hot mix plants should be located away from the populated areas and be fitted with the air pollution control equipment meeting the standards prescribed by CPCB/Uttar Pradesh State Pollution Control Board wherever applicable.

Following mitigation measures are suggested:

- Road should be designed in such a manner that no traffic congestion in the populated are along the road;
- Vehicles delivering loose and fine materials like sand and fine aggregates will be covered to reduce spills on existing road. Water may be sprayed on earthworks, on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to

prevent dust generation;

- All slopes and embankments will be turfed as per best engineering practices to minimize the dust generation during operation of the road;
- Asphalt and hot-mix plants will be located at least 1 km away in the down wind direction from inhabited urban and rural stretches along the road with the clearance from Uttar Pradesh State Pollution Control Board wherever applicable;
- Sprinkling water will control fugitive dust emissions from construction activities
- Sprinkling of water on the dust prone areas and construction yard;
- Regular maintenance of machinery and equipment will be carried out; and
- Ambient air quality monitoring should be carried out during construction phase. If monitored parameters are above the prescribed limited, suitable control measures must be taken.

Noise and Vibration

Noise will be generated from the various activities, such as, site clearing activities, excavation, erection and finishing. The anticipated typical noise levels from these activities are given hereunder:

Site clearing activities	85 dB(A)
Excavation	90 dB(A)
Erection	80 dB(A)
Finishing	85 dB(A)

During the construction phase, the noise level is bound to increase as a result of usages of construction machines, etc. The increase in noise levels is expected to be between 10 - 20 %. However, these noise levels will be temporary in nature mostly during daytime only.

For an approximate estimation of dispersion of noise in the ambient air, a standard mathematical model for sound wave propagation is used. The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

The resultant maximum noise level for the above sources as calculated is 90 dB(A). Assuming no environmental attenuation factors, based on the equations, calculations are made, which shows that noise level at different distance will be as under:

Area	Permissible Limits (Day Time)	Distance (m) from source
Residential	55 dB (A)	22.4
Commercial	65 dB (A)	7.1
Industrial	75 dB (A)	2.7

Therefore, the impact of noise on surrounding area during the construction phase will be limited within 25 m, hence inferred as moderate.

However, following mitigation measures are recommended:

- *Site Controls*: Stationary equipment will be placed along inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts;

- *Scheduling of Project Activities*: Operations will be scheduled to coincide with period when people would least likely to be affected. Construction activities will be strictly prohibited between 8 P.M. and 8 A.M. near residential areas;
- Protection devices (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines;
- Construction equipment and machinery should be fitted with silencers and maintained properly; and
- Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures.

Construction Workers' Camp

Upgrading of the project road will be completed within the 2-3 years by deployment of mostly local labour. Quantum of construction labour will vary time to time depending upon construction activities. In case construction camps are required, solid waste and sewage generated from construction camp may pollute the surroundings of camp and may cause health problems. Two construction labour camps are proposed for the proposed project during construction period of 2-3 years. Following mitigation measures are suggested for construction workers camps:

- Basic amenities, especially, drinking water supply and toilet facilities at construction camps shall be provided;
- Lavatories shall be located away from the water bodies;
- Proper disposal of domestic refuse will be undertaken;
- Temporary medical facilities will be provided for the construction workers; and
- Use of small temporary shanties / camps beside the project road should be strictly discouraged.

Historical Monuments

There is no archaeological monument along the project road. Therefore, no impact is anticipated in cultural, religious and historical monuments.

Socio- economic

Construction phases of the project road will have some beneficial impacts on socio-economic status of the area. Marginal increase in direct and indirect employment opportunities on short term basis for local people is expected during construction phase. Since the immigration of work force during construction phase i.e. for 2-3 years is likely to be very small, the social impacts on literacy, health care, transport facilities and cultural aspect are expected to be insignificant.

The relatively short-lived economic impacts of the construction phase are likely to be experienced in local communities during construction phase as workers and contractor will make everyday purchases from local traders. This is likely to give a short-lived stimulus to these traders that will disappear as soon as the construction is complete.

In addition to direct employment, several opportunities for locals will be available in terms of supply of construction materials & machinery, vehicles and other essential commodities.
Hence, overall impact is rated as:

- Preference will be given to locals for temporary direct and indirect employment;
- Local suppliers for machineries and construction materials will be given preference; and
- Local transporters will be preferred for transportation of machinery/ materials.

Property Management

Most of strengthening and widening of the existing road will be confined to exiting ROW except for following:

Requirement of Land

The land requirement is worked out on the following conditions

- Length of road is 25.525 Kms
- Land Plans are placed in Volume-IV (a) : Drawings – Road Work.
- Road corridor out will be 24 m in open areas and 20 m in the built-up areas.
- New construction for bypass is for full corridor width of 24 m. it is taken as 9 m for center line on valley side and 15 m from centre line on hill side.
- In short realignment portions for improvement works is based on 9 m from center line on valley side and 15m from center line on the hill side. In case of jetty ledges of the hill creating box cut will be knocked off, resulting requirement of land wider than the corridor width. Same is marked in the land plan.
- In view the non availability of ROW, the existing road width is tentatively taken as the available land for calculating balance land requirement.
- Land share of government and Private is 50 : 50
- Details of land requirement is as per the table below

Total Land Required	61.26 Ha
Land available	13.12 Ha
Land to be acquired	48.14 Ha

Disturbance to Community Resources and Safety

The disturbance to the community resources and safety will be mainly due to transportation of machinery and materials, storage and construction activities which shall be confined to ROW of existing road. There is a requirement for warning signs to minimize damage to the third-party vehicles. In addition, risk to public need to be managed by making mandatory for placing warning sign on vehicles and keeping vigilance during transportation by proper training and adequate manpower on board.

- Proper planning and communication with traffic police;
- Advance notice to local administration about the activities;
- Proper cordon off the site with sign Board;
- Diversion of traffic, if required;
- Placing the warning sign boards on the vehicles during transportation of machinery and

materials; and

- Proper training to the drivers about public safety.

2.3 Impacts During Operation Phase

It will mainly include the movement of traffic with the increased volume. The impacts during operation phase are described hereunder:

Drainage Pattern

No impact is envisaged as drainage pattern along the project road will be designed using the IRC criteria and code.587 nos. of culverts will be constructed along the low lying section of project road which are prone to water logging due to flooding in the monsoon season. Care shall be taken for removal of obstructions if any, in the cross drainage structures intercepting the flood waters.

Soil Environment

No impact is envisaged except accidental spillage.

Water Resources

During the operation phase, drainage pattern or hydrology of the area will not be affected. Therefore, no impact is anticipated during operation phase.

Water Environment

No impact is anticipated on water quality along the project road except accidental leakages, if any.

Biological Environment

Compensatory afforestation / plantation along the project road on available space will enhance aesthetics in the area. Compensatory afforestation should be carried out along the road during Construction phase/operation phase, wherever, it is possible. Monitoring of survival of trees shall be done at regular interval.

Ambient Air Quality

During the operation phase, air quality along the road will be affected by vehicular emissions on the project road. Pollutants of primary concern will include NOx, CO, SPM, RSPM and SO2. In the populated area, traffic congestion due to bottlenecks of constructed road may increase the air pollution problem in the along the road. Following mitigation measures are suggested to control the air pollution:

- Bottlenecks should be avoided for smooth flow of traffic;
- Proper traffic management system shall be adopted;
- Plantation of pollutants adsorbing trees along the road; and
- Ambient air quality monitoring should be carried out during operation phase. If monitored parameters are above the prescribed limited, suitable control measures must be taken.

Noise and Vibration

During the operation phase, noise will be generated through the vehicles movement. Noise levels will depend up on traffic density, number of traffic events. Plantation along the road and improved road conditions will be helpful in reduction on noise levels during operation phase. To mitigate the impact of noise levels during operation phase, following mitigation measure are recommended:

- Bottle-necks should be avoided for smooth flow of traffic;
- **Proper traffic management system shall be adopted;**
- Road should be designed in such a manner that no traffic congestion in the populated area along the road;
- Developing trees barriers between the road and sensitive area, wherever it is possible; and
- Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures.

Socio-economic

Once the strengthening and widening will be completed, there is likely to be regional beneficial long-term socio-economic changes in the areas served by the project road. This shall be due to generation of more direct and indirect opportunities for employment and business resulting from more industrial development, easy & speedy access to nearby areas and development of infrastructural facilities.

Disturbance to Community Resources and Safety

Improved road conditions would significantly reduce the accidents. The project will be implemented with due considerations for safety of pedestrians and school children near populated areas.

The measures will include speed humps, speed delimiting signs, cross walks, etc, at desired locations especially near habitations. Moreover, the upgraded road with improved geometrics will itself reduce the chances of accidents significantly. So all these factors cumulatively will have positive impacts on the safety aspects of the road users and the local populace.

Summary of Impacts

The environmental impacts are summarized as per given below:

Sn.	Impact On	Impact				
		Significant		Insignificant		None
		+ve	-ve	+ve	-ve	
1.0	**Construction Phase**					
1.1	***Physical Environment***					
1.1.1	Meteorological Conditions					√
1.1.2	Land		√			
1.1.3	Water				√	
1.1.4	Air				√	
1.1.5	Noise		√			
1.2	***Biological Environment***					
1.2.1	Terrestrial Ecology				√	

Sn.	Impact On	Impact				
		Significant		Insignificant		None
		+ve	-ve	+ve	-ve	
1.2.1.1	Flora				√	
1.2.1.2	Fauna					√
1.2.2	Aquatic Ecology					√
1.3	***Social Environment***					
1.3.1	Cultural and archaeological properties					√
1.3.2	Safety				√	
1.3.3	Land acquisition and PAH				√	
1.3.4	Socio-economic Conditions			√		
1.3.5	Employment Opportunity	√				
2	**Operation Phase**					
2.1	***Physical Environment***					
2.1.1	Meteorological Conditions					√
2.1.2	Land					√
2.1.3	Watercourses and Water Bodies					√
2.1.4	Air Quality				√	
2.1.5	Noise Quality				√	
2.2	***Biological Environment***					
2.2.1	Terrestrial Ecology			√		
2.2.1.1	Flora			√		
2.2.1.2	Fauna					√
2.2.2	Aquatic Ecology					√
2.3	***Social Environment***					
2.3.1	Cultural and archaeological properties					√
2.3.2	Safety				√	

ENVIRONMENTAL MANAGEMENT PLAN

Environmental Impacts	Mitigation Measures	Location	Time Frame	Responsibility	
A. Pre-construction Stage				**Implementation**	**Supervision**
A.I Pre-construction Activities by PIU					
Land and Properties Acquisition	The acquisition of land and private properties, if any will be carried out in accordance with the National Highway Act, 1988 and amendment thereof. It will be ensured that R&R activities are to be completed before the construction activity starts, on any sub-section of project roads.	ROW	Before Start Construction	Competent Authority for acquisition of land and properties.	Supervision Consultant, PIU MPWD
Removal of Trees	Approximately 2966 trees are envisaged to be removed from the ROW. Before the commencement of construction, prior Forest Clearance /permission if applicable will be taken from the Forest Department for removal of trees All works shall be carried out in such a fashion that the damage or disruption to the flora is minimum. As far as possible maximum efforts to minimize the list of trees proposed to be felled by suitable on the spot adjustment of engineering designs at the time of execution. Compensatory Plantation within ROW and adjacent areas can help to support local flora and fauna. The effort shall be made to conserve the trees by adjusting in the median.	ROW	Before Construction Starts	PIU/Contractor	Supervision Consultant, PIU MPWD
Utility Relocation	All utilities will be relocated with prior approval of the concerned agencies. Relocation will be reasonably complete before construction starts.	ROW	Before Construction Start	PIU, MPWDConstruction Agencies	Supervision Consultant, PIU MPWD
Removal of Community Utility	All community utilities, such as community sources of water will be replaced at appropriate locations. All electric pole/ transformers, etc, as per details given in Strip Plan	ROW	Before Construction Starts	Design Consultants/ PIU MPWD	PIU MPWD
A.II Pre-construction activities by PIU/Contractor					

Environmental Impacts	Mitigation Measures	Location	Time Frame	Responsibility	
Procurement of Machinery					
Hot-mix Plants & Batching Plants	Specifications of hot mix plants and batching plants will comply with the requirements of the relevant applicable pollution control rules, legislations and standards. It should have NOC from Uttar Pradesh State Pollution Control Board wherever applicable. Arrangements to minimize dust pollution through the provision of wind screens, mist spray units and dust encapsulation must be provided at all such sites	To be decided by contractor	Construction Phase	PIU/Contractor	Supervision Consultant, PIU MPWD
Other Construction Vehicles, Equipment and Machinery	The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. All vehicles, equipment and machinery to be procured for construction will conform to the relevant Bureau of Indian Standard (BIS) norms. Noise limits for construction equipments to be procured such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986.	ROW	Before Construction Starts	PIU MPWD, Construction Agencies	Supervision Consultant, PIU MPWD

Identification & Selection of Material Sources					
Quarries	The contractor will procure materials from existing licensed quarries with the suitable materials for construction. No new quarry will be opened by contractor. Apart from approval of the quality of the quarry materials, the Supervision Consultant's representative will verify the legal status from environment point of view.	ROW	Before Construction Starts	PIU NHAI, Construction Agencies	Supervision Consultant PIU MPWD

Arrangement for construction water	All efforts should be made to avoid competitive use of a single water source. The contractor shall use surface water depending upon the availability and quality by developing its own harvesting units in riverbeds.	Area near to project corridor	Before construction Starts	PIU/ Contractor	Supervision Consultant PIU MPWD
Labour Requirements	The contractor will use unskilled labour available from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply, etc.)	Area located near project corridor	Before Construction Starts	PIU MPWD, Construction Agencies	Supervision Consultant PIU MPWD
Setting up Construction Sites					
Construction Camp Locations Selection, Design & Layout	Following criteria should be followed: Construction camps will not be proposed within 1000m from the nearest habitation to avoid conflicts and stress over the infrastructure facilities, with the local community. Locations for stockyards for construction materials will be identified at least 1000 m from watercourses. The waste disposal and sewage system for the camp will be designed, built and operated such that no odour is generated. Unless otherwise arranged by the local sanitary authority, arrangements for disposal of excreta suitably approved by the local medical health or municipal authorities or as directed by Supervision Consultant will need to be provided by the contractor.	Areas along the road side	Before Construction Starts	PIU MPWD, Construction Agencies	Supervision Consultant PIU MPWD
Arrangements for Temporary Land Requirement	The contractor as per prevalent rules will carry out negotiations with the land owners for obtaining their consent for temporary use of lands for construction sites/ hot mix plants /traffic detours etc. The Supervision Consultant will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the contract.	Areas temporarily Acquired for construction sites/ hot mix plants/ borrow areas /diversions/ detours.	Before Construction Starts	PIU/Contractor	Supervision Consultant PIU MPWD
B. Construction Stage					
Construction Stage Activities by Contractor					
Site Clearance					

Clearing and Grubbing	The demarcated vegetation will be removed from the ROW before the commencement of construction. All works will be carried out such that the damage or disruption to flora is minimum Only ground cover / shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval from the Supervision Consultant. The contractor, under any circumstances will not damage trees (in addition to those already felled with prior permission from the forest department).	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD
Generation of debris from dismantling of pavement structures	Debris to be generated due to the dismantling of the existing pavement structure shall be suitably reused in the proposed construction, subjected to the suitability of the material and the approval of the Supervision Consultant. Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD
Bituminous and non- bituminous waste disposal	Bituminous and non- bituminous construction wastes will be utilized in the road construction. No disposal of solid waste will be required.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD

Planning Traffic Diversions Detours	Temporary diversions will be constructed with the approval of the Supervision Consultant. Detailed traffic control plans will be prepared and submitted to the Supervision Consultant for approval, 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction, details of traffic arrangement after cessation of work for each day, safety measures for transport of material and arrangement of flagmen. Environmental Personnel of the Supervision Consultant will assess the environmental impacts associated as the loss of vegetation, productive lands and the arrangement for temporary diversion of the land prior to the finalization of diversions and detours. Special consideration will be given to the preparation of the traffic control plan for safety of pedestrians and workers at night. The contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. He shall inform local community of changes to traffic routes, conditions and pedestrian access arrangements. The temporary traffic detours will be kept free of dust by frequent application of water.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD

Operation of Construction Equipments and Vehicles	All vehicles and equipment used for construction will be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers will be checked and if found to be defective will be replaced. Noise limits for construction equipment used in this project (measured at one meter from the edge of the equipment in free field) such as compactors, rollers, front loaders, concrete mixers, cranes moveable), vibrators and saws will not exceed 75 dB(A), as specified in the Environment (Protection) Rules, 1986. Notwithstanding any other conditions of contract, noise level from any item of plant(s) must comply with the relevant legislation for levels of noise emission.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD
Precautionary/ Safety Measures During Construction	All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 will be adhered to. Adequate safety measures for workers during handling of materials at site will be taken up. The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD
Earthworks					
Excavations	All excavations will be done in such a manner that the suitable materials available from excavation are satisfactorily utilized as decided upon beforehand. The excavations shall conform to the lines, grades, side slopes and levels shown in the drawings or as directed by the Supervision Consultant.	ROW	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD

	While planning or executing excavation, the contractor shall take all adequate precautions against soil erosion, water pollution, etc. and take appropriate drainage measures to keep the site free of water, through use of mulches, grasses, slope drains and other devices. The contractor shall take adequate protective measures to see that excavation operations do not affect or damage adjoining structures and water bodies. For safety precautions guidance may be taken from IS:3764. Earth fill Embankment and other fill areas, unless other wise permitted by the Supervision Consultant, be constructed evenly over their full width and the contractor will control and direct movement of construction vehicles and machinery over them.				
Earth fill	Embankment and other fill areas, unless other wise permitted by the Supervision Consultant, be constructed evenly over their full width and the contractor will control and direct movement of construction vehicles and machinery over them.	Along earth fill areas	Construction Phase	PIU/Contractor	Supervision Consultant PIU MPWD
Slope Protection and Control of Erosion	Embankments and other areas of unsupported fill with steeper side slopes, or to greater widths will not be constructed. While planning or executing excavations, Contractor will take all adequate precautions against soil erosion as per MoRTH 306. Turfing on critical road embankment slopes with grass sods, in accordance with the recommended practice for treatment of embankment slopes for erosion control. Other measures of slope stabilization will include mulching, netting and seeding of batters and drains immediately on completion of earthworks. Dry stone pitching for apron and revetment will be provided for bridges and cross drainage structures.	All along the project road.	During Construction Phase	Contractor	PIU MPWD

Coal Mining Rehabilitation	Identify the Coal Mines. Rate holes to be filled with sand. Improve drainage Turfing on critical road embankment slopes with grass sods, in accordance with the recommended practice for treatment of embankment slopes for erosion control. Other measures of slope stabilization will include mulching, netting and seeding of batters and drains immediately on completion of earthworks. Dry stone pitching for apron and revetment	All along the project road.	During Construction Phase	Contractor	CE (NH) PWD, Meghalaya
Dust Emissions	All earthworks will be protected in a manner acceptable to the Supervision Consultant to minimize generation of dust. The contractor will take every precaution to reduce the level of dust along construction sites involving earthworks, by frequent application of water. All vehicles delivering materials to the site shall be covered to avoid spillage of materials. The contractor shall ensure every precaution to reduce the level of dust emission from the hot mix plants and the batching plants up to the satisfaction of the Supervision Consultant in accordance with the relevant emission norms. Exiting roads used by vehicles of the contractor or sub contractor for supplies of materials or are part of the works shall be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles or their tires.	ROW	During Construction Phase	Contractor	Supervision Consultant PIU MPWD

Contamination of soil by Fuel and Lubricants	Vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An "Oil interceptor" will be provided for vehicle parking, wash down and refueling areas within the construction camps. Fuel storage will be in proper enclosed areas. All spills and collected petroleum products will be disposed off in accordance with MOEF and State Pollution Control Board guidelines. Fuel storage and refilling areas will be located at least 300 m from drains and important water bodies as directed by the Supervision Consultant. In all fuel storage and refueling areas, if located on agricultural land or areas supporting vegetation, the topsoil will be stripped, stockpiled and returned after cessation of such storage and refueling activities.	ROW and camp site	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Silting, Contamination of Water bodies	Silt fencing will be provided around stockpiles at the construction sites close to water bodies. The fencing needs to be provided prior to commencement of earthworks and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. Construction materials containing fine particles will be stored in an enclosure so that sediment-laden water does not drain into nearby watercourses. All discharge standards promulgated under Environmental Protection Act, 1986, will be adhered to. All liquid wastes generated from the site will be disposed off as acceptable to the Supervision Consultant.	Water bodies close to the project	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD

Sub-Base & Base	The contractor will take all necessary measures/ precautions to ensure that the execution of works and all associated operations are carried out in conformity with statutory and regulatory environmental requirements. The contractor will plan and provide for remedial measures to be implemented in event of occurrence of emergencies such as spillage of oil or bitumen or chemicals. The contractor will provide the Supervision Consultant with a statement of measures that he intends to implement in event of such an emergency, which will include a statement of how he intends to adequately train personnel to implement such measures. Adequate safety measures for workers during handling of materials at site will be taken up. The contractor will take every precaution to reduce the level of dust along the construction sites by frequent application of water. Noise levels from all vehicles and equipment used for construction will conform to standards. Construction activities involving equipment with high noise levels will be restricted to the daytime.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Surfacing	The contractor will take all necessary means to ensure that works and all associated operations are carried out in conformity with to MoRTH 501. All workers employed on mixing asphalt material etc. will be provided with protective footwear. Noise levels from all vehicles and equipment used for surfacing will conform to standards. Construction activities involving equipments with high noise levels will be restricted to the daytime.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD

Bridge Works & Culverts	While working across or close to the rivers, the contractor will not disrupt the flow of water. If for any bridgework, etc., closure of flow is required, the Contractor apart from obtaining the requisite clearances will seek approval of the Supervision consultant. The Supervision consultant will have the right to ask the Contractor to serve notice on the downstream users of water sufficiently in advance. Construction over and close to the non-perennial streams will be undertaken in the dry session. Construction work expected to disrupt users and impacting community water bodies will be taken up after serving notice on the local community. Dry stone pitching for apron and revetment will be provided for bridges and cross drainage structures.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Soil					
Generation of Debris	Debris generated due to construction will be suitably reused, subjected to the suitability of the material and approval of the Supervision Consultant All arrangements for transportation including provision, maintenance, dismantling and clearing debris, where necessary will be considered as incidental work and shall be planned and implemented as approved and directed by the Supervision consultant.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Loss of Top Soils	The top-soil from all identified areas shall be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2 m. At least 10% of the temporarily acquired area shall be earmarked for storing top soil.	Where productive land is acquired	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Compaction Soil	Construction vehicles, machinery and equipment shall be moved or stationed in the designated area only, while operating in temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities. Topsoil from agricultural land will be preserved as mentioned above.	Where productive land is acquired	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD

Soil Erosion	Slopes of all cut, fill etc, will be stabilized through retaining, breast walls and geo textile In addition shrubs and grasses will be planted on slops. The section with high filling and deep cutting, the side slop will be graded and covered with bushes and grasses as per specifications for stone pitching, grasses and shrubs.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
	The work shall consist of measures as per design or as directed by the Supervision Consultant to control soil erosion, sedimentation and water pollution through use beams, disks, sediment, basins, fibers mats, mulches, grasses, slope, drains and other devices. All temporary sedimentation and pollution control works and maintenance thereof will be deemed as incidental to the earthwork and other items of work.				
Transporting Construction Materials					
Transporting Construction Materials	All vehicles delivering materials to the site will be covered to avoid spillage of materials. All existing roads used by vehicles of the contractor or any of sub - contractor or suppliers of materials and roads which are part of the works will be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles. The unloading of materials at construction sites close to settlements will be restricted to daytime only.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD

Water					
Water Extraction for Project	The contractor will minimize wastage of water during construction activities. The contractor should not extract from new groundwater source without permission from Ground Water Board. The contractor may, however, use any existing bore well or any other source of water supply subject to necessary or relevant arrangement.	ROW	During Construction Phase	Contractor	All along the project road, PIU MPWD
Noise					

Operation of Construction Equipment and vehicles	All vehicles and equipment used for construction will be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers will be checked and if found to be defective will be replaced. Noise limits for construction equipment used in this project (measured at one meter from the edge of the equipment in free field) such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB (A), as specified in the Environment (Protection) Rules, 1986. Notwithstanding any other conditions of contract, noise level from any item of plant(s) must comply with the relevant legislation for levels of noise emission. The contractor will ensure that the Ambient Air Quality concentrations at the construction sites are within the acceptable limits of industrial uses in case of hot mix plants and crushers and residential uses around construction camps. At construction sites, nearest habitation noisy construction work such as crushing, concrete mixing and batching, mechanical compaction etc. will be stopped between 2200 hours to 0600 hours. Monitoring of the noise levels will be carried out by the agency identified.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Material Handling at Site					

Occupational Safety	All workers employed on mixing asphaltic material, cement, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Workers engaged in stone breaking activities will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
Road Furniture and Enhancements					
Road Furniture Enhancements	Road furniture including footpaths, railings, storm water drains, crash barrier, traffic signs, speed zone signs, pavement markers and any other such items will be provided as per design. The drains will be provided for near the outfall to a natural drain. Enhancement of cultural properties, water bodies, incidental spaces will be carried out as per the enhancement designs prior to completion of construction in road sub sections. Adequate signage along these enhancement locations will be erected.	ROW	During Construction Phase	Contractor	Supervision Consultant, PIU MPWD
C. CONTRACTOR DEMOBILIZATION					
Clearing of Construction of Camps & Restoration	Contractor to prepare site restoration plans for approval. The plan will be implemented by the contractor prior to demobilization. On completion of the works, all temporary structures will be cleared away. All rubbish burnt, excreta or other disposal pits or trenches should be filled in and effectively sealed off and the site left clean and tidy, to the entire satisfaction of the Supervision Consultant.	All Construction Workers' Camps	Construction Phase	Contractor	Supervision Consultant, PIU MPWD

D OPERATION STAGE ACTIVITIES BY PIU-ENVIRONMENTAL CELL			

Monitoring & Operational Performance	The PIU will monitor the operational performance of the various mitigation/enhancement measures carried out as a part of construction of the project road.	All along the project road	During Operation Phase	Contractor	Supervision Consultant, PIU MPWD
E. OTHER ACTIVITIES					
Orientation of implementing agency and contractors	The PIU shall organize orientation sessions during all stages of the project. The orientation session shall involve all staff of Environmental Cell, field level implementation staff of PIU, Supervision Consultant and Contractor.	All along the project road	During Operation Phase	Contractor	Supervision Consultant, PIU MPWD

Chapter – 9
Cost Estimate

COST ESTIMATE

Cost estimate has been worked out and is summarized as under:

Abstract of Estimated Cost for Road Ranikor - Maheshkhola - Baghmara to 2-Lane Standards (Km 30.000 to 55.525) - Package-II				
S.No	**Item of Work**	**Amount (Rs)**	**Amount (Cr.)**	**Cost (Crores)/Km**
1	Site Clearance	7376620	**0.74**	0.03
2	Earth work	577852052	**57.79**	2.26
3	Bases and sub Bases (Non Bituminous)	288427225	**28.84**	1.13
4	Bituminous Works	104917150	**10.49**	0.41
5	Protection Works Rwalls / Bwalls/ Toe Walls	349448005	**34.94**	1.37
6	Culverts	143821218	**14.38**	0.56
7	Bridges	253056852	**25.31**	0.99
8	Major Junctions and Minor Junctions	14856337	**1.49**	0.06
9	Drains	52156898	**5.22**	0.20
10	Traffic Signs and marking	71214490	**7.12**	0.28
11	Truck laybyes	0	**0.00**	0.00
12	Cost of Bus stops/bays	5198303	**0.52**	0.02
A	**Construction Cost (Rates adopted from current October'2019 SOR for National Highway Circle, Meghalaya are inclusive of GST @12% (1 to 12))**	**1868325150**	**186.83**	**7.32**
	Cost of GST @ 12%	200177694.7		
B	**Construction Cost (Excluding GST)**	**1668147455.548**		
	Cost Inflation for the year 2019-20 @ 4.65% based on WPI on B	86877119.48		
C	**Cost of Utility Shifting**			
	PHED Shifting	9823200	0.98	
	MePDCL Shifting	3504253.2	0.35	
D	**Estimated Civil Cost/ Cost Put upto Tender**	**1,76,83,52,028.23**	**176.84**	**6.93**
	GST @ 12% of D	212202243.4	**21.22**	
	Contingencies at 2.8% of D	49513856.79	**4.95**	
	Agency Charges @3% of D	53050560.85	**5.31**	

Abstract of Estimated Cost for Road Ranikor - Maheshkhola - Baghmara to 2-Lane Standards (Km 30.000 to 55.525) - Package-II				
S.No	**Item of Work**	**Amount (Rs)**	**Amount (Cr.)**	**Cost (Crores)/Km**
	O&M cost for last 5 years after construction @ 2.5% of D	44208800.71	**4.42**	
	Supervision @ 3% of D	53050560.85	**5.31**	
	Price Escalation @ 5% per year for 1 year on D	88417601.41	**8.84**	
E	**Total Project Civil Cost**	**2,26,87,95,652.22**	**226.88**	**8.89**
F	Land Acquisition Cost	697378325	69.74	
G	Forest Clearance & Environmental cost	50000000	5.00	
H	**Total Non Civil Cost (F+G)**	**747378325**	**74.74**	**2.93**
I	Total Project Cost(E+H)	3,01,61,73,977.22	**301.62**	**11.82**

Chapter – 10

Recommendations and Conclusions

CHAPTER- 10

RECOMMENDATIONS AND CONCLUSION

Strengthening, widening and improvement of the project road to 2-lane standard specifications will not pose any major issue and is recommended for acceptance.