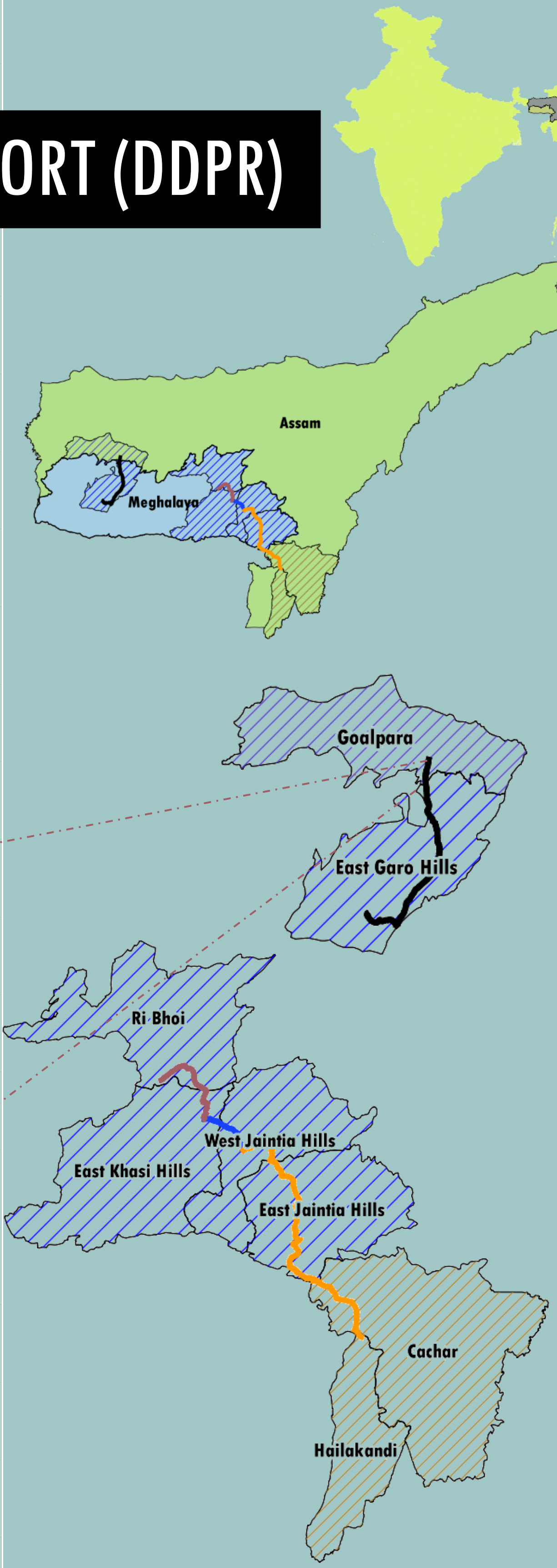
Sep. 2022

DRAFT DETAILED PROJECT REPORT (DDPR)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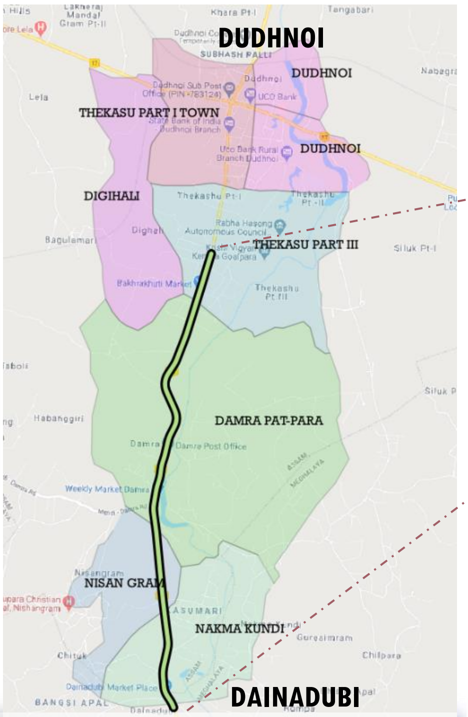
CONSULTANCY SERVICES FOR DEVELOPMENT OF ECONOMIC CORRIDORS, INTER CORRIDORS AND FEEDER ROUTES TO IMPROVE THE EFFICIENCY OF FREIGHT MOVEMENTIN INDIA UNDER BHARATMALA PARIYOGANA LOT-1

NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

DUDHNOI -DAINADUBI

(ECONOMIC CORRIDOR – DUDHNOI WILLIAM NAGAR)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DIGIHALI
THEKASU PART III
DAMRA PAT-PARA
NISAN GRAM
NAKMA KUNDI
DAINADUBI

VOLUME 2: DESIGN REPORT

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Volume-II
Design Report

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ABBREVIATIONS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
ADT	Average Daily Traffic
BBD	Benkelman Beam Deflection
BIS	Bureau of Indian Standard
BOQ	Bill of Quantities
CAD	Computer Aided Design
CBR	California Bearing Ratio
C-D	Cross-drainage
Ch.	Chainage
CMS	Content Management System
CPCB	Central Pollution Control Board
CWC	Central Water Commission
DPR	Detailed Project Report
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EL	Electrical Lines
EMP	Environment Management Plan
GAD	General Arrangement Drawing
GFC	Good for Construction
Govt.	Government
GSB	Granular Sub-base
IRC	Indian Road Congress
IRC-SP	Indian Road Congress – Special Publication
Km	Kilometer (Chainage)
Km	Kilometer (Length)
LA	Land Acquisition
LHS	Left Hand Side
MDR	Major District Road
MoRT&H	Ministry of Road Transport and Highways
NH	National Highway
NPV	Net Present Value
OD	Origin – Destination
OFC	Optical Fiber Cable
PAP	Project Affected Person
PIA	Project Influence Area
PMIS	Project Management Information Systems
PWD	Public Works Department
QAP	Quality Assurance Plan
R & R	Rehabilitation and Resettlement
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
RFP	Request for Proposal
RHS	Right Hand Side
ROB	Road Over Bridge.

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ROW	Right of Way
RUB	Road Under Bridge
SH	State Highway
SMA	Stone Mastic Asphalt
SPT	Standard Penetration Test
TOR	Terms of Reference
TYP	Typical
VDF	Vehicle Damage Factor
VOC	Vehicle Operating Costs
VUP	Vehicular Underpass

Part-I

Design of Roads & Pavements

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1 INTRODUCTION

1.1 General

Detailed ground reconnaissance surveys were undertaken which included various features along the existing alignment such as land use pattern along ROW, Topographical features of the area, identification of possible improvements in existing alignment, traffic pattern and identification of traffic homogeneous links, drainage system etc. The data and information obtained from the reconnaissance surveys was accordingly compiled and presented in Report.

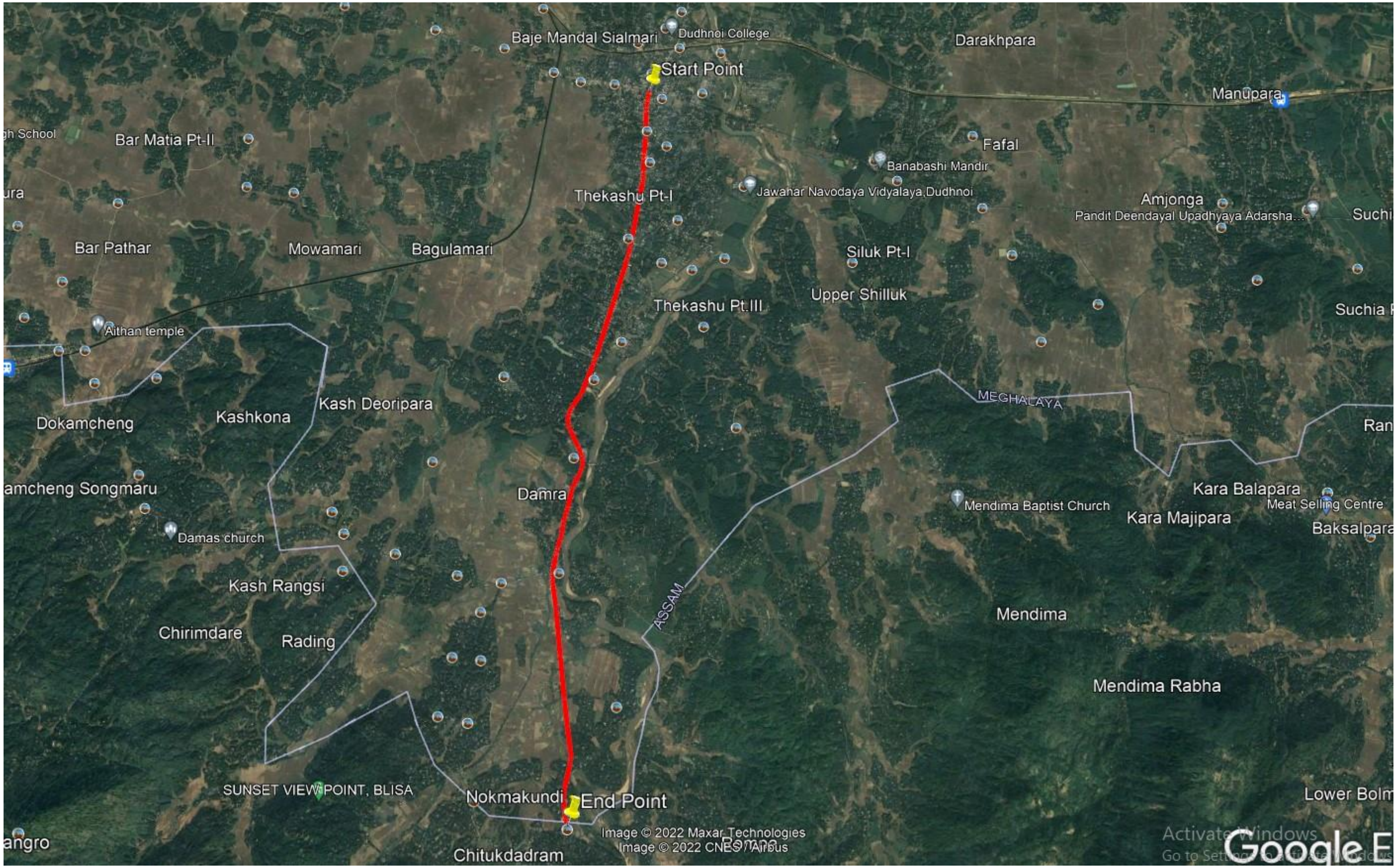
The design of the project road includes following design components:

- Analysis of present traffic and future projections;
- Analysis of existing pavement structure and its residual strength;
- Determination of requirements for the new pavement including overlay over the design period;
- Determination of adequacy of the CD structures;
- Review of existing condition of existing structures;
- Review of the road’s geometry (horizontal as well as vertical) and measures for improvement;
- Determination of adequacy of intersections and measures for improvement; and
- Road safety aspects through provision of traffic control devices, roadside furniture and project facilities.

1.2 Project Description

Project Road (Km. 0/000 to 8/415) commencing from Chainage 0/000 (Latitude: 25°58'58.65"N & Longitude- 90°46'56.20"E) at Dudhnoi passes through Thekashu Town, Damra Pat Para and terminates at Chainage 8/415 (Latitude- 25°54'33.23"N & Longitude- 90°46'28.20"E) at Dainadubi Design Length-8.415 km. The Project section is part of NH-217. Project road lies in Goalpara district in the state of Assam.

Figure 1.1: Project Road in show image below: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Dudhnoi College
Start Point
Darakhpara
Manupara
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Amjonga
Pandit Deendayal Upadhyaya Adarsha...
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Bar Pathar
Mowamari
Bagulamari
Siluk Pt-I
Upper Shilluk
Thekashu Pt.III
Suchia
Aithan temple
Kash Deoripara
MEGHALAYA
Dokamcheng
Kashkona
Ran
amcheng Songmaru
Damra
Kara Balapara
Meat Selling Centre
Mendima Baptist Church
Kara Majipara
Baksalpara
Damas church
Kash Rangsi
ASSAM
Mendima
Chirimdare
Rading
Mendima Rabha
SUNSET VIEW POINT, BLISA
Nokmakundi
End Point
Lower Bolm
angro
Chitukdadram
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Google E

1.3 Design Considerations

The project design comprises geometric design i.e., the horizontal alignment and the vertical profile, and the design of appurtenances and structures, traffic control devices, roadside furniture and other project facilities. The design standard/ practices proposed to be adopted for structure design are given in Chapter 8 and 9. The geometric design consists of the below mentioned features.

- Design of horizontal alignment, vertical alignment, intersections and other features for upgrading the existing lanes to required 2-lane with/without paved shoulder configuration by widening including realignment where required;
- Minimizing shifting/acquisition avoiding obstructions or constraints like trees, utilities and structures as far as possible without affecting safety;
- The geometric design is based on available right of way (ROW) and shall conform to the standards, set out as minimum, as far as possible safety mitigation measures to be provided wherever desirable design standards cannot be achieved;
- Wherever the existing road geometrics are deficient, due importance to improvement of these sections to meet the standards subject to land constraints;
- The uniformity of design standards is maintained throughout the length of the Project Road, to the extent practical with due consideration to safety;
- Correction of any deficiencies in the vertical profile in respect of grades layout and sight distance to meet the minimum requirements;
- Design of road side appurtenances and project facilities in accordance with relevant codes of IRC or other international standards;
- The design of cross drainage works in accordance with the relevant IRC Codes and considers the location of the cross drainage (CD) works, bridges and other structures.

Site Specific:

- The project road passes through plain and rolling terrain having villages and towns along the road. Considering the physical condition and cost effectiveness, the improvement proposals are conceived and developed under following standards:

- The desirable standards which could be adopted as a rule; and

- The minimum standards, which could be accepted for difficult stretches where application of the desirable standards, would lead to exorbitant costs.

- Accordingly, design standards for geometric elements would be considered under "desirable" and "minimum" categories. The proposed standards have to be consistent with and fall within the parameters recommended in the related standards of the Indian Roads congress.

1.4 Codes and Specifications for Road Design and Safety

The highway design is based on the IRC Codes and publications shown in Table 1.1 and is in conformity with requirements set forth in MORT&H Specifications for Road and Bridge Works, Fifth Revision.

All Materials, works and construction operations shall conform to the Guidelines for the Alignment Survey and Geometric Design of Hill Roads (IRC:52-2019) and Manual of

Specifications and Standards for Two-Laning of Highways with paved shoulder (IRC: SP:73-2018), referred to as the Manual and Indian Road Congress (IRC) Codes and Standards and MORTH Specifications for Road and Bridge Works.

Where the aforesaid Manuals, guidelines, codes, standards and specifications are silent on any aspect, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

Table 1.2: Design Codes / Specifications

Sr. No.	Description	Design Code
1.	Geometric Designs & standards	IRC:38-1988 Guidelines for design of horizontal curves for Highways
		IRC: SP-23-1983 – Vertical curves for Highways
		IRC:39-1986- Standards for Road Rail Level Crossings
		IRC:64-1990– Guidelines for Capacity of Roads in Rural Areas
		IRC:66-1976 – Recommended Practice for Sight Distance on Rural Highways
		IRC:73-1980– Geometric Design Standards for Rural (Nonurban) Highways
		IRC:75-2015 – Guidelines for the Design of High Embankments (First Revision)
		IRC:86-2018 – Geometric Design Standards for Urban Roads and Streets (First Revision)
		IRC:106-1990– Guidelines for Capacity of Urban Roads in Plain Areas
2.	Design of Pavement	IRC:37-2018 – Guidelines for Design of Flexible Pavements" (Fourth Revision)
		IRC:58-2015 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision)
		IRC:8-1997 – Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique (First Revision)
3.	Junctions/Intersections/ interchanges	IRC:65-2017- Guidelines for Planning and Design of Roundabouts (First Revision)
		IRC:92-2017 - Guidelines for Design of Interchanges in Urban Areas (First Revision)
		IRC: SP:41-1997 – Guideline for Type Designs for Check Barriers (First Revision)
4.	Kilometer stones, 200m stones and boundary pillar	IRC:81 – Type Design for Highway kilometer stones
		IRC:26-1967 - Type Design for 200-Metre Stones
		IRC:25-1967 - Type Designs for Boundary Stones
5.	Traffic Signs	IRC:67-2012 – Code of Practice for Road Signs (Third Revision)
		IRC:79-2019– Recommended Practice for Road Delineators (First Revision)
		IRC: SP:31 – Road Traffic signs
6.	Road Markings	IRC:35-2015– Code of Practice for Road Markings (Second Revision)
7.	Ancillary Works	IRC:80-1981 – Type Designs for Pick-up Bus Stops on Rural (i.e., Non-Urban) Highways
		IRC: SP: 12-2015– Guidelines for Parking Facilities in Urban Roads" (First Revision)
8.	Drainage	IRC: SP:42-2014 – Guidelines on Road Drainage (First Revision)
		IRC: SP:50-2013 – Guidelines on Urban Drainage
9.	Safety Measures	IRC:103-2014 – Guidelines on Tree Plantation along Rural Roads
		IRC: SP:44-1996– Highway Safety Code
		IRC: SP:55-2014 – Guidelines on Traffic Management in Work Zones" (First Revision)

1.5 Codes and Specifications of Bridge Design

The following codes and publications (latest editions) have been used for the design of bridge components including approaches:

Table 1.3: Codes and Publications used for the Design

IRC Code	Description and name of Code
IRC: 5-2015	Standard Specification and code of Practice for Road bridges, Section 1 – General Features of Design (Eighth Revision)
IRC: 6-2017	Standard specifications and code of practice for Road bridges (Section: II) Loads and Stresses Loads and Loads combinations (Seventh Revision)
IRC: 112 – 2011	Code of practice for concrete road bridges
IRC: SP:13 – 2004	Guidelines for the design of small bridges and culverts
IRC: 78-2014	Standard Specification and code of Practice for Road bridges, Section VII –Foundation and Substructure (Second Revision)
IRC: 83-2015 (Part I)	Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part I: Roller & Rocker Bearings (Second Revision)
IRC: 83-2018 (Part II)	Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings (Elastomeric Bearings), Part II (Second Revision)
IRC: 89 -2019	Guidelines for Design and Construction of River Training & Control Works for Road Bridges (Second Revision)
IRC: SP:35 -1990	Guidelines for inspection and Maintenance of Bridges
IRC: SP: 40 – 2019	Guidelines on Repair, Strengthening and Rehabilitation of Concrete Bridges (First Revision)
IRC: SP: 73-2018	Manual of Specifications & Standards for Two Lanning of Highways with Paved Shoulder" (Second Revision)

Where IRC Codes are silent, relevant BIS codes have been followed. In case even the BIS codes are silent, sound engineering practices have been adopted.

1.6 Key Design Parameters of Road Components

The design standards are primarily based on IRC publications, MORTH Specifications and relevant international standards and industry best practice. Where the design standards are silent, the consultant has based the design on their past experience and sound engineering practices. e.g.: geometrics embankment, pavement, structures, drainage, drawings, traffic safety and materials.

- Terrain Classification

The following terrain classification recommended by IRC:38-1988 /IRC: SP:73-2018 is proposed to be adopted:

Terrain	Cross Slope (%)
Plain	<10
Rolling	10 – 25
Mountainous	25 -60
Steep	> 60

- Design Speed

The allowed speeds are dependent on both terrain and horizontal curvature. While the project roads are in plain and rolling terrain, the roads have many horizontal curves not meeting the design speed. In view of this, the design speeds that could be achieved shall be reviewed based on the current geometry and efforts will be towards making the road safe and conforming to design standards within the constraints.

The design speed of 100 and 80 Kmph as ruling and minimum as per IRC: SP:73 of 2018 has been adopted for road falling in plain & rolling terrain.

(c) Site Specific: It is proposed to maintain a uniform design speed except in built up/ urban areas. Reduced design speed in urban areas has been adopted to enhance safety of users (both motorized/ non-motorized and other vulnerable users as pedestrians). The change in speed from rural to urban areas and vice versa shall be made in a gradual manner by introduction of traffic calming measures so that the road users become conditioned to the change gently.

Horizontal, vertical and other design parameters are detailed in subsequent sections and summary is given in Table 1.4 as follows.

Table 1.4: Design Parameters for Plain and Rolling Terrain

S. No.	Description	Details
1.	Design Speed	100 /80 Kph
2.	Lane width	3.5 m
3.	Camber (Pavement & Paved shoulder) Flexible Pavement	2.50%
4.	Camber (Pavement & Paved shoulder) Rigid Pavement	2.00%
5.	Camber (Gravel shoulder)	3.50%
6.	Kerb shyness on footpath / separator side	0.25 m
7.	Maximum super-elevation	5.00%
8.	Minimum Sight Distance	360 / 240 m
9.	Overtaking Sight Distance (ISD)	640 / 470 m
10.	Minimum radius of horizontal curve	400 / 250 m
11.	Min. vertical gradient (primarily on new/ reconstruction carriageway)	0.30%
12.	Ruling maximum vertical gradient (Mountainous/Steep)	5.0/6.0%
13.	Limiting maximum vertical gradient for short length (Mountainous/Steep)	6.0/7.0%
14.	Minimum length of vertical curve	60 m/ 50 m

2 ROAD CARRIAGEWAY AND CROSS-SECTIONS

2.1 Introduction

The project area was studied from satellite imaginaries and topographical maps (from Survey of India) to understand the terrain, environmental and social features including water bodies, forest areas, built-up areas etc. Reinforced with the information from maps, site visits were made to study and understand various site constraints, land uses, environmental sensitive features, developmental activities and presence of utilities. These were followed by detailed inventory and surveys of various road and structure features including carrying out of utility survey.

The following IRC codes and standards have been referred to for finalizing the design of cross-sectional elements.

Table 2.1: Codes Pertaining to Road Cross Sections

(i)	IRC:73-1980	Geometric Design Standards for Rural (Nonurban) Highways
(ii)	IRC:86-2018	Geometric Design Standards for Urban Roads and Streets (First Revision)
(iii)	IRC:106-1990	Guidelines for Capacity of Urban Roads in Plain Areas
(iv)	IRC:64-1990	Guidelines for Capacity of Roads in Rural Areas.
(v)	IRC: SP:73-2018	Manual of Specifications & Standards for Two Lanning of Highways with Paved Shoulder" (Second Revision)

2.2 Road Carriageway and Cross-sectional Elements

The cross-sectional elements of road comprise of:

- Right of way (ROW);
- Road carriageway;
- Width at cross drainage structures;
- Shoulders;
- Width of drainage or footpath and
- Camber or cross fall.

The above elements together constitute complete road cross section. Adoption of various elements in an appropriate manner, in accordance with IRC guidelines for safe movement of traffic is a major design requirement. These are detailed in the following sections. Details of Road inventory and pavement condition are attached in Annexure-I & II respectively.

2.3 Roadway Width (Carriageway Width)

The IRC:73-2018 lays down formation width guidelines for 2 lane carriageway configurations for Highways in plain & rolling terrain as 7.0m.

Shoulder Width:

The normal shoulder width as per IRC: SP:73-2018 shall be 2.5m on either side in roads passing through plain and rolling terrain. In open country 1.5 m paved & 1 m earthen shoulder and in built-up areas 2.5 m shoulder width is taken.

Type of Shoulder:

Type of Section	Width of shoulder (m) on either side		
	Paved	Earthen	Total
Open country with isolated built-up areas	2.5	1.5	4.0
Built-up section (2-lane section)	2.5	-	2.5
Approaches to grade separated structures	2.5	-	2.5
Approaches to bridges	2.5	1.5	4.0

Camber

As per IRC: SP:73-2018 a camber of 2.5% in straight sections of flexible pavement surface (including paved shoulder), 2.00% in rigid pavement surface (including paved shoulder) and 3.5% in the granular shoulder is recommended and same will be adopted.

Sr. No.	Pavement/Surface	Camber %
1.	Flexible	2.50
2.	Rigid	2.00
3.	Earthen Shoulder	3.50

Footpath

Nil

Site Specific

The project road is proposed new construction of 2-lane carriageway with earthen/paved shoulder. Since the road is important and considering the safety and future capacity issues, it is proposed to have the Formation width components shall comprise of as under:

For 2-lane & earthen Shoulder Configuration

Carriageway - 1 x 7.00 m =7.00 m

Paved shoulders - 2 x 1.5 m = 3.0 m

Earthen Shoulders - 2 x 1.0 m = 2.0 m

Following would be some departures/ changes from above:

- On horizontal curves, the carriageway width is increased to account for the extra widening requirements for curvature;
- In built-up areas, the earthen shoulder will be replaced by paved blocks wherever applicable;
- At built-up sections and other locations where traffic calming measures are considered, central hatching in for virtually segregating directional traffic may be provided where enough space is available.

2.4 Right of Way (ROW)

Proposed ROW will be as per the table given below:

Design Chainage From(km)	Design Chainage To(km)	Design Length (km)	EROW as per Revenue Records (m)	PROW (m)	Remarks
0.040	0.100	0.060	14	16	Built-up
0.100	0.200	0.100	12	16	Built-up
0.200	0.300	0.100	12.5	16	Built-up
0.300	0.400	0.100	10.5	16	Built-up
0.400	0.500	0.100	10	16	Built-up
0.500	0.600	0.100	10.8	16	Built-up
0.600	0.650	0.050	11	16	Built-up
0.650	0.700	0.050	11	16	Built-up
0.700	0.800	0.100	12	16	Built-up
0.800	0.900	0.100	12.6	16	Built-up
0.900	1.015	0.115	11.7	16	Built-up
1.015	1.100	0.085	12.6	16	Built-up
1.100	1.200	0.100	15	16	Built-up
1.200	1.300	0.100	11	16	Built-up
1.300	1.360	0.060	13	16	Built-up
1.360	1.400	0.040	13	18	Built-up
1.400	1.500	0.100	11.6	18	Built-up
1.500	1.600	0.100	10.7	18	Built-up
1.600	1.700	0.100	10.9	18	Built-up
1.700	1.800	0.100	11.7	16	Built-up
1.800	1.900	0.100	11.4	16	Built-up
1.900	2.000	0.100	11.4	16	Built-up
2.000	2.160	0.160	12	16	Built-up
2.160	2.200	0.040	10.2	14	Built-up
2.200	2.300	0.100	10.3	14	Built-up
2.300	2.400	0.100	8	14	Built-up
2.400	2.500	0.100	6.6	18	Built-up
2.500	2.600	0.100	7.2	16	Built-up
2.600	2.700	0.100	7.5	16	Built-up
2.700	2.800	0.100	7.5	16	Built-up
2.800	2.900	0.100	8	16	Built-up
2.900	3.000	0.100	7.8	16	Built-up
3.000	3.140	0.140	9.5	16	Built-up
3.140	3.200	0.060	9.1	16	Built-up
3.200	3.300	0.100	7.8	16	Built-up
3.300	3.400	0.100	7.2	16	Built-up
3.400	3.500	0.100	9.1	14	Built-up
3.500	3.600	0.100	8.5	14	
3.600	3.700	0.100	9.3	14	
3.700	3.800	0.100	10.4	30	Realignment
3.800	3.900	0.100	9.5	30	Realignment

Design Chainage From(km)	Design Chainage To(km)	Design Length (km)	EROW as per Revenue Records (m)	PROW (m)	Remarks
3.900	4.000	0.100	7.2	30	Realignment
4.000	4.050	0.050	9.5	30	Realignment
4.050	4.100	0.050	9.5	30	Realignment
4.100	4.200	0.100	9.5	30	Realignment
4.200	4.230	0.030	7.5	18	
4.230	4.300	0.070	7	16	
4.300	4.400	0.100	8.5	16	
4.400	4.440	0.040	12	16	
4.440	4.500	0.060	12	16	
4.500	4.540	0.040	10	16	
4.540	4.600	0.060	10	16	
4.600	4.700	0.100	7.5	16	
4.700	4.740	0.040	10	16	
4.740	4.800	0.060	7.5	18	
4.800	4.900	0.100	10	18	
4.900	5.000	0.100	9.8	18	
5.000	5.080	0.080	9.8	18	Built-up
5.080	5.100	0.020	9.8	18	Built-up
5.100	5.200	0.100	10	18	Built-up
5.200	5.300	0.100	8.7	18	Built-up
5.300	5.400	0.100	8.5	18	Built-up
5.400	5.540	0.140	9.5	18	LHS River
5.540	5.600	0.060	9.5	16	Built-up
5.600	5.700	0.100	6.5	16	Built-up
5.700	5.800	0.100	8.9	16	Built-up
5.800	5.825	0.025	15.8	16	Built-up RHS
5.825	5.900	0.075	8.5	16	Built-up RHS
5.900	6.000	0.100	6	18	Built-up RHS
6.000	6.060	0.060	5.6	18	Open Area
6.060	6.100	0.040	5.6	18	Open Area
6.100	6.200	0.100	6	18	Open Area
6.200	6.300	0.100	6.5	18	Open Area
6.300	6.400	0.100	7.7	18	Open Area
6.400	6.500	0.100	7.8	18	Open Area
6.500	6.600	0.100	6.8	18	Open Area
6.600	6.700	0.100	8.2	18	Open Area
6.700	6.800	0.100	7.4	18	Open Area
6.800	6.900	0.100	8.5	18	Open Area
6.900	7.000	0.100	6.3	18	Open Area
7.000	7.100	0.100	8.7	18	Open Area
7.100	7.200	0.100	8.4	18	Open Area
7.200	7.300	0.100	5.1	18	Open Area
7.300	7.400	0.100	5.5	18	Open Area

Design Chainage From(km)	Design Chainage To(km)	Design Length (km)	EROW as per Revenue Records (m)	PROW (m)	Remarks
7.400	7.500	0.100	13.7	18	Open Area
7.500	7.600	0.100	16.7	16.7	Open Area
7.600	7.700	0.100	18.6	18.6	Open Area
7.700	7.730	0.030	20.6	20.6	Open Area
7.730	7.800	0.070	20.6	29.5	Open Area With Truck Lay-By
7.800	7.835	0.035	22	27	Open Area With Truck Lay-By
7.835	7.900	0.065	8.8	27	Open Area With Truck Lay-By
7.900	7.970	0.070	6	27	Open Area With Truck Lay-By
7.970	8.000	0.030	6	18	Open Area
8.000	8.100	0.100	6	18	**Open Area**
8.100	8.200	0.100	7	18	Open Area
8.200	8.300	0.100	6	16	Built-up
8.300	8.350	0.050	9.7	16	Built-up
8.350	8.400	0.050	9.7	16	Built-up
8.400	8.415	0.015	7.5	16	Built-up
Total		8.375			

2.5 Typical Cross-Sections

Based on above features, operational requirements and to meet design standards stated in the Two Lanes Manual for the State Highways; typical cross-sections for new construction of road have been developed. Chainage wise details of cross-sections are given in Table 2.3 below.

Table 2.3: Summary of Typical Cross-Section (TCS)

(a) Summary of Typical Cross-Section (TCS)

Sr. No.	TCS Type	Length (km)	TCS Description
1	T1	3.675	Overlay/Widening (Built-up Section Both side drain)
2	T2	0.520	Overlay/Widening (Built-up Section one side drain)
3	T3	3.270	Overlay/Widening
4	T4	0.600	New Construction/Reconstruction
5	T5	0.160	New Construction
6	T6	0.150	LHS Protection
Grand Total		**8.375**	

3 IMPROVEMENT PROPOSALS

3.1 Formulation of Proposals

The project basically involves proposal of Alignment to 2-lane carriageway with paved shoulder with geometrics to provide a design speed of 100/80 kilometer per hour.

The two main components that comprises of improvement proposals are:

- Geometric
- Structural

The economic and traffic considerations determine and dictate the Geometric component. This component deals mainly with the visible elements of the roadway such as – horizontal and vertical alignments, sight distance considerations, cross sectional elements, lateral and vertical clearances, intersection treatment, control of access etc.

Similarly, the structural component with the invisible physical strength characteristics of the pavement and embankment aspects under the application of wheel loads, the adequacy of their durability to withstand such loads over the design period dictate the structural component.

3.2 Other Improvements

In addition to alignment proposals, other major improvement proposals include:

- Strengthening or reconstruction of existing pavement after pavement investigation
- Re-designing of major and minor junctions to IRC Standards
- Adequate drainage provision, both surface and sub-surface
- Cross-drainage structures – improvements and new
- Provision of road safety devices and road side furniture both for motorized and non- motorized users.
- New project facilities
- Landscaping and tree plantation.
- Street Lightening in Junctions and Bus shelters.

4 ALIGNMENT DESIGN

4.1 Introduction

The existing road is an intermediate / two lane and has relatively good to poor geometry. The road has been proposed to be improved for design speed of 100/80 kmph wherever possible due to land width restrictions.

The following IRC codes and standards have been referred to for finalizing the alignment.

Table 4.1: Codes Pertaining to Alignment Design

(i)	IRC:73	Geometric Design Standards for Rural (Non-Urban)
(ii)	IRC:86	Geometric Design Standards for Urban Roads in Plains
(iii)	IRC:106	Guidelines for Capacity of Urban Roads in Plain Areas
(iv)	IRC:64	Guidelines for Capacity of Roads in Rural Areas.
(v)	IRC: SP:73	Manual for Two Laning of State Highways

The various alignment (horizontal and vertical) elements of any road comprise of:

- Radius of curve
- Super-elevation
- Transition length
- Extra widening
- Vertical Curve length
- Gradient

The above elements together are integral part of geometry of road. Adoption of various elements in an appropriate manner, in accordance with IRC codes for safe movement of traffic is a major design requirement and is detailed in the following sections.

4.2 Horizontal Alignment

4.2.1 General

As per the requirements of IRC: SP: 73-2018, the following guidelines were followed during the design:

- Uniformity of design standards and speed;
- Horizontal alignment to be fluent and blend well with the surrounding topography;
- Limit the adverse impact to the existing environment
- Design of horizontal alignment in consideration of the longitudinal profile and vice versa; and
- Alignment near location of bridges and their approaches integrated keeping in view the overall technical DPR and improvement proposal of bridges

The geometric design shall also be undertaken to minimize impact on trees, utilities, properties, religious places and avoid extending beyond the existing right of way (ROW).

Site Specific

The Project Road is a State Highway. ROW details in the form of boundary stones are not found at site; therefore, ROW details based on Revenue map and observed property lines are considered for the design of alignment.

The horizontal alignment has been designed in such a way that additional land requirement /acquisition is minimum (to nil) and the impact of widening is less on existing built-up areas and existing environmental and social features. The existing carriageway, structures/bridges etc. are utilized to the extent possible unless proved otherwise.

4.2.2 Design Elements

Radius of Horizontal Curves

In general, horizontal curves consist of a circular curve portion flanked by a spiral transition on both ends. These shall correspond to the ruling minimum and absolute minimum design speeds and the maximum permissible values of super-elevation as per IRC: 73:1980 guidelines.

For the roads in plain/ rolling terrain, for the design speed of 100 kmph, the radius of more than

400 m and for the design speed of 80 km/h, the radius of more than 250 m shall be provided in design for the horizontal curves and is as per IRC: SP:73/IRC:73. Wherever possible and permissible, higher radii will be adopted.

The minimum radii of horizontal curves for different terrain conditions considering a maximum super-elevation of 7% is shown in Table 4.2.

Table 4.2: Minimum Radii of Horizontal Curves (in meters)

Plain & Rolling Terrain	
Desirable Minimum	Absolute Minimum
400	250

Super Elevation

Super elevation is required for all the horizontal curves with radius less than 1800 m in order to counteract the effect of centrifugal force. As per IRC: 38-1988, super-elevation to fully counteract the centrifugal force for 75% of the design speed neglecting the lateral friction developed will be adopted in design.

The maximum super elevation allowed as 7%, however maximum adopted is 5% on the project road.

Transition Curves - Transition curves are necessary for a vehicle to have smooth entry from a straight section into a circular curve. The transition curves also improve aesthetic appearance of the road besides permitting gradual application of the super-elevation and extra widening of carriageway as may be needed at the horizontal curves.

The horizontal curves with radius of curvature < 1800 m for 100 kmph and <1100 m for 80 kmph, transition curves are provided on both ends of circular curve.

4.2.3 Site Specific

Based on above methodology, the horizontal alignment has been designed using MX Road software. The horizontal alignment details with intersection points along with radius are listed in Annexure to Volume I (Main Report).

Extra widening at curves is proposed depending upon the radii that are less than 300m.

Due to constraints in ROW, large scale easing of sub-standard curves is not feasible. Wherever, improvement of curves for design speed considerations is not possible, speed limitation has been applied along with necessary safety measures.

4.3 Vertical Alignment

4.3.1 General

The vertical alignment is proposed to provide for a smooth longitudinal profile consistent with design speed, layout of the terrain and land-use. Too frequent grade changes cause kinks and visual discontinuities in the profile. Considering this, a gap of 150m has been adopted between two grades, mainly on sections with re-construction of pavement.

The existing road profile has been followed as far as possible, where the project road improvement is limited to widening and strengthening of the existing road. In case where the existing pavement has disintegrated and in sections which are prone to submergence, reconstruction of the pavement has been proposed and the design road level have been fixed taking into consideration the HFL.

Decks of small cross-drainage structures will conform to the profile of the new road section in case of new construction / reconstruction. Where existing structures are retained, the profile of the road has been suitably adjusted to avoid loading the existing deck with overburden/surcharge.

4.3.2 Design Elements

Gradients - Grades have been selected carefully keeping in view the design speed, terrain conditions and nature of traffic on the road.

The ruling and absolute maximum longitudinal gradients are recommended by IRC: SP:73 of 2018 as 2.5% and 3.3% respectively for plain & rolling terrain. Similarly, for mountainous terrain ruling & absolute maximum gradients are 5.0% & 6.0% respectively. Profile design of existing carriageway has been done keeping in view of minimizing profile corrective course (PCC) quantity.

Minimum Gradient for Drainage – As per IRC; SP: 73:2018, on un-kerbed pavements on embankment, near level grades may be acceptable when the pavement has sufficient camber to drain the storm water laterally. However, in cut sections, or roads at ground level, or where the pavement is provided with Krebs, it is necessary to provide some gradient for efficient drainage. Recommended minimum gradient for this purpose is 0.5% if side drains are lined and 1.0%, if these are unlined.

Further, a minimum longitudinal gradient of 0.3% would be ideally adopted from drainage point of view in re-construction sections.

Vertical Curves - These are introduced for smooth transition at grade changes. There are two types:

- Summit curves or convex vertical curves or hog curves; and
- Valley curves or concave vertical curves or sag curves.

Length of these curves is controlled by sight distance requirement, but curves with greater length are aesthetically better and improves safety. Minimum lengths of vertical curves as per IRC; SP:23-1993 and adopted are shown in Table 4.3 below.

Table 4.3: Minimum Length of Vertical Curves

Design Speed (Km/h)	Maximum grade change (percent) not requiring a vertical curve	Minimum length of vertical curve (meters)
Up to 35	1.5	15
40	1.2	20
50	1.0	30
65	0.8	40
80	0.6	50
100	0.5	60

Due to changes in grade in the vertical alignment of the road, vertical curves at the intersection of the different grades will be provided in the design so as to smoothen the vertical profile resulting in easing off of the changes in the gradients for the fast-moving vehicles. Both summit curves and valley curves will be introduced as per IRC guidelines.

Length of summit curves is governed by the choice of sight distance. Length of the valley curves should be such that for night travel, the head light beam distance is equal to the stopping sight distance. The lengths of the valley curves are worked out as per the guidelines and formula given in the IRC: 73.

4.3.3 Sight Distance

As per IRC recommendations, the minimum sight distance (Stopping sight distance, SSD) is 360 m for 100 kmph and 240 m for 80 kmph and overtaking sight distance (OSD) is 640 m for 100 kmph and 470 m for 80 kmph.

4.3.4 Site Specific

The vertical profile of the existing road is having the grades which are within permissible limits as per the terrain requirements. The profile will be smoothened by providing smooth vertical curves.

The profile of new and existing carriageway alignment has been designed with reference to the existing profile. The proposed alignment has been designed with smooth gradients. The profile of the existing road has many undulations, which have also been smoothened.

The details of vertical profiles are given in the drawing, enclosed in the Drawings Volume. The given profile shows the proposed levels along the proposed center line along with the detail's super elevation, extra widening and all existing features.

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The existing road has been used to maximum extent possible. The maximum proposed road gradient is 2.5% to provide a smooth longitudinal. The height of embankment has also been raised considering the hydrological data and HFL criteria. The road is designed for intermediate sight distance.

5 JUNCTIONS/ INTERSECTIONS

5.1 General

Intersections are important element of road and at grade intersections are very common. The design scope covers improvement of existing at grade junctions and intersections. The main objective of the intersection design is to minimize the severity of potential conflicts between cars, buses, trucks, cycles and pedestrians, while facilitating the convenience, ease and comfort of people traversing the intersections.

Intersection design should be fitted closely to the operating characteristics of users. Basic elements that have been considered in intersection design are:

- Human Factors: driving habits of road users, reaction time of various road users
- Traffic Considerations
- Physical Elements: median and island provisions, land availability, traffic control devices, drainage features etc.
- Economic Factors: cost of improvements.

5.2 Basic Design Principles

Primary considerations are safety, smooth and efficient flow of traffic. Intersections are designed having regard to flow, speed, composition, distribution and future growth of traffic. Design has to be specific for each site with due regard to physical conditions of the site, the amount and cost of land. Cost of construction and the effect of proposal on the neighborhood. Allowances for space are needed to accommodate traffic signs, lighting columns where applicable, drainage, public utilities etc.

Intersections are to be designed for peak hour volumes. Estimation of future traffic and its distribution during peak hours is done on the basis of estimated traffic and by accounting form factors like new development of land, socio-economic changes etc.

The radii of intersections curves depend on the turning characteristics of design vehicles their numbers and the speed at which vehicles enter or exit the intersection area. In urban area additional conditions like restriction of right of way widths, abutting developments, pedestrian crossings, parked vehicles and high cost of land govern minimum radii at intersections. However, to ensure traffic operation on arterial streets as per IRC SP:41, the common turning radii of 4.5 to 7.3 for passenger cars and 9m to 15 m for trucks and buses are recommended. And also, in urban area if curve radii is increased, the pedestrian crossing distance increases. Since this has pedestrian safety implications, this should be kept in view while deciding on the turning radius to be provided.

In hilly and rolling terrain, site condition governs the alignment, grade of the intersection. The following are the basic principles to be given due attention during the design.

- The intersecting roads shall meet at or nearly at right angle. However, angles above 60 degrees do not warrant realignment;
- Intersection on sharp curves should be avoided because the super elevation and widening of pavement complicates the design;
- The gradient of intersecting highways should be as flat as practicable up to section that are used for storage space; and
- Grades in excess of 3 percent should, therefore, be avoided on intersections while those in excess of 6 per cent should not be allowed.
- Junctions/ Intersections should be avoided inside the horizontal curves; primarily sharp as they obstruct the sightlines/ forward visibility.

The specific intersection design depends on physical conditions of the site, such as topography, available ROW, land use, development along the intersecting roads, expected volume of through and turning traffic.

It is desirable to provide Krebs at the intersections in urban and sub-urban area. Krebs are to be of mountable type except for pedestrian refuge where these shall be non-mountable. In intersection design the possible use of traffic control devices and another road furniture is considered. The common types of traffic control devices are: road markings; road signs; reflectors/ delineators and railings.

5.3 Site Specific

The majority of the existing road junctions are formed with village and minor roads except 01-Major junctions that necessitate careful design considerations. Following Junctions/Cross Roads will be improved as per specification:

There total 30 junctions of which 1 is Major junction & 29 are Minor Junction/Cross Road. List of Junction is given in the table below:

Table 5.1: Road Junctions

Sl. No	**Design Chainage (Km.)**	**Classification of crossroad**	**Type of Junction**	**Type of Cross Road**	**Side**	**Road Leading to**	**Remarks**
			(T, Y)				
Major Junctions							
1	0+000	Junction of NH-217 & NH-17	+ Junction	2-Lane BT	Four Sides	Back side Goalpara, RHS-Paikan, LHS-Guwahati	
Minor Junctions/Cross Roads							
1	0.170	Village Road	T Junction	BT Road	LHS	To Colony	
2	0.305	Village Road	T Junction	BT Road	LHS	To Colony	
3		Village Road	T Junction	BT Road	RHS	To Colony	
4	0.470	Village Road	T Junction	BT Road	LHS	To Colony	
5	0.530	Village Road	T Junction	BT Road	RHS	To Milan Path	

Sl. No	Design Chainage (Km.)	Classification of crossroad	Type of Junction	Type of Cross Road	Side	Road Leading to	Remarks
			(T, Y)				
6	0.680	Village Road	T Junction	BT Road	LHS	To Colony	
7	0.705	Village Road	T Junction	BT Road	RHS	To Colony	
8	0.800	Village Road	T Junction	BT Road	RHS	To Colony	
9	0.840	Village Road	T Junction	BT Road	LHS	To Colony	
10	1.010	Village Road	T Junction	BT Road	LHS	To Colony	
11	1.020	Village Road	T Junction	BT Road	RHS	To Colony	
12	1.180	Village Road	T Junction	BT Road	RHS	To Jyoti Chira Mill	
13	1.240	Village Road	T Junction	BT Road	LHS	To Colony	
14	1.360	Village Road	T Junction	BT Road	LHS	To Colony	
15	1.370	Village Road	T Junction	BT Road	RHS	To Colony	
16	2.040	Village Road	Y Junction	BT Road	RHS	To Colony	
17	2.300	Village Road	T Junction	BT Road	Both	To Colony	
18	2.570	Village Road	T Junction	BT Road	RHS	To Colony	
19	2.640	Village Road	T Junction	BT Road	LHS	To Colony	
20	3.100	Village Road	T Junction	BT Road	LHS	To Colony	
21		Village Road	T Junction	BT Road	RHS	To Colony	
22	4.100	Village Road	Y Junction	BT Road	RHS	To Bakrapur	
23	4+540	Village Road	T Junction	BT Road	LHS	To Damra village	
24	5.140	Village Road	T Junction	BT Road	RHS	To Colony	
25	5.500	Village Road	T Junction	BT Road	RHS	To Colony	
26	5.800	MDR	T Junction	BT Road	RHS	To Laskerpara village	
27	6.390	Village Road	T Junction	BT Road	LHS	Village road	
28	7.880	Village Road	Y Junction	BT Road	LHS	Village road	
29	8.110	Village Road	T Junction	BT Road	RHS	Village road	

Achieving desired standards would require land and structures acquisition. MORT&H guidelines will be followed.

For remaining road junctions with village/ minor roads, typical standard designs as per MORTH are proposed with appropriate modifications, considering the ROW constraint and additional safety measures. Specific designs will also be produced, as necessary.

The vertical profile/ grade line of cross-roads would meet the project road without undue steep gradients with a flat section adjoining mainline; with due consideration given to land and local constraints.

6 PAVEMENTS

6.1 Introduction

Pavement design aims at determining the total thickness of the pavement structure as well as the thickness of the individual structural components for carrying the estimated traffic loading under the prevailing environmental conditions. Many design methods, from purely empirical to rigorous analytical ones are available, and these are practiced in different parts of the world. The design methods adopted in other countries may not be applicable to Indian climatic conditions. In India, the generally adopted method of design of flexible pavement is based on IRC: 37. Accordingly IRC: 37-2018 “Guidelines for the Design of Flexible Pavements (Fourth Revision)”, has been adopted and used for the current project.

6.2 Review of Design Methods for New Construction

The AASHTO and IRC methods of pavement design have been reviewed before recommending the pavement composition. However, in the perspective of such review, it is important to note that no method in practice can be considered better than the other as each method has its own inherent limitations, owing to the characteristics of materials used in construction and their complex interaction, climatic and traffic conditions. The other methods of TAC and NAASRA may not be applicable for the current project road pavement design due to limitations on fatigue failure criteria and nature of materials considered in the design criteria does not suit the project requirements and hence the same were not considered for pavement design.

6.3 AASHTO-93, Guide for Design of Pavement Structures

This method of approach is based on empirical expressions obtained from the AASHO road tests. This approach considers the „Present Serviceability Index" (or PSI, the performance variable), „reliability" (probability that the pavement system will perform its intended function over the design life and under the conditions encountered during the operation period), resilient modulus of sub-grade besides the constituent materials, drainage and climatic conditions.

This method gives the total required pavement composition in terms of the parameter „Structural Number" (SN, which is represented by the sum of the product of the layer coefficient, the thickness expressed in inches and the drainage coefficient of each layer of pavement) and a procedure to arrive at the individual pavement layer thicknesses in relation to the strength characteristics of the pavement layers, defined as layer coefficients. An acceptable „serviceability" is considered as a main design criterion in this method. The end of design life is considered in the form of a terminal PSI, which usually corresponds to a minimum acceptable riding quality.

6.4 IRC: 37 – 2018, Guidelines for the Design of Flexible Pavements

The pavement designs given in this guide are based on the results of pavement research work done in India and experience gained over the years on the performance of the designs given therein. Flexible pavement has been modelled as a three-layer structure with stresses and strains at critical locations computed using the linear elastic model FPAVE developed under the Ministry of Road Transport & Highways Research Scheme, R – 56 and further updated it with IITPAVE recently.

The pavement designs are given for sub-grade CBR values ranging from 2% to 15% for different pavement type options like Cement Treated base and Sub base, use of RAP in asphalt layer with foamed bitumen or emulsion. The pavement compositions given in the design catalogue are relevant to Indian conditions, materials and specifications. Where changes to layer thickness and specification are considered desirable from practical considerations, the guidelines recommend modifications using an analytical approach. Hence, the design has been carried out based on the procedure given in IRC: 37-2018.

6.5 Design Methodology

The design shall be based on various design parameters as evaluated from various field and laboratory investigations, design procedures with the objective to ascertain optimal pavement structure meeting the structural requirements for the traffic and complying with the provisions of the relevant codes and guidelines. The structural requirements are:

(i) The total thickness of the pavement and the thickness of individual layers should be designed in such a way that they are not subjected to stresses or strains exceeding those admissible in view of the material characteristics and performance factors,

(ii) The pavement layers should be able to with stand repeated applications of wheel loads of different magnitudes under the actual conditions of sub grade, climate, drainage, and other environmental factors during the design life without causing

  a. Excessive permanent deformation in the form of rutting and undulations;
  b. Cracking of bituminous layers; and
  c. Other structural and functional deficiencies such as potholes

(iii) Ensure structural and functional performance under varied conditions and factors affecting the performance of the road i.e., soil type, traffic, environment, etc.

Pavement design guidelines given in IRC:37-2018 adopts are based on the Analytical method which is believed to have been developed based on performance of existing designs and using analytical approach (to limit the vertical compressive strain at the top of sub grade and horizontal tensile strain at bottom of bituminous layer adopting linear elastic model). Flow chart showing the various steps involved in the design process is given in Figure 6.1 below.

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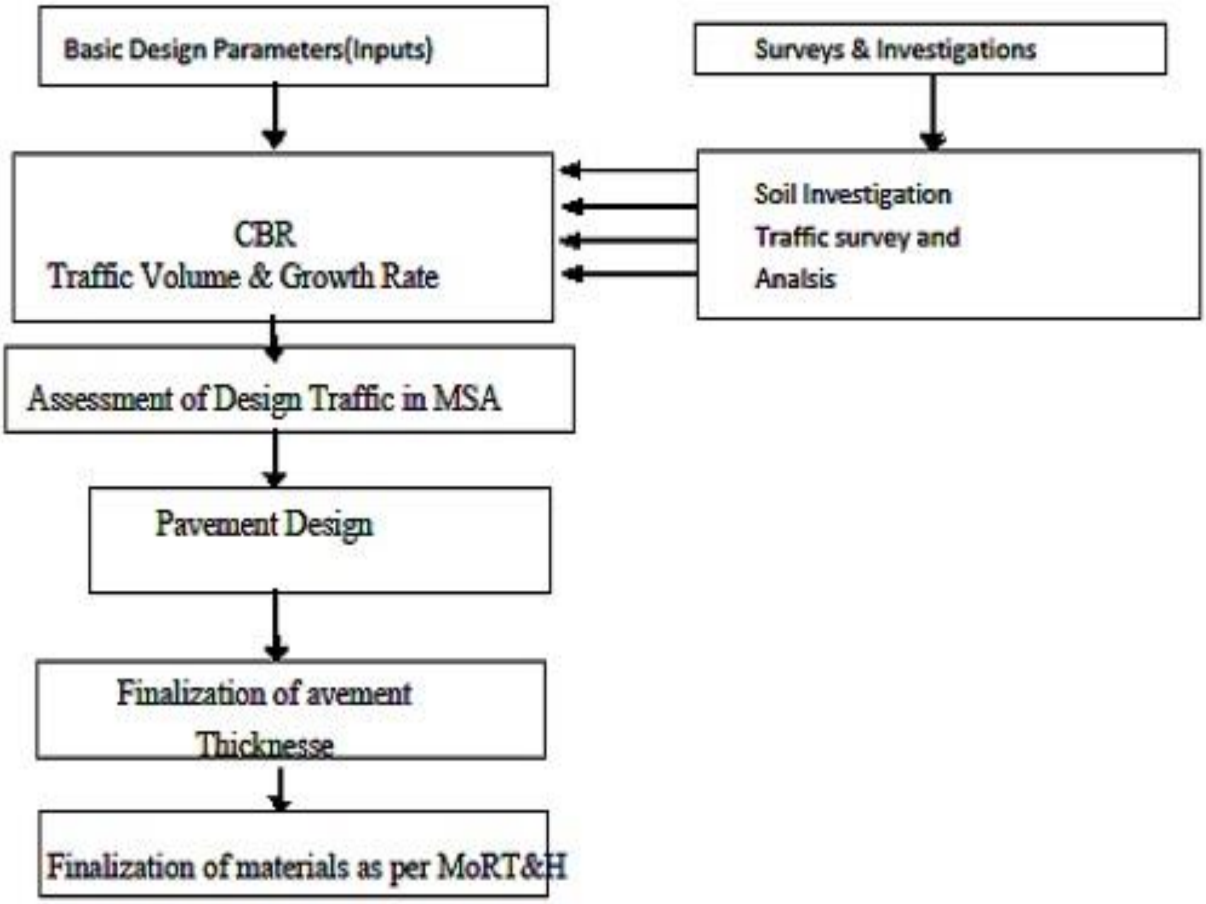
Figure 6.1: Flow Chart Showing the Pavement Design Methodology


Basic Design Parameters(Inputs)
Surveys & Investigations
CBR
Traffic Volume & Growth Rate
Soil Investigation
Traffic survey and
Analsis
Assessment of Design Traffic in MSA
Pavement Design
Finalization of avement Thicknesse
Finalization of materials as per MoRT&H

6.6 Evaluation of Pavement Design Parameters

6.6.1 Design Life

Design life is the time from original construction to a terminal condition for a pavement structure. Structural design is carried to withstand the pavement for a traffic loading encountered over the design life. IRC: 37-2018 suggests design life of 20 years for the flexible pavements and accordingly, design period of 20 years has been considered for the design of pavement.

6.6.2 Traffic Volumes

A detailed traffic surveys and analysis for the project roads have been conducted in the year 2018, hereinafter called, “Base Year”. Detailed traffic projections over the design life and growth rates obtained for different types of vehicles are discussed in traffic chapter. For the purpose of pavement design, commercial vehicles of gross vehicle weight more than 3 ton have been considered. Such vehicles consisted of buses, LCVs, 2 axle trucks, 3 axle trucks and multi axle trucks.

From total projected base year AADT and estimated traffic growth rates, vehicle category-wise traffic volume projections have been made for various design periods. Table 6.1 gives the total projected base year (2019) traffic volumes in terms of AADT for each of the identified traffic homogeneous section and has been used for the estimation of design traffic in terms of MSA for pavement design.

Table 6.1 AADT Traffic Summary

Vehicle Category	("At km 3+500 (Near Damra A.S.A. Playground)	
	AADT (Nos)	AADT (PCU)
Two Wheeler	1753	877
Three Wheeler/ Auto	1139	1139
Car/Jeep/Van/ Taxi	1076	1076
Mini Bus	70	105
Bus	21	63
LCV	255	383
2-Axle Truck	70	209
3-Axle Truck	5	16
M-Axle Truck	11	48
Tractor With Trailer	34	154
Tractor Without Trailer	2	2
Total Fast Moving Vehicles(FMV)	**4435**	**4071**
Cycle	926	463
Cycle Rickshaw	1	1
Hand Cart	10	29
Bullock Cart	1	9
Horse Cart	0	0
Total Slow Moving Vehicles(SMV)	**938**	**503**
Total	**5373**	**4573**
CVPD	**432**	**–**
Tollable Traffic	**1508**	**1899**

6.6.3 Projected Traffic

The total projected traffic is the sum of generated traffic, induced and diverted traffic. The total projected traffic on to the project road has been presented in Table 6.2 below.

Table 6.2: Traffic Forecasts

Year	FAST MOVING VEHICLES											SLOW MOVING VEHICLES					Total (No)	Total (PCU)	Design Year/ Remark
	Two Wheeler	Three-Wheeler / Auto	Car/ Jeep/ Van/ Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	Tractor With Trailer	Tractor Without Trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart			
2018	1753	1139	1076	70	21	255	70	5	11	34	2	926	1	10	1	0	5373	4573	Design Period
2019	1841	1196	1130	74	22	268	73	6	11	36	2	972	1	10	1	0	5642	4802	
2020	1933	1256	1186	77	23	281	77	6	12	38	2	1021	1	11	1	0	5924	5042	
2021	**1933**	**1256**	**1186**	**77**	**23**	**281**	**77**	**6**	**12**	**38**	**2**	**1021**	**1**	**11**	**1**	**0**	**5924**	**5042**	
2022	2029	1319	1246	81	24	295	81	6	12	40	2	1072	1	11	1	0	6220	5294	Construction Period
2023	2131	1384	1308	85	25	310	85	6	13	42	2	1126	1	12	1	0	6531	5559	
2024	**2237**	**1454**	**1373**	**89**	**27**	**326**	**89**	**7**	**14**	**44**	**2**	**1182**	**1**	**12**	**1**	**0**	**6857**	**5837**	**1**
2025	2349	1526	1442	94	28	342	93	7	14	46	2	1241	1	13	2	0	7200	6129	2
2026	2467	1603	1514	98	29	359	98	7	15	48	2	1303	1	14	2	0	7560	6435	3
2027	2590	1683	1590	103	31	377	103	8	16	50	2	1368	1	14	2	0	7938	6757	4
2028	**2719**	**1767**	**1669**	**109**	**32**	**396**	**108**	**8**	**17**	**53**	**2**	**1437**	**1**	**15**	**2**	**0**	**8335**	**7095**	**5**
2029	2855	1855	1753	114	34	416	113	9	17	56	3	1508	1	16	2	0	8752	7449	6
2030	2998	1948	1840	120	36	436	119	9	18	58	3	1584	1	17	2	0	9189	7822	7
2031	3148	2045	1932	126	37	458	125	9	19	61	3	1663	1	17	2	0	9649	8213	8
2032	3306	2148	2029	132	39	481	131	10	20	64	3	1746	1	18	2	0	10131	8624	9
2033	**3471**	**2255**	**2130**	**139**	**41**	**505**	**138**	**10**	**21**	**68**	**3**	**1833**	**1**	**19**	**2**	**0**	**10638**	**9055**	**10**
2034	3644	2368	2237	146	43	530	145	11	22	71	3	1925	1	20	2	0	11170	9508	11

Year	FAST MOVING VEHICLES											SLOW MOVING VEHICLES					Total (No)	Total (PCU)	Design Year/ Remark
	Two Wheeler	Three-Wheeler / Auto	Car/ Jeep/ Van/ Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	Tractor With Trailer	Tractor Without Trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart			
2035	3827	2486	2349	153	46	557	152	12	23	75	3	2021	2	21	2	0	11728	9983	12
2036	4018	2611	2466	160	48	585	159	12	25	78	4	2122	2	22	3	0	12315	10482	13
2037	4219	2741	2590	168	50	614	167	13	26	82	4	2229	2	23	3	0	12930	11006	14
2038	**4430**	**2878**	**2719**	**177**	**53**	**645**	**176**	**13**	**27**	**86**	**4**	**2340**	**2**	**25**	**3**	**0**	**13577**	**11556**	15
2039	4651	3022	2855	186	55	677	185	14	28	91	4	2457	2	26	3	0	14256	12134	16
2040	4884	3173	2998	195	58	711	194	15	30	95	4	2580	2	27	3	0	14969	12741	17
2041	5128	3332	3148	205	61	746	204	15	31	100	5	2709	2	28	3	0	15717	13378	18
2042	5384	3498	3305	215	64	784	214	16	33	105	5	2844	2	30	4	0	16503	14047	19
2043	**5654**	**3673**	**3470**	**226**	**67**	**823**	**224**	**17**	**35**	**110**	**5**	**2986**	**2**	**31**	**4**	**0**	**17328**	**14749**	20
2044	5936	3857	3644	237	71	864	236	18	36	116	5	3136	2	33	4	0	18194	15487	21
2045	6233	4050	3826	249	74	907	247	19	38	121	6	3293	3	35	4	0	19104	16261	22
2046	6545	4252	4017	261	78	953	260	20	40	127	6	3457	3	36	4	0	20059	17074	23
2047	6872	4465	4218	274	82	1000	273	21	42	134	6	3630	3	38	4	0	21062	17928	24
2048	**7216**	**4688**	**4429**	**288**	**86**	**1050**	**286**	**22**	**44**	**141**	**6**	**3812**	**3**	**40**	**5**	**0**	**22115**	**18824**	25
2049	7576	4923	4650	303	90	1103	301	23	46	148	7	4002	3	42	5	0	23221	19765	26
2050	7955	5169	4883	318	95	1158	316	24	49	155	7	4202	3	44	5	0	24382	20754	27
2051	8353	5427	5127	334	99	1216	332	25	51	163	7	4412	3	46	5	0	25601	21791	28
2052	8771	5699	5383	350	104	1277	348	26	54	171	8	4633	4	49	6	0	26881	22881	29
2053	**9209**	**5984**	**5653**	**368**	**110**	**1340**	**365**	**28**	**56**	**179**	**8**	**4865**	**4**	**51**	**6**	**0**	**28225**	**24025**	30

6.6.4 Vehicle Damage Factors

Project specific comprehensive axle load surveys were conducted for each the project road to estimate the loading behavior of commercial vehicles plying on the project road. The detailed analysis and raw data of axle loads collected from site from axle load surveys is provided in Chapter-3, Surveys & Investigations of this report. The summary of VDFs is given in Table 6.2 below.

Table 6.3: Vehicle Damage Factors

TYPE OF VEHICLES	VDF		
	UP	DOWN	MAX
M-Axle	8.655	4.084	**8.655**
3-Axle Truck	5.497	3.706	**5.497**
2-Axle Truck	2.619	3.738	**3.738**
Bus	0.334	0.741	**0.741**
Mini Bus	0.021	0.085	**0.085**
LCV	0.012	0.019	**0.019**

6.6.5 Strength of Sub grade

The strength of sub-grade in terms of California Bearing Ratio (CBR) is required for the design of new flexible pavement as per IRC: 37-2018. Where there is difference between the CBRs of the select sub grade and embankment soils, the design should be based on effective CBR. As new pavement will be constructed with select sub grade, the effective CBR will govern the design. Top

200mm of the embankment layer is also proposed to be constructed with select SG soil of the same CBR value to get higher effective CBR of the SG. Consultants have explored the potential sources of borrow areas with minimal leads from the project road by Inquiring with local inhabitants regarding the availability of land pieces for soil extraction enabled multitude of soil borrow areas identification. The details of materials investigation and testing have been briefly covered in the surveys and Investigations chapter. In general, Soil borrow areas will have to be rented or purchased, for which negotiations with private owner(s) may be required during execution phase of the project.

As per MoRT&H clause 305, the borrow earth material shall satisfy the following engineering properties for use in the sub grade and embankment.

Filled in	Free Swell Index	LL	PI	MDD(g/cc)
Sub grade	≤50%	50%	25%	≥1.75
Embankment	≤50%	50%	25%	≥1.52 up to 3m height ≥1.60 more than 3m height

6.6.7 Evaluation of Design Traffic (MSA) for Pavement Design

Base year traffic (vehicle category-wise & in terms of AADT), traffic growth rates, design life (in terms of number of years) and vehicle damage factors are required to estimate the design traffic in terms of equivalent standard axles. The following data have been considered to arrive at the design traffic (MSA).

- Base year – 2018
- Traffic opening year – 2024 (assumed)
- Design Life – 20 years (i.e., from year 2024 to year 2043, inclusive of both the years)
- Traffic growth rates adopted from project traffic studies conducted but minimum 5%.
- Vehicle damage factor – as listed above.

For flexible pavements, the percentage of vehicles in heaviest loaded lane can be determined as per IRC: 37-2018 guidelines given below:

Type of facility	Lane distribution factor
2- lane single carriageway	50 % of total two directional
2-lane Dual Carriageway	75% of total one directional

With the base year traffic in terms of CVPD, annual growth rate of each of commercial vehicle over the design period, design traffic in terms of MSA over the design life can be estimated using the following formula.

$$N = \frac{365\ x\ [(1+r)^n - 1]}{r} xA\ x\ D\ x\ F$$

Where, N = Cumulative number of standard axles to be catered

A = Initial number commercial vehicles per day in the year when the road is operational

r = Annual rate of growth of commercial traffic

n = Design period in years

D = Lane distribution factor, given below

F = Vehicle Damage Factor

The summary of MSA is given in Table 6.3 below.

Table 6.4: Design MSA for the Project Roads

Sr. No	Station	Calculated MSA on year 2043 (20th Design Year)
1	At km 3+500 (Near Damra A.S.A. Playground)	3.14

Details Traffic data (AADT, Traffic-projection & MSA Calculation) attached in Annexure-VI, VII & VIII.

6.6.8 Design of Pavement Structure as per IRC: 37-2018

As per Pavement Design Catalogue of IRC 37: 2018, flexible pavement thickness required is as follows:

The pavement structure has been worked out for all the homogeneous sections of the project road and is given in Table 6.4 below.

Table 6.5: Pavement Composition and Thickness for new construction.

Section	Design Period (Years)	Calculated MSA	Adopted MSA	CBR (%)	Pavement Crust Compositions				
					BC (mm)	DBM (mm)	WMM (mm)	CTSB (mm)	Total (mm)
Dudhnoi-Dainadubi	20	3.14	20	7	30	50	150	200	430

The calculated pavement thicknesses have been checked by IIT-PAVE software. As per IRC-37-2018, VG-40 is to be used in this case since design MSA is 20. Analysis & result of IIT-PAVE have been attached in Annexure-V.

6.6.7 Binder Selection for BC and DBM

The long-term satisfactory performance of pavements is influenced by the pavement ingredient materials and their properties. In bituminous pavements besides stone aggregates, the bituminous binder is the key ingredient which makes its selection an important task. It is the costliest component of the bituminous mix. In India, the bitumen grading was practiced until 1992 on the basis of penetration test, which is conducted at a temperature of 25°C, and 60/70 penetration grade bitumen, was widely used. The most common problem in the performance of bituminous mix with this binder was rutting during hot summer. The bitumen becomes soft in the 60 to 70°C temperature range (typical road surface temperature on a hot summer day) and starts to push and shove under loaded truck tires leading to rutting and corrugations in the wheel tracks of the roadway. To minimize this problem, the BIS switched over from Penetration based grading system (IS: 73-1992) to Viscosity based grading system (IS: 73-2006). This standard has been further revised and the current standard is: 73- 2013 (Paving Bitumen-Specifications).

The MORTH Specifications for Road and Bridge Works 5th revision allows use of both viscosity grade bitumen and modified bitumen.

The modified bitumen is not recommended due to following reasons:

- The modified bitumen requires the use of appropriate industrial process and plant with high shear mill, and testing facilities to achieve stable and homogeneous mix. Transportation tanks and storage tanks need to be insulated and equipped with effective heating system and circulation/ agitating device to maintain the specified temperature, homogeneity and viscosity of bitumen during transit and storage. Moreover, CRMB must be used as soon as possible since its quality can start to deteriorate as early as 6 hours after production. Crumb rubber is prone to degradation (devulcanization and depolymerization) if its use is delayed thereby losing its vital properties such as elasticity and viscosity.

- Crumb rubber tends to separate and settle down in the bitumen. If some crumb rubber particles have settled to the bottom of the transport tanker or contractor’s storage tank, the CRMB at the top may have quality, which is inferior to pure bitumen. This happens because the crumb rubber at the bottom has absorbed oils from the bitumen. In such cases, the CRMB actually used can be detrimental to the bituminous pavement. Therefore, after production CRMB should be agitated continuously through mechanical means during its transportation and its storage in contractor’s bitumen tank. In India at present, there is not adequate infrastructure and quality control Programme in place for the effective use of CRMB.

- Selection criteria for viscosity grade bitumen are based on highest and lowest daily mean temperatures at a particular site.
- The Climate of Goalpara District is Warm and Temperate. The summer here have a good deal of Rainfall while winter have a very little rainfall. The Average Annual temperature in Goalpara District is 21.8° C. About 3200mm of Rainfall received by the District annually. The driest Month is December and most of the Rainfall receive is during the Month of June-July. August is the warmest month in the District. The temperature in August is 25°C - 26°C. January is the Coldest Month with average temperature is 15°C.
- East Garo Hills has the unique distinction of having the wettest place on earth i.e. Mawsynram with an average annual rainfall of about 12,270 mm. This is followed by Cherrapunjee with an average annual rainfall of 11,600 mm. Southwest monsoon originating from the Bay of Bengal and the Arabian Sea directly influences this high rainfall. The high-altitude areas of the district experience temperate humid climate and low altitude areas experience tropical to sub-tropical humid climate.
- The whole year can be divided into four seasons namely summer, rainy, autumn and winter. The temperature varies from 1.7 °C to 24 °C.
- Hence VG-40 grade of binder is recommended for DBM and BC as per Table-9.1 for Traffic level 20-50msa is VG-40 for BC & DBM.

7.0 TRAFFIC CONTROL AND SAFETY MEASURES

To enhance the safety of road user’s adequate provisions for roadway width, geometric elements and junction improvements, have been proposed. In addition, due consideration has been given to the provisions contained in IRC: SP 44-1994, “Highway Safety Code”. Various measures have also been proposed to enhance traffic control.

7.1 Road Signs

Adequate road signs have been proposed for the project road in order to provide advance information to guide, regulate / control traffic flow and ensure safe operations. Road signs will either be ground mounted or displayed as overhead gantry signs. The signs will be of retro-reflective sheeting of encapsulated type as per the MoRT&H specifications for Road and Bridge Works, 2001. Detailed drawings will be prepared for major intersections showing position and type of road sign. Road signs are to be installed at 2.0 m from the extreme edge of carriageway to ensure a safe clear zone and bottom edge of the lowest sign is not less than 1.5 m above the crown of the pavement. Ideally, in kerbed sections it is to be installed 60 cm away from the edge of the kerb and bottom edge of the lowest sign is not being less than 2.0 m above the kerb.

Generally, all signs are to be placed on the left side of the project road except at few locations where duplicate signs are to be placed on right side as well as signs related to traffic calming measures.

There are three categories of signs; Cautionary, mandatory and informatory signs. These would be provided depending on the situation and function they perform in accordance with the IRC: 67-2012 guidelines for Road Signs. The sign boards would be in accordance with specification of clause 801-3 of MORTH for high insensible sheeting. Overhead signs are proposed in accordance with IRC: 67 -2012.

7.2 Road Markings

Road markings are provided to guide and assist the road users to negotiate conflict points and to be positioned at precisely the right location to make his maneuvers in the safest and quickest way so that the time vehicle's/ user's exposure to risk is minimized.

The markings serve as psychological barriers and signify the delineation of traffic paths and their lateral clearance from traffic hazards for safe movement of traffic. Road markings are therefore essential to ensure smooth and orderly flow of traffic and to promote road safety.

Pavement markings on the project road, location and type of marking lines, material and color have been proposed as per IRC: 35, “Code of Practice for Road Marking” with center-line, shyness and edge strip. The road markings would be carefully planned on carriageways, intersections, bridge locations and built-up sections.

The pavement marking will be in thermo-plastic paint with glass beads as per the MORT&H specification for Road and Bridge Works, 2001. Detailed instruction has been provided in the drawings for major and minor intersections showing lane markings, pedestrian crossings, directional arrows etc.

7.3 Kilometer Stones

The details of kilometer and 5th Km stones would be in accordance with IRC: 8 guidelines. These are to be made of precast M-20 grade reinforced cement concrete, and lettering / numbering as per the respective IRC codes. Kilometer stones would be located on the left-hand side of the road as one proceeds from the station from which the Kilometer count starts. Kilometer stones would be fixed at right angles to the center line of the carriageway.

7.3.1 200m Stones and Boundary Stones

The details of 200m stones and boundary stones would conform to IRC: 26 and IRC:
25. 200m stones would be located on the same side of the road as the kilometer stones. The inscription on the stones would be the numerals 2, 4, 6 and 8 marked in an ascending order in the direction of increasing kilometer age away from the starting station. The numerals would be 80mm high. The color of the numerals would be black on a white background.

Boundary stones at 100 m interval staggered on each side and kilometer stone have been proposed as per the provision of IRC: 25-1967. In addition, these would be fixed at all angular points of the boundary. Where the boundary is on a curve or the land is of significant value and likely to be encroached upon, the boundary stones, as required, would be installed at closer intervals.

7.4 Delineators and Object Markers

Roadway delineators are intended to mark the edges of the roadway so as to guide drivers on the alignment ahead. Object markers are used to indicate hazards and obstructions within the vehicle flow path, for example, traffic islands close to the intersections.

Delineators and object markers would be provided in accordance with the provisions of IRC: 79. They are basically driving aids and would not be regarded as substitutes for warning signs, road markings or barriers. They are not provided at locations where Chevron sign boards are provided

Delineators provide visual assistance to drivers about the alignment of road ahead, particularly at right side. Three types of delineators have been proposed for the project roads as per the provision contained in IRC: 79 "Recommended Practice for Road Delineators", namely:

- Roadway indicators with rectangular retro-reflectorized chevron markers (80mm x 100mm) for all curves of radius 1000m or less, horizontal curves with deflection angle > 30˚ on plain / rolling terrain. Delineator plastic post of 1m long and 10 cm square section painted alternatively black and white in 15cm wide strips. Delineator posts are to be erected at the edge of the roadway. The overall line of posts should be parallel to center line of the road. These are to be placed at outer and inner side of curves with the spacing defined in IRC: 79 "Recommended Practice for Road Delineators".
- Striped retro-reflectorized hazard markers (30 cm x 90 cm) consisting of alternative black and yellow stripes sloping downwards at an angle of 45 degree towards the side of obstruction. These are to be erected immediately ahead of bridge railing/ crash barrier. The inside edge of markers is to be in line with the inner edge of the obstruction.
- Cluster of red reflectors arranged on triangular panel as object markers provided at the heads of medians and directional islands. The object markers are to be setback by 50 cm from the face of the Kerb. Height of the post will be 50 cm. Size of equilateral triangular panel will be 30 cm and there will be four red reflectors of 75 mm diameter. Triangular panel and post will be painted white.

7.5 Guard Post

Guard posts are proposed on the location where embankment height is in between 2.0 and 3.0m. The spacing of guard post would be 5.0m c/c in these areas. Typical Guard post consists of precast (M20) post of size 200mm x 200mm and a height of 600mm above ground level. They are encased in M15 cement concrete for a depth of 450mm below ground level. Guard posts are painted with alternate black and white reflective paint of 150mm wide bands.

7.6 Solar Road Stud (SRS)

Solar Road Stud (SRS) is an active Road Safety Device, which is anchored to the road surface alongside of centerline and edge line markings and delineation for nighttime visibility. It is a self-contained device with some Solar Module, Battery, LED and electronics, designed to switch – ON automatically at Dusk and flash throughout the night to provide adequate visibility and advance warning to the motorist while driving on the road. SRS works on Solar energy to operate LEDs that flash throughout the night, providing long range visibility, guidance and advance warning to road users, thus improving safety on roads. SRS are suggested at major intersections, built-up areas, curves with radii less than 100m.

7.7 Project Facilities

For efficient functioning and operation of road, user facilities such as bus bays, bus shelters and truck lay byes and traffic calming measures through built-up and activity areas are required to be paid adequate attention.

7.8 Bus Shelters

The project road is passing through a number of villages/towns. The bus shelters are proposed at these locations to provide user facilities and improve safety of other users negotiating bus stop areas. Pedestrian crossing facility is also an integral part of bus stops to warn vehicle users and provide guided path for pedestrian to cross the highway. Total 2X4 bus shelters (Both Road) have been proposed in this section of project road.

Table 7.1: Locations for Bus shelter

S. No.	**Design Chainage**		**Location**
	Left	**Right**	
1	0+040	0+060	Dudhnoi
2	4+950	5+110	Near School
3	5+750	5+850	Damra
4	8+250	8+300	Daindubi

7.9 Truck Lay Bye

Truck lay bye has been proposed at 1X2 (In staggeed) location. List of locations is given in table below:

Table 7.2: Locations of Truck Lay Bye

Sl. No.	**Design Chainage from (m)**	**Design Chainage To(m)**	**Length (m)**	**Side**	**Nearest Village**
1	3700	4100	400	LHS	Bakrapur
2	7730	7970	240	RHS	Dainadubi

7.11 Toll Plaza

Nil

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Part-II

Design of Bridges & Culverts

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8 CROSS-DRAINAGE STRUCTURES – MAJOR AND MINOR BRIDGES

8.1 Design Standards for Bridges/Structures

The design standards and loading considered for culverts and bridges are those laid down from the latest IRC codes. Where the said codes are silent other codes at national or international level shall be followed in consultation with the client.

- The Indian Road Congress (IRC) codes will be the basis of bridge designs, underpasses and flyover/ROB‟s. For items not covered by latter, provisions of Special Publications and Specification for Roads and Bridges published by IRC shall be followed.
- Since number of new bridges in the project roads is less and majority of existing structures will be widened, it is proposed to design structures with working stress method based on IRC: 112.
- Grades of Concrete for superstructures will be as per MOST Specifications and IRC Standards. The Minimum grade shall be M40 for PSC and M25 for RCC respectively.
- For substructures and foundations, the concrete grade will not be lower than M25. For PCC substructures minimum grade of M20 will be adopted.
- The deck will have 2.5% unidirectional camber/cross fall and the wearing course will be of uniform thickness of 50mm BC laid over 12mm thick Mastic asphalt on all bridge decks.
- In general, it has been observed during the preliminary study that the open type foundations for the existing bridges have not suffered any distress.
- Pile / well foundations will be adopted for some of the Major bridges wherever open foundation is not feasible, depending on the properties of the foundation strata based on sub-soil investigation reports.

Table 8.1: Proposal of Major and Minor Bridges

Bridges

(a) Existing bridges to be re-constructed/widened

(i) The existing bridges at the following locations shall be re-constructed:

Sl. No.	**Bridge location (Ch)**	**Existing Span Arrangement (m)**	**Existing Width (m)**	**Proposed Span Arrangement (m)**	**Proposed Width (m)**	**Remarks**
1	4+150	1 x 25.00	8.40	1 x 25.00	16.00	Reconstruction
2	6+805	3 x 9.00	8.00	3 x 9.00	8.00	Widening

(b) New bridges

- Major Bridges: -

Sl. No	**Design Chainage**	**Name of Nallah/River**	**Span arrangement (m)**	**Total Width of Structure (m)**
Nil				

- FOB: -

Sl. No	Design Chainage	Name of Nallah/River	Span arrangement (m)	Total Width of Structure (m)
1	4+445	-	1 x 15.00	16.00

- Minor Bridges: -

Sl. No.	**Design Chainage**	**Type of Structure**	**Proposed Span Arrangement (m)**	**Proposed width (m)**	**Remarks**
Nil					

Note: Proposed span arrangement is minimum and any increase in length/span/height shall not be treated as change in scope of work.

IRC Class Special Vehicle loading shall be considered in the structural design of bridges/Flyover/VUP.

8.2 Design of Structures

Type of Structures

The structures are classified based on their functional use. The structures for the project road are classified as given below:

i) Drainage Structures

- Major Bridges
- Minor Bridges

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- Culverts

Sl. No.	Design Chainage	Type of Structure	Proposed Span Arrangement (m)	Proposed width (m)	Remarks
1	0+800	Box Culvert	1 x 2	12.0	Reconstruction
2	2+345	Box Culvert	1 x 2	12.0	Reconstruction
3	3+385	Box Culvert	1 x 2	12.0	Reconstruction
4	5+515	Box Culvert	1 x 2	12.0	Reconstruction
5	5+915	Box Culvert	1 x 6	12.0	Reconstruction
6	6+305	Box Culvert	1 x 3	12.0	Reconstruction
7	6+445	Box Culvert	1 x 2	12.0	Reconstruction
8	7+110	Box Culvert	1 x 2	16.0	Reconstruction
9	8+410	Box Culvert	1 x 2	12.0	Reconstruction

ii) Viaducts

iii Grade Separators

- Overpasses
- Road/Rail over Bridges
- Underpasses

The Bridges having an overall length varying from 6 m to 60 m are termed as minor bridges and those having an overall length more than 60 m are termed as major bridges.

The structures carrying the project road over land and spanning across the valleys are termed as viaducts. The structures carrying the cross roads above the project road are termed as overpasses and the structures carrying the cross roads below the project road are called underpasses. Box type structures are generally proposed at important village road crossings.

Design Loading

The bridges have been designed to sustain safely the most critical combination of various loads, forces and stresses that can co-exist as per the provisions of IRC: 6-2014. The allowable stresses and the permissible increase in stresses for various load combinations have been adopted as per the relevant IRC codes.

Carriageway Live Load

Structures carrying the proposed project road with carriageway width of 11.0 m are proposed to be designed for 3 lanes of Class-A loading or one lane of 70-R wheeled/tracked loading plus 1 lane of Class – A loading, whichever produces the most severe effect.

Structures carrying the proposed project road with carriageway width of 7.5 m shall be designed for 2 lanes of Class-A loading or one lane of 70-R wheeled/tracked loading whichever produces the most severe effect.

Tractive and Braking Force

The tractive and braking forces shall be considered as per the provisions of clause no. 211 of IRC:6-2017.

Footpath Live Load

The footpath live load shall be considered as per the provisions of clause no. 209 of the IRC: 6-2017. The intensity of the footpath loading has been considered as 500 Kg/sqm as per clause no.206 of IRC: 6-2017.

Wind Forces.

The effect of wind as per clause no. 212 of IRC: 6-2017 shall be considered for the design of the various components of the bridge.

Seismic Forces

Project roads pass through seismic zone II, III and IV. Seismic forces shall be calculated in accordance with clause number 222.5 of IRC: 6-2017.

Buoyancy Effects

The following buoyancy effects shall be considered wherever applicable for the design of various components of the bridge:

For Foundations	100 %
For Substructure below water	15 %

Deck Levels of Structures

The deck levels of the structures carrying the project road have been adopted based on the following parameters:

- Vertical clearance required above the cross roads;
- Vertical profile of the proposed project road;
- Vertical clearance required above the high flood level

8.3 Hydraulic and Hydrological Investigations and Methodology

The project roads pass through areas of heavy intensity rainfall. Detail hydrological investigations have been carried out to confirm the adequacy of existing structures and requirement of additional culverts.

i) Collection of Data and Design Assumptions

The hydraulic condition of each structure was assessed thoroughly by visual observations. These observations were supplemented with local inquiries.

ii) Return Period and Rainfall

As per IRC: 5 – 2015 (Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design (Eighth Revision)) the bridges are designed for a period of not less than 50 years. A flood of this specified return period should pass easily through the structure, while an extraordinary and rare flood may pass without doing excessive damage to the structure or the road.

Topographic maps, obtained from Survey of India, on 1: 50,000 scales, have been be utilized for the hydrological study of the corridor.

iii) Cross-Sections and Longitudinal Section at Bridges

For the calculation of discharge of the stream by Area-Velocity method, topographical survey including levelling surveys have been carried out across and along the watercourses to determine the cross-section and the longitudinal section of stream. A number of cross-sections have been taken at regular intervals on both upstream and downstream side of the structure, including one at the proposed location of the structure in accordance with IRC specifications.

The following assumptions shall be made during peak discharge calculation:

For bridges where the cross section is not defined, the cross-sections shall be extended up to the HFL, in order to calculate the effective cross-section of flow.

The longitudinal section to determine the bed slope shall be taken at an approximate regular interval following the channel course extending on both the upstream and the downstream sides of the structure. Caution shall be exercised by following the curved flow line for longitudinal gradient, rather than a straight line.

Table 8.2: Summary of Structures

SUMMARY OF STRUCTURES

Type of Structure	Existing Nos.	Retained	Not Required	Widening	Reconstruction / Upgradation				New Proposal
					To HPC	To BC	To MNB	To MJB	
FOB	-	-	-	-	-	-	-	-	01
Vehicular Overpass	-	-	-	-	-	-	-	-	-
Vehicular Underpass	-	-	-	-	-	-	-	-	-
Major Bridge	-	-	-	-	-	-	-	-	-
Minor Bridge	2	-	-	1	-	-	1	-	02
Slab Culvert	09	-	-	-	-	09	-	-	09
Box Culvert	-	-	-	-	-	-	-	-	-
HPC / Laid Pipe	-	-	-	-	-	-	-	-	-
Total	**11**	**0**	**0**	**1**	**10**				**12**

HPC - Hume Pipe Culvert

BC - Box Culvert

SC - Slab Culvert

MNB - Minor Bridge

MJB-Major Bridge

Foot Over Bridge

Hydrology and Hydraulics of the Cross-Drainage Structures

Assessment of Peak Discharge

The peak discharge and the HFL shall be calculated by following methods

- Empirical Method
- Area Velocity Method
- SUH Method

Empirical Method

Ingli's Formula which is as under as per IRC SP-13.

$$Q = \frac{125\,M}{(M + 10)^{1/2}}$$

Where,

Q = Peak run-off (cumec)

M = Catchment area (sq km)

Dickens Formula which is as under as per IRC SP-13.

$$Q = C\,M^{3/4}$$

Where,

Q = Peak run-off (cumec)

M = Catchment area (sq km)

C = Coefficient of run-off, depends upon annual rainfall

The catchment area M is determined from toposheets, Coefficient of run-off C is determined from IRC SP-13 depending upon the intensity of rainfall. This formula gives a simplified approach and results are approximate. Comparison is made with alternative methods for important structures.

Ryve's formula which is as under as per IRC SP-13.

$$Q = CM^{2/3}$$

Where,

Q = Peak run-off (cumec)

M = Catchment area (sq km)

C = Coefficient of run-off, depends upon annual rainfall

The catchment area M is determined from the toposheets, Coefficient of run-off C is determined from IRC SP-13 depending upon the intensity of rainfall. This formula gives a simplified approach and results are approximate. Comparison is made with alternative methods for important structures.

Area – Velocity Method (Manning’s Formula)

In this method, discharge is calculated using the formula given below

$$Q = A \times V$$

$$= A \times [(1/n) \times (R)^{2/3} \times (S)^{1/2}]$$

Where

Q = Discharge (cumecs)

A = Area of the cross section (sq. m.)

V = Velocity in (m/sec)

R = Hydraulic mean depth (m); R = A / P

P S = Wetted perimeter of the stream (m)

n = Bed slope of the stream

= Rugosity Co-efficient.

Synthetic Unit Hydrograph Method

This method is based on unit hydrograph principle, used when catchment area is greater than 10 sq miles. CWC has published Flood Estimation Reports for different zones for India. Comprehensive hydraulic analysis of various CD structures shall be carried out based on detailed topographical survey.

A detailed approach and equations of unit hydrograph has been given in the report “Estimation of Design Flood Peak, Mahanadi Sub-Zone- s-d published by CWC. In this method the design flood discharge has been calculated as per guidelines given in the report.

Design discharge has been taken as the maximum of the peak flood discharge by different methods provided it does not exceed the next highest discharge more than 50%. If it exceeds, it is restricted to that limit (As per Article 6.2.1 of IRC: SP: 13-2004).

Hydraulic Analysis for Design HFL

In hydraulic analysis, the Design HFL shall be calculated corresponding to the Design Discharge by Manning’s Equation at the bridge site, as described above.

Afflux Calculation

When the waterway area of the opening of a bridge is less than the unobstructed natural waterway area of the stream, i.e., when bridge contracts the stream, afflux occurs. The afflux will be calculated using Moles worth formula as given below:

$$h = \left(\frac{V^2}{17.88} + 0.01524\right)\left[(A/a)^2 - 1\right]$$

Where,

h = afflux (meters)

V = average velocity of water in the river prior to construction (m/sec)

A = Unobstructed sectional area of the river at proposed site (sq.m)

a = Constricted area of the river at the bridge (sq.m)

Scour Depth

Lacey"s equation is adopted for estimating normal scour depth as per IRC: 5

$d_{sm} = 1.34\,(D_b^2/K_{sf})^{1/3}$

Where R is the Lacey's regime scour depth, measured below HFL, q is the design discharge intensity under bridge in cumecs per meter and f is silt factor

given by the equation $K_{sf} = 1.76\,(d_m)^{1/2}$

Where d_{50} is the mean sediment size in mm. Normal scour depth based on Lacey's equation and the actual observed depth (equal to the difference between HFL and LBL)/1.27 are compared as per code. Higher of the two values is adopted for design. Silt factor „f" is found from Lacey's equation corresponding to d_{50} size of bed materials. Maximum scour level for pier and abutment are calculated using a factor of safety of 2 and 1.27 respectively as per IRC: Code-5. For computing scour depth, design discharge is enhanced by 30% to provide for adequate margin of safety as per provision of IRC: 78 - 2014.

Determination of Waterway for a New bridge

When a new bridge is to be constructed, a designer has all the freedom to provide waterway as required. As per IRC-5:2015 clause 106.5.1, waterway (W) should be equal to Lacey"s regime waterway (P) given by the equation:

$P = W = C\,(Q^{1/2})$

Where,

Q = design flood discharge in $m^{3/s}$

P = Wetted perimeter in meters

W = Linear waterway in meters (for wide river W is almost equal to P)

C = a constant usually taken as 4.8 for regime channels but it may vary from 4.5 to 6.3 according to local conditions.

The code also stipulates that the waterway so found should also be compared with linear waterway at HFL corresponding to design flood discharge and the minimum of the two should be adopted as the clear waterway under the bridge.

- Hydraulics Calculation is attached in Annexure-IX.

8.4 Design Methodology Minor Bridges (New)

General - the following aspects shall be considered while planning for the new bridges and structures:

- Proper sitting of bridge and geometrics of approaches;
- Linear waterways and minimum vertical clearances;
- Satisfactory geological conditions;
- Minimum distance from the existing structure consistent with construction requirements and hydraulic consideration;
- Modular approach in design for both superstructure and substructures;
- Minimum vertical clearance above design HFL

Deck Width - Overall deck width of structures is 16m.

Proposals - The proposals for minor bridges are based on the following considerations:

- Total deck width of the new minor bridges shall be 16m. with crash barrier on both sides.
- The new bridges are proposed to be designed for 4 - lanes of traffic.
- In order to reduce the number of expansion joints for improving the riding quality and for providing unobstructed flow under the bridges, the small multiple spans are proposed to be replaced with equivalent single spans wherever possible, matching with the existing opening.
- The new bridges will be on the same location to as existing ones.
- For bridges with RCC solid slab superstructures, tar paper bearings will be proposed and for bridges with PSC / RCC T-Beam and slab superstructures Pot cum PTFE / elastomeric bearings will be proposed based on design requirements.
- Strip seal expansion joints will be proposed for bridges with RCC T-beam and slab superstructure. For bridges with RCC solid slab superstructure filler type expansion joints are proposed.
- Foundations for the proposed structures will be same as those of existing bridges.
- Bed protection works will be provided for bridges with box cell structures.
- Splayed wing walls shall be provided for new / widened side of minor bridges.

Existing Bridges (Rehabilitation)

Deck Width - The existing two lanes minor and major bridges in good condition having deck width > 10 m are proposed to be retained with repairs and will not be widened under this project. For structures having deck width less than 10 m, the proposals will be as under:

a. Slab Bridges with open foundations:

Existing slab bridges in good condition are proposed to be widened to 16.0 m deck width by integrating existing and widened part. Symmetrical widening shall be proposed in general.

b. Arch Bridges with open foundations:

Existing arch bridges in good condition are proposed to be widened to 16.0 m deck width by adding a new structure along existing arch bridge [Asymmetrical widening] to get 16.0 m deck width.

Foundation details of arch bridges are not known except of few cases where well foundations are visible.

In case, arch bridge is found to be supported on well foundations during construction stage, widening proposal will require to be changed to new 2 Lane Bridge.

c. RCC/PSC/ Steel composite Bridges with open foundations:

i. Existing structures in good condition having carriageway width ≥ 7.5 m are proposed to be retained with repairs.

ii. Existing structures having carriageway width significantly less than 7.5 m are proposed to be replaced with new 2 Lane Bridge.

iii. Decision for existing structures in good condition having carriageway width marginally less than 7.5 m regarding retaining them with repairs

/ replaced with new 2 Lane Bridge will be taken on case-to-case basis in consultation with Client.

d. RCC/PSC/ Steel composite/Arch Bridges with well foundations:

i. Existing structures in good condition having carriageway width ≥ 7.5 m are proposed to be retained with repairs.

ii. Existing structures having carriageway width significantly less than 7.5 m are proposed to be replaced with new 2 Lane Bridge.

iii. Decision for existing structures in good condition having carriageway width marginally less than 7.5 m regarding retaining them with repairs / replaced with new 2 Lane Bridge will be taken on case-to-case basis in consultation with Client.

e. Existing bridges having poor structural condition, hydraulic deficiency [Overtopping, excessive scouring] or falling under realignment of road geometry are proposed to be replaced by new 2-lane bridge having 12 m deck width.

8.5 Design Methodology Minor Bridges (Reconstruction)

EXCAVATION FOR OPEN FOUNDATIONS

SCOPE

The method statement outlines the procedure to be complied with for the excavation of open foundations.

CONSTRUCTION PROCEDURE

4.1 Setting Out

* The limit of excavation shall be set out true to fines, curves and slopes

4.2 Excavation

- Excavation shall be done as per the dimensions specified in the drawings.
- The sides of excavation shall be left plumb.

4.3 Dewatering and protection

- Water met with in excavation shall be removed by pumping.
- Foundation trench shall always be kept dry
- Coffer dams of adequate depth and height shall be constructed to prevent the running water of river from entering foundation trench.

SAFETY

General Safety

The Site Managers will have overall responsibility for safety.

As the construction area will be generally isolated and with appropriate signs in place, the danger to injury of members of the general public is minimal. All site visitors within the areas will be accompanied by a member of the site team. The following general safety issues will be addressed on site Near towns, villages and all frequented places, trenches and foundation pits shall be

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securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. All adequate protective measures shall be taken to see that the excavation operations do not affect or damage adjoining structures.

Personnel and Safety

All new workers and staff will attend a Safety Induction Course before commencing of site work.
All personnel will wear safety helmets, safety boots and high visibility jackets.
All unsafe acts or conditions are to be identified and corrected promptly or referred to the respective supervisor. Any accident or incident is to be reported immediately so that preventive action can be taken to prevent reoccurrence.

Training

All staff members will be briefed on the importance of monitoring on site safety by the Safety manager.

ENVIRONMENT

The Site Managers will have overall responsibility for the environment.
All new workers and staff will attend the Environmental Induction Course before commencing of site.
Typical environmental management measures will be monitored in accordance with the following documents.
The Project Environmental Plan, The Project Management plan.

8.6 Design Methodology Minor Bridges (rehabilitation if any)

Proposals - The following measures are proposed for rehabilitation of existing bridges:

General Most of the bridges have many common deficiencies/defects, which are proposed for repaired as follows:

1) Railings / handrails are proposed be replaced with crash barriers to bring common bridge furniture across the project road. Keying of concrete crash barrier with brick work walls shall be done in addition to anchoring crash barrier reinforcement into brickwork by drilling holes and grouting with cement mortar.
2) Drainage spouts provided in the railing kerb, ending at face of soffit of slab are proposed be replaced with new drainage spouts having adequate length to prevent the water from falling / splashing on the superstructure.
3) Damaged faces of RCC pier caps/abutment caps over brick masonry (BM) / coursed rubble masonry (CRM) substructure shall be repaired by guiniting after removing the affected portions.
4) Damaged pointing in the BM / CRM to be removed and cleaned before applying fresh pointing.
5) Cracks in BM /CRM abutments/wing walls/piers shall be pressure grouted with cement grout through holes drilled in the masonry around the cracks.

6) Most of the existing bridges do not have approach slabs. Provision of approach slab is proposed to be made by reconstructing dirt wall with bracket to support approach slab for structures with RCC dirt walls. For structures PCC dirt walls, approach slab will not be provided in existing and widened part.

7) Stone pitching on earth fill around abutment has not been provided, except in 2-3 cases, resulting in settlement of earth fill exposing cantilever return walls, erosion of soil around return walls and in front of the spill through abutments. This can cause settlement of approach road behind abutments any time and block movement of traffic. This can cause traffic accidents also as parts of embankment can settle during rains.

8) Concrete wearing coat provided in number of bridges has suffered cracks and distress at number of locations. Reinforcement has come out is many distressed locations. Concrete wearing coat shall be replaced with bituminous wearing coat.

Solid Slab Superstructure

1) Edges of solid slab which show spilling of concrete over a smaller width or only small patches of the underside of slab which are distressed, are proposed be repaired by guiniting. The reinforcement, which has corroded, shall be sand ballasted and additional reinforcement, if required, shall be welded to the existing reinforcement before guiniting.

2) RCC solid slabs, which show honeycombing, shall be strengthened by pressure grouting with cement grout from the underside of the slab.

T-Beam and Slab Superstructure

1) No such structure is found on the project stretch

8.7 Bridges on various Roads

The list of minor bridges is given in previous sections for the project roads. The existing bridge is multi span bridges of span less than 10m. The span of the bridges ranges from 5m to 10m. Overall width of the structure is also varying from 7m to 11m.

The existing bridges are generally of solid slab type super structure, resting on PCC/RCC/Stone Masonry type of sub structure. The foundation type is also visible at few locations and generally the foundation is open foundation or raft foundation.

Condition of bridge constructed on RCC/PCC sub structure is generally fair. These bridges are relatively new bridges. The distress of super structure is clearly visible. Sub structure is also damaged and foundations are scoured.

Approach slabs are mostly not provided. Railing/Parapets are also broken. Condition of wing wall is also not good for most of the bridges.

Generally, the retained bridges which are in good condition need following repairs:

- Remove vegetation growth on structure.
- Repair damaged return walls.
- Clear the waterway.
- Replace existing parapet with RCC crash barrier.
- Replace damaged wearing coat.
- Provide approach slab.
- Repair for small damages in the structural components.

    - Details of Culvert & Bridge Inventory attached in Annexure-III & IV respectively.

    - Details of Improvement Proposal of Structures attached in Annexure-V.

9 CROSS-DRAINAGE STRUCTURES – CULVERTS

9.1 Hydrology

According to IRC: SP:73-2018 Clause 7.7 Culvert and Bridge using Pipes.

Project Road should have adequate cross drainage facility as large number natural drains/outfalls are present in project road. Additional culverts are required to balance the flood water on both sides of embankment to reduce flood level on one side of road; To balance the discharge from road catchment area and discharge passing through new/existing cross drainage structures as localized natural drains are very less in the project area, Cross drainage structure density is low – in some locations there is no culvert in 1 km stretch

Intermediate culverts, also called balancing culverts, have been proposed to reduce the length and size of the roadside drain. Guidelines in IRC: SP: 42, IRC: SP: 13-2004 and relevant IRC have been followed for proposing the number of cross drainage structures.

9.2 Proposal for New Culverts

For culverts, following guidelines will be followed:

- For culverts in new carriageway, minimum span and vent height will be kept equal to that of those in the existing carriageway; raising of deck level according to highway alignment will be made wherever required
- Weak and non-functional culverts to be dismantled and new culverts to be
- constructed with deck level matching with highway plan and profile.
- For widening of culverts to required width, existing Brickwork / RR masonry / PCC abutments will be widened on both sides of the existing culverts. Existing slab shall be widened with specified camber to be cast for the full length
- In case of culverts whose bed and floor have scoured off severely and considerable afflux is observed, the same will be replaced with new culverts having adequate vents or with a minor bridge, based on hydrological studies
- Culverts will be designed for IRC Class-A/Class-70R Tracked/Class-70R Wheeled Loading as per relevant IRC provisions
- Culverts shall be constructed for full formation width of the roadway
- All new pipe culverts shall be of minimum 1.2 m diameter.

9.3 Improvement Proposals

9.3.1 Culverts

Hume pipe culverts are proposed for reconstruction in NP4 RCC Pipes in full formation width including parapets, as per type design requirements laid down in IRC: SP:13. These culverts have been proposed in such stretches where required minimum cushion over the pipe is available. The bedding for pipe shall be first class bedding, comprising of granular material for culverts with cushion above the pipe not less than 0.6 m and not exceeding 4 m. details of improvements proposal are culvert.

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Table 9.1: New Culverts

Culverts shall be provided at the following locations:

Sr. No.	***Design Chainage***	***Proposed Type of Culvert***	***Proposed Span Arrangement (m)***	***Proposed Overall Width (m)***	***Remarks***
Nil					

a. Over all width of all culverts shall be equal to roadway width of the approaches.

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10 PROTECTION WORKS & DRAIN

10.1 Retaining wall

Reinforced earth wall has been proposed at high embankment locations. Details are tabulated below.

Table 10.1: Details of Retaining Wall

Sl. No.	Left Side			Right Side			Remark
	From (Ch.)	To (Ch.)	Length	From (Ch.)	To (Ch.)	Length	
1	5380	5530	150				LHS Dudhnoi River
TOTAL LENGTH (m)			**150**				

10.2 Stone Pitching

Stone Pitching has been proposed where the filling is of more than 3.0m height. Details of Stone Pitching proposed are given in the table below:

Table 10.2: Details of Stone Pitching

Left Side			**Right Side**		
From	**To**	**Length**	**From**	**To**	**Length**
6000.00	6850.00	850.00	5360.00	5420.00	60.00
			6000.00	6850.00	850.00
Total		**850.00**			**910.00**

10.3 Metal Beam Crash Barriers

The safety measures shall be provided at all hazardous/sinking/land slide locations. The safety barriers (W-beam Crash barriers) shall also be provided at the following hazardous structure (Bridges, culverts) locations where the embankment height is greater than 3.0m. Details are tabulated below.

Table 10.3: Details of Metal beam Crash Barrier

LEFT SIDE			RIGHT SIDE			
From (Km.)	To (Km.)	Length (M)	From (Km.)	To (Km.)	Length (M)	Remark
2.326	2.341	15	2.326	2.341	15	High Embankment
2.350	2.365	15	2.350	2.365	15	High Embankment
3.390	3.405	15	3.390	3.405	15	High Embankment
3.841	4.084	243	3.841	4.084	243	High Embankment
4.084	4.134	50	4.084	4.134	50	High Embankment
4.166	4.216	50	4.166	4.216	50	High Embankment
5.894	5.909	15	5.300	5.340	40	High Embankment
5.922	5.937	15	5.894	5.909	15	High Embankment
6.000	6.100	100	5.922	5.937	15	High Embankment
6.285	6.300	15	6.000	6.100	100	High Embankment

LEFT SIDE			RIGHT SIDE			
From (Km.)	To (Km.)	Length (M)	From (Km.)	To (Km.)	Length (M)	Remark
6.310	6.325	15	6.100	6.280	180	High Embankment
6.426	6.441	15	6.285	6.300	15	High Embankment
6.450	6.465	15	6.310	6.325	15	High Embankment
6.736	6.786	50	6.426	6.441	15	High Embankment
6.825	6.875	50	6.450	6.465	15	High Embankment
7.091	7.106	15	6.736	6.786	50	High Embankment
7.115	7.130	15	6.825	6.875	50	High Embankment
7.632	7.811	179	7.091	7.106	15	High Embankment
		0	7.115	7.130	15	High Embankment
	TOTAL	**887**	**m**		**1560**	**m**

10.4 Lined Drain

Lined drain shall be provided in the following stretches:

Table 10.4: Details of Lined Drain

LEFT			RIGHT			REMARK
FROM CHAINAGE (M)	TO CHAINAGE (M)	LENGTH (M)	FROM CHAINAGE (M)	TO CHAINAGE (M)	LENGTH (M)	
40	796	756	40	796	756	Lined Drain with Utility Duct
805	1360	555	805	1360	555	Lined Drain with Utility Duct
1700	2160	460	1700	2160	460	Lined Drain with Utility Duct
			2160	2340	180	Lined Drain with Utility Duct
			2349	2400	51	Lined Drain with Utility Duct
2400	3381	981	2400	3381	981	Lined Drain with Utility Duct
			3390	3550	160	Lined Drain with Utility Duct
3740	3900	160	3740	3900	160	Lined Drain
4230	4600	370	4230	4600	370	Lined Drain with Utility Duct
			4600	4720	120	Lined Drain with Utility Duct
5530	5900	370	5530	5900	370	Lined Drain with Utility Duct
8250	8406	156	8250	8406	156	Lined Drain with Utility Duct
Total		**3808**	**Total**		**4319**	

The above locations are minimum. Additional locations if any required as per site condition shall be provided as per manual. It shall not be treated as change in scope of work.

Road Inventory Data Sheet

Annexure-I

Name of the Road : NH 62 New NH 217

Road Classification- Dudhnoi to Dinadubi

From: 0.000 **To** 8.415

Date of Survey- ………………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Left Type	Left Width (m)	Condition (G/F/P/VP)	Right Type	Right Width (m)	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
0.000	**0.100**	Plain	BU	BU	Dudhnoi	10.0	F	7.00	BT	Paved	1.800	P	Paved	1.200	P	0.0	0.0	0.000	7.00	Junction (Left side to Guwhati)
0.100	**0.200**	Plain	BU	BU	Dudhnoi	9.7	F	7.00	BT	Paved	1.500	P	Paved	1.200	P	0.0	0.0	0.000	7.00	Junction (Right side to Golpara)
0.200	**0.300**	Plain	BU	BU	Dudhnoi	15.7	F	7.00	BT	Paved	3.200	P	Paved	5.500	P	0.0	0.0	0.000	7.00	Junction (Back Side to Dudhnoi)
0.300	**0.400**	Plain	BU	BU	Dudhnoi	15.4	F	7.00	BT	Paved	4.000	P	Paved	4.400	P	0.0	0.0			
0.400	**0.500**	Plain	BU	BU	Dudhnoi	13.0	F	7.00	BT	Paved	3.000	P	Paved	3.000	P	0.0	0.0			
0.500	**0.600**	Plain	BU	BU	Dudhnoi	14.5	F	7.00	BT	Earthen	4.000	P	Earthen	3.500	P	0.0	0.0			
0.600	**0.700**	Plain	BU	BU	Dudhnoi	14.5	F	7.00	BT	Earthen	3.900	P	Earthen	3.600	P	0.0	0.0			
0.700	**0.800**	Plain	BU	BU	Dudhnoi	11.6	F	7.00	BT	Earthen	2.400	P	Earthen	2.200	P	0.0	0.0			
0.800	**0.900**	Plain	BU	BU	Dudhnoi	10.6	F	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	0.0	0.0			
0.900	**1.000**	Plain	BU	BU	Dudhnoi	10.8	F	7.00	BT	Earthen	1.9	P	Earthen	1.9	P	0.0	0.0			
1.000	**1.100**	Plain	BU	BU	Dudhnoi	10.6	F	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	0.0	0.0			
1.100	**1.200**	Plain	BU	BU	Dudhnoi	11.2	F	7.00	BT	Earthen	2.1	P	Earthen	2.1	P	0.0	0.0			
1.200	**1.300**	Plain	BU	BU	Dudhnoi	10.4	F	7.00	BT	Earthen	1.8	P	Earthen	1.6	P	0.0	0.0			

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Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217**

Road Classification- Dudhnoi to Dinadubi

From: 0.000 To 8.415

Date of Survey- ………………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Type Left	Width (m) Left	Condition (G/F/P/VP)	Type Right	Width (m) Right	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
1.300	**1.400**	Plain	BU	BU	Dudhnoi	10.3	F	7.00	BT	Earthen	2.1	P	Earthen	1.2	P	0.0	0.0			
1.400	**1.500**	Plain	BU	BU	Dudhnoi	9.9	F	7.00	BT	Earthen	1.6	P	Earthen	1.3	P	0.0	0.0			
1.500	**1.600**	Plain	BU	BU	Dudhnoi	10.2	F	7.00	BT	Earthen	1.800	P	Earthen	1.4	P	0.0	0.0			
1.600	**1.700**	Plain	BU	BU	Dudhnoi	9.6	F	7.00	BT	Earthen	1.300	P	Earthen	1.3	P	0.0	0.0			
1.700	**1.800**	Plain	BU	BU	Dudhnoi	9.9	F	7.00	BT	Earthen	1.500	P	Earthen	1.400	P	0.0	0.0			
1.800	**1.900**	Plain	BU	BU	Dudhnoi	9.7	F	7.00	BT	Earthen	1.2	P	Earthen	1.500	P	0.0	0.0			
1.900	**2.000**	Plain	BU	BU	Dudhnoi	10.1	F	7.00	BT	Earthen	1.3	P	Earthen	1.800	P	0.0	0.0			
2.000	**2.100**	Plain	BU	BU	Dudhnoi	10.1	F	7.00	BT	Earthen	1.4	P	Earthen	1.700	P	0.0	0.0			
2.100	**2.200**	Plain	BU	BU	Dudhnoi	9.9	F	7.00	BT	Earthen	1.3	P	Earthen	1.600	P	0.0	0.0			
2.200	**2.300**	Plain	BU	BU	Dudhnoi	9.5	F	7.00	BT	Earthen	1.6	P	Earthen	0.9	P	0.0	0.0			
2.300	**2.400**	Plain	BU	BU	Dudhnoi	10.7	F	7.00	BT	Earthen	1.8	P	Earthen	1.9	P	0.0	0.0			
2.400	**2.500**	Plain	BU	BU	Dudhnoi	10.7	F	7.00	BT	Earthen	1.9	P	Earthen	1.8	P	0.0	0.0			

GLOBAL INFRA SOLUTIONS BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : NH 62 New NH 217

Road Classification- Dudhnoi to Dinadubi

From: 0.000 **To** 8.415

Date of Survey- ……………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
										Left			Right							
2.500	**2.600**	Plain	BU	BU	Dudhnoi	10.9	F	7.00	BT	Earthen	1.8	P	Earthen	2.1	P	0.0	0.0			
2.600	**2.700**	Plain	BU	BU	Dudhnoi	10.7	F	7.00	BT	Earthen	2.1	P	Earthen	1.6	P	0.0	0.0			
2.700	**2.800**	Plain	BU	BU	Dudhnoi	9.8	F	7.00	BT	Earthen	1.6	P	Earthen	1.2	P	0.0	0.0			
2.800	**2.900**	Plain	BU	BU	Dudhnoi	9.5	F	7.00	BT	Earthen	1.2	P	Earthen	1.3	P	0.0	0.0			
2.900	**3.000**	Plain	BU	BU	Dudhnoi	9.7	F	7.00	BT	Earthen	1.3	P	Earthen	1.4	P	0.0	0.0			
3.000	**3.100**	Plain	BU	BU	Dudhnoi	10.0	F	7.00	BT	Earthen	1.4	P	Earthen	1.600	P	0.0	0.0			
3.100	**3.200**	Plain	BU	BU	Damra	10.1	F	7.00	BT	Earthen	1.3	P	Earthen	1.8	P	0.20	0.30			
3.200	**3.300**	Plain	BU	BU	Damra	9.8	F	7.00	BT	Earthen	0.9	P	Earthen	1.9	P	0.20	1.30			
3.300	**3.400**	Plain	BU	BU	Damra	10.6	F	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	0.30	1.60			

GLOBAL INFRA SOLUTIONS
BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217**

Road Classification- Dudhnoi to Dinadubi

From: 0.000 To 8.415

Date of Survey- ………………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
										Left			Right							
3.400	**3.500**	Plain	BU	BU	Damra	11.0	F	7.00	BT	Earthen	1.9	P	Earthen	2.1	P	0.4	1.4			
3.500	**3.600**	Plain	BU	BU	Damra	10.4	F	7.00	BT	Earthen	1.8	P	Earthen	1.6	P	0.2	1.6			
3.600	**3.700**	Plain	BU	BU	Damra	10.3	F	7.00	BT	Earthen	2.1	P	Earthen	1.2	P	0.3	1.5			
3.700	**3.800**	Plain	BU	BU	Damra	9.9	F	7.00	BT	Earthen	1.6	P	Earthen	1.3	P	0.2	1.9			
3.800	**3.900**	Plain	BU	BU	Damra	9.6	F	7.00	BT	Earthen	1.2	P	Earthen	1.4	P	1.2	2.1			
3.900	**4.000**	Plain	BU	BU	Damra	10.0	F	7.00	BT	Earthen	1.3	P	Earthen	1.700	P	2.2	2.4			
4.000	**4.100**	Plain	BU	BU	Damra	10.5	F	7.00	BT	Earthen	1.4	P	Earthen	2.100	P	4.0	3.0			
4.100	**4.200**	Plain	BU	BU	Damra	10.7	F	7.00	BT	Earthen	1.9	P	Earthen	1.800	P	5.0	3.0			
4.200	**4.300**	Plain	BU	BU	Damra	10.1	F	7.00	BT	Earthen	1.4	P	Earthen	1.700	P	0.1	0.1			

GLOBAL INFRA SOLUTIONS BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : NH 62 New NH 217

Road Classification- Dudhnoi to Dinadubi

From: 0.000 **To** 8.415

Date of Survey- ………………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Left Type	Left Width (m)	Left Condition (G/F/P/VP)	Right Type	Right Width (m)	Right Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
4.300	**4.400**	Plain	BU	BU	Damra	10.3	F	7.00	BT	Paved	1.8	P	Earthen	1.500	P	0.0	0.0			
4.400	**4.500**	Plain	BU	BU	Damra	10.1	F	7.00	BT	Paved	1.9	P	Earthen	1.200	P	0.0	0.0			
4.500	**4.600**	Plain	BU	BU	Damra	8.8	F	7.00	BT	Earthen	1.8	P	Earthen		P	1.2	1.2			
4.600	**4.700**	Plain	BU	BU	Damra	10.9	F	7.00	BT	Earthen	2.1	P	Earthen	1.8	P	1.5	1.5			
4.700	**4.800**	Plain	BU	BU	Damra	10.5	F	7.00	BT	Earthen	1.6	P	Earthen	1.9	P	1.8	1.9			
4.800	**4.900**	Plain	BU	BU	Damra	10.0	F	7.00	BT	Earthen	1.2	P	Earthen	1.8	P	3.0	2.8			
4.900	**5.000**	Plain	BU	BU	Damra	10.4	F	7.00	BT	Earthen	1.3	P	Earthen	2.1	P	2.5	2.5			
5.000	**5.100**	Plain	BU	BU	Damra	10.0	F	7.00	BT	Earthen	1.4	P	Earthen	1.6	P	2.1	2.2			
5.100	**5.200**	Plain	BU	BU	Damra	9.5	F	7.00	BT	Earthen	1.3	P	Earthen	1.2	P	1.5	3.2			
5.200	**5.300**	Plain	BU	BU	Damra	9.2	F	7.00	BT	Earthen	0.9	P	Earthen	1.3	P	1.6	3.5			

GLOBAL INFRA SOLUTIONS BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217** **Road Classification- Dudhnoi to Dinadubi**

From: **0.000** **To** **8.415** **Date of Survey- ………………………………………..**

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
										Left			Right							
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
5.300	**5.400**	Plain	BU	BU	Damra	9.6	F	7.00	BT	Earthen	1.2	P	Earthen	1.4	P	2.2	1.1			
5.400	**5.500**	Plain	BU	BU	Damra	10.3	F	7.00	BT	Paved	1.8	P	Paved	1.500	P	3.5	1.2			
5.500	**5.600**	Plain	BU	BU	Damra	9.9	F	7.00	BT	Paved	1.7	P	Paved	1.200	P	0.0	0.0			
5.600	**5.700**	Plain	BU	BU	Damra	9.9	F	7.00	BT	Earthen	1.5	P	Earthen	1.400	P	0.0	0.0			
5.700	**5.800**	Plain	BU	BU	Damra	10.8	F	7.00	BT	Earthen	1.9	P	Earthen	1.9	P	0.0	0.0			
5.800	**5.900**	Plain	BU	BU	Damra	10.6	F	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	0.0	0.0			
5.900	**6.000**	Plain	BU	AGL	Damra	11.2	F	7.00	BT	Earthen	2.1	P	Earthen	2.1	P	0.0	0.0			
6.000	**6.100**	Plain	BU	AGL	Damra	10.2	F	7.00	BT	Earthen	1.6	P	Earthen	1.6	P	0.0	0.0			
6.100	**6.200**	Plain	BU	AGL	Nisan Gram	9.4	P	7.00	BT	Earthen	1.2	P	Earthen	1.2	P	4.0	3.5			
6.200	**6.300**	Plain	BU	AGL	Nisan Gram	9.6	P	7.00	BT	Earthen	1.3	P	Earthen	1.3	P	4.0	3.5			

GLOBAL INFRA SOLUTIONS BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217** **Road Classification- Dudhnoi to Dinadubi**

From: 0.000 To 8.415 **Date of Survey- ………………………………………..**

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of Embankment / Cutting (m)		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly	Left	Right			Pavement Condition (G/F/P/VP)	Width (m) Avarage	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Left	Right	Location (Km)	Carriageway Width(m)	
										Left			Right							
6.300	6.400	Plain	AGL	AGL	Nisan Gram	9.8	P	7.00	BT	Earthen	1.4	P	Earthen	1.4	P	4.0	3.5			
6.400	6.500	Plain	AGL	AGL	Nisan Gram	10.8	P	7.00	BT	Earthen	1.9	P	Earthen	1.9	P	4.0	3.5			
6.500	6.600	Plain	AGL	AGL	Nisan Gram	9.8	P	7.00	BT	Earthen	1.4	P	Earthen	1.4	P	4.0	3.5			
6.600	6.700	Plain	AGL	AGL	Nisan Gram	10.6	P	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	4.0	3.5			
6.700	6.800	Plain	AGL	AGL	Nisan Gram	10.8	P	7.00	BT	Earthen	1.9	P	Earthen	1.9	P	4.0	3.5			
6.800	6.900	Plain	AGL	AGL	Nisan Gram	10.6	P	7.00	BT	Earthen	1.8	P	Earthen	1.8	P	2.7	2.5			
6.900	7.000	Plain	AGL	AGL	Nisan Gram	11.2	P	7.00	BT	Earthen	2.1	P	Earthen	2.1	P	1.9	2.2			
7.000	7.100	Plain	AGL	AGL	Nisan Gram	10.2	P	7.00	BT	Earthen	1.6	P	Earthen	1.6	P	2.8	1.2			
7.100	7.200	Plain	AGL	AGL	Nisan Gram	9.4	P	7.00	BT	Earthen	1.2	P	Earthen	1.2	P	3.1	0.0			
7.200	7.300	Plain	AGL	AGL	Nakma Kundi	9.6	P	7.00	BT	Earthen	1.3	P	Earthen	1.3	P	3.2	0.2			

GLOBAL INFRA SOLUTIONS BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217** **Road Classification- Dudhnoi to Dinadubi**

From: 0.000 To 8.415 **Date of Survey- ………………………………………..**

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly					Pavement Condition (G/F/P/VP)	Width (m)	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Embankment / Cutting (m)		Location (Km)	Carriageway Width(m)	
			Left	Right				Avarage		Left			Right			Left	Right			
7.300	7.400	Plain	AGL	AGL	Nakma Kundi	9.8	P	7.00	BT	Earthen	1.4	P	Earthen	1.4	P	3.1	0.1			
7.400	7.500	Plain	AGL	AGL	Nakma Kundi	9.6	P	7.00	BT	Earthen	1.3	P	Earthen	1.3	P	0.2	1.6			
7.500	7.600	Plain	AGL	AGL	Nakma Kundi	10.7	P	7.00	BT	Earthen	1.9	P	Earthen	1.8	P	0.3	1.5			
7.600	7.700	Plain	AGL	AGL	Nakma Kundi	10.9	P	7.00	BT	Earthen	1.8	P	Earthen	2.1	P	0.2	1.9			
7.700	7.800	Plain	AGL	AGL	Nakma Kundi	10.7	P	7.00	BT	Earthen	2.1	P	Earthen	1.6	P	1.9	2.2			
7.800	7.900	Plain	AGL	AGL	Nakma Kundi	9.8	P	7.00	BT	Earthen	1.6	P	Earthen	1.2	P	2.8	1.2			
7.900	8.000	Plain	AGL	AGL	Nakma Kundi	9.5	P	7.00	BT	Earthen	1.2	P	Earthen	1.3	P	3.1	0.0			
8.000	8.100	Plain	AGL	AGL	Nakma Kundi	9.7	P	7.00	BT	Earthen	1.3	P	Earthen	1.4	P	3.2	0.2			
8.100	8.200	Plain	BU	AGL	Nakma Kundi	10.3	P	7.00	BT	Earthen	1.4	P	Earthen	1.9	P	3.1	0.1			
8.200	8.300	Plain	BU	BU	Nakma Kundi	11.1	P	7.00	BT	Earthen	1.9	P	Earthen	2.200	P	3.2	1.1			

GLOBAL INFRA SOLUTIONS
BHOPAL

Road Inventory Data Sheet

Annexure-I

Name of the Road : **NH 62 New NH 217**

Road Classification- Dudhnoi to Dinadubi

From: **0.000** **To** **8.415**

Date of Survey- …………………………………………..

Chainage (Km.)		Terrain	Adjacent Landuse Pattern		Village / Town Name	Roadway Width (m)	Carriageway			Shoulder						Height of		Type of Cross Road		Remarks
From	To	Plain, Rolling, Hilly					Pavement Condition (G/F/P/VP)	Width (m)	Surface Type (BT/CC/GR/ER)	Type	Width (m)	Condition (G/F/P/VP)	Type	Width (m)	Condition (G/F/P/VP)	Embankment / Cutting (m)		Location (Km)	Carriageway Width(m)	
			Left	Right				Avarage		Left			Right			Left	Right			
8.300	**8.400**	Plain	BU	BU	Nakma Kundi	10.8	F	7.00	BT	Earthen	1.4	P	Earthen	2.400	P	3.1	1.2			
8.400	**8.500**	Plain	BU	BU	Nakma Kundi	10.9	F	7.00	BT	Earthen	1.8	P	Earthen	2.100	P	2.9	2.4			
8.500	**8.600**	Plain	BU	BU	Nakma Kundi	10.8	F	7.00	BT	Earthen	1.9	P	Earthen	1.900	P	3.2	2.1			

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-II

Inventory & Condition Survey for Culverts

Road Name: Dudhnoi to Dainadubi Road (NH-217)

Sr. No.	Roadometer Chainage (km)	Existing Chainage (km)	Design Chainage (km)	Type of Culvert	Thk of Slab (m)	Span Arrangement		Length (m)	Carriage-way Width (m)	Overall Width (m)	Height above Bed Level (m)		Condition of various features of culvert						Details of Protection		Direction of Flow	Skew Angle (Deg.)	Bed Condition	Presence of Scour	Soil Type	Remarks
						No.	Span Length (m)				U/S	D/S	Sub Structure	Slab / Pipe / Box / Arch	Head walls	Wing walls	Return walls	ParaPet / Handrail	Type	Condition						
1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1		0+800	0+800	RCC Slab Culvert	0.25	1	1.50	1.95	11.40	12.00	1.10	1.20	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-
2	2+345	2+320	2+320	RCC Slab Culvert	0.25	1	1.50	1.95	11.40	12.00	1.10	1.20	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-
3	3+380	3+385	3+385	RCC Slab Culvert	0.28	1	1.80	2.20	11.40	12.00	1.40	1.50	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Dry	-	-	-
4		5+500	5+515	RCC Slab Culvert	0.25	1	1.50	1.95	11.40	12.00	1.10	1.20	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-
5	5+900	5+900	5+915	RCC Slab Culvert	0.28	1	1.60	2.70	11.50	11.90	2.10	2.30	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-
6	6+310	6+300	6+305	RCC Slab Culvert	0.25	1	1.00	2.20	11.50	12.00	2.40	2.50	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Dry	-	-	-
7	6+450	6+440	6+445	RCC Slab Culvert	0.25	1	1.00	2.20	11.50	11.80	1.70	1.80	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Dry	-	-	-
8	7+100	7+100	7+110	RCC Slab Culvert	0.30	1	1.50	2.50	11.50	11.90	1.80	2.00	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-
9	8+370	8+355	8+340	RCC Slab Culvert	0.25	1	1.60	2.65	11.40	12.00	1.00	1.30	Poor	Fair	-	Poor	-	Poor	-	-	R-L	-	Dry	-	-	-
10	8+600	8+585	8+580	RCC Slab Culvert	0.35	1	4.00	5.00	7.50	8.60	2.50	2.70	Poor	Poor	-	Poor	-	Poor	-	-	R-L	-	Wet	-	-	-

GLOBAL INFRA SOLUTIONS
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Annexure-III

Inventory and Condition Survey for Bridges

Road Name: Dudhnoi to Dainadubi Road (NH-217)

Sr. No.	Roadometer Chainage (km)	Existing Chainage (km Stone)	Design Chainage (km Stone)	Type of Bridge	Name of River	Year of Construction	Number of Spans	Span Length (C/C of Exp. Joint) (m)	Clear Span (m)	Overall Length of Bridge (i/c RW) (m)	High Level / Submissible	Carriageway Width of Bridge (m)	Overall Width of Bridge (m)	Width of Footpath (m)	Super Structure					Details of Wearing coat		Sub Structure								Foundation				Protection Work		Total Vertical Height (From top of deck Slab) (m)	Skew Angle (Degree)	Direction of Flow	High Flood level (HFL)	Present Condition of Bridge					Wet Dry	Soil Type	Remark
																						Pier				Abutment				Pier Foundation		Abutment Foundation															
															Gradient	Type	Thickness of Slab / Girder (m)	Type of Bearing	Handrail / Parapet (Thk. & Ht.) (m)	Type	Thickness (mm)	Type	Thk. on Top (m)	Thk. on Bottom (m)	Height (m)	Type	Thk. on Top (m)	Thk. on Bottom (m)	Height (m)	Type	Material	Type	Material	Bed	Approach					Abutments	Piers	Slab	Bearings	Parapet			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	4+175	4+150	4+185	Minor Bridge	-	-	1	25.00	24.00	35.00	High level	7.50	8.40	-	-	T Beam	2.30	Elastomeric	0.300/ 1.200	BT	-	-	-	-	7.50	-	-	-	7.50	-	-	Open	RCC	-	-	11.20	-	R to L	-	Poor	-	Fair	Fair	Poor	Wet	Sandy	-
2	6+820	6+800	6+805	Minor Bridge	-	-	3	9.00	28.10	38.00	High level	7.50	8.00	-	-	RCC Slab	0.50	Tar Paper	0.300/ 1.200	BT	-	-	-	-	5.50	-	-	-	5.50	-	-	Open	PCC	-	-	5.80	-	R to L	-	Poor	Poor	Poor	-	Poor	Wet	-	-

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Annexure-IV

IMPROVEMENT PROPOSAL FOR STRUCTURES

Road Name: Dudhnoi to Dainadubi Road (NH-217)

Sr. No.	Location			Details of Existing Structure					Details of Proposed Structure						Remarks
	Roadometer Chainage	Existing Chainage	Design Chainage	Type of Structure	Span Arrangement (m)		Overall Width (m)	Condition of Structure	Recommeded Proposal for Structure	Type of Structure	Span Arrangement (m)		Overall Width (m)	Overall Length (m)	
1		0+800	0+800	RCC Slab Culvert	1	1.50	12.00	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
2	2+345	2+345	2+345	RCC Slab Culvert	1	1.50	12.00	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
3	3+380	3+380	3+385	RCC Slab Culvert	1	1.80	12.00	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
4	4+175	4+150	4+150	Minor Bridge	1	25.00	8.40	Poor	Retained + Newproposal	Minor Bridge	1	25.00	16.0	32.80	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction (with foothpath)
5	-	-	4+445	-	-	-	-	-	Newproposal	FOB (Steel)	1	15.00	16.0	37.00	
6		5+500	5+515	RCC Slab Culvert	1	1.50	12.00	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	
7	5+900	5+900	5+915	RCC Slab Culvert	1	1.60	11.90	Poor	Reconstruction	Box Culvert	1	6.0	12.0	13.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
8	6+310	6+295	6+305	RCC Slab Culvert	1	1.00	12.00	Poor	Reconstruction	Box Culvert	1	3.0	12.0	10.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
9	6+450	6+435	6+445	RCC Slab Culvert	1	1.00	11.80	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
10	6+820	6+800	6+805	Minor Bridge	3	9.00	8.00	Poor	Widening	Minor Bridge	3	9.00	8.0	39.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
11	7+100	7+090	7+110	RCC Slab Culvert	1	1.50	11.90	Poor	Reconstruction	Box Culvert	1	2.0	16.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction
12	8+370	8+355	8+410	RCC Slab Culvert	1	1.60	12.00	Poor	Reconstruction	Box Culvert	1	2.0	12.0	9.00	Due to Condition of existing structure is poor this Structure is recommeded to reconstruction

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FLEXIBLE PAVEMENT DESIGN IRC:37-2018

Dudhnoi to Dainadubi Road

Estimation of effective subgrade modulus/CBR :-

Subgrade 90th percentile CBR = 5.375 %
Borrow Area CBR = 8.62 %

Elasic modulus of the prepared (upper 500 mm) embankment soil = $17.6 * (CBR)^{0.64}$ Eq. 6.2 of IRC-37-2018
= 51.64 Mpa

Elasic modulus of the selected borrow area material = $17.6 * (CBR)^{0.64}$ Eq. 6.2 of IRC-37-2018
= 69.86 Mpa

Consider the poisson's ratio value of both the layers to be = 0.35
Single load= 40000 N
Contact Pressure= 0.56 Mpa
Radius of circular contact area for this load and contact pressure = 150.8 mm
From input data, Surface deflection (From IITPAVE) = 2.256 mm (IITPAVE Results attached)

Foe an equivalent single layer system, the modulus value of thew single layer which will produce the same surface deflection of **2.256 mm** for the same load and for a poisson's ratio of 0.35

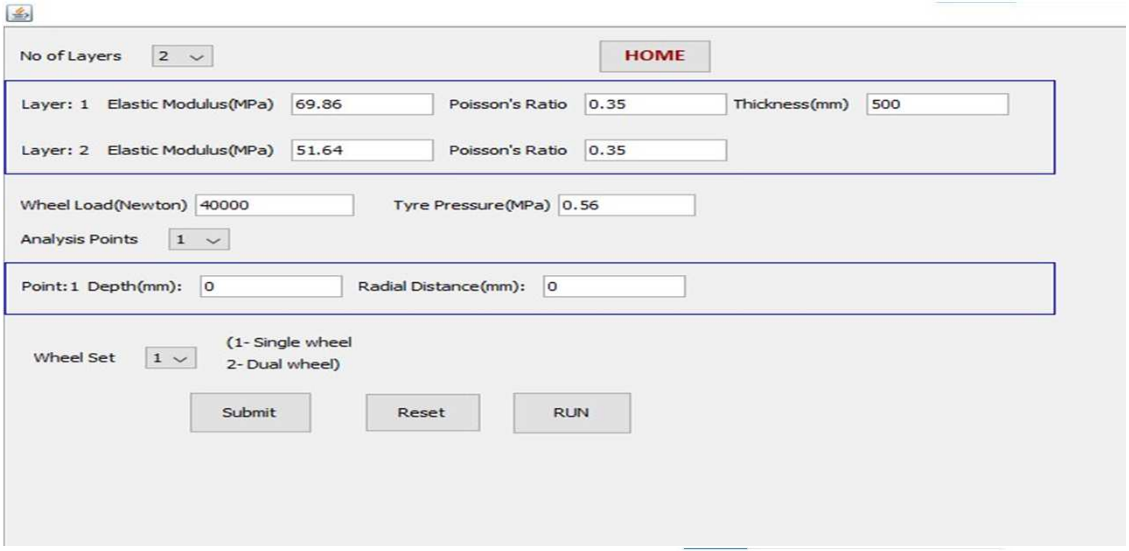
$$M_{RS} = \frac{2(1-\mu^{2})pa}{\delta}$$ Eq. 6.3 of IRC-37-2018

M_{RS}= 65.694 Mpa

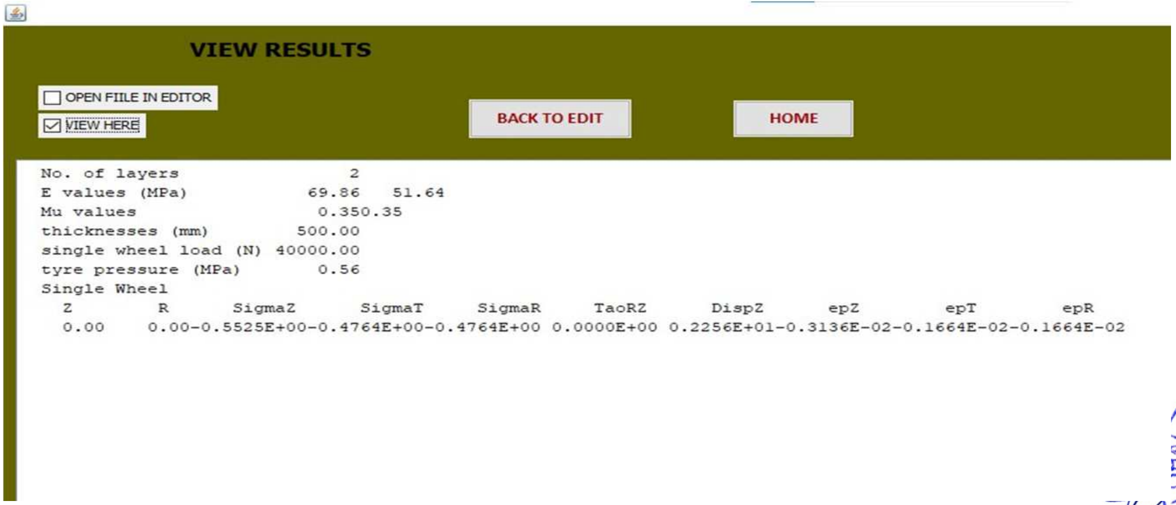
Using eq. 6.2 The corresponding CBR= 7.83 %

The effective CBR is 7.83 % of the subgrade has been determined as per clause 6.4 of IRC 37-2018.

Further, **7% effective CBR** is adopted for the Pavement Design Purpose.



No of Layers: 2
Layer: 1 Elastic Modulus(MPa) 69.86 Poisson's Ratio 0.35 Thickness(mm) 500
Layer: 2 Elastic Modulus(MPa) 51.64 Poisson's Ratio 0.35
Wheel Load(Newton) 40000 Tyre Pressure(MPa) 0.56
Analysis Points 1
Point: 1 Depth(mm): 0 Radial Distance(mm): 0
Wheel Set 1 (1- Single wheel 2- Dual wheel)



```
No. of layers                2
E values (MPa)            69.86   51.64
Mu values                  0.350.35
thicknesses (mm)         500.00
single wheel load (N) 40000.00
tyre pressure (MPa)        0.56
Single Wheel
  Z        R       SigmaZ       SigmaT      SigmaR      TaoRZ       DispZ      epZ        epT        epR
  0.00     0.00-0.5525E+00-0.4764E+00-0.4764E+00 0.0000E+00 0.2256E+01-0.3136E-02-0.1664E-02-0.1664E-02
```

Annexure-V

FLEXIBLE PAVEMENT DESIGN IRC:37-2018

Dudhnoi to Dainadubi Road

Effective CBR =	7	%
Thickness of Granular layer =	150	mm
µ bituminous =	0.35	
µ granular =	0.35	
µctb/ctsb =	0.25	
Design MSA (Bituminous) =	20	
Design MSA (CT base / granular) =	20	
Reliability =	90	%

Assumed Thickness (mm)	
BC	30
DBM	50
WMM	150
CT sub base	200
	430

Resilient Modulus (M_{RS}) of Sub-grade :-

M_{RS}=10.0*CBR For CBR upto 5%

M_{RS}=17.6*(CBR)$^{0.64}$ For CBR > 5%

As per IRC:37-2018 , Clause 6.3 of page no. 20

M_{RS}= 61.15 Mpa

E_{WMM}= 350.00 Mpa

Elastic modulus of cemented layer :

As per IRC:37-2018,Table 11.1, page no. 36

E_{CTSB}= 600 Mpa

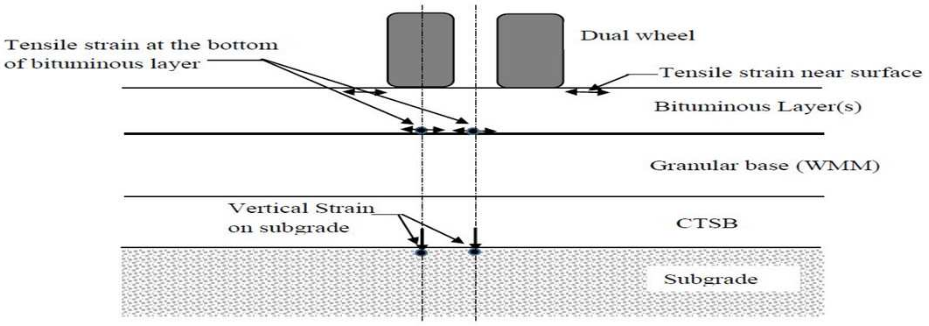

Tensile strain at the bottom of bituminous layer
Dual wheel
Tensile strain near surface
Bituminous Layer(s)
Granular base (WMM)
Vertical Strain on subgrade
CTSB
Subgrade

Figure 3.6 A pavement section with bituminous layer(s), granular base (WMM) and CTSB showing the locations of critical strains

Fatigue cracking criteria for bituminous layer i.e., Allowable tensile strain at the bottom of the bituminous layer :-

$N_f = 0.5161*C*10^{-04}[1/\varepsilon_t]^{3.89}*[1/M_{Rm}]^{0.854}$

Where, (for 90% reliabilty from equation 3.4, page no. 6 IRC:37-2018)

$C=10^M$, and $M=4.84*[V_{be}/(V_a+V_{be})-0.69]$

N_f= 20 Msa= 20x10^6

M_{Rm}= 3000

Volume of Bitumen V_{be} = 11.5 %

Volume of Airvoids V_a = 3.5 % (Clause 12.3, page no. 35 of IRC:37-2018)

M= 0.371066667

C= 2.349993531

ε_t= 0.0002028 (By IITPave)

$20*10^6 = 0.5161 \times 2.35 \times 10^{-4} \times (1/\varepsilon_t)^{3.89} \times (1/3000)^{0.854}$

$20*10^6 = 0.000121283 \times (1/\varepsilon t)^{3.89} \times 0.001072849$

$$(1/\varepsilon t)^{3.89} = \frac{20000000}{0.000121283 \quad x \quad 0.001072849}$$

$(1/\varepsilon t)^{3.89}$ = 1.53706E+14

$(1/\varepsilon t)$ = 4435.721521

ε_t = 0.000225442

Hence the Pavement Composition on Bituminous Layer is SAFE

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Annexure-V

Subgrade Rutting criteria i.e.,
Allowable verticle compressive strain on the top of the Subgrade :-

$N_R=1.41x10^{-08}[1/\varepsilon_v]^{4.5337}$

(for 90% reliabilty from equation 3.2, page no. 5 IRC:37-2018)

N_R= 20 Msa = 20x10^6

$20x10^6=1.41X10^{-08}[1/\varepsilon_v]^{4.5337}$

$[1/\varepsilon v]^{4.5337} = \frac{20000000}{1.41E-08}$

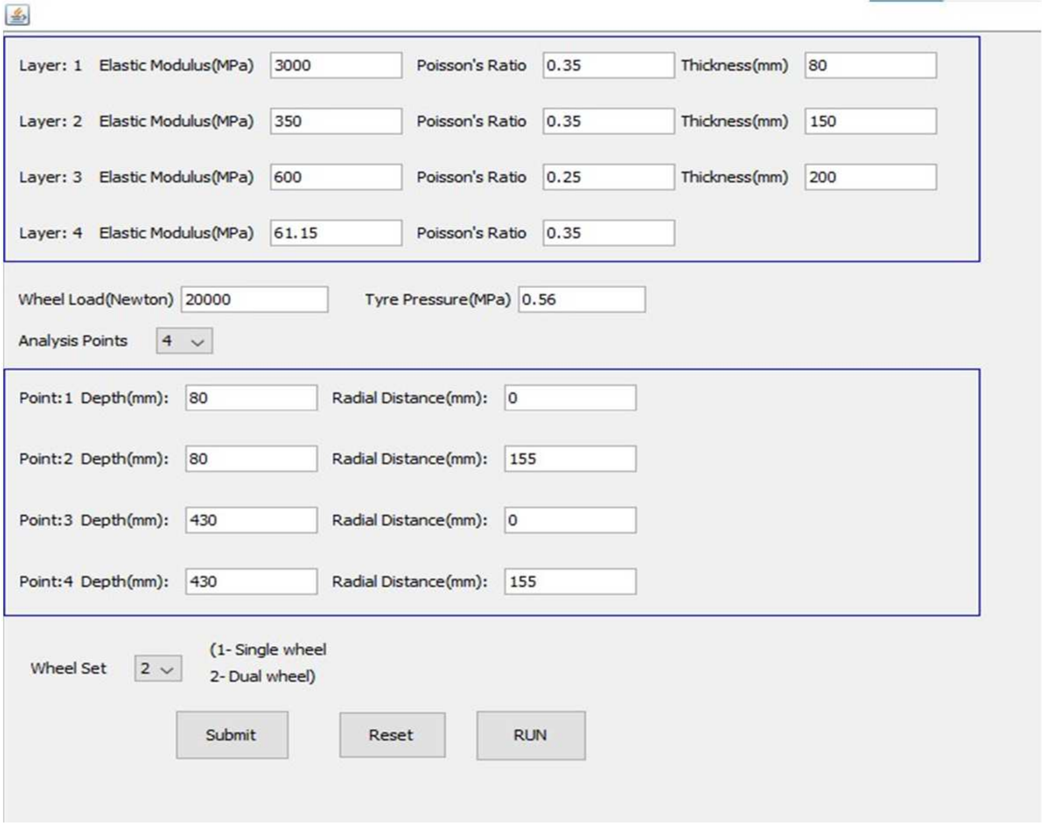
$[1/\varepsilon v]^{4.5337}$ = 1.41844E+15

$1/\varepsilon v$ = 2198.066929

ε_v= 0.000454945

ε_v= 0.0004059 (By IITPave)

Hence the Pavement Composition on Subgrade is SAFE



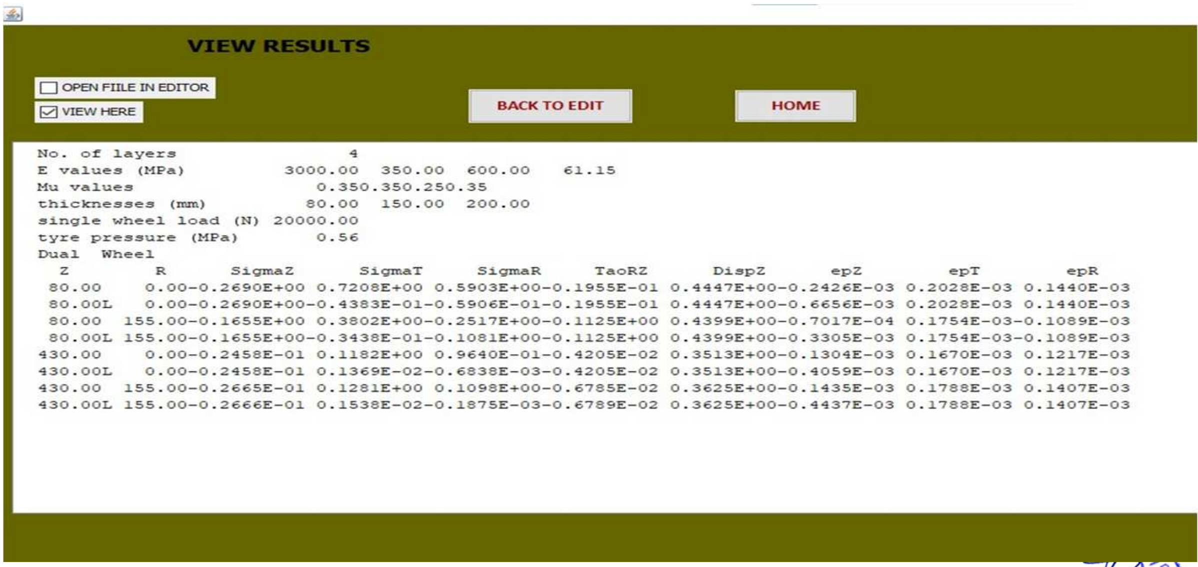
Layer: 1	Elastic Modulus(MPa)	3000	Poisson's Ratio	0.35	Thickness(mm)	80
Layer: 2	Elastic Modulus(MPa)	350	Poisson's Ratio	0.35	Thickness(mm)	150
Layer: 3	Elastic Modulus(MPa)	600	Poisson's Ratio	0.25	Thickness(mm)	200
Layer: 4	Elastic Modulus(MPa)	61.15	Poisson's Ratio	0.35		

Wheel Load(Newton) 20000 Tyre Pressure(MPa) 0.56

Analysis Points 4

Point:1 Depth(mm):	80	Radial Distance(mm):	0
Point:2 Depth(mm):	80	Radial Distance(mm):	155
Point:3 Depth(mm):	430	Radial Distance(mm):	0
Point:4 Depth(mm):	430	Radial Distance(mm):	155

Wheel Set 2 (1- Single wheel 2- Dual wheel)



```
No. of layers                  4
E values (MPa)          3000.00  350.00  600.00   61.15
Mu values                 0.350.350.250.35
thicknesses (mm)          80.00  150.00  200.00
single wheel load (N) 20000.00
tyre pressure (MPa)       0.56
Dual  Wheel
  Z        R       SigmaZ      SigmaT     SigmaR     TaoRZ      DispZ      epZ        epT        epR
 80.00    0.00-0.2690E+00 0.7208E+00 0.5903E+00-0.1955E-01 0.4447E+00-0.2426E-03 0.2028E-03 0.1440E-03
 80.00L   0.00-0.2690E+00-0.4383E-01-0.5906E-01-0.1955E-01 0.4447E+00-0.6656E-03 0.2028E-03 0.1440E-03
 80.00  155.00-0.1655E+00 0.3802E+00-0.2517E+00-0.1125E+00 0.4399E+00-0.7017E-04 0.1754E-03-0.1089E-03
 80.00L 155.00-0.1655E+00-0.3438E-01-0.1081E+00-0.1125E+00 0.4399E+00-0.3305E-03 0.1754E-03-0.1089E-03
430.00    0.00-0.2458E-01 0.1182E+00 0.9640E-01-0.4205E-02 0.3513E+00-0.1304E-03 0.1670E-03 0.1217E-03
430.00L   0.00-0.2458E-01 0.1369E-02-0.6838E-03-0.4205E-02 0.3513E+00-0.4059E-03 0.1670E-03 0.1217E-03
430.00  155.00-0.2665E-01 0.1281E+00 0.1098E+00-0.6785E-02 0.3625E+00-0.1435E-03 0.1788E-03 0.1407E-03
430.00L 155.00-0.2666E-01 0.1538E-02-0.1875E-03-0.6789E-02 0.3625E+00-0.4437E-03 0.1788E-03 0.1407E-03
```

Two Laning with Paved Shoulders : Dudhnoi Road Section (NH-217)

FWD Survey Data (Analysis) Deflection Readings (PKG 1B)

Direction	LHS									Asphalt Temperature(^{0}C)							
S.No.	Chainage (KM)	Load (KN)	Field Deflections(mm)								Normalized Field Deflections(mm)						
			D_0	D_1	D_2	D_3	D_4	D_5	D_6		D_0	D_1	D_2	D_3	D_4	D_5	D_6
			0	**200**	**300**	**450**	**600**	**900**	**1200**		**0**	**200**	**300**	**450**	**600**	**900**	**1200**
1	0.000	42.6	0.29767	0.21367	0.18833	0.14100	0.11033	0.06800	0.04533	22.6	0.27928	0.20047	0.17670	0.13229	0.10352	0.06380	0.04253
2	0.510	39.9	0.81600	0.52067	0.45900	0.32367	0.23967	0.14700	0.09100	28.6	0.81873	0.52241	0.46054	0.32475	0.24047	0.14749	0.09130
3	0.990	40.5	0.59800	0.43600	0.34933	0.24167	0.17667	0.10833	0.06733	26.9	0.59110	0.43097	0.34530	0.23888	0.17463	0.10708	0.06656
4	1.610	39.5	0.79300	0.53833	0.46233	0.32600	0.23200	0.13333	0.08167	28.1	0.80372	0.54561	0.46858	0.33041	0.23514	0.13514	0.08277
5	1.980	39.6	0.74567	0.50767	0.37867	0.23967	0.14600	0.06300	0.03567	26.4	0.75257	0.51236	0.38217	0.24188	0.14735	0.06358	0.03600
6	2.480	39.3	0.82800	0.54500	0.47167	0.32767	0.21633	0.10833	0.05667	33.1	0.84275	0.55471	0.48007	0.33350	0.22019	0.11026	0.05768
7	3.020	40.2	0.49033	0.28200	0.19467	0.11200	0.07100	0.03833	0.02533	30.4	0.48830	0.28083	0.19386	0.11154	0.07071	0.03817	0.02523
8	3.560	40.5	0.58067	0.41967	0.34167	0.23633	0.14767	0.08200	0.04733	32.2	0.57303	0.41414	0.33717	0.23322	0.14572	0.08092	0.04671
9	4.100	39.4	0.74133	0.49233	0.39767	0.24833	0.16767	0.08900	0.05100	32.5	0.75262	0.49983	0.40372	0.25212	0.17022	0.09036	0.05178
10	4.540	39.7	0.66300	0.47067	0.33867	0.21000	0.13000	0.06167	0.03700	31.1	0.66745	0.47383	0.34094	0.21141	0.13087	0.06208	0.03725
11	5.020	38.9	0.81400	0.55067	0.39967	0.23867	0.14933	0.06967	0.04067	32.7	0.83774	0.56672	0.41132	0.24563	0.15369	0.07170	0.04185
12	5.570	37.8	0.92233	0.67133	0.50267	0.29400	0.18900	0.08533	0.04733	33.3	0.97688	0.71103	0.53239	0.31139	0.20018	0.09038	0.05013
13	6.060	38.4	0.76933	0.54900	0.42200	0.26600	0.18000	0.09400	0.05700	33.0	0.80209	0.57237	0.43997	0.27732	0.18766	0.09800	0.05943
14	6.580	39.5	0.61067	0.38633	0.26167	0.14833	0.07100	0.01967	0.00800	33.0	0.61788	0.39089	0.26476	0.15008	0.07184	0.01990	0.00809
15	7.030	39.3	0.64400	0.41400	0.28867	0.16033	0.10200	0.05100	0.02933	32.1	0.65547	0.42137	0.29381	0.16319	0.10382	0.05191	0.02986
16	7.540	39.8	0.57100	0.37733	0.27733	0.17400	0.11667	0.06900	0.04633	31.8	0.57339	0.37891	0.27849	0.17473	0.11715	0.06929	0.04653
17	8.020	41.7	0.38700	0.22400	0.18133	0.11133	0.06800	0.03100	0.01933	31.1	0.37122	0.21487	0.17394	0.10679	0.06523	0.02974	0.01855

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Dudhnoi Road Section (NH-217)

Back Calculated Layer Moduli & Correction for Temperature (LHS)

S.No.	Chainage (KM)	Load (KN)	Asphalt Temperature(^{0}C)	Normalized Field Deflections(mm)							Layer Thickness(mm)		Poisson's Ratio			Existing Condition (G/F/P)	BT Moduli Range(Mpa)		Granular Layers Moduli Range(Mpa)		Subgrade Moduli Range(Mpa)		Back Calculated Moduli(Mpa)			Corrected Moduli(Mpa)		
				D_0	D_1	D_2	D_3	D_4	D_5	D_6																		
				0	200	300	450	600	900	1200	BT	NBT	BT	NBT	Subgrade		Lower	Upper	Lower	Upper	Lower	Upper	BT	Granular	Subgrade	BT	Granular	Subgrade
1	0.000	40.0	22.6	0.27928	0.20047	0.17670	0.13229	0.10352	0.06380	0.04253	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1430	498.0	100.0	852.63	394.79	86.65
2	0.510	40.0	28.6	0.81873	0.52241	0.46054	0.32475	0.24047	0.14749	0.09130	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1462.4	486.7	99.9	1112.52	387.56	86.56
3	0.990	40.0	26.9	0.59110	0.43097	0.34530	0.23888	0.17463	0.10708	0.06656	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1484.9	494.9	100.0	1053.32	392.81	86.65
4	1.610	40.0	28.1	0.80372	0.54561	0.46858	0.33041	0.23514	0.13514	0.08277	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1490.3	498.8	99.9	1114.03	395.30	86.56
5	1.980	40.0	26.4	0.75257	0.51236	0.38217	0.24188	0.14735	0.06358	0.03600	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1484.9	258.7	100.0	1035.14	224.15	86.65
6	2.480	40.0	33.1	0.84275	0.55471	0.48007	0.33350	0.22019	0.11026	0.05768	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1444.1	496.1	100.0	1331.87	393.58	86.65
7	3.020	40.0	30.4	0.48830	0.28083	0.19386	0.11154	0.07071	0.03817	0.02523	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1476.3	476.9	100.0	1210.74	381.23	86.65
8	3.560	40.0	32.2	0.57303	0.41414	0.33717	0.23322	0.14572	0.08092	0.04671	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1329	492.2	100.0	1176.42	391.09	86.65
9	4.100	40.0	32.5	0.75262	0.49983	0.40372	0.25212	0.17022	0.09036	0.05178	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1272	497.7	100.0	1141.42	394.60	86.65
10	4.540	40.0	31.1	0.66745	0.47383	0.34094	0.21141	0.13087	0.06208	0.03725	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1462.4	439.4	100.0	1237.44	356.57	86.65
11	5.020	40.0	32.7	0.83774	0.56672	0.41132	0.24563	0.15369	0.07170	0.04185	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1467.7	347.1	100.0	1329.09	292.20	86.65
12	5.570	40.0	33.3	0.97688	0.71103	0.53239	0.31139	0.20018	0.09038	0.05013	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1492.5	322.1	100.0	1382.85	273.70	86.65
13	6.060	40.0	33.0	0.80209	0.57237	0.43997	0.27732	0.18766	0.09800	0.05943	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1488.2	476.5	100.0	1366.27	380.98	86.65
14	6.580	40.0	33.0	0.61788	0.39089	0.26476	0.15008	0.07184	0.01990	0.00809	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1359.1	100.4	99.9	1247.74	73.40	86.56
15	7.030	40.0	32.1	0.65547	0.42137	0.29381	0.16319	0.10382	0.05191	0.02986	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1495.7	351.4	100.0	1318.00	295.34	86.65
16	7.540	40.0	31.8	0.57339	0.37891	0.27849	0.17473	0.11715	0.06929	0.04653	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1443	496.9	100.0	1254.43	394.09	86.65
17	8.020	40.0	31.1	0.37122	0.21487	0.17394	0.10679	0.06523	0.02974	0.01855	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1475.3	384.3	100.0	1248.35	318.84	86.65

15th Percentile Value	**=**	**1077**	**281**	**87**

GLOBAL INFRA SOLUTIONS
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Two Laning with Paved Shoulders : Dudhnoi Road Section (NH-217)

FWD Survey Data (Analysis) Deflection Readings (PKG 1B)

Direction RHS

S.No.	Chainage (KM)	Load (KN)	Field Deflections(mm)							Asphalt Temperature(^{0}C)	Normalized Field Deflections(mm)						
			D_0	D_1	D_2	D_3	D_4	D_5	D_6		D_0	D_1	D_2	D_3	D_4	D_5	D_6
			0	200	300	450	600	900	1200		0	200	300	450	600	900	1200
1	0.012	41.3	0.28100	0.24100	0.18800	0.14200	0.10233	0.06267	0.04000	27.6	0.27215	0.23341	0.18208	0.13753	0.09911	0.06069	0.03874
2	0.530	41.1	0.54267	0.38600	0.33000	0.24767	0.18333	0.12000	0.08267	27.6	0.52814	0.37567	0.32117	0.24104	0.17843	0.11679	0.08045
3	1.007	40.4	0.50200	0.43033	0.35500	0.26333	0.18600	0.11133	0.07300	27.6	0.49703	0.42607	0.35149	0.26073	0.18416	0.11023	0.07228
4	1.630	39.6	0.80933	0.62767	0.52667	0.39767	0.28167	0.15533	0.08767	27.3	0.81820	0.63454	0.53243	0.40202	0.28475	0.15703	0.08863
5	1.995	40.9	0.49033	0.38167	0.29100	0.18267	0.11767	0.05933	0.04033	27.6	0.47915	0.37296	0.28436	0.17850	0.11498	0.05798	0.03941
6	2.510	40.5	0.50033	0.41300	0.34000	0.24033	0.16333	0.07900	0.04233	27.3	0.49375	0.40757	0.33553	0.23717	0.16118	0.07796	0.04178
7	3.035	41.2	0.36900	0.30700	0.23633	0.16333	0.10433	0.05967	0.04433	27.4	0.35854	0.29830	0.22964	0.15870	0.10138	0.05798	0.04308
8	3.581	41.2	0.40867	0.26133	0.22167	0.13967	0.09433	0.04767	0.02867	27.7	0.39676	0.25372	0.21521	0.13560	0.09159	0.04628	0.02783
9	4.121	40.9	0.43000	0.32067	0.23700	0.16133	0.09433	0.04267	0.02500	27.3	0.42088	0.31387	0.23197	0.15791	0.09233	0.04176	0.02447
10	4.556	40.1	0.57100	0.46233	0.36967	0.26400	0.16000	0.07100	0.03433	27.6	0.57005	0.46156	0.36905	0.26356	0.15973	0.07088	0.03428
11	5.034	41.0	0.45400	0.32767	0.24233	0.16033	0.09600	0.04933	0.03200	27.4	0.44293	0.31967	0.23642	0.15642	0.09366	0.04813	0.03122
12	5.589	40.2	0.58933	0.48267	0.36767	0.25333	0.17600	0.10533	0.06700	27.4	0.58640	0.48027	0.36584	0.25207	0.17512	0.10481	0.06667
13	6.080	40.5	0.42533	0.35433	0.29767	0.20167	0.14467	0.07500	0.04167	27.3	0.42043	0.35025	0.29423	0.19934	0.14300	0.07414	0.04119
14	6.590	40.6	0.50600	0.39800	0.31033	0.21733	0.13667	0.06767	0.03900	27.6	0.49811	0.39180	0.30550	0.21395	0.13454	0.06661	0.03839
15	7.044	39.0	0.81067	0.63833	0.49567	0.31133	0.18667	0.07500	0.04067	26.7	0.83216	0.65526	0.50881	0.31959	0.19162	0.07699	0.04175
16	7.555	39.6	0.58667	0.46333	0.37533	0.26733	0.18733	0.10700	0.06600	27.1	0.59259	0.46801	0.37912	0.27003	0.18923	0.10808	0.06667
17	8.032	40.2	0.63000	0.51100	0.40667	0.27133	0.17033	0.07300	0.04000	27.6	0.62687	0.50846	0.40464	0.26998	0.16949	0.07264	0.03980

GLOBAL INFRA SOLUTIONS
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Dudhnoi Road Section (NH-217)

Back Calculated Layer Moduli & Correction for Temperature (RHS)

S.No.	Chainage (KM)	Load (KN)	Asphalt Temperature(^{0}C)	Normalized Field Deflections(mm)							Layer Thickness(mm)		Poisson's Ratio			Existing Condition (G/F/P)	BT Moduli Range(Mpa)		Granular Layers Moduli Range(Mpa)		Subgrade Moduli Range(Mpa)		Back Calculated Moduli(Mpa)			Corrected Moduli(Mpa)		
				D_0	D_1	D_2	D_3	D_4	D_5	D_6																		
				0	200	300	450	600	900	1200	BT	NBT	BT	NBT	Subgrade		Lower	Upper	Lower	Upper	Lower	Upper	BT	Granular	Subgrade	BT	Granular	Subgrade
1	0.012	40.0	27.6	0.27215	0.23341	0.18208	0.13753	0.09911	0.06069	0.03874	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1476.3	499.6	99.9	1079.73	395.81	86.56
2	0.530	40.0	27.6	0.52814	0.37567	0.32117	0.24104	0.17843	0.11679	0.08045	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1498.9	499.6	99.9	1096.26	395.81	86.56
3	1.007	40.0	27.6	0.49703	0.42607	0.35149	0.26073	0.18416	0.11023	0.07228	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1410.8	499.6	99.9	1031.83	395.81	86.56
4	1.630	40.0	27.3	0.81820	0.63454	0.53243	0.40202	0.28475	0.15703	0.08863	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1465.6	498.8	99.9	1058.42	395.30	86.56
5	1.995	40.0	27.6	0.47915	0.37296	0.28436	0.17850	0.11498	0.05798	0.03941	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1444.1	491.8	100.0	1056.18	390.83	86.65
6	2.510	40.0	27.3	0.49375	0.40757	0.33553	0.23717	0.16118	0.07796	0.04178	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1457.0	493.0	100.0	1052.21	391.60	86.65
7	3.035	40.0	27.4	0.35854	0.29830	0.22964	0.15870	0.10138	0.05798	0.04308	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1459.1	498.8	100.0	1058.18	395.30	86.65
8	3.581	40.0	27.7	0.39676	0.25372	0.21521	0.13560	0.09159	0.04628	0.02783	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1491.4	493.0	99.9	1095.39	391.60	86.56
9	4.121	40.0	27.3	0.42088	0.31387	0.23197	0.15791	0.09233	0.04176	0.02447	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1463.4	499.2	99.9	1056.83	395.56	86.56
10	4.556	40.0	27.6	0.57005	0.46156	0.36905	0.26356	0.15973	0.07088	0.03428	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1495.7	493.4	100.0	1093.92	391.86	86.65
11	5.034	40.0	27.4	0.44293	0.31967	0.23642	0.15642	0.09366	0.04813	0.03122	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1443.0	494.9	100.0	1046.51	392.81	86.65
12	5.589	40.0	27.4	0.58640	0.48027	0.36584	0.25207	0.17512	0.10481	0.06667	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1447.3	496.5	100.0	1049.63	393.84	86.65
13	6.080	40.0	27.3	0.42043	0.35025	0.29423	0.19934	0.14300	0.07414	0.04119	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1466.7	496.9	100.0	1059.22	394.09	86.65
14	6.590	40.0	27.6	0.49811	0.39180	0.30550	0.21395	0.13454	0.06661	0.03839	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1438.7	497.3	100.0	1052.23	394.35	86.65
15	7.044	40.0	26.7	0.83216	0.65526	0.50881	0.31959	0.19162	0.07699	0.04175	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1493.5	484.4	100.0	1051.66	386.08	86.65
16	7.555	40.0	27.1	0.59259	0.46801	0.37912	0.27003	0.18923	0.10808	0.06667	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1433.3	498.4	100.0	1026.41	395.05	86.65
17	8.032	40.0	27.6	0.62687	0.50846	0.40464	0.26998	0.16949	0.07264	0.03980	50	450	0.5	0.4	0.4	Good	750	2000	100	500	20	100	1465.6	498.4	100.0	1071.91	395.05	86.65

	15th Percentile Value	**=**	**1048**	**392**	**87**

GLOBAL INFRA SOLUTIONS
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Overlay Design Summary (10 Years)		
Existinf Pavement Composition Adopted for aanalysis		
BT	50mm	
Granular	400mm	
Strength of Different Layers (Minimum) from Backcalculation		
BT Existing	983	Mpa
Granular Existing	234	Mpa
Subgrade	87	Mpa
Thickness of Different Layers (Minimum) adopted		
BT Existing	50	mm
Granular Existing	400	mm
Stress Analysis Result		
Tensile Allowed	276	
Tensile Calculated	244	
Comp. Allowed	484	
Comp. Calculated	304	
Result	Safe	
Overlay Details		
Thickness of BT (BC + DBM)	**80**	**mm**

GLOBAL INFRA SOLUTIONS
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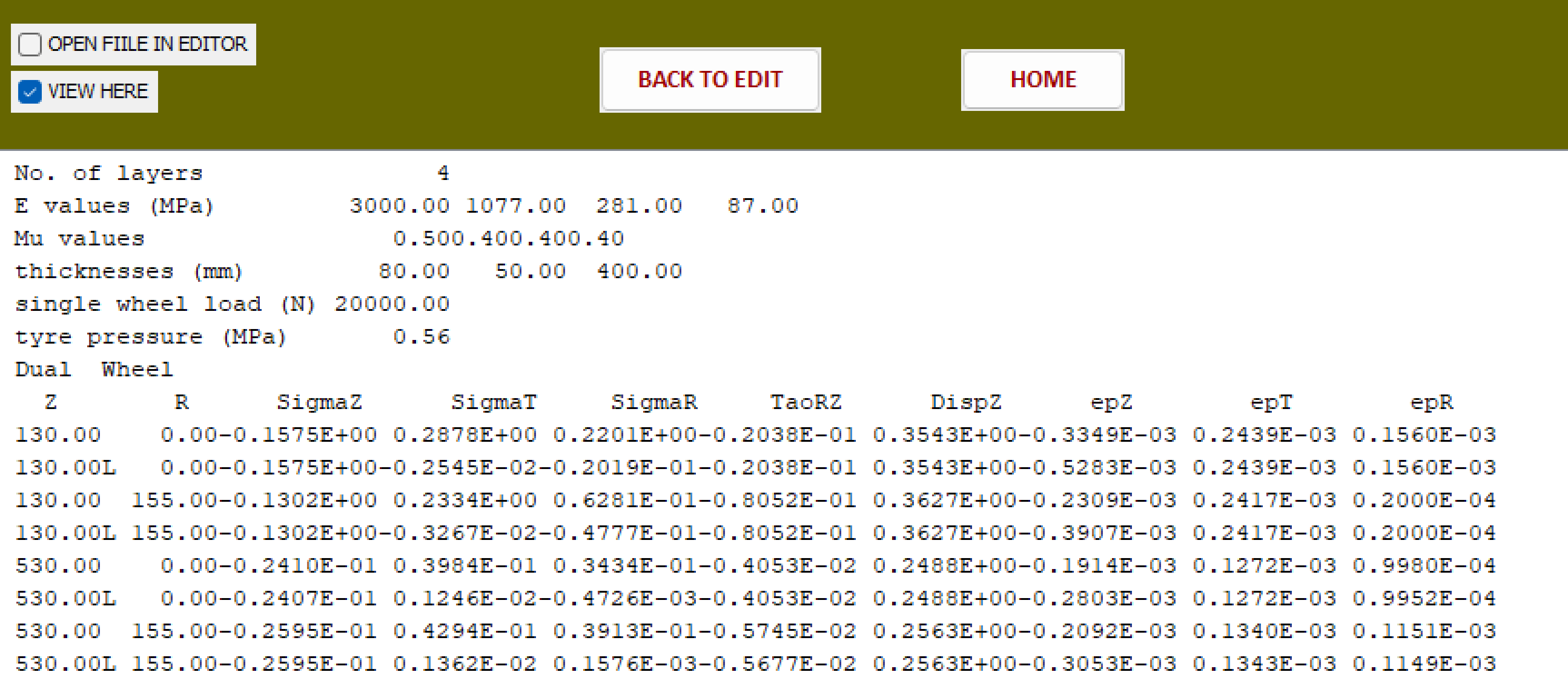

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No. of layers                4
E values (MPa)         3000.00 1077.00  281.00   87.00
Mu values                 0.500.400.400.40
thicknesses (mm)         80.00   50.00  400.00
single wheel load (N) 20000.00
tyre pressure (MPa)       0.56
Dual  Wheel
  Z        R      SigmaZ      SigmaT     SigmaR     TaoRZ      DispZ      epZ        epT        epR
130.00    0.00-0.1575E+00 0.2878E+00 0.2201E+00-0.2038E-01 0.3543E+00-0.3349E-03 0.2439E-03 0.1560E-03
130.00L   0.00-0.1575E+00-0.2545E-02-0.2019E-01-0.2038E-01 0.3543E+00-0.5283E-03 0.2439E-03 0.1560E-03
130.00  155.00-0.1302E+00 0.2334E+00 0.6281E-01-0.8052E-01 0.3627E+00-0.2309E-03 0.2417E-03 0.2000E-04
130.00L 155.00-0.1302E+00-0.3267E-02-0.4777E-01-0.8052E-01 0.3627E+00-0.3907E-03 0.2417E-03 0.2000E-04
530.00    0.00-0.2410E-01 0.3984E-01 0.3434E-01-0.4053E-02 0.2488E+00-0.1914E-03 0.1272E-03 0.9980E-04
530.00L   0.00-0.2407E-01 0.1246E-02-0.4726E-03-0.4053E-02 0.2488E+00-0.2803E-03 0.1272E-03 0.9952E-04
530.00  155.00-0.2595E-01 0.4294E-01 0.3913E-01-0.5745E-02 0.2563E+00-0.2092E-03 0.1340E-03 0.1151E-03
530.00L 155.00-0.2595E-01 0.1362E-02 0.1576E-03-0.5677E-02 0.2563E+00-0.3053E-03 0.1343E-03 0.1149E-03
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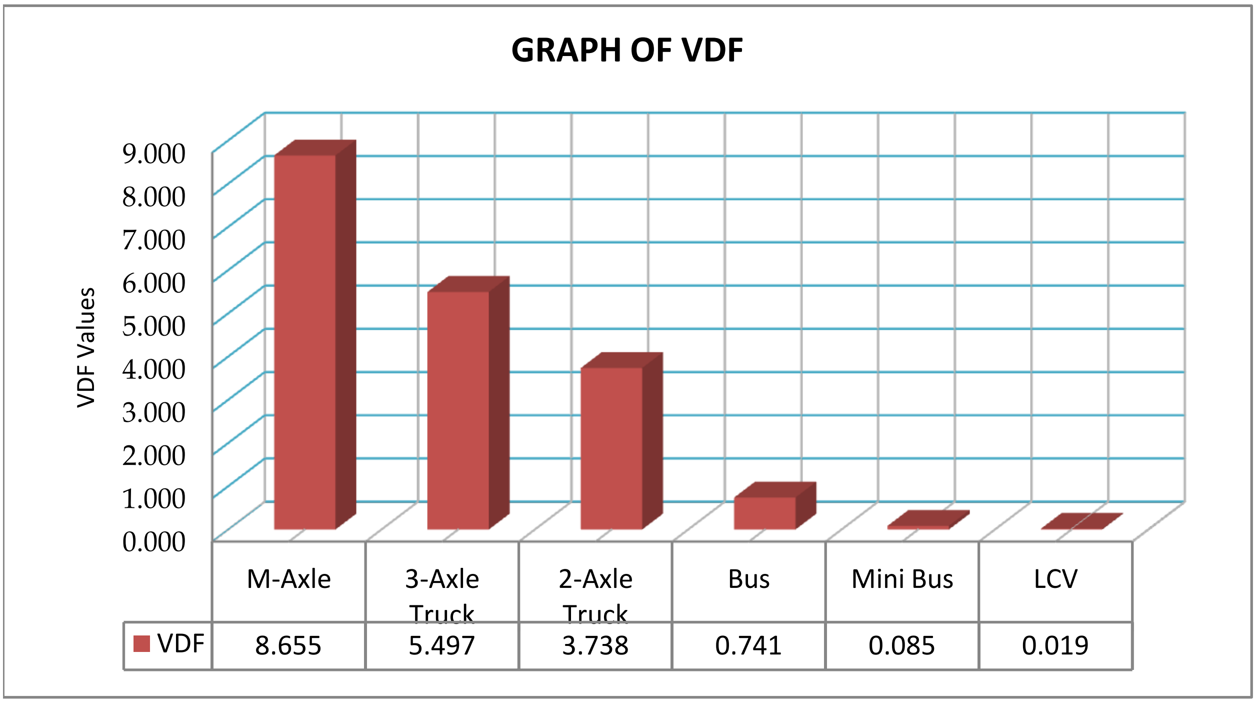
Annexure-VI

AXLE LOAD ANALYSIS

Road : Dudhoni - Damra (5 km) **Date-** Friday, November 23, 2018

Location : At km 3+500 (Near Damra A.S.A. Playground)□

TYPE OF VEHICLES	VDF		
	UP	DOWN	MAX
M-Axle	8.655	4.084	**8.655**
3-Axle Truck	5.497	3.706	**5.497**
2-Axle Truck	2.619	3.738	**3.738**
Bus	0.334	0.741	**0.741**
Mini Bus	0.021	0.085	**0.085**
LCV	0.012	0.019	**0.019**



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Annexure-VI

AXLE-LOAD SURVEY (UP Direction)

Road : Dudhoni - Damra (5 km)
Section: Section-1
Location : At km 3+500 (Near Damra A.S.A. Playground)
Date : Friday, November 23, 2018
Direction : Dudhoni - Damra
Weather : Normal

Sl No	Vehicle Type	Origin	Destination	Commodity	Axle Load (Tonnes)				Remark
					Front	Rear1	Rear2	Rear3	
1	2	4	5	6	7	8	9	10	12
1	2-Axle	Dudhnoi	Damra	Empty	4.10	3.76			
2	LCV	Abhayapuri	Resubelpara	Animal Food	1.35	1.63			
3	LCV	Barpeta	Damra	Gas Cylender	1.37	1.71			
4	Mini Bus	Dudhnoi	Meghalaya	Passenger	1.63	2.49			
5	LCV	Guwahati	Songsak	Cement	1.69	2.09			
6	2-Axle	Dudhnoi	Damra	Gas Cylender	6.52	11.43			
7	LCV	Dudhnoi	Rongjeng	Transformer	1.37	1.79			
8	LCV	Paltan Bazaar	Shillong	Gas Cylender	1.43	2.07			
9	M-Axle	Bongaigaon	Rongjeng	Kabada	6.84	5.81	13.40	11.65	
10	Mini Bus	Kamakhya Mandir	Damra	Passenger	1.85	2.88			
11	2-Axle	Guwahati	Damra	Empty	3.80	3.34			
12	Bus	Hulukanda Hill	Shallang	Passenger	4.83	5.69			
13	LCV	Goalpara	Silchar	Empty	1.07	0.89			
14	LCV	Dudhnoi	Damra	Fruits	1.77	2.39			
15	LCV	Dudhnoi College	Tengasot Govt. Higher Sec. School	Furniture	1.45	1.79			
16	2-Axle	Abhayapuri	Hailakandi	Gas Cylender	6.48	11.01			
17	LCV	Dudhnoi	Mizoram	Sugar	1.85	2.17			
18	Mini Bus	Kamakhya Mandir	Damra	Passenger	1.99	2.90			
19	Bus	Mornoi	Songsak	Passenger	3.96	4.71			
20	LCV	Dudhnoi	Damra	Cement	1.57	2.09			
21	LCV	Paltan Bazaar	Market Damra	Khad	1.27	1.63			
22	2-Axle	Nalbari	Resubelpara	Oil Tanker	4.79	9.15			
23	Mini Bus	Manas National Park	Nongstoin	Passenger	1.57	2.43			
24	LCV	Jogighopa	Wageasi	Furniture	1.83	2.56			
25	M-Axle	Dudhnoi	Market Damra	Petrol	6.42	5.65	10.91	10.42	
26	Bus	Guwahati	Adugiri	Passenger	3.72	4.65			
27	LCV	Guwahati	Damra	Machine	1.61	2.07			
28	LCV	Guwahati	Rangram	Kabada	1.85	2.29			
29	2-Axle	Paltan Bazaar	Silchar	Oil Tanker	5.65	11.03			
30	LCV	Guwahati	Williamnagar	Sand	1.55	1.89			
31	LCV	Guwahati	Rangram	Empty	0.89	0.76			
32	LCV	Abhayapuri	Damra	Gas Cylinder	1.25	1.57			
33	2-Axle	Guwahati	Ranikor	Empty	3.64	3.30			
34	LCV	Bongaigaon	Silchar	Parcel	1.43	2.07			

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

AXLE-LOAD SURVEY (UP Direction)

Road : Dudhoni - Damra (5 km)

Location : At km 3+500 (Near Damra A.S.A. Playground)□

Direction : Dudhoni - Damra

Section: Section-1

Date : Friday, November 23, 2018

Weather : Normal

Sl No	Vehicle Type	Origin	Destination	Commodity	Axle Load (Tonnes)				Remark
					Front	Rear1	Rear2	Rear3	
1	2	4	5	6	7	8	9	10	12
35	LCV	Dudhnoi College	Tengasot Govt. Higher Sec. School	Furniture	1.93	2.56			
36	LCV	Goalpara	Market Damra	Empty	0.93	0.74			
37	M-Axle	Barpeta	Shillong	Bricks	6.18	4.79	11.37	9.74	
38	Bus	Alipurduar	Shillong	Passenger	4.41	5.29			
39	LCV	Guwahati	Rongjeng	Bamboo	1.85	2.56			
40	Mini Bus	Guwahati	Meghalaya	Passenger	1.79	2.82			
41	2-Axle	Jogighopa	Damra	Furniture	4.99	10.60			
42	LCV	Jogighopa	Shillong	Empty	0.72	0.54			
43	LCV	Paltan Bazaar	Hailakandi	Empty	1.01	0.82			
44	LCV	Barpeta	Market Damra	Paper Roll	1.43	1.97			
45	2-Axle	Dudhnoi	Mizoram	Groceries	4.71	10.08			
46	LCV	Nalbari	Shallang	Mixture Machine	1.85	2.80			
47	LCV	Bongaigaon	Shallang	Wood	1.43	2.09			
48	2-Axle	Paltan Bazaar	Wageasi	Petrol Tanker	4.91	9.84			
49	M-Axle	Guwahati	Kolkata	Iron	6.50	4.57	12.31	10.95	
50	2-Axle	Barpeta	Shallang	Bricks	4.79	9.88			
51	2-Axle	Jogighopa	Shillong	Fruits	6.30	12.09			
52	Mini Bus	Agia	Shallang	Passenger	2.05	3.28			
53	M-Axle	Nalbari	Mizoram	Oil Tank	6.44	5.09	11.75	9.70	
54	3-Axle	Guwahati	Damra	Wheat	6.14	11.21	9.09		
55	3-Axle	Guwahati	Sahibganj	Petrol	6.58	13.48	11.15		
56	3-Axle	Nalbari	Silchar	Iron	6.26	11.33	9.50		

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

AXLE-LOAD SURVEY (Down Direction)

Road : Dudhoni - Damra (5 km) **Section:** Section-1

Location : At km 3+500 (Near Damra A.S.A. Playground) **Date :** 11/23/2018

Direction : Damra-Dudhoni **Weather :** Normal

Sl No	Vehicle Type	Origin	Destination	Commodity	Axle Load (Tonnes)				Remark
					Front	Rear 1	Rear 2	Rear 3	
1	2	4	5	6	7	8	9		11
1	2-Axle	Churaibari	Guwahati	Auto Parts	5.76	10.18			
2	LCV	Damra Market	Dhupdhara	Chicken	1.47	2.13			
3	Bus	Shallang	Dudhnoi	Passenger	5.09	6.44			
4	3-Axle	Damra	Guwahati	Cement Pole	5.70	11.71	9.08		
5	LCV	Shallang	Bongaigaon	Fertilizer Bags	1.19	1.83			
6	2-Axle	Damra	Dudhnoi	Empty	3.58	3.14			
7	Mini Bus	Shillong	Goalpara	Passenger	1.73	2.70			
8	LCV	Rongram	Dhubri	Branch	1.79	2.60			
9	Bus	Dainadubi	Agia	Passenger	4.67	6.94			
10	3-Axle	Chokpot	Bongaigaon	Plastic Bags	4.81	11.39	8.45		
11	LCV	Shillong	Gohpur	Paddy	1.83	2.64			
12	2-Axle	Damra	Dudhnoi	Bricks	5.05	10.93			
13	LCV	Williamnagar	Dari Duri	Rice	1.21	1.93			
14	Bus	Shallang	Dudhnoi	Passenger	4.89	7.55			
15	Mini Bus	Wageasi Market	Abhayapuri	Passenger	1.99	3.20			
16	LCV	Damra	Dudhoni	Cloths Bundell	1.21	1.79			
17	LCV	Agartala	Dhupdhara	Cement	1.79	2.54			
18	2-Axle	Damra	Dudhnoi	Cement	6.30	12.86			
19	LCV	Damra	Goalpara	Fertilizer Bags	1.83	2.66			
20	Bus	Dainadubi	Dudhnoi	Passenger	4.25	5.82			
21	LCV	Churaibari	Guwahati	Machine	1.45	1.99			
22	Mini Bus	Shallang	Chapar	Passenger	3.54	4.67			
23	LCV	Tura	Agia	Chair	1.80	2.52			
24	2-Axle	Rongram	Darjeeling	Bricks	5.59	11.47			
25	LCV	Mizoram	Nalbari	Empty	0.87	0.78			
26	LCV	Shillong	Dudhnoi	Kabada	1.79	2.37			
27	LCV	Rompa	Bongaigaon	Chemical Tanke	1.87	2.64			
28	Mini Bus	Shillong	Krishnai	Passenger	3.86	5.74			
29	M-Axle	Tripura	Dhubri	Empty	4.51	3.60	3.34	2.80	
30	2-Axle	Shillong	Guwahati	Iron Rod	5.41	11.45			
31	LCV	Silchar	Dhupdhara	Plastic Pipe	1.81	2.87			
32	LCV	Shillong	Dudhnoi	Parcel	1.37	1.95			
33	2-Axle	Nairang	Goalpara	Gitti	4.79	10.87			
34	Mini Bus	Dainadubi	Dudhnoi	Passenger	2.46	3.10			
35	LCV	Churaibari	Guwahati	Groceries	1.79	2.58			
36	2-Axle	Siju	Boko	Iron	5.82	11.89			
37	LCV	Silchar	Barpeta	Gitti	1.55	2.27			
38	2-Axle	Shillong	Dhubri	Kabada	5.21	11.17			

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

AXLE-LOAD SURVEY (Down Direction)

Road : Dudhoni - Damra (5 km) **Section:** Section-1

Location : At km 3+500 (Near Damra A.S.A. Playground) **Date :** 11/23/2018

Direction : Damra-Dudhoni **Weather :** Normal

Sl No	Vehicle Type	Origin	Destination	Commodity	Axle Load (Tonnes)				Remark
					Front	Rear 1	Rear 2	Rear 3	
1	2	4	5	6	7	8	9		11
39	LCV	Williamnagar	Agia	Empty	0.58	0.54			
40	Mini Bus	Shillong	Krishnai	Passenger	1.85	2.88			
41	2-Axle	Tura	Gohpur	Iron Pole	5.11	9.92			
42	LCV	Mizoram	Goalpara	Cement	1.87	2.42			
43	M-Axle	Agartala	Guwahati	Medicine	5.76	3.40	11.85	10.57	
44	2-Axle	Agartala	Goalpara	Sand	5.57	10.93			
45	LCV	Rongram	Dhubri	Empty	0.97	0.83			
46	Mini Bus	Williamnagar	Mornoi	Passenger	2.05	3.28			
47	2-Axle	Rompa	Guwahati	Cartoon Box	5.78	11.53			
48	LCV	Damra Market	Krishnai	Cement	1.39	3.36			
49	2-Axle	Tripura	Bongaigaon	Medicine	5.28	10.63			
50	LCV	Chokpot	Bongaigaon	Wood	1.37	2.13			
51	2-Axle	Mizoram	Dari Duri	Empty	4.21	3.84			
52	Mini Bus	Siju	Goalpara	Passenger	1.99	2.90			
53	LCV	Shillong	Barpeta	Gas Cylinder	1.47	2.13			
54	2-Axle	Rongram	Goalpara	Plywood	5.28	11.29			
55	LCV	Nairang	Agia	Sand	1.01	1.67			
56	2-Axle	Tripura	Dhubri	Paper Roll	4.77	11.93			
57	LCV	Tura	Goalpara	Water Tank	1.45	2.27			
58	Mini Bus	Williamnagar	Dhupdhara	Passenger	2.88	2.48			
59	2-Axle	Siju	Nalbari	hemical Tanke	4.97	11.67			
60	LCV	Chokpot	Nalbari	Caret Box	1.27	1.61			
61	2-Axle	Agartala	Guwahati	Parcel	5.11	11.23			
62	2-Axle	Silchar	Goalpara	Groceries	4.67	11.70			

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

VDF Calculations (M-Axle)

M-Axle Truck (UP)

Sl No	Vehicle Type	Type of Commodity	Wheel Load (Tonne)				Total Weight (Tonne)	Wheel Load (kN)				Total Weight (kN)	Equivalency Factor				VDF	Average VDF
			Axle										Axle					
			Front	Rear-1	Rear-2	Rear-3		Front	Rear-1	Rear-2	Rear-3		Front	Rear-1	Rear-2	Rear-3		
2	M-Axle	Kabada	6.84	5.81	13.40	11.65	38.00	67.09	57.02	131.41	114.25	369.77	1.13	0.26	7.28	4.16	12.83	8.655
3	M-Axle	Petrol	6.42	5.65	10.91	10.42	33.00	62.94	55.45	106.95	102.21	327.55	0.88	0.23	3.19	2.66	6.97	
4	M-Axle	Bricks	6.18	4.79	11.37	9.74	32.00	60.58	46.96	111.48	95.50	314.52	0.75	0.12	3.77	2.03	6.68	
5	M-Axle	Iron	6.50	4.57	12.31	10.95	34.00	63.73	44.79	120.76	107.34	336.62	0.92	0.10	5.19	3.24	9.46	
6	M-Axle	Oil Tank	6.44	5.09	11.75	9.70	33.00	63.14	49.92	115.23	95.11	323.40	0.89	0.15	4.30	2.00	7.34	

M- Axle Truck (DN)

Sl No	Vehicle Type	Type of Commodity	Wheel Load (Tonne)				Total Weight (Tonne)	Wheel Load (kN)				Total Weight (kN)	Equivalency Factor				VDF	Average VDF
			Axle										Axle					
			Front	Rear-1	Rear-2	Rear-3		Front	Rear-1	Rear-2	Rear-3		Front	Rear-1	Rear-2	Rear-3		
1	M-Axle	Empty	4.51	3.60	3.34	2.80	14.00	44.21	35.33	32.76	27.43	139.74	0.21	0.04	0.03	0.01	0.29	4.084
2	M-Axle	Medicine	5.76	3.40	11.85	10.57	32.00	56.53	33.35	116.25	103.62	309.75	0.57	0.03	4.46	2.81	7.87	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

VDF Calculations (3-Axle)

Sl No	3-Axle Truck (UP)													
	Vehicle Type	Type of Commodity	Wheel Load (Tonne)			Total Weight (Tonne)	Wheel Load (kN)			Total Weight (kN)	Equivalency Factor		Total VDF	Avg. VDF
			Axle								Axle			
			Front	Rear-1	Rear-2		Front	Rear-1	Rear-2		Front	Rear-1 & 2		
1	3-Axle	Wheat	6.14	11.21	9.09	26.00	60.18	109.91	89.19	259.27	0.735	3.275	4.010	5.497
2	3-Axle	Petrol	6.58	13.48	11.15	31.00	64.52	132.20	109.31	306.04	0.971	7.091	8.062	
3	3-Axle	Iron	6.26	11.33	9.50	27.00	61.37	111.09	93.13	265.59	0.794	3.626	4.420	

Sl No	3-Axle Truck (DN)													
	Vehicle Type	Type of Commodity	Wheel Load (Tonne)			Total Weight (Tonne)	Wheel Load (kN)			Total Weight (kN)	Equivalency Factor		Total VDF	Avg. VDF
			Axle								Axle			
			Front	Rear-1	Rear-2		Front	Rear-1	Rear-2		Front	Rear-1 & 2		
1	3-Axle	Cement	5.70	11.71	9.08	26.00	55.85	114.87	89.01	259.73	0.545	3.601	4.146	3.706
2	3-Axle	Plastic Bags	4.81	11.39	8.45	25.00	47.17	111.71	82.89	241.77	0.277	2.989	3.267	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

VDF Calculations (2-Axle)

Sl No	2-Axle Truck (UP)												
	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	2-Axle	Empty	4.1045	3.7624	8.00	40.25	36.90	77.15	0.147	0.045	0.192	2.619
2	2-Axle	Gas Cylender	6.5189	11.428	18.00	63.93	112.08	176.01	0.936	3.852	4.788	
3	2-Axle	Empty	3.8027	3.3399	7.00	37.29	32.75	70.05	0.108	0.028	0.136	
4	2-Axle	Gas Cylender	6.4786	11.006	17.00	63.54	107.93	171.47	0.913	3.313	4.226	
5	2-Axle	Oil Tanker	4.7886	9.1546	14.00	46.96	89.78	136.74	0.272	1.586	1.859	
6	2-Axle	Oil Tanker	5.6537	11.026	17.00	55.45	108.13	163.58	0.529	3.337	3.867	
7	2-Axle	Empty	3.6417	3.2997	7.00	35.71	32.36	68.07	0.091	0.027	0.118	
8	2-Axle	Furniture	4.9898	10.603	16.00	48.93	103.99	152.92	0.321	2.855	3.176	
9	2-Axle	Groceries	4.7081	10.08	15.00	46.17	98.86	145.03	0.255	2.332	2.586	
10	2-Axle	Petrol Tanker	4.9093	9.8387	15.00	48.15	96.49	144.63	0.301	2.116	2.417	
11	2-Axle	Bricks	4.7886	9.8789	15.00	46.96	96.88	143.84	0.272	2.151	2.423	
12	2-Axle	Fruits	6.2976	12.092	18.00	61.76	118.59	180.35	0.815	4.828	5.643	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Sl No	2-Axle Truck (DN)											
	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	2-Axle	Auto Parts	5.76	10.18	16.00	56.45	99.87	156.31	0.569	2.428	2.997	3.738
2	2-Axle	Empty	3.58	3.14	7.00	35.13	30.79	65.92	0.085	0.022	0.107	
3	2-Axle	Bricks	5.05	10.93	16.00	49.54	107.17	156.71	0.337	3.221	3.558	
4	2-Axle	Cement	6.30	12.86	19.00	61.78	126.12	187.89	0.816	6.176	6.992	
5	2-Axle	Bricks	5.59	11.47	17.00	54.87	112.50	167.37	0.508	3.910	4.418	
6	2-Axle	Iron Rod	5.41	11.45	17.00	53.09	112.30	165.39	0.445	3.883	4.328	
7	2-Axle	Gitti	4.79	10.87	16.00	46.97	106.58	153.55	0.273	3.150	3.423	
8	2-Axle	Iron	5.8161	11.894	18.00	57.04	116.64	173.68	0.593	4.519	5.112	
9	2-Axle	Kabada	5.2124	11.169	16.00	51.12	109.54	160.66	0.383	3.515	3.897	
10	2-Axle	Iron Pole	5.1118	9.9216	15.00	50.13	97.30	147.43	0.354	2.188	2.542	
11	2-Axle	Sand	5.5746	10.928	17.00	54.67	107.17	161.84	0.500	3.221	3.721	
12	2-Axle	Cartoon Box	5.7759	11.532	17.00	56.64	113.09	169.73	0.577	3.993	4.570	
13	2-Axle	Medicine	5.28	10.63	16.00	51.83	104.25	156.08	0.404	2.884	3.288	
14	2-Axle	Empty	4.21	3.84	8.00	41.25	37.70	78.95	0.162	0.049	0.211	
15	2-Axle	Plywood	5.28	11.29	17.00	51.79	110.68	162.47	0.403	3.664	4.067	
16	2-Axle	Paper Roll	4.77	11.93	17.00	46.78	117.02	163.79	0.268	4.578	4.846	
17	2-Axle	Chemical Tanker	4.97	11.67	17.00	48.75	114.45	163.20	0.316	4.189	4.506	
18	2-Axle	Parcel	5.11	11.23	16.00	50.13	110.15	160.28	0.354	3.594	3.948	
19	2-Axle	Groceries	4.67	11.70	16.00	45.81	114.79	160.60	0.247	4.239	4.485	

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

VDF Calculations (Bus)

Bus (UP)												
Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	Bus	Passenger	4.83	5.69	10.52	47.36	55.84	103.20	0.282	0.237	0.519	0.334
2	Bus	Passenger	3.96	4.71	8.67	38.87	46.17	85.04	0.128	0.111	0.239	
3	Bus	Passenger	3.72	4.65	8.37	36.50	45.58	82.08	0.099	0.105	0.205	
4	Bus	Passenger	4.41	5.29	9.70	43.21	51.89	95.11	0.195	0.177	0.372	

Bus (DN)												
Sl No.	Vehicle Type	Type of Commodity	Wheel Load		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	Bus	Passenger	5.09	6.44	11.53	49.93	63.16	113.09	0.348	0.388	0.737	0.741
2	Bus	Passenger	4.67	6.94	11.61	45.79	68.09	113.88	0.246	0.525	0.771	
3	Bus	Passenger	4.89	7.55	12.44	47.96	74.01	121.97	0.296	0.733	1.029	
4	Bus	Passenger	4.25	5.82	10.06	41.64	57.04	98.68	0.168	0.258	0.427	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

VDF Calculations (Mini Bus)

Bus (UP)

Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	Mini Bus	Passenger	1.6297	2.4949	4.12	15.98	24.47	40.45	0.004	0.009	0.012	0.021
2	Mini Bus	Passenger	1.85	2.88	4.73	18.15	28.22	46.37	0.006	0.015	0.022	
3	Mini Bus	Passenger	1.99	2.90	4.89	19.53	28.41	47.95	0.008	0.016	0.024	
4	Mini Bus	Passenger	1.57	2.43	4.00	15.39	23.88	39.27	0.003	0.008	0.011	
5	Mini Bus	Passenger	1.79	2.82	4.61	17.56	27.62	45.19	0.005	0.014	0.020	
6	Mini Bus	Passenger	2.05	3.28	5.33	20.13	32.16	52.29	0.009	0.026	0.035	

Bus (DN)

Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	Mini Bus	Passenger	1.73	2.70	4.43	16.97	26.45	43.42	0.005	0.012	0.017	0.085
2	Mini Bus	Passenger	1.99	3.20	5.19	19.54	31.38	50.92	0.008	0.024	0.032	
3	Mini Bus	Passenger	3.542	4.669	8.21	34.74	45.79	80.53	0.082	0.107	0.189	
4	Mini Bus	Passenger	3.864	5.7356	9.60	37.89	56.25	94.14	0.116	0.244	0.360	
5	Mini Bus	Passenger	2.4553	3.0993	5.55	24.08	30.39	54.47	0.019	0.021	0.040	
6	Mini Bus	Passenger	1.8515	2.8779	4.73	18.16	28.22	46.38	0.006	0.015	0.022	
7	Mini Bus	Passenger	2.0528	3.2804	5.33	20.13	32.17	52.30	0.009	0.026	0.035	
8	Mini Bus	Passenger	1.9924	2.898	4.89	19.54	28.42	47.96	0.008	0.016	0.024	
9	Mini Bus	Passenger	2.8779	2.4754	5.35	28.22	24.28	52.50	0.036	0.008	0.044	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

VDF Calculations (LCV)

LCV (UP)

Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	LCV	Animal Food	1.35	1.63	3.00	13.22	15.98	29.20	0.002	0.004	0.005	0.012
2	LCV	Gas Cylender	1.37	1.71	3.00	13.42	16.77	30.19	0.002	0.004	0.006	
3	LCV	Cement	1.69	2.09	4.00	16.57	20.52	37.10	0.004	0.010	0.014	
4	LCV	Transformer	1.37	1.79	3.00	13.42	17.56	30.98	0.002	0.005	0.007	
5	LCV	Gas Cylender	1.43	2.07	4.00	14.01	20.32	34.33	0.002	0.010	0.012	
6	LCV	Empty	1.07	0.89	2.00	10.46	8.68	19.14	0.001	0.000	0.001	
7	LCV	Fruits	1.77	2.39	4.00	17.36	23.48	40.84	0.005	0.017	0.022	
8	LCV	Furniture	1.45	1.79	3.00	14.21	17.56	31.77	0.002	0.005	0.008	
9	LCV	Sugar	1.85	2.17	4.00	18.15	21.31	39.46	0.006	0.012	0.018	
10	LCV	Cement	1.57	2.09	4.00	15.39	20.52	35.91	0.003	0.010	0.013	
11	LCV	Khad	1.27	1.63	3.00	12.43	15.98	28.41	0.001	0.004	0.005	
12	LCV	Furniture	1.83	2.56	4.00	17.96	25.06	43.02	0.006	0.022	0.028	
13	LCV	Machine	1.61	2.07	4.00	15.79	20.32	36.11	0.003	0.010	0.013	
14	LCV	Kabada	1.85	2.29	4.00	18.15	22.49	40.65	0.006	0.014	0.020	
15	LCV	Sand	1.55	1.89	3.00	15.19	18.55	33.74	0.003	0.007	0.010	
16	LCV	Empty	0.89	0.76	2.00	8.68	7.50	16.18	0.000	0.000	0.000	
17	LCV	Gas Cylinder	1.25	1.57	3.00	12.23	15.39	27.62	0.001	0.003	0.004	
18	LCV	Parcel	1.43	2.07	4.00	14.01	20.32	34.33	0.002	0.010	0.012	
19	LCV	Furniture	1.93	2.56	4.00	18.94	25.06	44.00	0.007	0.022	0.029	
20	LCV	Empty	0.93	0.74	2.00	9.08	7.30	16.38	0.000	0.000	0.001	
21	LCV	Bamboo	1.85	2.56	4.00	18.15	25.06	43.21	0.006	0.022	0.028	
22	LCV	Empty	0.72	0.54	1.00	7.10	5.33	12.43	0.000	0.000	0.000	
23	LCV	Empty	1.01	0.82	2.00	9.87	8.09	17.96	0.001	0.000	0.001	
24	LCV	Paper Roll	1.43	1.97	3.00	14.01	19.34	33.35	0.002	0.008	0.010	
25	LCV	Mixture Machine	1.85	2.80	5.00	18.15	27.43	45.58	0.006	0.032	0.038	
26	LCV	Wood	1.43	2.09	4.00	14.01	20.52	34.53	0.002	0.010	0.012	

LCV (DN)

Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
1	LCV	Chicken	1.47	2.13	4.00	14.41	20.92	35.33	0.002	0.011	0.013	0.019
2	LCV	Fertilizer Bags	1.19	1.83	3.00	11.64	17.96	29.60	0.001	0.006	0.007	
3	LCV	Branch	1.79	2.60	4.00	17.57	25.46	43.03	0.005	0.024	0.029	
4	LCV	Paddy	1.83	2.64	4.00	17.96	25.85	43.82	0.006	0.025	0.031	
5	LCV	Rice	1.21	1.93	3.00	11.84	18.95	30.79	0.001	0.007	0.008	
6	LCV	Cloths Bundell	1.21	1.79	3.00	11.84	17.57	29.41	0.001	0.005	0.006	
7	LCV	Cement	1.79	2.54	4.00	17.57	24.87	42.43	0.005	0.021	0.027	
8	LCV	Fertilizer Bags	1.8314	2.6565	4.00	17.96	26.05	44.01	0.006	0.026	0.032	
9	LCV	Machine	1.45	1.99	3.00	14.21	19.54	33.75	0.002	0.008	0.010	
10	LCV	Chair	1.80	2.52	4.00	17.66	24.73	42.39	0.005	0.021	0.026	
11	LCV	Empty	0.87	0.78	2.00	8.49	7.70	16.18	0.000	0.000	0.000	
12	LCV	Kabada	1.79	2.37	4.00	17.57	23.29	40.85	0.005	0.016	0.022	
13	LCV	Chemical Tanker	1.87	2.64	5.00	18.36	25.85	44.21	0.006	0.025	0.031	
14	LCV	Plastic Pipe	1.81	2.87	5.00	17.78	28.10	45.89	0.006	0.035	0.041	
15	LCV	Parcel	1.37	1.95	3.00	13.42	19.14	32.57	0.002	0.008	0.009	
16	LCV	Groceries	1.7911	2.576	4.00	17.57	25.26	42.83	0.005	0.023	0.028	

Annexure-VI

Sl No.	Vehicle Type	Type of Commodity	Wheel Load (Tonnes)		Total Weight (Tonne)	Wheel Load (kN)		Total Weight (kN)	Equivalency Factor		Total VDF	Average VDF
			Axle						Axle			
			Front	Rear		Front	Rear		Front	Rear		
17	LCV	Gitti	1.5496	2.2741	4.00	15.20	22.30	37.50	0.003	0.014	0.017	
18	LCV	Empty	0.5836	0.5434	1.00	5.72	5.33	11.05	0.000	0.000	0.000	
19	LCV	Cement	1.8716	2.415	4.00	18.36	23.68	42.04	0.006	0.018	0.024	
20	LCV	Empty	0.966	0.8251	2.00	9.47	8.09	17.57	0.000	0.000	0.001	
21	LCV	Cement	1.3886	3.3609	5.00	13.62	32.96	46.58	0.002	0.066	0.068	
22	LCV	Wood	1.3685	2.1333	4.00	13.42	20.92	34.34	0.002	0.011	0.013	
23	LCV	Gas Cylinder	1.4691	2.1333	4.00	14.41	20.92	35.33	0.002	0.011	0.013	
24	LCV	Sand	1.0063	1.6704	3.00	9.87	16.38	26.25	0.001	0.004	0.005	
25	LCV	Water Tank	1.449	2.2741	4.00	14.21	22.30	36.51	0.002	0.014	0.016	
26	LCV	Caret Box	1.2679	1.61	3.00	12.43	15.79	28.22	0.001	0.003	0.005	

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

AVERAGE DAILY TRAFFIC (Summary)

Road : Dudhnoi - Dainadubi (8.6 km) **Road No. :** 1 **From:** Saturday, November 17, 2018

Location : At km 3+500 (Near Damra A.S.A. Playground)□ **Station No. :** 1 **To:** Friday, November 23, 2018

DAY	Motorised Traffic											Non-Motorised Traffic					Grand Total
	Passenger Vehicles					Goods Vehicles				Agri Tractor		Passenger Vehicles		Goods Vehicles			
							Truck								Animal Drawn		
	Two Wheeler	Three Wheeler/ Auto	Car/ Jeep/ Van/ Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart	Vehicle (No)
DAY-1 UP	743	518	533	13	10	71	27	2	7	12	2	441	0	1	0	0	**2380**
DAY-1 DN	767	447	505	13	11	70	13	7	2	20	1	482	0	0	0	0	**2338**
DAY-2 UP	861	408	524	24	4	75	16	0	5	12	0	431	0	1	0	0	**2361**
DAY-2 DN	801	447	607	18	9	88	16	6	9	15	0	434	0	6	0	0	**2456**
DAY-3 UP	886	490	504	40	8	81	28	0	8	12	1	364	0	5	1	0	**2428**
DAY-3 DN	1005	498	496	39	3	135	21	3	8	11	1	511	0	7	0	0	**2738**
DAY-4 UP	889	593	538	41	12	112	46	2	3	22	2	404	0	5	0	0	**2669**
DAY-4 DN	961	654	554	35	9	161	34	1	2	19	2	539	0	3	1	0	**2975**
DAY-5 UP	1123	713	572	40	10	210	54	3	9	20	0	475	5	0	0	0	**3234**
DAY-5 DN	1059	725	568	41	20	201	44	6	4	22	2	569	0	6	0	0	**3267**
DAY-6 UP	769	531	514	48	15	144	57	0	5	22	0	445	0	11	1	0	**2562**
DAY-6 DN	898	622	606	43	12	200	54	3	2	25	0	415	0	6	1	0	**2887**
DAY-7 UP	737	622	522	45	10	111	42	1	7	11	0	450	0	10	3	0	**2571**
DAY-7 DN	772	705	489	50	13	127	35	3	4	16	0	522	0	7	1	0	**2744**
Total Weekly Traffic (Nos)	12271	7973	7532	490	146	1786	487	37	75	239	11	6482	5	68	8	0	**37610**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

Total Weekly Traffic (PCU)	6136	7973	7532	735	438	2679	1461	111	338	1076	17	3241	10	204	64	0	**32015**
ADT (NO)	**1753**	**1139**	**1076**	**70**	**21**	**255**	**70**	**5**	**11**	**34**	**2**	**926**	**1**	**10**	**1**	**0**	**5373**
ADT (PCU)	**877**	**1139**	**1076**	**105**	**63**	**383**	**209**	**16**	**48**	**154**	**2**	**463**	**1**	**29**	**9**	**0**	**4573**
PCU Factor	0.5	1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	4.5	1.5	0.5	2.0	3.0	8.0	4.0	
AADT (NO)	**1753**	**1139**	**1076**	**70**	**21**	**255**	**70**	**5**	**11**	**34**	**2**	**926**	**1**	**10**	**1**	**0**	**5373**
AADT (PCU)	**877**	**1139**	**1076**	**105**	**63**	**383**	**209**	**16**	**48**	**154**	**2**	**463**	**1**	**29**	**9**	**0**	**4574**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Traffic Compostion in terms of Nos. and PCU of ADT and AADT

Road : Dudhnoi - Dainadubi (8.6 km)
Location : At km 3+500 (Near Damra A.S.A. Playground)

Traffic Composition	**ADT (Nos)**	**ADT (PCU)**	**AADT (Nos)**	**AADT (PCU)**
Two Wheeler	1753	877	1753	877
Three Wheeler/ Auto	1139	1139	1139	1139
Car/Jeep/Van/ Taxi	1076	1076	1076	1076
Mini Bus	70	105	70	105
Bus	21	63	21	63
LCV	255	383	255	383
2-Axle Truck	70	209	70	209
3-Axle Truck	5	16	5	16
M-Axle Truck	11	48	11	48
Tractor With Trailer	34	154	34	154
Tractor Without Trailer	2	2	2	2
Total Fast Moving Vehicles(FMV)	**4435**	**4071**	**4435**	**4071**
Cycle	926	463	926	463
Cycle Rickshaw	1	1	1	1
Hand Cart	10	29	10	29
Bullock Cart	1	9	1	9
Horse Cart	0	0	0	0
Total Slow Moving Vehicles(SMV)	**938**	**503**	**938**	**503**
Total	**5373**	**4573**	**5373**	**4573**
CVPD	**432**	**–**	**432**	**–**
Tollable Traffic	**1508**	**1899**	**1508**	**1899**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Traffic Compostion in terms of Percentage of Nos and PCU of ADT

Road : Dudhnoi - Dainadubi (8.6 km)
Locatio At km 3+500 (Near Damra A.S.A. Playground)

Traffic Composition	ADT (Nos)	% of Total	ADT (PCU)	% of Total
Two Wheeler	1753	32.63	877	19.17
Three Wheeler/ Auto	1139	21.20	1139	24.91
Car/Jeep/Van/ Taxi	1076	20.03	1076	23.53
Mini Bus	70	1.30	105	2.30
Bus	21	0.39	63	1.37
LCV	255	4.75	383	8.37
2-Axle Truck	70	1.29	209	4.56
3-Axle Truck	5	0.10	16	0.35
M-Axle Truck	11	0.20	48	1.05
Tractor With Trailer	34	0.64	154	3.36
Tractor Without Trailer	2	0.03	2	0.05
Total Fast Moving Vehicles(FMV)	**4435**	**82.55**	**4071**	**89.01**
Cycle	926	17.23	463	10.12
Cycle Rickshaw	1	0.01	1	0.03
Hand Cart	10	0.18	29	0.64
Bullock Cart	1	0.02	9	0.20
Horse Cart	0	0.00	0	0.00
Total Slow Moving Vehicles(SMV)	**938**	**17.45**	**503**	**10.99**
Total	**5373**	**100.00**	**4573**	**100.00**

GLOBAL INFRA SOLUTIONS
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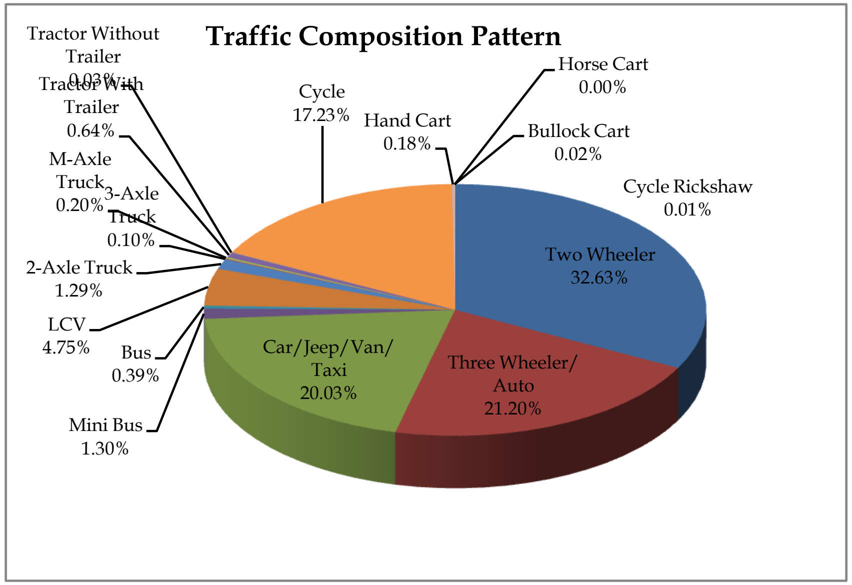
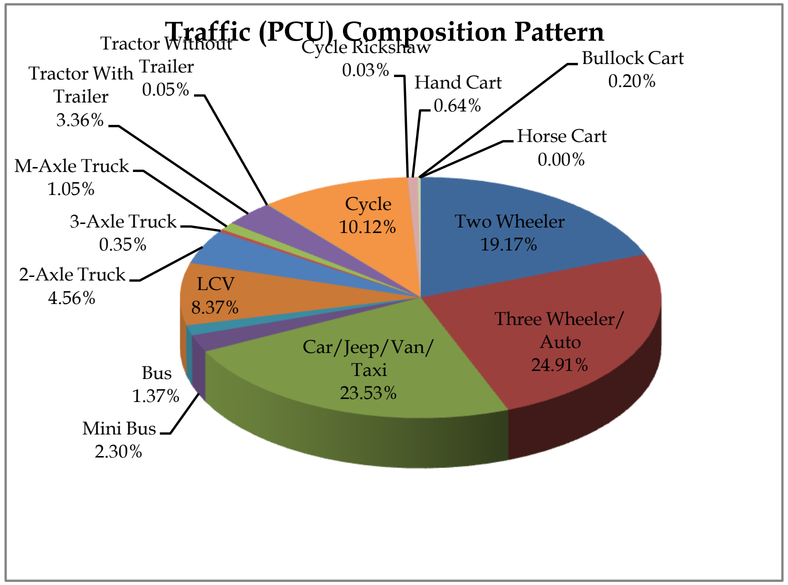
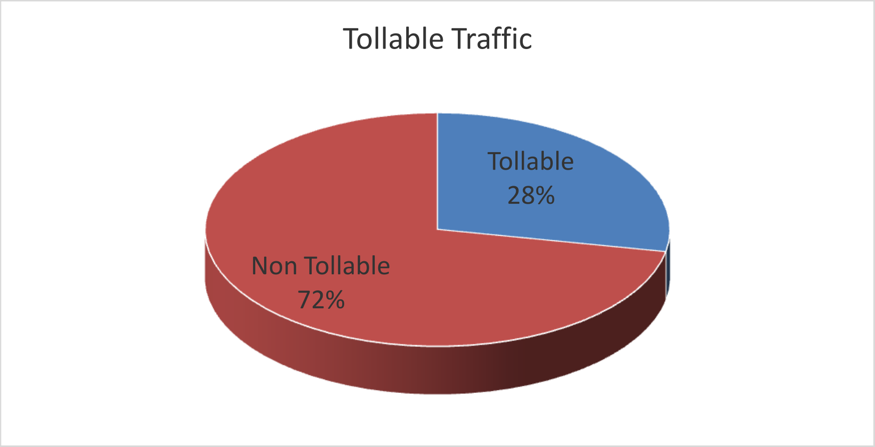
Annexure-VI

Pie Chart for traffic Compositions and Tollable and Non- Tollable traffic







GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road : Dudhnoi - Dainadubi (8.6 km)
Road No. : 1
Direction : Dudhnoi - Dainadubi
Station No. : 1
Addl. Information:
Location : At km 3+500 (Near Damra A.S.A. Playground)
Date & Day : Saturday, November 17, 2018
Weather: Normal
Hour : 8 AM to 8 AM

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
								Truck			Agri Tractor														
		Two Wheeler	Three Wheeler / Auto	Car/ Jeep/ Van/ Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer			Cycle	Cycle Rickshaw		Bullock Cart	Horse Cart						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	34	26	25	0	1	3	3	0	2	2	0	96	102.5	31	0	0	0	0	31	15.5	127	5.34	118.0	5.97
2	9-10	47	45	41	0	1	1	2	0	0	2	0	139	129.0	22	0	0	0	0	22	11.0	161	6.76	140.0	7.08
3	10-11	56	43	46	2	2	4	1	0	0	0	1	155	136.5	46	0	0	0	0	46	23.0	201	8.45	159.5	8.07
4	11-12	77	62	42	2	2	3	1	0	0	0	0	189	159.0	35	0	0	0	0	35	17.5	224	9.41	176.5	8.93
5	12-13	52	49	44	0	2	5	0	0	0	0	1	153	134.0	58	0	0	0	0	58	29.0	211	8.87	163.0	8.24
6	13-14	75	43	34	0	0	1	2	0	0	3	0	158	135.5	38	0	1	0	0	39	22.0	197	8.28	157.5	7.96
7	14-15	72	62	42	0	0	4	0	0	0	4	0	184	164.0	27	0	0	0	0	27	13.5	211	8.87	177.5	8.98
8	15-16	66	44	47	1	0	9	1	0	1	0	0	169	146.5	29	0	0	0	0	29	14.5	198	8.32	161.0	8.14
9	16-17	59	52	43	2	0	5	2	0	0	0	0	163	141.0	46	0	0	0	0	46	23.0	209	8.78	164.0	8.29
10	17-18	49	37	37	1	1	7	1	0	0	0	0	133	116.5	36	0	0	0	0	36	18.0	169	7.10	134.5	6.80
11	18-19	20	11	34	0	0	6	0	0	0	0	0	71	64.0	11	0	0	0	0	11	5.5	82	3.45	69.5	3.51
12	19-20	35	11	27	0	0	7	0	0	0	0	0	80	66.0	6	0	0	0	0	6	3.0	86	3.61	69.0	3.49
13	20-21	12	3	14	0	0	2	2	0	0	0	0	33	32.0	2	0	0	0	0	2	1.0	35	1.47	33.0	1.67
14	21-22	9	3	13	0	0	2	0	0	0	0	0	27	23.5	11	0	0	0	0	11	5.5	38	1.60	29.0	1.47
15	22-23	5	0	9	0	1	1	0	0	0	0	0	16	16.0	0	0	0	0	0	0	0.0	16	0.67	16.0	0.81
16	23-00	4	1	4	0	0	2	1	0	0	0	0	12	13.0	0	0	0	0	0	0	0.0	12	0.50	13.0	0.66
17	00-1	0	0	0	0	0	1	1	0	0	0	0	2	4.5	0	0	0	0	0	0	0.0	2	0.08	4.5	0.23
18	1-2	1	0	2	0	0	0	3	0	0	0	0	6	11.5	0	0	0	0	0	0	0.0	6	0.25	11.5	0.58
19	2-3	2	0	2	0	0	1	0	0	0	0	0	5	4.5	0	0	0	0	0	0	0.0	5	0.21	4.5	0.23
20	3-4	0	0	2	0	0	3	1	0	0	0	0	6	9.5	0	0	0	0	0	0	0.0	6	0.25	9.5	0.48
21	4-5	0	0	1	1	0	0	2	0	0	0	0	4	8.5	0	0	0	0	0	0	0.0	4	0.17	8.5	0.43
22	5-6	8	1	3	0	0	0	0	1	0	0	0	13	11.0	6	0	0	0	0	6	3.0	19	0.80	14.0	0.71
23	6-7	21	4	8	1	0	0	1	1	4	0	0	40	48.0	20	0	0	0	0	20	10.0	60	2.52	58.0	2.93
24	7-8	39	21	13	3	0	4	3	0	0	1	0	84	77.5	17	0	0	0	0	17	8.5	101	4.24	86.0	4.35
Total in numbers		**743**	**518**	**533**	**13**	**10**	**71**	**27**	**2**	**7**	**12**	**2**	**1938**	**1754**	**441**	**0**	**1**	**0**	**0**	**442**	**224**	**2380**	**100**	**1978**	**100**

Annexure-VI

% of modal split of number	31	22	22.39	0.55	0.42	2.98	1.13	0.08	0.29	0.50	0.08	**81.43**		18.53	0.00	0.04	0.00	0.00	**18.57**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	371.5	518	533	19.5	30	106.5	81	6	31.5	54	3		**1754.0**	220.5	0	3	0	0		**223.5**			**1977.5**	
% of Total P.C.U.	18.79	26.19	26.95	0.99	1.52	5.39	4.10	0.30	1.59	2.73	0.15		**88.70**	11.15	0.00	0.15	0.00	0.00		**11.30**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road : Dudhnoi - Dainadubi (8.6 km)
Direction : Dainadubi - Dudhnoi
Location : At km 3+500 (Near Damra A.S.A. Playground)

Road No. : 1
Station No. : 1
Date & Day : Saturday, November 17, 2018
Hour : 8 AM to 8 AM

Addl. Information: 0
Weather: Normal

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/ Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	18	13	17	0	0	1	2	0	0	0	0	51	46.5	19	0	0	0	0	19	9.5	70	2.99	56.0	2.96
2	9-10	33	26	28	1	3	2	2	0	0	1	0	96	94.5	36	0	0	0	0	36	18.0	132	5.65	112.5	5.94
3	10-11	51	48	41	3	3	3	2	0	0	1	0	152	143.0	40	0	0	0	0	40	20.0	192	8.21	163.0	8.60
4	11-12	62	55	44	2	0	4	2	1	0	1	0	171	152.5	46	0	0	0	0	46	23.0	217	9.28	175.5	9.26
5	12-13	70	53	49	0	0	4	2	1	0	0	0	179	152.0	58	0	0	0	0	58	29.0	237	10.14	181.0	9.55
6	13-14	67	47	32	0	1	7	1	2	0	2	0	159	144.0	54	0	0	0	0	54	27.0	213	9.11	171.0	9.03
7	14-15	47	58	43	4	3	4	1	1	2	2	1	166	171.0	24	0	0	0	0	24	12.0	190	8.13	183.0	9.66
8	15-16	101	48	53	0	0	6	1	0	0	1	0	210	168.0	46	0	0	0	0	46	23.0	256	10.95	191.0	10.08
9	16-17	95	43	40	2	1	10	0	1	0	8	0	200	190.5	75	0	0	0	0	75	37.5	275	11.76	228.0	12.03
10	17-18	73	39	53	1	0	12	0	0	0	4	0	182	166.0	31	0	0	0	0	31	15.5	213	9.11	181.5	9.58
11	18-19	52	4	24	0	0	12	0	0	0	0	0	92	72.0	12	0	0	0	0	12	6.0	104	4.45	78.0	4.12
12	19-20	35	0	16	0	0	1	0	0	0	0	0	52	35.0	6	0	0	0	0	6	3.0	58	2.48	38.0	2.01
13	20-21	25	1	13	0	0	2	0	1	0	0	0	42	32.5	1	0	0	0	0	1	0.5	43	1.84	33.0	1.74
14	21-22	9	1	8	0	0	1	0	0	0	0	0	19	15.0	0	0	0	0	0	0	0.0	19	0.81	15.0	0.79
15	22-23	6	1	5	0	0	0	0	0	0	0	0	12	9.0	0	0	0	0	0	0	0.0	12	0.51	9.0	0.48
16	23-00	3	0	3	0	0	1	0	0	0	0	0	7	6.0	0	0	0	0	0	0	0.0	7	0.30	6.0	0.32
17	00-1	0	0	1	0	0	0	0	0	0	0	0	1	1.0	0	0	0	0	0	0	0.0	1	0.04	1.0	0.05
18	1-2	2	0	4	0	0	0	0	0	0	0	0	6	5.0	0	0	0	0	0	0	0.0	6	0.26	5.0	0.26
19	2-3	0	0	1	0	0	0	0	0	0	0	0	1	1.0	0	0	0	0	0	0	0.0	1	0.04	1.0	0.05
20	3-4	0	0	3	0	0	0	0	0	0	0	0	3	3.0	0	0	0	0	0	0	0.0	3	0.13	3.0	0.16
21	4-5	1	0	1	0	0	0	0	0	0	0	0	2	1.5	0	0	0	0	0	0	0.0	2	0.09	1.5	0.08
22	5-6	3	1	3	0	0	0	0	0	0	0	0	7	5.5	11	0	0	0	0	11	5.5	18	0.77	11.0	0.58
23	6-7	4	5	11	0	0	0	0	0	0	0	0	20	18.0	12	0	0	0	0	12	6.0	32	1.37	24.0	1.27
24	7-8	10	4	12	0	0	0	0	0	0	0	0	26	21.0	11	0	0	0	0	11	5.5	37	1.58	26.5	1.40
Total in numbers		**767**	**447**	**505**	**13**	**11**	**70**	**13**	**7**	**2**	**20**	**1**	**1856**	**1653.5**	**482**	**0**	**0**	**0**	**0**	**482**	**241**	**2338**	**100**	**1894.5**	**100**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

% of modal split of number	33	19	21.60	1	0.47	3	0.56	0	0.09	1	0.04	**79.38**					0.00	0.00	**0.00**			**79.4**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	383.5	447	505	19.5	33	105	39	21	9	90	1.5		**1653.5**	241	0	0	0	0		**241.0**			**1894.5**	
% of Total P.C.U.	20.24	23.59	26.66	1.03	1.74	5.54	2.06	1.11	0.48	4.75	0.08		**87.28**	12.72	0.00	0.00	0.00	0.00		**12.72**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dudhnoi - Dainadubi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Sunday, November 18, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	105	41	18	2	0	3	0	0	0	1	0	170	123.5	16	0	0	0	0	16	8.0	186	7.88	131.5	7.05
2	9-10	94	38	26	3	0	3	0	0	0	1	0	165	124.5	35	0	1	0	0	36	20.5	201	8.51	145.0	7.77
3	10-11	64	32	28	3	0	0	1	0	0	0	0	128	99.5	28	0	0	0	0	28	14.0	156	6.61	113.5	6.08
4	11-12	88	43	33	2	1	3	0	0	0	0	0	170	130.5	34	0	0	0	0	34	17.0	204	8.64	147.5	7.90
5	12-13	66	23	32	0	0	6	0	0	0	0	0	127	97.0	22	0	0	0	0	22	11.0	149	6.31	108.0	5.79
6	13-14	39	23	24	0	0	5	0	0	0	0	0	91	74.0	33	0	0	0	0	33	16.5	124	5.25	90.5	4.85
7	14-15	55	45	48	0	0	7	2	0	0	0	0	157	137.0	49	0	0	0	0	49	24.5	206	8.73	161.5	8.65
8	15-16	67	42	55	1	1	4	0	0	2	3	0	175	163.5	40	0	0	0	0	40	20.0	215	9.11	183.5	9.83
9	16-17	65	37	51	0	0	3	0	0	0	0	0	156	125.0	40	0	0	0	0	40	20.0	196	8.30	145.0	7.77
10	17-18	62	19	54	1	0	6	0	0	0	0	0	142	114.5	26	0	0	0	0	26	13.0	168	7.12	127.5	6.83
11	18-19	20	8	38	1	0	2	4	0	0	2	0	75	81.5	10	0	0	0	0	10	5.0	85	3.60	86.5	4.64
12	19-20	19	4	24	0	0	1	2	0	0	0	0	50	45.0	5	0	0	0	0	5	2.5	55	2.33	47.5	2.55
13	20-21	12	2	23	0	0	1	1	0	0	0	0	39	35.5	4	0	0	0	0	4	2.0	43	1.82	37.5	2.01
14	21-22	8	0	6	0	0	2	0	0	0	0	0	16	13.0	4	0	0	0	0	4	2.0	20	0.85	15.0	0.80
15	22-23	7	0	10	0	0	0	1	0	0	0	0	18	16.5	0	0	0	0	0	0	0.0	18	0.76	16.5	0.88
16	23-00	0	1	8	0	0	0	0	0	0	0	0	9	9.0	0	0	0	0	0	0	0.0	9	0.38	9.0	0.48
17	00-1	0	0	4	0	1	0	0	0	0	0	0	5	7.0	0	0	0	0	0	0	0.0	5	0.21	7.0	0.38
18	1-2	1	0	1	0	0	0	0	0	0	0	0	2	1.5	0	0	0	0	0	0	0.0	2	0.08	1.5	0.08
19	2-3	1	0	4	0	0	1	0	0	0	0	0	6	6.0	0	0	0	0	0	0	0.0	6	0.25	6.0	0.32
20	3-4	0	1	0	0	0	2	0	0	0	0	0	3	4.0	0	0	0	0	0	0	0.0	3	0.13	4.0	0.21
21	4-5	6	15	5	1	0	12	3	0	0	0	0	42	51.5	6	0	0	0	0	6	3.0	48	2.03	54.5	2.92
22	5-6	14	10	8	4	0	9	1	0	0	2	0	48	56.5	24	0	0	0	0	24	12.0	72	3.05	68.5	3.67
23	6-7	32	9	13	5	1	3	1	0	2	2	0	68	74.0	29	0	0	0	0	29	14.5	97	4.11	88.5	4.74
24	7-8	36	15	11	1	0	2	0	0	1	1	0	67	57.5	26	0	0	0	0	26	13.0	93	3.94	70.5	3.78
Total in numbers		**861**	**408**	**524**	**24**	**4**	**75**	**16**	**0**	**5**	**12**	**0**	**1929**	**1648**	**431**	**0**	**1**	**0**	**0**	**432**	**219**	**2361**	**100**	**1866**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	36	17	22.19	1.02	0.17	3.18	0.68	0.00	0.21	0.51	0.00	**81.70**		18.25	0.00	0.04	0.00	0.00	**18.3**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	430.5	408	524	36	12	112.5	48	0	22.5	54	0		**1647.5**	215.5	0	3	0	0		**218.5**			**1866.0**	
% of Total P.C.U.	23.07	21.86	28.08	1.93	0.64	6.03	2.57	0.00	1.21	2.89	0.00		**88.29**	11.55	0.00	0.16	0.00	0.00		**11.71**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dainadubi - Dudhnoi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Sunday, November 18, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	96	50	52	3	1	6	0	0	1	0	0	209	171.0	26	0	1	0	0	27	16.0	236	9.61	187.0	9.12
2	9-10	79	36	33	3	1	8	0	0	3	2	0	165	150.5	42	0	0	0	0	42	21.0	207	8.43	171.5	8.37
3	10-11	42	33	37	0	1	2	0	0	0	2	0	117	106.0	42	0	0	0	0	42	21.0	159	6.47	127.0	6.20
4	11-12	58	35	41	2	0	6	0	0	1	0	0	143	121.5	31	0	0	0	0	31	15.5	174	7.08	137.0	6.68
5	12-13	92	30	51	1	1	7	2	0	0	0	0	184	148.0	58	0	0	0	0	58	29.0	242	9.85	177.0	8.64
6	13-14	62	32	26	3	1	7	0	0	0	0	0	131	107.0	25	0	0	0	0	25	12.5	156	6.35	119.5	5.83
7	14-15	61	55	56	0	1	4	3	1	1	1	0	183	171.5	37	0	3	0	0	40	27.5	223	9.08	199.0	9.71
8	15-16	86	44	55	0	0	4	0	0	1	1	0	191	157.0	47	0	1	0	0	48	26.5	239	9.73	183.5	8.95
9	16-17	89	43	72	0	0	4	1	0	0	2	0	211	177.5	43	0	0	0	0	43	21.5	254	10.34	199.0	9.71
10	17-18	50	30	65	1	0	8	2	0	0	5	0	161	162.0	33	0	0	0	0	33	16.5	194	7.90	178.5	8.71
11	18-19	30	23	35	0	1	12	1	3	0	0	0	105	106.0	12	0	0	0	0	12	6.0	117	4.76	112.0	5.46
12	19-20	16	9	10	1	0	2	0	0	1	0	0	39	36.0	6	0	0	0	0	6	3.0	45	1.83	39.0	1.90
13	20-21	9	6	11	0	0	3	2	0	0	0	0	31	32.0	1	0	0	0	0	1	0.5	32	1.30	32.5	1.59
14	21-22	6	1	5	0	0	4	0	0	1	0	0	17	19.5	0	0	1	0	0	1	3.0	18	0.73	22.5	1.10
15	22-23	0	0	6	0	0	1	0	0	0	0	0	7	7.5	1	0	0	0	0	1	0.5	8	0.33	8.0	0.39
16	23-00	0	1	5	0	0	1	0	2	0	0	0	9	13.5	0	0	0	0	0	0	0.0	9	0.37	13.5	0.66
17	00-1	0	0	1	0	0	1	2	0	0	0	0	4	8.5	0	0	0	0	0	0	0.0	4	0.16	8.5	0.41
18	1-2	0	0	2	0	0	0	0	0	0	0	0	2	2.0	0	0	0	0	0	0	0.0	2	0.08	2.0	0.10
19	2-3	3	0	1	0	0	0	0	0	0	0	0	4	2.5	0	0	0	0	0	0	0.0	4	0.16	2.5	0.12
20	3-4	0	0	3	0	0	0	3	0	0	0	0	6	12.0	0	0	0	0	0	0	0.0	6	0.24	12.0	0.59
21	4-5	2	1	9	0	0	3	0	0	0	0	0	15	15.5	0	0	0	0	0	0	0.0	15	0.61	15.5	0.76
22	5-6	0	1	2	0	0	0	0	0	0	0	0	3	3.0	2	0	0	0	0	2	1.0	5	0.20	4.0	0.20
23	6-7	8	7	6	1	0	2	0	0	0	1	0	25	26.0	12	0	0	0	0	12	6.0	37	1.51	32.0	1.56
24	7-8	12	10	23	3	2	3	0	0	0	1	0	54	58.5	16	0	0	0	0	16	8.0	70	2.85	66.5	3.24
Total in numbers		**801**	**447**	**607**	**18**	**9**	**88**	**16**	**6**	**9**	**15**	**0**	**2016**	**1814.5**	**434**	**0**	**6**	**0**	**0**	**440**	**235**	**2456**	**100**	**2049.5**	**100**

Annexure-VI

% of modal split of number	33	18	24.71	1	0.37	4	0.65	0	0.37	1	0.00	**82.08**					0.00	0.00	**0.0**			**82.1**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	400.5	447	607	27	27	132	48	18	40.5	67.5	0		**1814.5**	217	0	18	0	0		**235.0**			**2049.5**	
% of Total P.C.U.	19.54	21.81	29.62	1.32	1.32	6.44	2.34	0.88	1.98	3.29	0.00		**88.53**	10.59	0.00	0.88	0.00	0.00		**11.47**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road : Dudhnoi - Dainadubi (8.6 km)
Road No. : 1
Direction : Dudhnoi - Dainadubi
Station No. : 1
Addl. Information: 0
Location : At km 3+500 (Near Damra A.S.A. Playground)
Date & Day : Monday, November 19, 2018
Weather: Normal
Hour : 8 AM to 8 AM

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	106	74	19	2	0	4	0	0	2	2	0	209	173.0	19	0	0	0	0	19	9.5	228	9.39	182.5	9.02
2	9-10	98	55	35	6	0	5	0	0	2	1	0	202	169.0	41	0	2	0	0	43	26.5	245	10.09	195.5	9.66
3	10-11	69	58	27	1	0	5	2	0	1	2	0	165	148.0	30	0	1	1	0	32	26.0	197	8.11	174.0	8.60
4	11-12	93	58	50	3	1	7	2	0	0	0	1	215	180.0	39	0	0	0	0	39	19.5	254	10.46	199.5	9.86
5	12-13	77	50	46	2	2	7	1	0	1	1	0	187	166.0	19	0	0	0	0	19	9.5	206	8.48	175.5	8.68
6	13-14	70	58	58	1	0	7	1	0	0	0	0	195	166.0	25	0	0	0	0	25	12.5	220	9.06	178.5	8.82
7	14-15	71	24	28	1	0	6	0	0	0	1	0	131	102.5	25	0	0	0	0	25	12.5	156	6.43	115.0	5.68
8	15-16	62	31	38	1	0	3	1	0	0	0	0	136	109.0	27	0	0	0	0	27	13.5	163	6.71	122.5	6.06
9	16-17	50	23	28	2	0	3	0	0	0	0	0	106	83.5	43	0	0	0	0	43	21.5	149	6.14	105.0	5.19
10	17-18	46	8	45	4	0	5	0	0	0	0	0	108	89.5	24	0	0	0	0	24	12.0	132	5.44	101.5	5.02
11	18-19	31	4	29	2	1	2	0	0	0	0	0	69	57.5	11	0	0	0	0	11	5.5	80	3.29	63.0	3.11
12	19-20	13	5	17	0	0	1	1	0	0	0	0	37	33.0	3	0	0	0	0	3	1.5	40	1.65	34.5	1.71
13	20-21	11	5	17	0	0	0	0	0	0	0	0	33	27.5	3	0	0	0	0	3	1.5	36	1.48	29.0	1.43
14	21-22	7	2	10	1	0	1	1	0	0	0	0	22	21.5	6	0	0	0	0	6	3.0	28	1.15	24.5	1.21
15	22-23	6	0	7	0	0	3	4	0	0	0	0	20	26.5	0	0	0	0	0	0	0.0	20	0.82	26.5	1.31
16	23-00	6	0	7	0	0	0	0	0	1	0	0	14	14.5	0	0	0	0	0	0	0.0	14	0.58	14.5	0.72
17	00-1	2	0	3	0	0	1	2	0	0	0	0	8	11.5	0	0	0	0	0	0	0.0	8	0.33	11.5	0.57
18	1-2	1	0	1	0	0	2	1	0	0	0	0	5	7.5	0	0	0	0	0	0	0.0	5	0.21	7.5	0.37
19	2-3	0	0	1	0	0	1	1	0	0	0	0	3	5.5	0	0	0	0	0	0	0.0	3	0.12	5.5	0.27
20	3-4	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0	0	0.00	0.0	0.00
21	4-5	0	0	4	1	0	3	3	0	0	2	0	13	28.0	1	0	0	0	0	1	0.5	14	0.58	28.5	1.41
22	5-6	12	4	10	3	0	3	4	0	0	0	0	36	41.0	7	0	0	0	0	7	3.5	43	1.77	44.5	2.20
23	6-7	23	10	11	4	3	7	1	0	1	2	0	62	74.5	13	0	0	0	0	13	6.5	75	3.09	81.0	4.00
24	7-8	32	21	13	6	1	5	3	0	0	1	0	82	83.0	28	0	2	0	0	30	20.0	112	4.61	103.0	5.09
Total in numbers		**886**	**490**	**504**	**40**	**8**	**81**	**28**	**0**	**8**	**12**	**1**	**2058**	**1818**	**364**	**0**	**5**	**1**	**0**	**370**	**205**	**2428**	**100**	**2023**	**100**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

% of modal split of number	36	20	20.76	1.65	0.33	3.34	1.15	0.00	0.33	0.49	0.04	**84.76**		14.99	0.00	0.21	0.04	0.00	**15.24**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	443	490	504	60	24	121.5	84	0	36	54	1.5		**1818.0**	182	0	15	8	0		**205.0**			**2023.0**	
% of Total P.C.U.	21.90	24.22	24.91	2.97	1.19	6.01	4.15	0.00	1.78	2.67	0.07		**89.87**	9.00	0.00	0.74	0.40	0.00		**10.13**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dainadubi - Dudhnoi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Monday, November 19, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	110	50	61	6	0	4	0	0	0	0	0	231	181.0	45	0	0	0	0	45	22.5	276	10.08	203.5	9.24
2	9-10	68	55	35	2	1	4	1	0	0	2	0	168	148.0	31	0	1	0	0	32	18.5	200	7.30	166.5	7.56
3	10-11	63	62	29	3	0	4	0	0	0	2	0	163	142.0	37	0	0	0	0	37	18.5	200	7.30	160.5	7.29
4	11-12	90	58	41	5	0	5	1	0	3	2	0	205	184.5	47	0	1	0	0	48	26.5	253	9.24	211.0	9.58
5	12-13	124	57	64	2	0	8	1	0	1	1	1	259	211.5	46	0	0	0	0	46	23.0	305	11.14	234.5	10.65
6	13-14	58	48	26	4	0	23	2	0	2	0	0	163	158.5	21	0	2	0	0	23	16.5	186	6.79	175.0	7.95
7	14-15	103	56	37	0	0	13	1	0	0	0	0	210	167.0	86	0	0	0	0	86	43.0	296	10.81	210.0	9.54
8	15-16	90	38	25	6	0	15	3	0	1	1	0	179	157.5	58	0	1	0	0	59	32.0	238	8.69	189.5	8.61
9	16-17	81	21	34	3	1	7	0	0	0	0	0	147	113.5	59	0	2	0	0	61	35.5	208	7.60	149.0	6.77
10	17-18	73	16	31	3	0	17	2	0	0	2	0	144	128.5	27	0	0	0	0	27	13.5	171	6.25	142.0	6.45
11	18-19	51	1	29	2	0	15	2	0	0	0	0	100	87.0	12	0	0	0	0	12	6.0	112	4.09	93.0	4.22
12	19-20	23	2	19	1	0	4	0	0	0	0	0	49	40.0	9	0	0	0	0	9	4.5	58	2.12	44.5	2.02
13	20-21	16	0	13	0	1	3	1	0	0	0	0	34	31.5	1	0	0	0	0	1	0.5	35	1.28	32.0	1.45
14	21-22	14	2	5	0	0	0	1	1	0	0	0	23	20.0	1	0	0	0	0	1	0.5	24	0.88	20.5	0.93
15	22-23	6	0	5	0	0	1	2	0	1	0	0	15	20.0	0	0	0	0	0	0	0.0	15	0.55	20.0	0.91
16	23-00	3	0	3	0	0	1	1	0	0	0	0	8	9.0	0	0	0	0	0	0	0.0	8	0.29	9.0	0.41
17	00-1	0	0	3	0	0	2	3	0	0	0	0	8	15.0	0	0	0	0	0	0	0.0	8	0.29	15.0	0.68
18	1-2	1	0	0	0	0	0	0	2	0	0	0	3	6.5	0	0	0	0	0	0	0.0	3	0.11	6.5	0.30
19	2-3	0	0	0	0	0	1	0	0	0	0	0	1	1.5	0	0	0	0	0	0	0.0	1	0.04	1.5	0.07
20	3-4	0	0	1	0	0	1	0	0	0	0	0	2	2.5	0	0	0	0	0	0	0.0	2	0.07	2.5	0.11
21	4-5	1	0	1	0	0	2	0	0	0	0	0	4	4.5	0	0	0	0	0	0	0.0	4	0.15	4.5	0.20
22	5-6	1	2	6	0	0	2	0	0	0	0	0	11	11.5	3	0	0	0	0	3	1.5	14	0.51	13.0	0.59
23	6-7	13	6	13	1	0	2	0	0	0	0	0	35	30.0	11	0	0	0	0	11	5.5	46	1.68	35.5	1.61
24	7-8	16	24	15	1	0	1	0	0	0	1	0	58	54.5	17	0	0	0	0	17	8.5	75	2.74	63.0	2.86
Total in numbers		**1005**	**498**	**496**	**39**	**3**	**135**	**21**	**3**	**8**	**11**	**1**	**2220**	**1925.5**	**511**	**0**	**7**	**0**	**0**	**518**	**276.5**	**2738**	**100**	**2202**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	37	18	18.12	1	0.11	5	0.77	0	0.29	0	0.04	**81.08**					0.00	0.00	**0.00**			**81.1**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	502.5	498	496	58.5	9	202.5	63	9	36	49.5	1.5		**1925.5**	255.5	0	21	0	0		**276.5**			**2202.0**	
% of Total P.C.U.	22.82	22.62	22.52	2.66	0.41	9.20	2.86	0.41	1.63	2.25	0.07		**87.44**	11.60	0.00	0.95	0.00	0.00		**12.56**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dudhnoi - Dainadubi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Tuesday, November 20, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
								Truck			Agri Tractor														
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer			Cycle	Cycle Rickshaw		Bullock Cart	Horse						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	77	60	37	4	0	12	0	0	0	4	1	195	179.0	20	0	0	0	0	20	10.0	215	8.06	189.0	8.16
2	9-10	81	57	45	3	1	7	1	0	0	2	0	197	172.5	54	0	0	0	0	54	27.0	251	9.40	199.5	8.61
3	10-11	58	67	32	7	1	13	2	1	2	2	0	185	188.0	26	0	0	0	0	26	13.0	211	7.91	201.0	8.67
4	11-12	77	81	39	2	2	11	4	1	0	3	0	220	212.5	34	0	0	0	0	34	17.0	254	9.52	229.5	9.90
5	12-13	72	73	44	5	1	10	1	0	0	2	0	208	190.5	28	0	1	0	0	29	17.0	237	8.88	207.5	8.95
6	13-14	61	66	45	2	1	9	2	0	0	1	0	187	171.5	22	0	0	0	0	22	11.0	209	7.83	182.5	7.87
7	14-15	100	28	36	1	0	4	0	0	0	1	0	170	126.0	35	0	2	0	0	37	23.5	207	7.76	149.5	6.45
8	15-16	66	50	36	2	0	5	1	0	0	1	0	161	137.0	37	0	1	0	0	38	21.5	199	7.46	158.5	6.84
9	16-17	72	40	32	1	0	5	1	0	0	0	1	152	121.5	42	0	0	0	0	42	21.0	194	7.27	142.5	6.15
10	17-18	57	14	56	3	0	5	1	0	0	0	0	136	113.5	25	0	0	0	0	25	12.5	161	6.03	126.0	5.44
11	18-19	36	9	32	0	0	3	4	0	0	1	0	85	80.0	10	0	0	0	0	10	5.0	95	3.56	85.0	3.67
12	19-20	17	4	16	0	0	0	3	0	0	0	0	40	37.5	8	0	0	0	0	8	4.0	48	1.80	41.5	1.79
13	20-21	16	0	15	1	0	3	5	0	0	0	0	40	44.0	3	0	0	0	0	3	1.5	43	1.61	45.5	1.96
14	21-22	11	1	9	0	0	2	1	0	0	0	0	24	21.5	7	0	0	0	0	7	3.5	31	1.16	25.0	1.08
15	22-23	2	0	12	1	0	1	1	0	0	0	0	17	19.0	0	0	0	0	0	0	0.0	17	0.64	19.0	0.82
16	23-00	3	0	4	0	1	0	2	0	0	0	0	10	14.5	0	0	0	0	0	0	0.0	10	0.37	14.5	0.63
17	00-1	0	0	0	0	0	0	3	0	0	0	0	3	9.0	0	0	0	0	0	0	0.0	3	0.11	9.0	0.39
18	1-2	0	0	2	0	0	0	1	0	0	0	0	3	5.0	0	0	0	0	0	0	0.0	3	0.11	5.0	0.22
19	2-3	2	0	1	0	0	1	0	0	0	0	0	4	3.5	0	0	0	0	0	0	0.0	4	0.15	3.5	0.15
20	3-4	0	0	1	0	0	6	0	0	0	0	0	7	10.0	1	0	0	0	0	1	0.5	8	0.30	10.5	0.45
21	4-5	0	0	1	0	0	4	3	0	0	0	0	8	16.0	1	0	0	0	0	1	0.5	9	0.34	16.5	0.71
22	5-6	4	9	5	1	0	4	1	0	0	0	0	24	26.5	8	0	0	0	0	8	4.0	32	1.20	30.5	1.32
23	6-7	34	14	14	4	4	6	4	0	1	0	0	81	88.5	18	0	0	0	0	18	9.0	99	3.71	97.5	4.21
24	7-8	43	20	24	4	1	1	5	0	0	5	0	103	113.5	25	0	1	0	0	26	15.5	129	4.83	129.0	5.57
Total in numbers		**889**	**593**	**538**	**41**	**12**	**112**	**46**	**2**	**3**	**22**	**2**	**2260**	**2101**	**404**	**0**	**5**	**0**	**0**	**409**	**217**	**2669**	**100**	**2318**	**100**

Annexure-VI

% of modal split of number	33	22	20.16	1.54	0.45	4.20	1.72	0.07	0.11	0.82	0.07	**84.68**		15.14	0.00	0.19	0.00	0.00	**15.32**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	444.5	593	538	61.5	36	168	138	6	13.5	99	3		**2100.5**	202	0	15	0	0		**217.0**			**2317.5**	
% of Total P.C.U.	19.18	25.59	23.21	2.65	1.55	7.25	5.95	0.26	0.58	4.27	0.13		**90.64**	8.72	0.00	0.65	0.00	0.00		**9.36**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road : Dudhnoi - Dainadubi (8.6 km)
Direction : Dainadubi - Dudhnoi
Location : At km 3+500 (Near Damra A.S.A. Playground)

Road No. : 1
Station No. : 1
Date & Day : Tuesday, November 20, 2018
Hour : 8 AM to 8 AM

Addl. Information: 0
Weather: Normal

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	60	64	37	6	0	16	0	0	0	1	0	184	168.5	59	0	0	0	0	59	29.5	243	8.17	198.0	7.92
2	9-10	64	74	34	1	2	8	0	0	0	2	0	185	168.5	45	0	0	0	0	45	22.5	230	7.73	191.0	7.64
3	10-11	82	84	39	1	0	7	6	1	1	3	0	224	215.0	36	0	0	0	0	36	18.0	260	8.74	233.0	9.33
4	11-12	84	81	47	6	0	6	0	0	0	1	0	225	192.5	41	0	2	0	0	43	26.5	268	9.01	219.0	8.77
5	12-13	79	71	54	4	1	17	8	0	0	2	1	237	233.5	24	0	1	0	0	25	15.0	262	8.81	248.5	9.95
6	13-14	83	71	48	5	0	26	0	0	0	3	0	236	220.5	39	0	0	0	0	39	19.5	275	9.24	240.0	9.61
7	14-15	118	47	82	3	0	8	1	0	0	0	0	259	207.5	84	0	0	1	0	85	50.0	344	11.56	257.5	10.31
8	15-16	92	34	39	2	1	6	4	0	0	1	0	179	150.5	45	0	0	0	0	45	22.5	224	7.53	173.0	6.92
9	16-17	91	39	49	2	2	14	3	0	0	1	0	201	177.0	71	0	0	0	0	71	35.5	272	9.14	212.5	8.51
10	17-18	74	30	48	1	0	18	0	0	0	2	1	174	154.0	39	0	0	0	0	39	19.5	213	7.16	173.5	6.94
11	18-19	54	4	8	1	0	18	3	0	0	1	0	89	81.0	10	0	0	0	0	10	5.0	99	3.33	86.0	3.44
12	19-20	26	4	15	0	0	3	2	0	0	2	0	52	51.5	8	0	0	0	0	8	4.0	60	2.02	55.5	2.22
13	20-21	12	0	13	0	1	1	0	0	0	0	0	27	23.5	1	0	0	0	0	1	0.5	28	0.94	24.0	0.96
14	21-22	8	0	8	0	1	4	1	0	0	0	0	22	24.0	1	0	0	0	0	1	0.5	23	0.77	24.5	0.98
15	22-23	0	0	3	0	0	1	3	0	0	0	0	7	13.5	0	0	0	0	0	0	0.0	7	0.24	13.5	0.54
16	23-00	2	0	1	0	0	1	0	0	0	0	0	4	3.5	0	0	0	0	0	0	0.0	4	0.13	3.5	0.14
17	00-1	0	2	0	0	0	0	0	0	0	0	0	2	2.0	0	0	0	0	0	0	0.0	2	0.07	2.0	0.08
18	1-2	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0	0	0.00	0.0	0.00
19	2-3	0	0	1	0	0	1	0	0	0	0	0	2	2.5	0	0	0	0	0	0	0.0	2	0.07	2.5	0.10
20	3-4	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0	0	0.00	0.0	0.00
21	4-5	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0	0	0.00	0.0	0.00
22	5-6	1	2	2	0	0	0	0	0	1	0	0	6	9.0	5	0	0	0	0	5	2.5	11	0.37	11.5	0.46
23	6-7	10	18	10	2	1	1	2	0	0	0	0	44	46.5	16	0	0	0	0	16	8.0	60	2.02	54.5	2.18
24	7-8	21	29	16	1	0	5	1	0	0	0	0	73	67.5	15	0	0	0	0	15	7.5	88	2.96	75.0	3.00
Total in numbers		**961**	**654**	**554**	**35**	**9**	**161**	**34**	**1**	**2**	**19**	**2**	**2432**	**2212**	**539**	**0**	**3**	**1**	**0**	**543**	**286.5**	**2975**	**100**	**2498.5**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	32	22	18.62	1	0.30	5	1.14	0	0.07	1	0.07	**81.75**					0.03	0.00	**0.03**			**81.8**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	480.5	654	554	52.5	27	241.5	102	3	9	85.5	3		**2212.0**	269.5	0	9	8	0		**286.5**			**2498.5**	
% of Total P.C.U.	19.23	26.18	22.17	2.10	1.08	9.67	4.08	0.12	0.36	3.42	0.12		**88.53**	10.79	0.00	0.36	0.32	0.00		**11.47**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dudhnoi - Dainadubi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Wednesday, November 21, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
								Truck			Agri Tractor														
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer			Cycle	Cycle Rickshaw		Bullock Cart	Horse						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	151	94	47	3	0	8	2	0	0	3	0	308	252.5	85	0	0	0	0	85	42.5	393	12.15	295.0	10.53
2	9-10	131	60	42	3	0	11	0	0	0	3	0	250	202.0	66	1	0	0	0	67	35.0	317	9.80	237.0	8.46
3	10-11	87	67	52	3	0	11	3	0	3	1	0	227	210.5	41	1	0	0	0	42	22.5	269	8.32	233.0	8.32
4	11-12	109	76	48	4	1	7	1	0	0	1	0	247	205.5	35	1	0	0	0	36	19.5	283	8.75	225.0	8.03
5	12-13	84	70	53	2	2	3	2	0	0	2	0	218	193.5	32	0	0	0	0	32	16.0	250	7.73	209.5	7.48
6	13-14	71	62	36	1	0	10	2	0	0	2	0	184	165.0	21	0	0	0	0	21	10.5	205	6.34	175.5	6.27
7	14-15	96	64	44	1	1	7	1	0	0	2	0	216	183.0	28	0	0	0	0	28	14.0	244	7.54	197.0	7.03
8	15-16	70	60	35	3	0	7	1	0	0	2	0	178	157.0	33	0	0	0	0	33	16.5	211	6.52	173.5	6.20
9	16-17	65	33	39	1	0	4	4	0	1	0	0	147	128.5	32	0	0	0	0	32	16.0	179	5.53	144.5	5.16
10	17-18	57	31	41	1	0	4	5	0	1	1	0	141	132.0	27	0	0	0	0	27	13.5	168	5.19	145.5	5.20
11	18-19	38	13	34	0	1	5	3	0	0	0	0	94	85.5	8	0	0	0	0	8	4.0	102	3.15	89.5	3.20
12	19-20	17	5	28	2	1	2	1	0	0	1	0	57	58.0	3	0	0	0	0	3	1.5	60	1.86	59.5	2.12
13	20-21	16	5	11	0	1	6	1	0	0	0	0	40	39.0	2	0	0	0	0	2	1.0	42	1.30	40.0	1.43
14	21-22	9	0	12	0	0	1	2	2	0	0	0	26	30.0	3	0	0	0	0	3	1.5	29	0.90	31.5	1.12
15	22-23	6	1	5	0	0	7	1	0	0	0	0	20	22.5	3	0	0	0	0	3	1.5	23	0.71	24.0	0.86
16	23-00	3	1	3	0	0	2	1	0	0	0	0	10	11.5	0	0	0	0	0	0	0.0	10	0.31	11.5	0.41
17	00-1	1	0	7	0	0	3	4	1	1	1	0	18	36.0	0	0	0	0	0	0	0.0	18	0.56	36.0	1.29
18	1-2	0	0	6	0	0	0	4	0	0	0	0	10	18.0	0	0	0	0	0	0	0.0	10	0.31	18.0	0.64
19	2-3	0	1	0	0	0	1	2	0	0	0	0	4	8.5	0	0	0	0	0	0	0.0	4	0.12	8.5	0.30
20	3-4	0	0	0	0	0	1	0	0	0	0	0	1	1.5	0	0	0	0	0	0	0.0	1	0.03	1.5	0.05
21	4-5	1	1	1	1	0	4	2	0	0	0	0	10	16.0	2	0	0	0	0	2	1.0	12	0.37	17.0	0.61
22	5-6	7	18	0	5	0	31	4	0	1	0	0	66	92.0	6	1	0	0	0	7	5.0	73	2.26	97.0	3.46
23	6-7	60	22	12	5	2	54	7	0	0	0	0	162	179.5	12	0	0	0	0	12	6.0	174	5.38	185.5	6.62
24	7-8	44	29	16	5	1	21	1	0	2	1	0	120	125.5	36	1	0	0	0	37	20.0	157	4.85	145.5	5.20
Total in numbers		**1123**	**713**	**572**	**40**	**10**	**210**	**54**	**3**	**9**	**20**	**0**	**2754**	**2553**	**475**	**5**	**0**	**0**	**0**	**480**	**248**	**3234**	**100**	**2801**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	35	22	17.69	1.24	0.31	6.49	1.67	0.09	0.28	0.62	0.00	**85.16**		14.69	0.15	0.00	0.00	0.00	**14.8**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	561.5	713	572	60	30	315	162	9	40.5	90	0		**2553.0**	237.5	10	0	0	0		**247.5**			**2800.5**	
% of Total P.C.U.	20.05	25.46	20.42	2.14	1.07	11.25	5.78	0.32	1.45	3.21	0.00		**91.16**	8.48	0.36	0.00	0.00	0.00		**8.84**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road : Dudhnoi - Dainadubi (8.6 km)
Road No. : 1
Direction : Dainadubi - Dudhnoi
Station No. : 1
Addl. Information: 0
Location : At km 3+500 (Near Damra A.S.A. Playground)
Date & Day : Wednesday, November 21, 2018
Weather: Normal
Hour : 8 AM to 8 AM

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
								Truck			Agri Tractor														
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer			Cycle	Cycle Rickshaw		Bullock Cart	Horse						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	105	76	58	5	2	8	0	0	0	1	0	255	216.5	49	0	0	0	0	49	24.5	304	9.31	241.0	8.55
2	9-10	99	67	53	1	2	15	1	0	0	1	0	239	207.0	68	0	0	0	0	68	34.0	307	9.40	241.0	8.55
3	10-11	98	74	43	2	0	20	1	0	0	2	1	241	212.5	48	0	1	0	0	49	27.0	290	8.88	239.5	8.50
4	11-12	100	82	52	1	0	16	9	2	0	1	0	263	247.0	78	0	0	0	0	78	39.0	341	10.44	286.0	10.15
5	12-13	124	82	58	2	3	10	1	0	0	0	1	281	233.5	56	0	0	0	0	56	28.0	337	10.32	261.5	9.28
6	13-14	90	69	28	5	0	9	5	1	0	2	0	209	190.0	45	0	1	0	0	46	25.5	255	7.81	215.5	7.65
7	14-15	73	63	51	6	2	12	1	0	0	3	0	211	200.0	55	0	1	0	0	56	30.5	267	8.17	230.5	8.18
8	15-16	75	45	35	5	1	6	1	0	0	1	0	169	144.5	38	0	0	0	0	38	19.0	207	6.34	163.5	5.80
9	16-17	108	47	47	5	3	5	1	0	1	2	0	219	188.5	49	0	1	0	0	50	27.5	269	8.23	216.0	7.67
10	17-18	79	23	47	4	1	21	6	0	0	4	0	185	186.0	26	0	0	0	0	26	13.0	211	6.46	199.0	7.06
11	18-19	43	12	18	1	1	32	4	0	2	2	0	115	134.0	12	0	0	0	0	12	6.0	127	3.89	140.0	4.97
12	19-20	17	6	13	0	0	6	4	0	1	1	0	48	57.5	6	0	0	0	0	6	3.0	54	1.65	60.5	2.15
13	20-21	12	1	19	1	0	4	1	0	0	0	0	38	36.5	2	0	0	0	0	2	1.0	40	1.22	37.5	1.33
14	21-22	8	2	10	0	0	13	2	0	0	1	0	36	46.0	1	0	0	0	0	1	0.5	37	1.13	46.5	1.65
15	22-23	4	0	1	0	0	0	2	1	0	0	0	8	12.0	0	0	0	0	0	0	0.0	8	0.24	12.0	0.43
16	23-00	1	1	3	1	0	2	0	0	0	0	0	8	9.0	1	0	0	0	0	1	0.5	9	0.28	9.5	0.34
17	00-1	0	0	1	0	1	0	0	0	0	1	0	3	8.5	0	0	0	0	0	0	0.0	3	0.09	8.5	0.30
18	1-2	0	0	1	0	0	3	0	0	0	0	0	4	5.5	0	0	0	0	0	0	0.0	4	0.12	5.5	0.20
19	2-3	0	0	1	0	0	0	0	0	0	0	0	1	1.0	0	0	0	0	0	0	0.0	1	0.03	1.0	0.04
20	3-4	0	0	1	0	0	0	2	2	0	0	0	5	13.0	0	0	0	0	0	0	0.0	5	0.15	13.0	0.46
21	4-5	0	1	0	0	0	1	0	0	0	0	0	2	2.5	0	0	0	0	0	0	0.0	2	0.06	2.5	0.09
22	5-6	0	6	1	0	0	3	0	0	0	0	0	10	11.5	4	0	0	0	0	4	2.0	14	0.43	13.5	0.48
23	6-7	5	20	6	0	0	3	1	0	0	0	0	35	36.0	16	0	1	0	0	17	11.0	52	1.59	47.0	1.67
24	7-8	18	48	21	2	4	12	2	0	0	0	0	107	117.0	15	0	1	0	0	16	10.5	123	3.76	127.5	4.52
Total in numbers		**1059**	**725**	**568**	**41**	**20**	**201**	**44**	**6**	**4**	**22**	**2**	**2692**	**2515.5**	**569**	**0**	**6**	**0**	**0**	**575**	**302.5**	**3267**	**100**	**2818**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	32	22	17.39	1	0.61	6	1.35	0	0.12	1	0.06	**82.40**					0.00	0.00	**0.0**			**82.4**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	529.5	725	568	61.5	60	301.5	132	18	18	99	3		**2515.5**	284.5	0	18	0	0		**302.5**			**2818.0**	
% of Total P.C.U.	18.79	25.73	20.16	2.18	2.13	10.70	4.68	0.64	0.64	3.51	0.11		**89.27**	10.10	0.00	0.64	0.00	0.00		**10.73**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dudhnoi - Dainadubi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Thursday, November 22, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
								Truck			Agri Tractor														
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer			Cycle	Cycle Rickshaw		Bullock Cart	Horse						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	70	52	25	4	0	9	0	0	0	3	0	163	145.0	83	0	0	0	0	83	41.5	246	9.60	186.5	8.04
2	9-10	60	43	29	2	2	13	0	0	0	3	0	152	144.0	47	0	1	0	0	48	26.5	200	7.81	170.5	7.35
3	10-11	53	44	39	8	1	8	6	0	1	2	0	162	168.0	29	0	0	1	0	30	22.5	192	7.49	190.5	8.22
4	11-12	70	53	35	5	3	5	1	0	0	1	0	173	154.5	25	0	0	0	0	25	12.5	198	7.73	167.0	7.20
5	12-13	78	44	46	1	4	6	3	0	0	2	0	184	169.5	31	0	0	0	0	31	15.5	215	8.39	185.0	7.98
6	13-14	49	38	56	2	1	8	1	0	0	1	0	156	144.0	28	0	0	0	0	28	14.0	184	7.18	158.0	6.81
7	14-15	78	56	45	0	0	9	0	0	0	1	0	189	158.0	25	0	9	0	0	34	39.5	223	8.70	197.5	8.52
8	15-16	63	50	30	3	0	8	0	0	0	2	0	156	137.0	34	0	1	0	0	35	20.0	191	7.46	157.0	6.77
9	16-17	64	45	41	1	0	6	3	0	0	1	0	161	142.0	45	0	0	0	0	45	22.5	206	8.04	164.5	7.10
10	17-18	43	31	41	0	0	5	3	0	0	0	0	123	110.0	21	0	0	0	0	21	10.5	144	5.62	120.5	5.20
11	18-19	20	8	23	2	1	0	5	0	0	0	0	59	62.0	10	0	0	0	0	10	5.0	69	2.69	67.0	2.89
12	19-20	17	5	22	0	0	3	6	0	0	0	0	53	58.0	2	0	0	0	0	2	1.0	55	2.15	59.0	2.54
13	20-21	12	3	20	0	0	4	3	0	0	0	0	42	44.0	5	0	0	0	0	5	2.5	47	1.83	46.5	2.01
14	21-22	8	2	10	0	0	0	0	0	0	0	0	20	16.0	11	0	0	0	0	11	5.5	31	1.21	21.5	0.93
15	22-23	6	1	13	0	0	3	2	0	0	0	0	25	27.5	3	0	0	0	0	3	1.5	28	1.09	29.0	1.25
16	23-00	6	0	7	0	0	2	2	0	0	0	0	17	19.0	0	0	0	0	0	0	0.0	17	0.66	19.0	0.82
17	00-1	0	1	3	0	1	2	1	0	0	0	0	8	13.0	0	0	0	0	0	0	0.0	8	0.31	13.0	0.56
18	1-2	0	0	0	0	0	0	1	0	0	0	0	1	3.0	0	0	0	0	0	0	0.0	1	0.04	3.0	0.13
19	2-3	0	0	0	0	0	0	1	0	0	0	0	1	3.0	0	0	0	0	0	0	0.0	1	0.04	3.0	0.13
20	3-4	0	0	0	0	0	0	3	0	0	0	0	3	9.0	0	0	0	0	0	0	0.0	3	0.12	9.0	0.39
21	4-5	0	0	1	1	0	10	2	0	0	0	0	14	23.5	0	0	0	0	0	0	0.0	14	0.55	23.5	1.01
22	5-6	4	15	0	8	0	30	3	0	0	0	0	60	83.0	8	0	0	0	0	8	4.0	68	2.65	87.0	3.75
23	6-7	29	17	12	7	1	8	8	0	0	0	0	82	93.0	12	0	0	0	0	12	6.0	94	3.67	99.0	4.27
24	7-8	39	23	16	4	1	5	3	0	4	6	0	101	129.0	26	0	0	0	0	26	13.0	127	4.96	142.0	6.12
Total in numbers		**769**	**531**	**514**	**48**	**15**	**144**	**57**	**0**	**5**	**22**	**0**	**2105**	**2055**	**445**	**0**	**11**	**1**	**0**	**457**	**264**	**2562**	**100**	**2319**	**100**

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

% of modal split of number	30	21	20.06	1.87	0.59	5.62	2.22	0.00	0.20	0.86	0.00	**82.16**		17.37	0.00	0.43	0.04	0.00	**17.8**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	384.5	531	514	72	45	216	171	0	22.5	99	0		**2055.0**	222.5	0	33	8	0		**263.5**			**2318.5**	
% of Total P.C.U.	16.58	22.90	22.17	3.11	1.94	9.32	7.38	0.00	0.97	4.27	0.00		**88.63**	9.60	0.00	1.42	0.35	0.00		**11.37**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road :	Dudhnoi - Dainadubi (8.6 km)	Road No. :	1		
Direction :	Dainadubi - Dudhnoi	Station No. :	1	Addl. Information:	0
Location :	At km 3+500 (Near Damra A.S.A. Playground)	Date & Day :	Thursday, November 22, 2018	Weather:	Normal
		Hour :	8 AM to 8 AM		

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/ Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	38	37	29	2	1	5	5	0	0	1	0	118	118.0	39	0	0	0	0	39	19.5	157	5.44	137.5	5.28
2	9-10	67	54	41	5	2	7	1	0	0	2	0	179	164.5	34	0	0	0	0	34	17.0	213	7.38	181.5	6.97
3	10-11	70	56	52	3	0	17	5	0	0	1	0	204	192.5	54	0	0	0	0	54	27.0	258	8.94	219.5	8.43
4	11-12	71	51	62	2	2	5	1	0	1	2	0	197	181.5	24	0	1	0	0	25	15.0	222	7.69	196.5	7.55
5	12-13	66	51	47	5	0	11	2	0	0	1	0	183	165.5	30	0	0	1	0	31	23.0	214	7.41	188.5	7.24
6	13-14	66	48	37	3	1	19	4	0	0	3	0	181	179.5	17	0	0	0	0	17	8.5	198	6.86	188.0	7.22
7	14-15	122	99	99	8	1	19	0	0	0	2	0	350	311.5	34	0	1	0	0	35	20.0	385	13.34	331.5	12.73
8	15-16	111	64	35	3	0	31	0	0	0	2	0	246	214.5	55	0	1	0	0	56	30.5	302	10.46	245.0	9.41
9	16-17	113	60	56	4	2	23	8	2	0	2	0	270	258.0	65	0	3	0	0	68	41.5	338	11.71	299.5	11.50
10	17-18	82	39	43	5	0	22	6	0	0	9	0	206	222.0	26	0	0	0	0	26	13.0	232	8.04	235.0	9.03
11	18-19	28	16	24	1	0	13	4	1	0	0	0	87	90.0	8	0	0	0	0	8	4.0	95	3.29	94.0	3.61
12	19-20	19	2	12	1	0	11	0	0	1	0	0	46	46.0	5	0	0	0	0	5	2.5	51	1.77	48.5	1.86
13	20-21	9	0	6	0	0	1	5	0	0	0	0	21	27.0	1	0	0	0	0	1	0.5	22	0.76	27.5	1.06
14	21-22	6	0	6	0	1	2	3	0	0	0	0	18	24.0	1	0	0	0	0	1	0.5	19	0.66	24.5	0.94
15	22-23	2	1	1	0	0	2	0	0	0	0	0	6	6.0	0	0	0	0	0	0	0.0	6	0.21	6.0	0.23
16	23-00	0	0	1	0	0	1	0	0	0	0	0	2	2.5	0	0	0	0	0	0	0.0	2	0.07	2.5	0.10
17	00-1	0	0	3	0	0	0	0	0	0	0	0	3	3.0	0	0	0	0	0	0	0.0	3	0.10	3.0	0.12
18	1-2	1	0	3	0	0	3	1	0	0	0	0	8	11.0	0	0	0	0	0	0	0.0	8	0.28	11.0	0.42
19	2-3	0	0	1	0	0	1	1	0	0	0	0	3	5.5	0	0	0	0	0	0	0.0	3	0.10	5.5	0.21
20	3-4	0	0	1	0	0	1	1	0	0	0	0	3	5.5	0	0	0	0	0	0	0.0	3	0.10	5.5	0.21
21	4-5	0	0	1	0	0	1	0	0	0	0	0	2	2.5	0	0	0	0	0	0	0.0	2	0.07	2.5	0.10
22	5-6	1	2	2	0	0	0	0	0	0	0	0	5	4.5	4	0	0	0	0	4	2.0	9	0.31	6.5	0.25
23	6-7	13	11	14	0	1	1	2	0	0	0	0	42	42.0	6	0	0	0	0	6	3.0	48	1.66	45.0	1.73
24	7-8	13	31	30	1	1	4	5	0	0	0	0	85	93.0	12	0	0	0	0	12	6.0	97	3.36	99.0	3.80
Total in numbers		**898**	**622**	**606**	**43**	**12**	**200**	**54**	**3**	**2**	**25**	**0**	**2465**	**2370**	**415**	**0**	**6**	**1**	**0**	**422**	**233.5**	**2887**	**100**	**2603.5**	**100**

Annexure-VI

% of modal split of number	31	22	20.99	1	0.42	7	1.87	0	0.07	1	0.00	**85.38**					0.03	0.00	**0.0**			**85.4**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	449	622	606	64.5	36	300	162	9	9	112.5	0		**2370.0**	207.5	0	18	8	0		**233.5**			**2603.5**	
% of Total P.C.U.	17.25	23.89	23.28	2.48	1.38	11.52	6.22	0.35	0.35	4.32	0.00		**91.03**	7.97	0.00	0.69	0.31	0.00		**8.97**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (UP)

Road : Dudhnoi - Dainadubi (8.6 km)
Direction : Dudhnoi - Dainadubi
Location : At km 3+500 (Near Damra A.S.A. Playground)

Road No. : 1
Station No. : 1
Date & Day : Friday, November 23, 2018
Hour : 8 AM to 8 AM

Addl. Information: 0
Weather: Normal

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	70	46	28	6	0	5	0	0	2	0	0	157	134.5	79	0	0	0	0	79	39.5	236	9.18	174.0	7.68
2	9-10	69	54	47	3	1	7	0	0	0	0	0	181	153.5	48	0	0	2	0	50	40.0	231	8.98	193.5	8.54
3	10-11	57	68	29	7	1	12	2	0	0	1	0	177	167.5	47	0	0	0	0	47	23.5	224	8.71	191.0	8.43
4	11-12	65	71	38	2	2	7	2	0	2	0	0	189	176.0	27	0	0	0	0	27	13.5	216	8.40	189.5	8.36
5	12-13	66	65	35	2	2	4	2	0	0	0	0	176	154.0	34	0	1	0	0	35	20.0	211	8.21	174.0	7.68
6	13-14	55	67	37	1	1	4	0	0	1	0	0	166	146.5	25	0	1	1	0	27	23.5	193	7.51	170.0	7.50
7	14-15	52	53	57	2	0	5	1	0	0	1	0	171	154.0	32	0	0	0	0	32	16.0	203	7.90	170.0	7.50
8	15-16	61	38	45	3	0	7	1	0	0	1	0	156	136.0	37	0	0	0	0	37	18.5	193	7.51	154.5	6.82
9	16-17	68	38	29	2	0	4	1	0	0	0	0	142	113.0	30	0	0	0	0	30	15.0	172	6.69	128.0	5.65
10	17-18	47	39	57	0	1	9	6	0	0	0	0	159	154.0	25	0	1	0	0	26	15.5	185	7.20	169.5	7.48
11	18-19	22	12	31	1	0	3	2	0	0	0	0	71	66.0	10	0	0	0	0	10	5.0	81	3.15	71.0	3.13
12	19-20	15	8	21	0	0	4	2	0	0	0	0	50	48.5	2	0	0	0	0	2	1.0	52	2.02	49.5	2.18
13	20-21	11	6	12	0	0	8	1	0	0	1	0	39	43.0	6	0	0	0	0	6	3.0	45	1.75	46.0	2.03
14	21-22	9	1	7	0	0	3	0	0	0	0	0	20	17.0	0	0	7	0	0	7	21.0	27	1.05	38.0	1.68
15	22-23	4	1	5	0	0	3	1	1	0	0	0	15	18.5	4	0	0	0	0	4	2.0	19	0.74	20.5	0.90
16	23-00	4	1	4	0	0	0	5	0	1	0	0	15	26.5	0	0	0	0	0	0	0.0	15	0.58	26.5	1.17
17	00-1	0	0	4	0	0	0	2	0	0	0	0	6	10.0	0	0	0	0	0	0	0.0	6	0.23	10.0	0.44
18	1-2	1	0	1	0	0	1	3	0	0	0	0	6	12.0	0	0	0	0	0	0	0.0	6	0.23	12.0	0.53
19	2-3	1	0	2	0	0	0	1	0	0	0	0	4	5.5	1	0	0	0	0	1	0.5	5	0.19	6.0	0.26
20	3-4	1	0	0	0	0	2	3	0	0	0	0	6	12.5	0	0	0	0	0	0	0.0	6	0.23	12.5	0.55
21	4-5	0	0	3	1	0	10	4	0	0	0	0	18	31.5	0	0	0	0	0	0	0.0	18	0.70	31.5	1.39
22	5-6	8	10	6	2	0	6	1	0	0	0	0	33	35.0	8	0	0	0	0	8	4.0	41	1.59	39.0	1.72
23	6-7	23	18	9	8	2	4	1	0	0	3	0	68	79.0	16	0	0	0	0	16	8.0	84	3.27	87.0	3.84
24	7-8	28	26	15	5	0	3	1	0	1	4	0	83	92.5	19	0	0	0	0	19	9.5	102	3.97	102.0	4.50
Total in numbers		**737**	**622**	**522**	**45**	**10**	**111**	**42**	**1**	**7**	**11**	**0**	**2108**	**1987**	**450**	**0**	**10**	**3**	**0**	**463**	**279**	**2571**	**100**	**2266**	**100**

Annexure-VI

% of modal split of number	29	24	20.30	1.75	0.39	4.32	1.63	0.04	0.27	0.43	0.00	**81.99**		17.50	0.00	0.39	0.12	0.00	**18.01**			**100.0**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	368.5	622	522	67.5	30	166.5	126	3	31.5	49.5	0		**1986.5**	225	0	30	24	0		**279.0**			**2265.5**	
% of Total P.C.U.	16.27	27.46	23.04	2.98	1.32	7.35	5.56	0.13	1.39	2.18	0.00		**87.68**	9.93	0.00	1.32	1.06	0.00		**12.32**				**100.0**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

HOURLY ABSTRACT OF CLASSIFIED TRAFFIC VOLUME COUNT SURVEY (DOWN)

Road : Dudhnoi - Dainadubi (8.6 km)
Road No. : 1
Direction : Dainadubi - Dudhnoi
Station No. : 1
Addl. Information: 0
Location : At km 3+500 (Near Damra A.S.A. Playground)
Date & Day : Friday, November 23, 2018
Weather: Normal
Hour : 8 AM to 8 AM

Sl No	TIME (Hours)	FAST MOVING VEHICLES													SLOW MOVING VEHICLES							Total in No (Fast + Slow)	Hourly % in No (Fast + Slow)	Total PCU (Fast + Slow)	Hourly % in PCU (Fast + Slow)
		Passenger Vehicles					Goods Vehicles				Agricultural Vehicles		Total (No)	Total (PCU)	Passenger Vehicles		Hand Cart	Animal Drawn		Total Slow (No)	Total Slow (PCU)				
		Two Wheeler	Three Wheeler / Auto	Car/Jeep/Van/Taxi	Mini Bus	Bus	LCV	Truck			Agri Tractor				Cycle	Cycle Rickshaw		Bullock Cart	Horse						
								2-Axle	3-Axle	M-Axle	With Trailer	Without Trailer													
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	8-9	50	58	48	5	2	6	0	0	0	0	0	169	153.5	70	0	1	0	0	71	38.0	240	8.75	191.5	8.05
2	9-10	65	79	39	2	3	17	0	0	0	0	0	205	188.0	72	0	1	0	0	73	39.0	278	10.13	227.0	9.54
3	10-11	68	64	48	6	0	12	0	0	0	0	0	198	173.0	32	0	0	0	0	32	16.0	230	8.38	189.0	7.95
4	11-12	73	75	40	2	0	9	0	0	0	0	0	199	168.0	32	0	1	0	0	33	19.0	232	8.45	187.0	7.86
5	12-13	74	67	35	4	2	6	3	0	0	0	0	191	169.0	25	0	1	0	0	26	15.5	217	7.91	184.5	7.76
6	13-14	62	70	34	6	2	7	1	1	0	2	0	185	175.5	25	0	0	0	0	25	12.5	210	7.65	188.0	7.90
7	14-15	60	55	47	4	0	8	1	0	0	1	0	176	157.5	30	0	0	1	0	31	23.0	207	7.54	180.5	7.59
8	15-16	62	46	33	6	0	5	3	0	0	0	0	155	135.5	44	0	0	0	0	44	22.0	199	7.25	157.5	6.62
9	16-17	91	40	36	5	1	4	2	0	3	1	0	183	162.0	68	0	0	0	0	68	34.0	251	9.15	196.0	8.24
10	17-18	63	42	36	3	2	12	6	0	1	10	0	175	205.5	49	0	2	0	0	51	30.5	226	8.24	236.0	9.92
11	18-19	36	8	27	3	0	9	7	1	0	1	0	92	99.5	9	0	0	0	0	9	4.5	101	3.68	104.0	4.37
12	19-20	15	6	16	1	0	9	4	0	0	1	0	52	61.0	6	0	0	0	0	6	3.0	58	2.11	64.0	2.69
13	20-21	8	3	6	0	0	6	1	0	0	0	0	24	25.0	2	0	0	0	0	2	1.0	26	0.95	26.0	1.09
14	21-22	6	1	9	0	0	4	3	0	0	0	0	23	28.0	2	0	0	0	0	2	1.0	25	0.91	29.0	1.22
15	22-23	2	2	0	0	0	4	4	0	0	0	0	12	21.0	0	0	0	0	0	0	0.0	12	0.44	21.0	0.88
16	23-00	0	0	1	0	0	1	0	1	0	0	0	3	5.5	0	0	0	0	0	0	0.0	3	0.11	5.5	0.23
17	00-1	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0	0	0.00	0.0	0.00
18	1-2	0	0	1	0	0	0	0	0	0	0	0	1	1.0	0	0	0	0	0	0	0.0	1	0.04	1.0	0.04
19	2-3	0	0	0	0	0	1	0	0	0	0	0	1	1.5	0	0	0	0	0	0	0.0	1	0.04	1.5	0.06
20	3-4	0	0	0	0	0	1	0	0	0	0	0	1	1.5	0	0	0	0	0	0	0.0	1	0.04	1.5	0.06
21	4-5	0	0	2	0	0	3	0	0	0	0	0	5	6.5	0	0	0	0	0	0	0.0	5	0.18	6.5	0.27
22	5-6	7	12	9	0	0	0	0	0	0	0	0	28	24.5	9	0	0	0	0	9	4.5	37	1.35	29.0	1.22
23	6-7	9	31	11	1	0	2	0	0	0	0	0	54	51.0	18	0	0	0	0	18	9.0	72	2.62	60.0	2.52
24	7-8	21	46	11	2	1	1	0	0	0	0	0	82	75.0	29	0	1	0	0	30	17.5	112	4.08	92.5	3.89
Total in numbers		**772**	**705**	**489**	**50**	**13**	**127**	**35**	**3**	**4**	**16**	**0**	**2214**	**2088.5**	**522**	**0**	**7**	**1**	**0**	**530**	**290**	**2744**	**100**	**2378.5**	**100**

Annexure-VI

% of modal split of number	28	26	17.82	2	0.47	5	1.28	0	0.15	1	0.00	**80.69**					0.04	0.00	**0.04**			**80.7**		
PCU conversion factor	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50			0.50	2.00	3.00	8.00	4.00						
P.C.U.	386	705	489	75	39	190.5	105	9	18	72	0		**2088.5**	261	0	21	8	0		**290.0**			**2378.5**	
% of Total P.C.U.	16.23	29.64	20.56	3.15	1.64	8.01	4.41	0.38	0.76	3.03	0.00		**87.81**	10.97	0.00	0.88	0.34	0.00		**12.19**				**100.0**

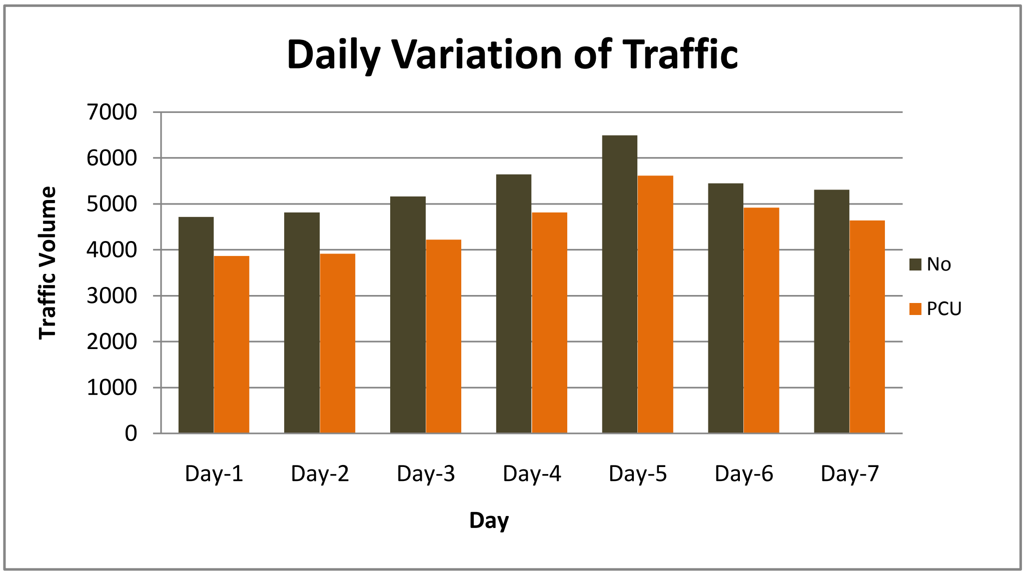
GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Daily and Hourly variation of Traffic

Road : Dudhnoi - Dainadubi (8.6 km)
Location : At km 3+500 (Near Damra A.S.A. Playground)□

Daily Variation of Traffic	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7
Numbers	4718	4817	5166	5644	6501	5449	5315
PCU	3872	3916	4225	4816	5619	4922	4644

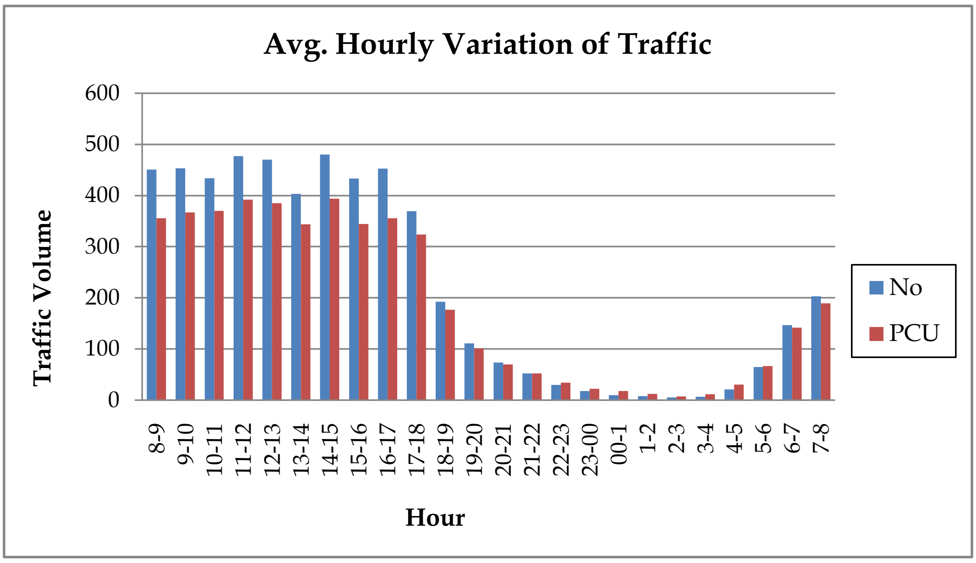


GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Average Hourly Variation of Traffic

Time (Hour)	Traffic (Number)	Traffic (PCU)	Peak Hour Factor (%)
8-9	451	356	7.78
9-10	453	367	8.03
10-11	434	371	8.10
11-12	477	392	8.58
12-13	470	385	8.43
13-14	404	344	7.53
14-15	**480**	**394**	**8.62**
15-16	434	345	7.54
16-17	453	356	7.79
17-18	370	324	7.09
18-19	193	177	3.87
19-20	111	102	2.22
20-21	74	70	1.53
21-22	53	52	1.15
22-23	30	34	0.75
23-00	18	23	0.49
00-1	10	18	0.40
1-2	8	13	0.28
2-3	6	8	0.16
3-4	7	12	0.26
4-5	21	30	0.67
5-6	65	67	1.47
6-7	147	142	3.11
7-8	203	190	4.15
Total	**5373**	**4573**	



GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

TRAFFIC PROJECTION

Road Name: Dudhnoi - Dainadubi (8.6 km) **Location :** At km 3+500 (Near Damra A.S.A. Playground)

	Traffic Growth Rates																		
Growth Rates	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%			
PCU	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50	0.50	2.00	3.00	8.00	4.00			
Year	**FAST MOVING VEHICLES**											**SLOW MOVING VEHICLES**					**Total (No)**	**Total (PCU)**	**Design Year/ Remark**
	Two Wheeler	**Three Wheeler/ Auto**	**Car/ Jeep/ Van/ Taxi**	**Mini Bus**	**Bus**	**LCV**	**2-Axle**	**3-Axle**	**M-Axle**	**Tractor With Trailer**	**Tractor Without Trailer**	**Cycle**	**Cycle Rickshaw**	**Hand Cart**	**Bullock Cart**	**Horse Cart**			
2018	1753	1139	1076	70	21	255	70	5	11	34	2	926	1	10	1	0	5373	4573	**Design Period**
2019	1841	1196	1130	74	22	268	73	6	11	36	2	972	1	10	1	0	5642	4802	
2020	1933	1256	1186	77	23	281	77	6	12	38	2	1021	1	11	1	0	5924	5042	
2021	**1933**	**1256**	**1186**	**77**	**23**	**281**	**77**	**6**	**12**	**38**	**2**	**1021**	**1**	**11**	**1**	**0**	**5924**	**5042**	
2022	2029	1319	1246	81	24	295	81	6	12	40	2	1072	1	11	1	0	6220	5294	
2023	2131	1384	1308	85	25	310	85	6	13	42	2	1126	1	12	1	0	6531	5559	**Constuction Period**
2024	**2237**	**1454**	**1373**	**89**	**27**	**326**	**89**	**7**	**14**	**44**	**2**	**1182**	**1**	**12**	**1**	**0**	**6857**	**5837**	**1**
2025	2349	1526	1442	94	28	342	93	7	14	46	2	1241	1	13	2	0	7200	6129	**2**
2026	2467	1603	1514	98	29	359	98	7	15	48	2	1303	1	14	2	0	7560	6435	**3**
2027	2590	1683	1590	103	31	377	103	8	16	50	2	1368	1	14	2	0	7938	6757	**4**
2028	**2719**	**1767**	**1669**	**109**	**32**	**396**	**108**	**8**	**17**	**53**	**2**	**1437**	**1**	**15**	**2**	**0**	**8335**	**7095**	**5**
2029	2855	1855	1753	114	34	416	113	9	17	56	3	1508	1	16	2	0	8752	7449	**6**
2030	2998	1948	1840	120	36	436	119	9	18	58	3	1584	1	17	2	0	9189	7822	**7**
2031	3148	2045	1932	126	37	458	125	9	19	61	3	1663	1	17	2	0	9649	8213	**8**
2032	3306	2148	2029	132	39	481	131	10	20	64	3	1746	1	18	2	0	10131	8624	**9**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

TRAFFIC PROJECTION

Road Name: Dudhnoi - Dainadubi (8.6 km) **Location :** At km 3+500 (Near Damra A.S.A. Playground)

	Traffic Growth Rates															
Growth Rates	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
PCU	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50	0.50	2.00	3.00	8.00	4.00

Year	FAST MOVING VEHICLES											SLOW MOVING VEHICLES					Total (No)	Total (PCU)	Design Year/ Remark
	Two Wheeler	Three Wheeler/ Auto	Car/ Jeep/ Van/ Taxi	Mini Bus	Bus	LCV	2-Axle	3-Axle	M-Axle	Tractor With Trailer	Tractor Without Trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart			
2033	**3471**	**2255**	**2130**	**139**	**41**	**505**	**138**	**10**	**21**	**68**	**3**	**1833**	**1**	**19**	**2**	**0**	**10638**	**9055**	10
2034	3644	2368	2237	146	43	530	145	11	22	71	3	1925	1	20	2	0	11170	9508	**11**
2035	3827	2486	2349	153	46	557	152	12	23	75	3	2021	2	21	2	0	11728	9983	**12**
2036	4018	2611	2466	160	48	585	159	12	25	78	4	2122	2	22	3	0	12315	10482	**13**
2037	4219	2741	2590	168	50	614	167	13	26	82	4	2229	2	23	3	0	12930	11006	**14**
2038	**4430**	**2878**	**2719**	**177**	**53**	**645**	**176**	**13**	**27**	**86**	**4**	**2340**	**2**	**25**	**3**	**0**	**13577**	**11556**	15
2039	4651	3022	2855	186	55	677	185	14	28	91	4	2457	2	26	3	0	14256	12134	**16**
2040	4884	3173	2998	195	58	711	194	15	30	95	4	2580	2	27	3	0	14969	12741	**17**
2041	5128	3332	3148	205	61	746	204	15	31	100	5	2709	2	28	3	0	15717	13378	**18**
2042	5384	3498	3305	215	64	784	214	16	33	105	5	2844	2	30	4	0	16503	14047	**19**
2043	**5654**	**3673**	**3470**	**226**	**67**	**823**	**224**	**17**	**35**	**110**	**5**	**2986**	**2**	**31**	**4**	**0**	**17328**	**14749**	20
2044	5936	3857	3644	237	71	864	236	18	36	116	5	3136	2	33	4	0	18194	15487	**21**
2045	6233	4050	3826	249	74	907	247	19	38	121	6	3293	3	35	4	0	19104	16261	**22**
2046	6545	4252	4017	261	78	953	260	20	40	127	6	3457	3	36	4	0	20059	17074	**23**
2047	6872	4465	4218	274	82	1000	273	21	42	134	6	3630	3	38	4	0	21062	17928	**24**
2048	**7216**	**4688**	**4429**	**288**	**86**	**1050**	**286**	**22**	**44**	**141**	**6**	**3812**	**3**	**40**	**5**	**0**	**22115**	**18824**	25
2049	7576	4923	4650	303	90	1103	301	23	46	148	7	4002	3	42	5	0	23221	19765	**26**
2050	7955	5169	4883	318	95	1158	316	24	49	155	7	4202	3	44	5	0	24382	20754	**27**
2051	8353	5427	5127	334	99	1216	332	25	51	163	7	4412	3	46	5	0	25601	21791	**28**

Annexure-VI

TRAFFIC PROJECTION

Road Name: Dudhnoi - Dainadubi (8.6 km) **Location :** At km 3+500 (Near Damra A.S.A. Playground)

	Traffic Growth Rates																		
Growth Rates	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%			
PCU	0.50	1.00	1.00	1.50	3.00	1.50	3.00	3.00	4.50	4.50	1.50	0.50	2.00	3.00	8.00	4.00			
Year	**FAST MOVING VEHICLES**											**SLOW MOVING VEHICLES**					**Total (No)**	**Total (PCU)**	**Design Year/ Remark**
	Two Wheeler	**Three Wheeler/ Auto**	**Car/ Jeep/ Van/ Taxi**	**Mini Bus**	**Bus**	**LCV**	**2-Axle**	**3-Axle**	**M-Axle**	**Tractor With Trailer**	**Tractor Without Trailer**	**Cycle**	**Cycle Rickshaw**	**Hand Cart**	**Bullock Cart**	**Horse Cart**			
2052	8771	5699	5383	350	104	1277	348	26	54	171	8	4633	4	49	6	0	26881	22881	**29**
2053	**9209**	**5984**	**5653**	**368**	**110**	**1340**	**365**	**28**	**56**	**179**	**8**	**4865**	**4**	**51**	**6**	**0**	**28225**	**24025**	30

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

LANE REQUIREMENT

Road : Dudhnoi - Dainadubi (8.6 km)

Location : At km 3+500 (Near Damra A.S.A. Playground)

Year	AADT (PCU)	Lane Requirement (LOS B) as per IRC-64-1990	Lane Requirement as per new MoRT&H Circular
2018	4573	Intermediate Lane	2-Lane + P.S
2019	4802	Intermediate Lane	2-Lane + P.S
2020	5042	Intermediate Lane	2-Lane + P.S
2021	5042	Intermediate Lane	2-Lane + P.S
2022	5294	Intermediate Lane	2-Lane + P.S
2023	5559	Intermediate Lane	2-Lane + P.S
2024	5837	Intermediate Lane	2-Lane + P.S
2025	6129	2-Lane	2-Lane + P.S
2026	6435	2-Lane	2-Lane + P.S
2027	6757	2-Lane	2-Lane + P.S
2028	7095	2-Lane	2-Lane + P.S
2029	7449	2-Lane	2-Lane + P.S
2030	7822	2-Lane	2-Lane + P.S
2031	8213	2-Lane	2-Lane + P.S
2032	8624	2-Lane	2-Lane + P.S
2033	9055	2-Lane	2-Lane + P.S
2034	9508	2-Lane	2-Lane + P.S
2035	**9983**	**2-Lane**	**2-Lane + P.S**
2036	10482	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2037	11006	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2038	11556	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2039	12134	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2040	**12741**	**2-Lane**	**2-Lane + P.S, capacity augmentation for 4-lane to be started**
2041	13378	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2042	14047	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2043	14749	2-Lane	2-Lane + P.S, capacity augmentation for 4-lane to be started
2044	15487	2-Lane + P.S	4-Lane
2045	16261	2-Lane + P.S	4-Lane
2046	17074	2-Lane + P.S	4-Lane
2047	17928	2-Lane + P.S	4-Lane
2048	18824	4-Lane	4-Lane
2049	19765	4-Lane	4-Lane
2050	20754	4-Lane	4-Lane
2051	21791	4-Lane	4-Lane
2052	22881	4-Lane	4-Lane
2053	24025	4-Lane	4-Lane

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

MSA CALCULATION SHEET

Road Name: Dudhnoi - Dainadubi (8.6 km)   **Location:** At km 3+500 (Near Damra A.S.A. Playground)

Lane Distribution Factor : 0.50

Year	Mini Bus	Bus	LCV	2 Axle	3 Axle	M Axle	Total yearly CVs (nos.)	Cummulative yearly CVs (nos.)	Yearly Design ESA	Cummulative Design ESA	MSA	Design year
VDF	0.085	0.741	0.019	3.738	5.497	8.655						
2018	70	21	255	70	5	11	**Design Period**					
2019	74	22	268	73	6	11						
2020	77	23	281	77	6	12						
2021	77	23	281	77	6	12						
2022	81	24	295	81	6	12						
2023	85	25	310	85	6	13	**Constuction Period**					
2024	89	27	326	89	7	14	201044	**201044**	95020	95020	**0.10**	1
2025	94	28	342	93	7	14	211097	**412141**	99771	194790	**0.19**	2
2026	98	29	359	98	7	15	221651	**633793**	104759	299549	**0.30**	3
2027	103	31	377	103	8	16	232734	**866527**	109997	409546	**0.41**	4
2028	**109**	**32**	**396**	**108**	**8**	**17**	**244371**	**1110897**	**115497**	**525043**	**0.53**	**5**
2029	114	34	416	113	9	17	256589	**1367487**	121272	646315	**0.65**	6
2030	120	36	436	119	9	18	269419	**1636905**	127335	773650	**0.77**	7
2031	126	37	458	125	9	19	282890	**1919795**	133702	907352	**0.91**	8
2032	132	39	481	131	10	20	297034	**2216829**	140387	1047739	**1.05**	9
2033	**139**	**41**	**505**	**138**	**10**	**21**	**311886**	**2528715**	**147407**	**1195146**	**1.20**	**10**
2034	146	43	530	145	11	22	327480	**2856195**	154777	1349923	**1.35**	11
2035	153	46	557	152	12	23	343854	**3200050**	162516	1512439	**1.51**	12
2036	160	48	585	159	12	25	361047	**3561097**	170642	1683080	**1.68**	13
2037	168	50	614	167	13	26	379099	**3940196**	179174	1862254	**1.86**	14
2038	**177**	**53**	**645**	**176**	**13**	**27**	**398054**	**4338250**	**188132**	**2050386**	**2.05**	**15**
2039	186	55	677	185	14	28	417957	**4756207**	197539	2247925	**2.25**	16
2040	195	58	711	194	15	30	438855	**5195062**	207416	2455341	**2.46**	17
2041	205	61	746	204	15	31	460798	**5655859**	217787	2673127	**2.67**	18
2042	215	64	784	214	16	33	483837	**6139697**	228676	2901803	**2.90**	19
2043	**226**	**67**	**823**	**224**	**17**	**35**	**508029**	**6647726**	**240110**	**3141913**	**3.14**	**20**
2044	237	71	864	236	18	36	533431	**7181157**	252115	3394028	**3.39**	21
2045	249	74	907	247	19	38	560102	**7741259**	264721	3658749	**3.66**	22
2046	261	78	953	260	20	40	588107	**8329366**	277957	3936706	**3.94**	23
2047	274	82	1000	273	21	42	617513	**8946879**	291855	4228561	**4.23**	24
2048	**288**	**86**	**1050**	**286**	**22**	**44**	**648388**	**9595267**	**306448**	**4535009**	**4.54**	**25**
2049	303	90	1103	301	23	46	680808	**10276075**	321770	4856779	**4.86**	26
2050	318	95	1158	316	24	49	714848	**10990923**	337859	5194637	**5.19**	27
2051	334	99	1216	332	25	51	750591	**11741514**	354751	5549389	**5.55**	28
2052	350	104	1277	348	26	54	788120	**12529634**	372489	5921878	**5.92**	29
2053	**368**	**110**	**1340**	**365**	**28**	**56**	**827526**	**13357160**	**391113**	**6312991**	**6.31**	**30**

$$N = \frac{365 \times [(1 + r)^{n} - 1]}{r} \times A \times D \times F$$

N = MSA
r = Traffic Growth Rate
n = Design Year
D = Lane Distribution Factor
F = VDF
A = No of Commercial Vehicles at the start of projection

For 20 Year **N=** **3.14** **MSA**
For 30 Year **N=** **6.31** **MSA**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
1	CAR	NL 4 AU 8634	Cooch Behar	11	Cooch Behar	WB	Damra	1	Goalpara	AS	W	N	Personal	230
2	MINI BUS	AS 18 AC 4822	Dudhnoi	1	Goalpara	AS	Meghalaya	9	Meghalaya	ML	W	N	Bussiness	200
3	CAR	AS 18 64 85	Dudhnoi	1	Goalpara	AS	Nawre	6	East Garo Hills	ML	D	Y	Personal	88
4	CAR	AS 24 A 7352	Dudhnoi	1	Goalpara	AS	Market Damra	1	Goalpara	AS	W	N	Self	50
5	MINI BUS	AS 18 K 9752	Guwahati	4	Guwahati	AS	Meghalaya	9	Meghalaya	ML	D	Y	Bussiness	195
6	CAR	AS 24 A 1263	Dudhnoi	1	Goalpara	AS	Market Damra	1	Goalpara	AS	D	Y	Work	45
7	VAN	AS 18 AC 7622	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	W	N	Work	150
8	CAR	AS 18 BC 4961	Kamakhya	4	Kamrup	AS	Wageasi	6	East Garo Hills	ML	M	N	Work	220
9	CAR	AS 18 BC 1530	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Bussiness	35
10	CAR	AS 18 AC 7522	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Bussiness	45
11	MINI BUS	AS 18 BC 6536	Kamakhya Mandir	4	Kamrup	AS	Damra	1	Goalpara	AS	D	Y	Passenger	150
12	CAR	AS 18 A 6778	Guwahati	4	Guwahati	AS	Nokrek National Park	8	West Garo Hills	ML	W	N	Personal	200
13	VAN	AS 18 78 55	Goalpara	2	Goalpara	AS	Songsak	6	East Garo Hills	ML	D	Y	Personal	95
14	BUS	AS 10 16 65	Kamakhya Mandir	4	Kamrup	AS	Damra	1	Goalpara	AS	D	Y	Passenger	150
15	CAR	AS 1 Q 5846	Dhupdhara	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	D	Y	Personal	190
16	CAR	AS 18 L 5231	Nagaon	5	Nagaon	AS	Ranikor	8	East Khasi Hills	ML	Y	N	Work	215
17	JEEP	AS 18 K 8686	Guwahati	4	Guwahati	AS	Rongram	8	West Garo Hills	ML	W	N	Personal	186
18	CAR	AS 18 C 852	Bongaigaon	3	Bongaigaon	AS	Siju	9	South Garo Hills	ML	W	N	Personal	165
19	CAR	AS 18 D 3476	Hulukanda Hill	2	Goalpara	AS	Dachi Lake Resort, Anogre	7	West Garo Hills	ML	D	Y	Personal	70

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Date: Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
20	MINI BUS	AS 10 B 1325	Dudhnoi College	1	Goalpara	AS	Williamnagar	6	East Garo Hills	ML	D	Y	Bussiness	125
21	CAR	AS 24 S 236	Agia	2	Goalpara	AS	Wageasi	6	East Garo Hills	ML	D	Y	Personal	80
22	CAR	AS 18 A 753	Guwahati	4	Guwahati	AS	Nokrek National Park	8	West Garo Hills	ML	M	N	Personal	200
23	MINI BUS	AS 1 Q 3423	Dudhnoi College	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Passenger	35
24	CAR	UP 22 BC 5954	Mornoi	2	Goalpara	AS	Ranikor	8	East Khasi Hills	ML	W	N	Work	235
25	CAR	AS 24 C 2566	Guwahati	4	Guwahati	AS	Rongram	8	West Garo Hills	ML	W	N	Bussiness	186
26	BUS	AS 18 AC 7526	Alipurduar	11	Jalpaiguri	WB	Shillong	8	East Khasi Hills	ML	W	N	Passenger	450
27	CAR	AS 24 C 8496	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	W	N	Personal	150
28	CAR	AS 18 H 5673	Tezpur	5	Sonitpur	AS	Rongrenggre Reserved Forest	6	East Garo Hills	ML	M	N	Personal	350
29	JEEP	AS 18 BC 1473	Mornoi	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	W	N	Work	195
30	CAR	AS 18 AC 3865	Goalpara	2	Goalpara	AS	Siju	9	South Garo Hills	ML	D	Y	Personal	90
31	CAR	AS 18 BC 6682	Jogighopa	3	Bongaigaon	AS	Dachi Lake Resort, Anogre	7	West Garo Hills	ML	D	Y	Bussiness	85
32	MINI BUS	AS 18 G 3364	Kamakhya Mandir	4	Kamrup	AS	Rongjeng	6	East Garo Hills	ML	W	N	Passenger	225
33	CAR	AS 18 K 6863	Dhupdhara	2	Goalpara	AS	Depa	6	East Garo Hills	ML	W	N	Personal	125
34	CAR	AS 18 BC 6862	Guwahati	4	Guwahati	AS	Nokrek National Park	8	West Garo Hills	ML	Y	N	Personal	200
35	JEEP	AS 18 G 5546	Boko	4	Kamrup	AS	Songsak	6	East Garo Hills	ML	D	Y	Bussiness	180
36	CAR	UP 16 G 7566	Bongaigaon	3	Bongaigaon	AS	Shallang	8	West Khasi Hills	ML	W	N	Work	150

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
37	VAN	AS 18 G 6524	Nagaon	5	Nagaon	AS	Damra	1	Goalpara	AS	W	N	Work	200
38	BUS	AS 18 N 9846	Manas National Park	3	Barpeta	AS	Nongstoin	8	West Khasi Hills	ML	W	N	Bussiness	250
39	CAR	AS 18 C 8562	Guwahati	4	Guwahati	AS	Williamnagar	6	East Garo Hills	ML	M	N	Personal	200
40	CAR	AS 24 C 2463	Goalpara	2	Goalpara	AS	Siju	9	South Garo Hills	ML	W	N	Personal	90
41	MINI BUS	AS 18 D 6452	Dudhnoi College	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Passenger	50
42	CAR	AS 18 R 8462	Buxa Wildlife Sanctuary	11	Jalpaiguri	WB	Wageasi	6	East Garo Hills	ML	W	N	Education	500
43	CAR	AS 18 G 8446	Guwahati	4	Guwahati	AS	Rongram	8	West Garo Hills	ML	W	N	Work	186
44	CAR	AS 18 BC 6358	Maa Kali Mandir Dudhnoi	1	Goalpara	AS	Shillong	8	East Khasi Hills	ML	M	N	Darshan	250
45	JEEP	AS 18 C 7965	Agia	2	Goalpara	AS	Ranikor	8	East Khasi Hills	ML	W	N	Work	240
46	CAR	AS 18 E 5263	Kamakhya Mandi	4	Kamrup	AS	Damra	1	Goalpara	AS	D	Y	Darshan	150
47	CAR	AS 18 G 4522	Nainital	12	Nainital	UK	Riat Phyllaw Waterfall	8	West Khasi Hills	ML	Y	N	Personal	1800
48	VAN	AS 18 C 7856	Dudhnoi College	1	Goalpara	AS	Rompa	2	Goalpara	AS	D	Y	Bussiness	35
49	CAR	UP 16 G 2364	Guwahati	4	Guwahati	AS	Tura	8	West Garo Hills	ML	D	Y	Work	180
50	BUS	AS 18 E 7522	Hulukanda Hill	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	M	N	Bussiness	200
51	CAR	AS 18 G 6527	Guwahati	4	Guwahati	AS	Nokrek National Park	8	West Garo Hills	ML	W	N	Personal	200
52	CAR	AS 18 F 6846	Dhupdhara	2	Goalpara	AS	Williamnagar	6	East Garo Hills	ML	W	N	Personal	125

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Date: Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
53	CAR	AS 18 H 2436	Bongaigaon	3	Bongaigaon	AS	Siju	9	South Garo Hills	ML	D	Y	Personal	165
54	CAR	AS 18 G 17856	Bharbari	2	Goalpara	AS	Depa	6	East Garo Hills	ML	D	Y	Personal	100
55	JEEP	AS 18 BG 2846	Kamakhya Mandir	4	Kamrup	AS	Rongjeng	6	East Garo Hills	ML	M	N	Bussiness	225
56	CAR	AS 18 E 8622	Tezpur	5	Sonitpur	AS	Dachi Lake Resort, Anogre	7	West Garo Hills	ML	Y	N	Tourist	365
57	CAR	AS 18 B 8674	Guwahati	4	Guwahati	AS	Tura	8	West Garo Hills	ML	M	N	Bussiness	180
58	CAR	AS 18 E 2564	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	M	N	Bussiness	150
59	MINI BUS	AS 18 G 5634	Agia	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	D	Y	Bussiness	185
60	CAR	AS 24 A 7522	Manas National Park	3	Barpeta	AS	Tura	8	West Garo Hills	ML	M	N	Tourist	200
61	CAR	AS 18 CC 3426	Alipurduar	11	Jalpaiguri	WB	Silchar	5	Cachar	AS	W	N	Work	720
62	BUS	AS 18 E 8946	Mornoi	2	Goalpara	AS	Songsak	6	East Garo Hills	ML	D	Y	Bussiness	90
63	CAR	AS 18 G 6584	Jogighopa	3	Bongaigaon	AS	Damra	1	Goalpara	AS	W	N	Tourist	45
64	CAR	AS 24 A 2533	Nainital	12	Nainital	UK	Ranikor	8	East Khasi Hills	ML	M	N	Work	1850
65	CAR	AS 18 G 9856	Guwahati	4	Guwahati	AS	Tura	8	West Garo Hills	ML	M	N	Bussiness	180
66	CAR	AS 18 EA 4526	Tezpur	5	Sonitpur	AS	Wageasi	6	East Garo Hills	ML	M	N	Bussiness	350
67	CAR	AS 18 BC 6622	Agia	2	Goalpara	AS	Siju	9	South Garo Hills	ML	D	Y	Work	85
68	MINI BUS	AS 18 E 7563	Kamakhya Mandir	4	Kamrup	AS	Damra	1	Goalpara	AS	D	Y	Bussiness	150
69	CAR	AS 18 BC 7924	Statue Of Mahabir Chilarai	3	Bongaigaon	AS	Shillong	8	East Khasi Hills	ML	M	N	Personal	255
70	CAR	AS 18 H 5236	Guwahati	4	Guwahati	AS	Williamnagar	6	East Garo Hills	ML	Y	N	Bussiness	200

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
71	JEEP	AS 18 AA 5625	Bongaigaon	3	Bongaigaon	AS	Dachi Lake Resort, Anogre	7	West Garo Hills	ML	D	Y	Tourist	80
72	VAN	AS 18 CC 7626	Boko	4	Kamrup	AS	Shallang	8	West Khasi Hills	ML	M	N	Tourist	150
73	CAR	AS 18 BC 7862	Alipurduar	11	Jalpaiguri	WB	Shillong	8	East Khasi Hills	ML	M	N	Personal	500
74	MINI BUS	AS 18 BQ 6346	Manas National Park	3	Barpeta	AS	Nongstoin	8	West Khasi Hills	ML	M	N	Bussiness	250
75	CAR	AS 18 A 2596	Agia	2	Goalpara	AS	Siju	9	South Garo Hills	ML	D	Y	Work	85
76	CAR	AS 18 AC 7463	Hulukanda Hill	2	Goalpara	AS	Damra	1	Goalpara	AS	W	N	Personal	45
77	CAR	UP 16 C 8433	Buxa Wildlife Sanctuary	11	Jalpaiguri	WB	Tura	8	West Garo Hills	ML	M	N	Work	250
78	BUS	AS 18 AC 8462	Guwahati	4	Guwahati	AS	Adugiri	7	West Garo Hills	ML	W	N	Bussiness	230
79	CAR	AS 10 E 5862	Bongaigaon	3	Bongaigaon	AS	Songsak	6	East Garo Hills	ML	D	Y	Personal	130
80	CAR	AS 18 H 7856	Guwahati	4	Guwahati	AS	Adugiri	7	West Garo Hills	ML	W	N	Bussiness	230
81	CAR	AS 18 B 6246	Mornoi	2	Goalpara	AS	Ranikor	8	East Khasi Hills	ML	Y	N	Work	235
82	CAR	AS 18 H 8463	Kamakhya Mandir	4	Kamrup	AS	Williamnagar	6	East Garo Hills	ML	W	N	Darshan	230
83	CAR	AS 18 AC 8655	Dhupdhara	2	Goalpara	AS	Williamnagar	6	East Garo Hills	ML	D	Y	Passenger	120
84	MINI BUS	AS 18 F 4526	Tezpur	5	Sonitpur	AS	Shallang	8	West Khasi Hills	ML	W	N	Work	330
85	CAR	AS 18 BC 7956	Hulukanda Hill	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	M	N	Self	200
86	VAN	AS 18 AC 2648	Dudhnoi College	1	Goalpara	AS	Rompa	2	Goalpara	AS	D	Y	Self	35
87	JEEP	AS 18 E 7625	Agia	2	Goalpara	AS	Siju	9	South Garo Hills	ML	D	Y	Bussiness	85

Annexure-VI

Origin and Destination Survey for Passanger Vehicles (UP Direction)

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Date: Friday, November 23, 2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
88	CAR	AS 18 BC 8499	Nagaon	5	Nagaon	AS	Ranikor	8	East Khasi Hills	ML	Y	N	Bussiness	215
89	CAR	AS 24 GA 8462	Alipurduar	11	Jalpaiguri	WB	Silchar	5	Cachar	AS	M	N	Work	720
90	MINI BUS	AS 18 AC 2786	Mornoi	2	Goalpara	AS	Songsak	6	East Garo Hills	ML	D	Y	Work	110
91	CAR	AS 18 C 3588	Guwahati	4	Guwahati	AS	Tura	8	West Garo Hills	ML	M	N	Bussiness	180
92	CAR	AS 11 AC 8655	Kamakhya	4	Kamrup	AS	Damra	1	Goalpara	AS	M	N	Personal	150
93	VAN	AS 11 F 4526	Agia	2	Goalpara	AS	Shallang	8	West Khasi Hills	ML	M	N	Bussiness	175
94	CAR	AS 11 BC 7956	Bongaigaon	3	Bongaigaon	AS	Dachi Lake Resort,	7	West Garo Hills	ML	D	Y	Bussiness	80
95	CAR	AS 11 AC 2648	Kamakhya	4	Kamrup	AS	Williamnagar	6	East Garo Hills	ML	W	N	Personal	230
96	CAR	AS 11 E 7625	Hulukanda Hill	2	Goalpara	AS	Rongrenggre	6	East Garo Hills	ML	D	Y	Personal	105
97	MINI BUS	AS 11 BC 8499	Manas National	3	Barpeta	AS	Wageasi	6	East Garo Hills	ML	D	Y	Bussiness	135
98	CAR	AS 24 G 6584	Buxa Wildlife	11	Jalpaiguri	WB	Tura	8	West Garo Hills	ML	M	N	Personal	250
99	JEEP	UP 16 A 9348	Agia	2	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Bussiness	36
100	CAR	AS 11 AC 2786	Kamakhya	4	Kamrup	AS	Songsak	6	East Garo Hills	ML	M	N	Personal	180
101	VAN	AS 11 C 3588	Guwahati	4	Guwahati	AS	Williamnagar	6	East Garo Hills	ML	W	N	Bussiness	200

GLOBAL INFRA SOLUTIONS
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Annexure-VI

Origin and Destination Survey for Passanger Vehicles

Package No.: NHIDCL/BHARATMALA/DPR/

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:**

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
1	CAR	ML 7 B 9308	Churaibari	5	Karimganj	AS	Guwahati	4	Guwahati	AS	W	N	Personal	315
2	CAR	ML 6 C 9223	Siju	9	South Garo Hills	ML	Khutera	11	Chatra	JH	M	N	Work	1050
3	MINI BUS	ML 5 BC 3033	Shillong	9	East Khasi Hill	ML	Dudhnoi	1	Goalpara	AS	W	N	Passenger	230
4	CAR	ML 6 BC 2039	Nongjri	9	West Khasi Hills	ML	Dudhnoi	1	Goalpara	AS	W	N	Personal	165
5	BUS	ML 7 B 5238	Williamnagar	6	East Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Passenger	120
6	CAR	AS 24 A 708	Jamshedpur	11	Jamshedpur	JH	Dudhnoi	1	Goalpara	AS	M	N	Bussiness	950
7	VAN	AS 18 E 8335	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Personal	35
8	CAR	AS 18 H 8308	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	25
9	MINI BUS	ML 6 AC 8888	Nongjri	9	West Khasi Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	165
10	CAR	AS 18 AC 7305	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	35
11	CAR	ML 5 A 3852	Shillong	9	East Khasi Hill	ML	Guwahati	4	Guwahati	AS	D	Y	Personal	95
12	CAR	AS 19 K 3298	Damra	1	Goalpara	AS	Jogighopa	3	Bongaigaon	AS	D	Y	Personal	45
13	BUS	ML 5 K 7225	Shallang	9	West Khasi Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Passenger	165
14	CAR	ML 7 L 9928	Williamnagar	6	East Garo Hills	ML	Manupara	1	Goalpara	AS	D	Y	Work	135
15	MINI BUS	ML 5 K 2833	Shillong	9	East Khasi Hill	ML	Goalpara	2	Goalpara	AS	M	N	Work	235
16	CAR	AS 11 K 3353	Ampati	7	uth West Garo H	ML	Ianas National Par	3	Barpeta	AS	W	N	Tourists	250
17	CAR	AS 18 KS 9233	Rompa	2	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	20
18	CAR	ML 6 BC 2203	Jengjal	7	West Garo Hills	ML	Krishnai	2	Goalpara	AS	D	Y	Darshan	120
19	JEEP	AS 18 FC 3355	Depa	6	East Garo Hills	ML	Goalpara	2	Goalpara	AS	D	Y	Work	85
20	CAR	AS 11 BC 3854	Ampati	7	uth West Garo H	ML	Bilasipara	3	Dhubri	AS	D	Y	Personal	135
21	BUS	ML 8 KC 7585	Dainadubi	6	East Garo Hills	ML	Agia	2	Goalpara	AS	D	Y	Bussiness	90
22	CAR	WB 69 KS 3325	Shillong	9	East Khasi Hill	ML	Hasimara	11	Alipurduar	WB	W	N	Passenger	430
23	CAR	AS 18 KZ 7725	Damra	1	Goalpara	AS	Vigyan Kendra G	2	Goalpara	AS	D	Y	Education	35
24	MINI BUS	ML 8 TC 8309	Wageasi Market	6	East Garo Hills	ML	Abhayapuri	3	Bongaigaon	AS	D	Y	Work	125

Annexure-VI

Origin and Destination Survey for Passanger Vehicles

Package No.: NHIDCL/BHARATMALA/DPR/

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:**

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
25	CAR	UP 85 FC 2078	Siju	9	South Garo Hills	ML	Krishnai	2	Goalpara	AS	D	Y	Relative	105
26	CAR	ML 6 D 5783	Nekora	9	South Garo Hills	ML	Goalpara	2	Goalpara	AS	W	N	Work	90
27	MINI BUS	ML 8 BC 2053	Shallang	9	West Khasi Hills	ML	Chapar	3	Dhubri	AS	D	Y	Work	150
28	CAR	AS 11 CC 8085	Kolkata	11	Kolkata	WB	Tezpur	5	Sonitpur	AS	Y	N	Bussiness	1110
29	CAR	AS A 59 1 8	Ampati	7	uth West Garo H	ML	Agia	2	Goalpara	AS	M	N	Darshan	160
30	CAR	AS 18 BC 8878	Damra	1	Goalpara	AS	udhnoi High Scho	1	Goalpara	AS	D	Y	Education	45
31	VAN	ML 6 AC 5338	Jengjal	7	West Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Darshan	105
32	CAR	AS 18 H 7035	Depa	6	East Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Relative	95
33	CAR	ML 8 CC 5220	Meatha	9	South Garo Hills	ML	Agia	2	Goalpara	AS	D	Y	Work	85
34	CAR	UP 22 C 585	Damra	1	Goalpara	AS	Rangjuli	1	Goalpara	AS	D	Y	Bussiness	35
35	CAR	AS 11 RC 7350	Tamilnadu	12	Tamilnadu	TN	Guwahati	4	Guwahati	AS	W	N	Work	3000
36	MINI BUS	ML 5 76 28	Shillong	9	East Khasi Hill	ML	Krishnai	2	Goalpara	AS	W	N	Personal	240
37	CAR	ML 7 AC 7088	Williamnagar	6	East Garo Hills	ML	Dhupdhara	2	Goalpara	AS	D	Y	Personal	120
38	MINI BUS	AS 18 AA 8282	Market Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	60
39	MINI BUS	ML 8 PC 8370	Williamnagar	6	East Garo Hills	ML	Manupara	1	Goalpara	AS	D	Y	Personal	115
40	CAR	AS 18 F 3578	Damra	1	Goalpara	AS	Krishi Vigyan Kendra Goalpara	2	Goalpara	AS	D	Y	Education	35
41	JEEP	ML 7 C 2088	Williamnagar	6	East Garo Hills	ML	Chikni	3	Barpeta	AS	D	Y	Work	150
42	BUS	ML 9 PB 8395	Siju	9	South Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Personal	80
43	CAR	ML 5 CC 2983	Shillong	9	East Khasi Hill	ML	Madhya Madariha	11	Alipurduar	WB	M	N	Personal	430
44	CAR	AS 18 AC 2798	Depa	6	East Garo Hills	ML	Dudhnoi	1	Goalpara	AS	W	N	Personal	95
45	MINI BUS	ML 4 AC 893	Shallang	9	West Khasi Hills	ML	Agia	2	Goalpara	AS	W	N	Work	195

Annexure-VI

Origin and Destination Survey for Passanger Vehicles

Package No.: NHIDCL/BHARATMALA/DPR/

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:**

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
46	CAR	UP 27 AC 722	Balpakram National Park	9	South Garo Hills	ML	Guwahati	4	Guwahati	AS	D	Y	Family	180
47	VAN	ML 6 FC 928	Jengjal	7	West Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Tourists	105
48	CAR	AS 18 AC 7092	Damra	1	Goalpara	AS	Rangjuli	1	Goalpara	AS	D	Y	Bussiness	30
49	CAR	AS 11 K 9353	Kolkata	11	Kolkata	WB	Jorhat	5	Jorhat	AS	Y	N	Bussiness	1300
50	CAR	ML 8 K 9258	Williamnagar	6	East Garo Hills	ML	Dhupdhara	2	Goalpara	AS	D	Y	Passenger	125
51	CAR	AS 24 A 382	Damra	1	Goalpara	AS	Dhupdhara	2	Goalpara	AS	W	N	Bussiness	35
52	MINI BUS	ML 8 F 8552	Wageasi	6	East Garo Hills	ML	Abhayapuri	3	Bongaigaon	AS	D	Y	Work	125
53	CAR	ML 8 FC 9323	Meatha	9	South Garo Hills	ML	Krishnai	2	Goalpara	AS	D	Y	Bussiness	105
54	VAN	ML 08 BC 2822	Jowai	9	Jaintia Hills	ML	Goalpara	2	Goalpara	AS	W	N	Personal	300
55	CAR	AS 11 BC 2722	Tamilnadu	12	Tamilnadu	TN	Guwahati	4	Guwahati	AS	Y	N	Work	3000
56	CAR	ML 5 Z 2720	Jengjal	7	West Garo Hills	ML	Chapar	3	Dhubri	AS	D	Y	Personal	135
57	CAR	AS 16 BC 8709	Damra	1	Goalpara	AS	Krishi Vigyan Kendra Goalpara	2	Goalpara	AS	D	Y	Personal	45
58	MINI BUS	ML 5 F 2898	Chokpot	9	South Garo Hills	ML	Bilasipara	3	Dhubri	AS	W	N	Bussiness	250
59	CAR	WB 69 AC 8773	Shillong	9	East Khasi Hill	ML	Hasimara	11	Alipurduar	WB	M	N	Work	430
60	CAR	ML 6 94 75	Balpakram National Park	9	South Garo Hills	ML	Dispur	4	Guwahati	AS	D	Y	Passenger	220
61	CAR	ML 8 12 52	Meatha	9	South Garo Hills	ML	Dudhnoi	1	Goalpara	AS	Y	N	Self	80
62	CAR	ML 7 Q 3322	Williamnagar	6	East Garo Hills	ML	Dhupdhara	2	Goalpara	AS	D	Y	Personal	120
63	CAR	ML 8 12 5298	Siju	9	South Garo Hills	ML	Bilasipara	3	Dhubri	AS	W	N	Work	250
64	MINI BUS	ML 8 AP 8898	Dainadubi	6	East Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	85
65	CAR	NL 07 B 7225	Kolkata	11	Kolkata	WB	Dimapur	10	Dimapur	NL	M	N	Bussiness	1000

Origin and Destination Survey for Passanger Vehicles

Package No.: NHIDCL/BHARATMALA/DPR/

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:**

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
66	CAR	UP 32 C 355	Williamnagar	6	East Garo Hills	ML	Boko	4	Kamrup	AS	W	N	Relative	230
67	VAN	AS 10 BC 220	Jowai	9	Jaintia Hills	ML	Goalpara	2	Goalpara	AS	W	N	Work	300
68	BUS	AS 12 B 2333	Shallang	9	West Khasi Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	165
69	CAR	ML 5 E 5572	Siju	9	South Garo Hills	ML	Dudhnoi	1	Goalpara	AS	M	N	Darshan	80
70	MINI BUS	ML 5 B 3307	Shillong	9	East Khasi Hill	ML	Krishnai	2	Goalpara	AS	M	N	Bussiness	240
71	CAR	AS 19 C 3523	Damra	1	Goalpara	AS	Jogighopa	3	Bongaigaon	AS	D	Y	Work	45
72	CAR	ML 4 Q 7250	Odisha	12	Odisha	OR	Guwahati	4	Guwahati	AS	W	N	Work	1300
73	CAR	ML 8 C 3238	Williamnagar	6	East Garo Hills	ML	Mornoi	1	Goalpara	AS	D	Y	Work	125
74	MINI BUS	AS 7 A 325	Williamnagar	6	East Garo Hills	ML	Mornoi	1	Goalpara	AS	D	Y	Bussiness	122
75	CAR	NE W	Balpakram National Park	9	South Garo Hills	ML	Nalbari	5	Nalbari	AS	Y	N	Work	225
76	CAR	AS 19 A 934	Siju	9	South Garo Hills	ML	Abhayapuri	3	Bongaigaon	AS	M	N	Work	185
77	CAR	AS 24 C 5222	Meatha	9	South Garo Hills	ML	Dudhnoi	1	Goalpara	AS	W	N	Darshan	80
78	MINI BUS	AS 29 A 6084	Siju	9	South Garo Hills	ML	Goalpara	2	Goalpara	AS	D	Y	Work	90
79	CAR	AS 11 BC 1875	Odisha	12	Odisha	OR	Guwahati	4	Guwahati	AS	W	N	Bussiness	1300
80	VAN	AS 8 FC 9068	Williamnagar	6	East Garo Hills	ML	Dhupdhara	2	Goalpara	AS	W	N	Work	120
81	CAR	UP 32 SA 9357	Shillong	9	East Khasi Hill	ML	Dudhnoi	1	Goalpara	AS	M	N	Bussiness	230
82	JEEP	AS 11 BC 5820	Damra	1	Goalpara	AS	udhnoi High Scho	1	Goalpara	AS	D	Y	Education	30
83	CAR	AS 12 AX 5842	Jowai	9	Jaintia Hills	ML	Krishnai	2	Goalpara	AS	M	N	Personal	315
84	BUS	AS 9 BC 4694	Dainadubi	6	East Garo Hills	ML	Dudhnoi	1	Goalpara	AS	D	Y	Bussiness	90
85	VAN	AS 8 J 7580	Williamnagar	6	East Garo Hills	ML	Boko	4	Kamrup	AS	Y	N	Bussiness	230
86	CAR	AS 11 B 9225	Damra	1	Goalpara	AS	Dhupdhara	2	Goalpara	AS	D	Y	Personal	35
87	MINI BUS	ML 7 B 6425	Williamnagar	6	East Garo Hills	ML	Dhupdhara	2	Goalpara	AS	D	Y	Work	120
88	CAR	ML 4 94 6	Siju	9	South Garo Hills	ML	anas National Par	3	Barpeta	AS	W	N	Tourists	240

Annexure-VI

Origin and Destination Survey for Passanger Vehicles

Package No.: NHIDCL/BHARATMALA/DPR/

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:**

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Trip purpose	Trip (Km)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State				
89	MINI BUS	AS 11 NV 3319	Shallang	9	West Khasi Hills	ML	Goalpara	2	Goalpara	AS	D	Y	Personal	185
90	CAR	AS 18 FC 3198	Meatha	9	South Garo Hills	ML	Krishnai	2	Goalpara	AS	D	Y	Relative	105

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Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity Type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
1	2XL	ML 08 BC 2696	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	W	N	Equpments	150	12
2	LCV	AS 14 FC 5672	Dudhnoi	1	Goalpara	AS	Mizoram	10	Mizoram	MZ	M	N	Sugar	700	4
3	LCV	AS 18 B 9131	Barpeta	3	Barpeta	AS	Damra	1	Goalpara	AS	D	Y	Gas Cylender	130	2
4	2XL	AS 20 KC 7969	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Empty	35	0
5	LCV	AS 14 CC 5459	Paltan Bazaar	4	Guwahati	AS	Market Damra	1	Goalpara	AS	W	N	Khad	155	2
6	LCV	AS 18 FC 2299	Dudhnoi	1	Goalpara	AS	Rongjeng	6	East Garo Hills	ML	D	Y	Transformer	100	3
7	2XL	ML 05 FC 9222	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	W	N	Gas Cylender	50	10
8	MXL	AS 24 G 1418	Bongaigaon	3	Bongaigaon	AS	Rongjeng	6	East Garo Hills	ML	D	Y	Kabada	130	38
9	LCV	AS 14 CA 5648	Jogighopa	3	Bongaigaon	AS	Wageasi	6	East Garo Hills	ML	W	N	Furniture	135	2
10	LCV	AS 18 KS 1249	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Fruits	50	2
11	2XL	AS 20 A 6248	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	W	N	Empty	150	0
12	LCV	AS 12 FC 7626	Guwahati	4	Guwahati	AS	Rangram	11	Singhbhum	JH	W	N	Kabada	1120	1
13	LCV	AS 18 K 9498	Dudhnoi	1	Goalpara	AS	Damra	1	Goalpara	AS	D	Y	Cement	35	1
14	2XL	AS 11 BC 5468	Abhayapuri	3	Bongaigaon	AS	Hailakandi	5	Hailakandi	AS	M	N	Gas Cylender	450	10
15	LCV	ML 7 UU 7067	Guwahati	4	Guwahati	AS	Williamnagar	6	East Garo Hills	ML	M	N	Sand	205	1.5
16	LCV	AS 24 AM 2824	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	M	N	Machine	150	2
17	MXL	UP 93 C 5782	Dudhnoi	1	Goalpara	AS	Market Damra	1	Goalpara	AS	D	Y	Petrol	35	40
18	2XL	ML 8 N 9604	Nalbari	5	Nalbari	AS	Resubelpara	6	East Garo Hills	ML	W	N	Oil Tanker	250	12

Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity Type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
19	LCV	AS 12 AC 7565	Abhayapuri	3	Bongaigaon	AS	Damra	1	Goalpara	AS	D	Y	Gas Cylinder	55	3
20	LCV	AS 21 BC 1879	Guwahati	4	Guwahati	AS	Rangram	11	Singhbhum	JH	Y	N	Empty	1120	0
21	2XL	ML 6 DC 2505	Paltan Bazaar	4	Guwahati	AS	Silchar	5	Cachar	AS	W	N	Oil Tanker	330	12
22	LCV	AS 12 NC 7688	Bongaigaon	3	Bongaigaon	AS	Silchar	5	Cachar	AS	W	N	Parcel	500	2
23	LCV	ML 8 FC 9224	Dudhnoi College	1	Goalpara	AS	Govt. Higher Se	1	Goalpara	AS	W	N	Furniture	45	3
24	2XL	AS 11 C 3155	Guwahati	4	Guwahati	AS	Ranikor	8	East Khasi Hills	ML	D	Y	Empty	135	0
25	MXL	AS 24 N 1907	Barpeta	3	Barpeta	AS	Shillong	8	East Khasi Hills	ML	W	N	Bricks	180	32
26	LCV	AS 12 CC 2088	Goalpara	1	Goalpara	AS	Market Damra	1	Goalpara	AS	D	Y	Empty	50	0
27	LCV	ML 6 FC 8066	Paltan Bazaar	4	Guwahati	AS	Hailakandi	5	Hailakandi	AS	W	N	Empty	300	0
28	2XL	AS 24 C 5282	Jogighopa	3	Bongaigaon	AS	Damra	1	Goalpara	AS	W	N	Furniture	45	10
29	LCV	ML 5 FB 8139	Jogighopa	3	Bongaigaon	AS	Shillong	8	East Khasi Hills	ML	W	N	Empty	250	0
30	LCV	ML 8 FB 2099	Bongaigaon	3	Bongaigaon	AS	Shallang	8	West Khasi Hills	ML	M	N	Wood	150	2
31	2XL	ML 7 H 5153	Dudhnoi	1	Goalpara	AS	Mizoram	10	Mizoram	MZ	Y	N	Groceries	700	10
32	LCV	AS 19 MC 3418	Barpeta	3	Barpeta	AS	Market Damra	1	Goalpara	AS	W	N	Paper Roll	132	1
33	LCV	AS 30 CC 6056	Abhayapuri	3	Bongaigaon	AS	Resubelpara	6	East Garo Hills	ML	D	Y	Animal Food	125	3
34	MXL	UP 85 MN 9160	Guwahati	4	Guwahati	AS	Kolkata	11	Kolkata	WB	M	N	Iron	1020	40
35	2XL	AS 24 BC 6355	Paltan Bazaar	4	Guwahati	AS	Wageasi	6	East Garo Hills	ML	M	N	Petrol Tanker	195	12
36	LCV	AS 12 G 6257	Nalbari	5	Nalbari	AS	Shallang	8	West Khasi Hills	ML	M	N	Mixture Machine	350	1.5

Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Dudhnoi-Damra -Dainadubi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity Type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
37	LCV	ML 9 A 5918	Guwahati	4	Guwahati	AS	Songsak	6	East Garo Hills	ML	D	Y	Cement	205	2
38	2XL	ML 05 E 8972	Barpeta	3	Barpeta	AS	Shallang	8	West Khasi Hills	ML	W	N	Bricks	230	9
39	LCV	AS 30 NV 4313	Guwahati	4	Guwahati	AS	Rongjeng	6	East Garo Hills	ML	W	N	Bamboo	200	1.5
40	2XL	ML 05 AC 6505	Jogighopa	3	Bongaigaon	AS	Shillong	8	East Khasi Hills	ML	M	N	Fruits	250	12
41	MXL	AS 24 A 6530	Nalbari	5	Nalbari	AS	Mizoram	10	Mizoram	MZ	W	N	Oil Tank	650	34
42	LCV	AS 19 FC 6677	Paltan Bazaar	4	Guwahati	AS	Shillong	8	East Khasi Hills	ML	D	Y	Gas Cylender	90	1.5
43	3XL	AS 18 F 6994	Guwahati	4	Guwahati	AS	Damra	1	Goalpara	AS	W	N	Wheat	150	18
44	LCV	AS 30 AC 5339	Goalpara	1	Goalpara	AS	Silchar	5	Cachar	AS	M	N	Empty	450	0
45	3XL	ML 8 GC 7066	Guwahati	4	Guwahati	AS	Sahibganj	11	Sahibganj	JH	M	N	Petrol	750	20
46	LCV	AS 30 H 7310	Dudhnoi College	1	Goalpara	AS	Govt. Higher S	1	Goalpara	AS	D	Y	Furniture	50	2
47	3XL	AS 24 N 2787	Nalbari	5	Nalbari	AS	Silchar	5	Cachar	AS	W	N	Iron	385	15

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
1	2XL	ML 4 H 6940	Churaibari	5	Karimganj	AS	Guwahati	4	Guwahati	AS	Y	N	Auto Parts	315	10
2	LCV	AS 24 C 6228	Agartala	10	Agartala	TR	Dhupdhara	2	Goalpara	AS	Y	N	Cement	650	2
3	LCV	NL 1 A 3781	Damra	1	Goalpara	AS	Dudhoni	1	Goalpara	AS	D	Y	Cloths Bundell	45	2
4	2XL	MZ 2 3 2763	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Empty	50	0
5	LCV	ML 5 BC 1875	Churaibari	5	Karimganj	AS	Guwahati	4	Guwahati	AS	W	N	Machine	315	1
6	LCV	AS 24 25 2186	Damra	1	Goalpara	AS	Goalpara	2	Goalpara	AS	W	N	Fertilizer Bags	40	1.2
7	2XL	ML 4 T 4738	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	W	N	Bricks	50	12
8	LCV	ML 5 BC 3352	Shillong	8	East Khasi Hill	ML	Dudhnoi	1	Goalpara	AS	W	N	Kabada	230	2
9	2XL	ML 5 E 5072	Damra	1	Goalpara	AS	Dudhnoi	1	Goalpara	AS	D	Y	Cement	55	8
10	LCV	AS 18 BC 4816	Tura	7	West Garo Hills	ML	Agia	2	Goalpara	AS	D	Y	Chair	150	1.5
11	LCV	ML 6 AC 3967	Shillong	8	East Khasi Hill	ML	Dudhnoi	1	Goalpara	AS	W	N	Parcel	230	2
12	2XL	AS 11 BQ 2141	Rongram	7	West Garo Hills	ML	Darjeeling	11	Darjeeling	WB	M	N	Bricks	460	9
13	LCV	ML 5 CC 5444	Churaibari	5	Karimganj	AS	Guwahati	4	Guwahati	AS	W	N	Groceries	315	2
14	LCV	AS 18 C 1870	Mizoram	10	Mizoram	MZ	Nalbari	5	Nalbari	AS	W	N	Empty	650	0
15	MXL	UP 78 E 8115	Tripura	10	Tripura	TR	Dhubri	3	Dhubri	AS	M	N	Empty	720	0
16	2XL	NL 1 NC 5868	shillong	8	East Khasi Hill	ML	Guwahati	4	Guwahati	AS	D	Y	Iron rod	95	12
17	LCV	ML 1 AA 3181	Silchar	5	Cachar	AS	Barpeta	3	Barpeta	AS	Y	N	Gitti	400	1.5
18	2XL	ML 4 C 8879	Nairang	8	West Khasi Hills	ML	Goalpara	2	Goalpara	AS	D	Y	Gitti	185	10

GLOBAL INFRA SOLUTIONS
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Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
19	LCV	AS 24 C 9299	Rompa	1	Goalpara	AS	Bongaigaon	3	Bongaigaon	AS	D	Y	Oil Tanker	50	2
20	LCV	ML 6 BC 8014	Williamnagar	6	East Garo Hills	ML	Agia	2	Goalpara	AS	D	Y	Empty	120	0
21	2XL	MZ 5 A 1334	siju	10	South Garo Hills	ML	Boko	4	Kamrup	AS	D	Y	Iron	120	12
22	LCV	ML 8 BC 4644	Mizoram	10	Mizoram	MZ	Goalpara	2	Goalpara	AS	M	N	Cement	732	1
23	LCV	AS 18 BC 5866	Silchar	5	Cachar	AS	Dhupdhara	2	Goalpara	AS	W	N	Plastic Pipe	435	2
24	2XL	AS 18 A 4772	shillong	8	East Khasi Hill	ML	Dhubri	2	Dhubri	AS	Y	N	Kabada	350	12
25	LCV	ML 6 CC 6246	Rongram	7	West Garo Hills	ML	Dhubri	2	Dhubri	AS	D	Y	Empty	140	0
26	2XL	AS 11 D 5228	Tura	7	West Garo Hills	ML	Gohpur	5	Biswanath	AS	M	N	Iron Pole	500	10
27	LCV	ML 8 EE 2545	Damra market	1	Goalpara	AS	Krishnai	2	Goalpara	AS	D	Y	Cement	50	2
28	MXL	ML 6 BC 5651	Agartala	10	Agartala	TR	Guwahati	4	Guwahati	AS	W	N	Medicine	500	32
29	2XL	AS 11 CC 6647	Agartala	10	Agartala	TR	Goalpara	2	Goalpara	AS	W	N	Sand	660	10
30	LCV	ML 9 H 7195	Chokpot	10	South Garo Hills	ML	Bongaigaon	2	Bongaigaon	AS	W	N	Wood	165	2
31	2XL	ML 6 C 5013	Rompa	1	Goalpara	AS	Guwahati	4	Guwahati	AS	W	N	Cartoon Box	150	8
32	LCV	ML 5 G 3661	shillong	8	East Khasi Hill	ML	Barpeta	2	Barpeta	AS	D	Y	Gas Cylinder	180	1
33	2XL	ML 8 B 9306	Tripura	10	Tripura	TR	Bongaigaon	3	Bongaigaon	AS	W	N	Medicine	650	9
34	LCV	AS 03PC 5136	Nairang	8	West Khasi Hills	ML	Agia	2	Goalpara	AS	D	Y	Sand	190	1.5
35	2XL	ML 6 R 1253	Mizoram	10	Mizoram	MZ	Dari Duri	2	Goalpara	AS	M	N	Empty	750	0
36	LCV	AS 8 BC 7199	Tura	7	West Garo Hills	ML	Goalpara	2	Goalpara	AS	W	N	Water Tank	135	2
37	2XL	ML 8 1 9086	Rongram	7	West Garo Hills	ML	Goalpara	2	Goalpara	AS	D	Y	Plywood	135	12
38	LCV	AS 6 AA 8047	Chokpot	10	South Garo Hills	ML	Nalbari	5	Nalbari	AS	W	N	Caret Box	320	1.5
39	MXL	MZ 4 C 5375	Mizoram	10	Mizoram	MZ	Sikkim	11	Sikkim	SK	Y	N	Iron Road	1150	38

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Annexure-VI

Origin and Destination Survey for Goods Vehicles

Road Section : Dudhnoi-Damra (5.00 Km)

Location: At km 3+500 (Near Damra A.S.A. Play Ground) **Date:** 11/23/2018

Direction : Damra-Dudhnoi

Sr. No.	Vehicle Type	Vehicle Reg. No.	Origin				Destination				Trip Frequency	Round Trip in the same	Commodity type	Trip (Km)	Weight (T)
			Village/ Town	Zone	District	State	Village/ Town	Zone	District	State					
40	2XL	ML 9 H 6176	Tripura	10	Tripura	TR	Dhubri	3	Dhubri	AS	W	N	Paper Roll	720	10
41	LCV	AS 10 N 9693	Damra market	1	Goalpara	AS	Dhupdhara	2	Goalpara	AS	D	Y	Chicken	35	2.5
42	2XL	ML 10 A 4250	siju	10	South Garo Hills	ML	Nalbari	5	Nalbari	AS	Y	N	Chemical Tanke	320	10
43	LCV	WB 6 D 5906	Shallang	8	West Khasi Hills	ML	Bongaigaon	2	Bongaigaon	AS	D	Y	Fertilizer Bags	150	2
44	2XL	ML 12 G 1324	Agartala	10	Agartala	TR	Guwahati	4	Guwahati	AS	W	N	Parcel	500	12
45	LCV	NE 4 8922	Rongram	7	West Garo Hills	ML	Dhubri	2	Dhubri	AS	W	N	Branch	140	2
46	2XL	ML 8 CD 7889	Silchar	5	Cachar	AS	Goalpara	2	Goalpara	AS	M	N	Empty	450	0
47	LCV	AS 24 C 3012	shillong	8	East Khasi Hill	ML	Gohpur	5	Biswanath	AS	W	N	Paddy	350	1.5
48	3XL	UP 70 BC 1754	Damra	1	Goalpara	AS	Guwahati	4	Guwahati	AS	D	Y	Cement Pole	150	20
49	LCV	AS 6 C 9035	Williamnagar	6	East Garo Hills	ML	Dari Duri	2	Goalpara	AS	D	Y	Rice	125	2
50	3XL	ML 9 C 8078	Chokpot	10	South Garo Hills	ML	Bongaigaon	2	Bongaigaon	AS	W	N	Plastic Bags	165	18

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Annexure-VI

Traffic Flow

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Section : Dudhnoi-Damra (5.00 Km)
Location: At km 3+500 (Near Damra A.S.A. Play Ground)
Direction : Dudhnoi-Damra -Dainadubi

		Data	
State	**District**	**Count of District**	**Percentage of District**
Assam	Barpeta	13	2.26%
	Biswanath	2	0.35%
	Bongaigaon	29	5.03%
	Cachar	9	1.56%
	Dhubri	10	1.74%
	Goalpara	195	33.85%
	Guwahati	53	9.20%
	Hailakandi	2	0.35%
	Jorhat	1	0.17%
	Kamrup	16	2.78%
	Karimganj	4	0.69%
	Nagaon	3	0.52%
	Nalbari	8	1.39%
	Sonitpur	5	0.87%
Assam Total		**350**	**60.76%**
Jharkahand	Chatra	1	0.17%
	Jamshedpur	1	0.17%
	Sahibganj	1	0.17%
	Singhbhum	2	0.35%
Jharkahand Total		**5**	**0.87%**
Meghalaya	East Garo Hills	58	10.07%
	East Khasi Hill	15	2.60%
	East Khasi Hills	15	2.60%
	Jaintia Hills	3	0.52%
	Meghalaya	2	0.35%
	South Garo Hills	30	5.21%
	South West Garo Hills	3	0.52%
	West Garo Hills	32	5.56%
	West Khasi Hills	25	4.34%
Meghalaya Total		**183**	**31.77%**
Mizoram	Mizoram	7	1.22%
Mizoram Total		**7**	**1.22%**
Nagaland	Dimapur	1	0.17%
Nagaland Total		**1**	**0.17%**
Odhisa	Odisha	2	0.35%
Odhisa Total		**2**	**0.35%**
Sikkim	Sikkim	1	0.17%
Sikkim Total		**1**	**0.17%**
Tamilnadu	Tamilnadu	2	0.35%
Tamilnadu Total		**2**	**0.35%**
Tripura	Agartala	4	0.69%

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Tripura	Tripura	3	0.52%
Tripura Total		**7**	**1.22%**
Uttarakhand	Nainital	2	0.35%
Uttarakhand Total		**2**	**0.35%**
West Bengal	Alipurduar	3	0.52%
	Cooch Behar	1	0.17%
	Darjeeling	1	0.17%
	Jalpaiguri	7	1.22%
	Kolkata	4	0.69%
West Bengal Total		**16**	**2.78%**
Grand Total		**576**	**100.00%**

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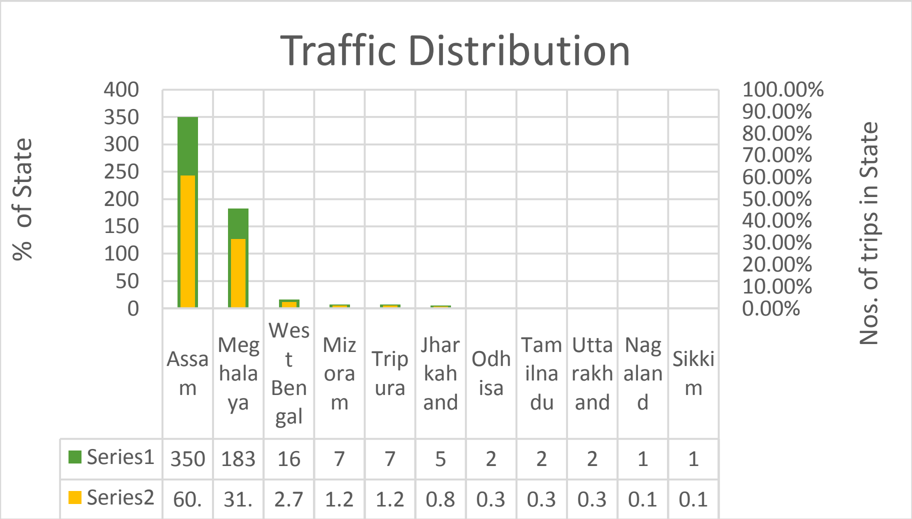
Trafffic Distribution Statewise

Sr No.	State	Count of State	% of State
1	Assam	350	60.76%
2	Meghalaya	183	31.77%
3	West Bengal	16	2.78%
4	Mizoram	7	1.22%
5	Tripura	7	1.22%
6	Jharkahand	5	0.87%
7	Odhisa	2	0.35%
8	Tamilnadu	2	0.35%
9	Uttarakhand	2	0.35%
10	Nagaland	1	0.17%
11	Sikkim	1	0.17%
12	**Grand Total**	**576**	**100.00%**



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Annexure-VI

Zoning of Orizin-Destination (OD) Survey

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018
Road Section : Dudhnoi-Damra (5.00 Km)
Location: At km 3+500 (Near Damra A.S.A. Play Ground)
Direction : Dudhnoi-Damra -Dainadubi

Zone No.	Zone Description	Zone Type	Remarks
1	Local within 5-8km from survey location (Dudhnoi, Damra,Manupara etc.)	Internal	Local
2	Rest of Golpara District (Assam)	Internal	City/Town level
3	Barpeta, Bogaigaon, Dubri (Assam)	External	District Level
4	Guwahati District & Kamrup District (Assam)	External	District Level
5	Rest of Assam	External	State Level
6	North Garo Hills & East Garo Hills (Meghalaya)	External	District Level
7	South West Garo Hills & West Garo Hills (Meghalaya)	External	District Level
8	East Khasi Hill & West Khasi Hill (Meghalaya)	External	District Level
9	Rest of Meghalaya	External	State Level
10	Mizoram, Nagaland, Tripura State	External	State Level
11	West Bengal,Jharkhand & Sikkim	External	State Level
12	Rest of India	External	State Level

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Annexure-VI

TRIP MATRIX FOR Passenger and Goods vehicles

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018
Road Section : Dudhnoi-Damra (5.00 Km)
Location: At 3+200km (Near Damra A.S.A. Play Ground)
Direction : Dudhnoi-Damra

TRIP MATRIX FOR PASSENGER VEHICLES

	DESTINATION ZONES												TOTAL
ORIZIN ZONES	**O/D**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
	1	*14*	*7*	*2*	*0*	*0*	*2*	*0*	*1*	*1*	*0*	*0*	*0*	**27**
	2	*3*	*0*	*0*	*0*	*0*	*9*	*1*	*9*	*5*	*0*	*0*	*0*	**27**
	3	*1*	*0*	*0*	*0*	*0*	*2*	*3*	*5*	*2*	*0*	*0*	*0*	**13**
	4	*8*	*0*	*0*	*0*	*0*	*10*	*2*	*12*	*1*	*0*	*0*	*0*	**33**
	5	*1*	*0*	*0*	*1*	*0*	*2*	*1*	*3*	*0*	*0*	*0*	*0*	**8**
	6	*9*	*7*	*3*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**21**
	7	*2*	*2*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**7**
	8	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	9	*10*	*14*	*5*	*3*	*1*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	**37**
	10	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	11	*2*	*0*	*0*	*0*	*4*	*1*	*0*	*4*	*0*	*1*	*0*	*0*	**12**
	12	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	**6**
	TOTAL	**50**	**30**	**13**	**10**	**5**	**26**	**7**	**36**	**9**	**1**	**4**	**0**	**191**

TRIP MATRIX FOR GOODS VEHICLES

	DESTINATION ZONES												TOTAL
ORIZIN ZONES	**O/D**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
	1	*12*	*3*	*1*	*2*	*1*	*1*	*0*	*0*	*0*	*2*	*0*	*0*	**22**
	2	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	3	*4*	*0*	*0*	*0*	*2*	*3*	*0*	*5*	*0*	*0*	*0*	*0*	**14**
	4	*5*	*0*	*0*	*0*	*2*	*4*	*0*	*2*	*0*	*0*	*4*	*0*	**17**
	5	*0*	*2*	*1*	*3*	*1*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	**10**
	6	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**2**
	7	*0*	*5*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	**7**
	8	*2*	*5*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**9**
	9	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	10	*0*	*6*	*3*	*3*	*3*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	**16**
	11	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	12	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**0**
	TOTAL	**23**	**23**	**5**	**9**	**11**	**9**	**0**	**8**	**0**	**3**	**6**	**0**	**97**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

Zone Influnce factor

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018
Road Section : Dudhnoi-Damra (5.00 Km)
Location: At km 3+500 (Near Damra A.S.A. Play Ground)
Direction : Dudhnoi-Damra -Dainadubi

Zone Influence Factor of Passenger Vehicles

Zone No.	Zone Description	Trip Production	Trip Attraction	ZIF (%)
1	Local within 5-8km from survey location (Dudhnoi, Damra,Manupara etc.)	27	50	20.16
2	Rest of Golpara District (Assam)	27	30	14.92
3	Barpeta, Bogaigaon, Dubri (Assam)	13	13	6.81
4	Guwahati District & Kamrup District (Assam)	33	10	11.26
5	Rest of Assam	8	5	3.40
6	North Garo Hills & East Garo Hills (Meghalaya)	21	26	12.30
7	South West Garo Hills & West Garo Hills (Meghalaya)	7	7	3.66
8	East Khasi Hill & West Khasi Hill (Meghalaya)	0	36	9.42
9	Rest of Meghalaya	37	9	12.04
10	Mizoram, Nagaland, Tripura State	0	1	0.26
11	West Bengal,Jharkhand & Sikkim	12	4	4.19
12	Rest of India	6	0	1.57
Total		**191**	**191**	**100**

Zone Influence Factor of Goods Vehicles

Zone No.	Zone Description	Trip Production	Trip Attraction	ZIF (%)
1	Local within 5-8km from survey location (Dudhnoi, Damra,Manupara etc.)	22	23	23.20
2	Rest of Golpara District (Assam)	0	23	11.86
3	Barpeta, Bogaigaon, Dubri (Assam)	14	5	9.79
4	Guwahati District & Kamrup District (Assam)	17	9	13.40
5	Rest of Assam	10	11	10.82
6	North Garo Hills & East Garo Hills (Meghalaya)	2	9	5.67
7	South West Garo Hills & West Garo Hills (Meghalaya)	7	0	3.61
8	East Khasi Hill & West Khasi Hill (Meghalaya)	9	8	8.76
9	Rest of Meghalaya	0	0	0.00
10	Mizoram, Nagaland, Tripura State	16	3	9.79
11	West Bengal,Jharkhand & Sikkim	0	6	3.09
12	Rest of India	0	0	0.00
Total		**97**	**97**	**100**

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VI

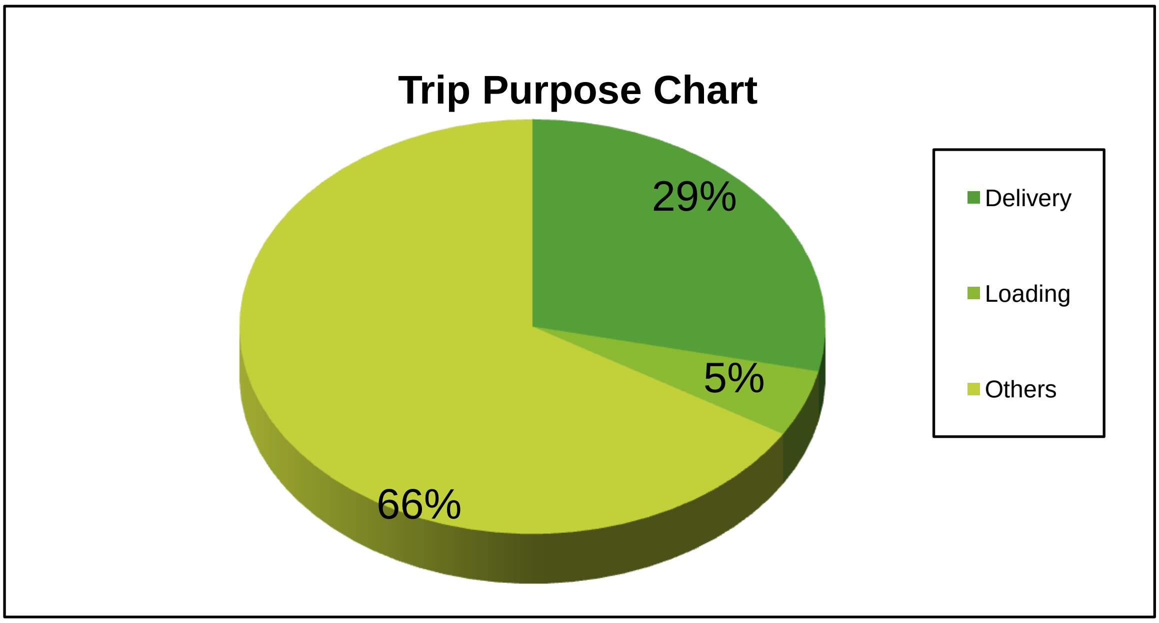
Trip Purpose Chart

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Name : Dudhnoi-Damra (5.00 Km) Date: 11/23/2018

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Purpose of Trip	Total No	Composition (%)
Delivery	82	28.5
Loading	15	5.2
Others	191	66.3
Total	**288**	**100**



GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

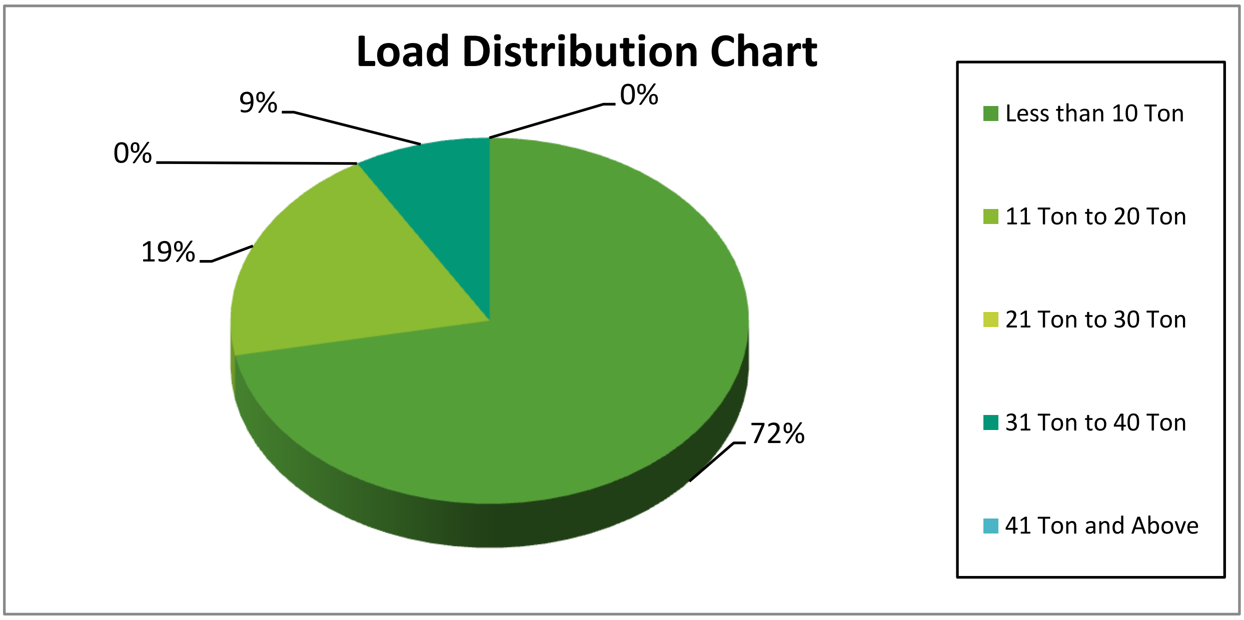
Load Distribution Pattern

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Name: Dudhnoi-Damra (5.00 Km) Date: 11/23/2018

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Load Distribution	**Total No**	**Composition**
Less than 10 Ton	59	72.0
11 Ton to 20 Ton	16	19.5
21 Ton to 30 Ton	0	0.0
31 Ton to 40 Ton	7	8.5
41 Ton and Above	0	0.0
Total	**82**	**100.0**



GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VI

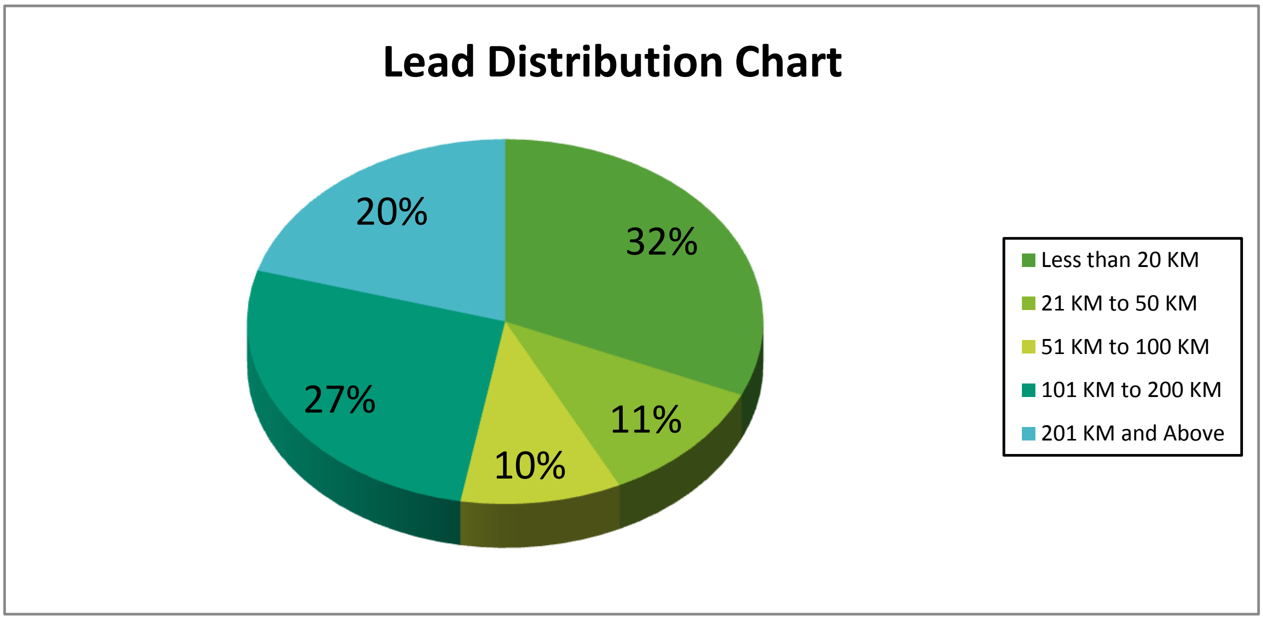
Lead Distribution Pattern

Package No.: NHIDCL/BHARATMALA/DPR/PHASE1/LOT1/PKG 1A/PKG1B/2018

Road Name: Dudhnoi-Damra (5.00 Km) **Date:** 11/23/2018

Location: At km 3+500 (Near Damra A.S.A. Play Ground)

Lead Pattern	Total No	Composition
Less than 20 KM	91	31.60
21 KM to 50 KM	32	11.11
51 KM to 100 KM	29	10.07
101 KM to 200 KM	77	26.74
201 KM and Above	59	20.49
Total	**288**	**100.00**



GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VII

INDEX

Name of Project :- Consultancy Services For Development Of Economic Corridors, Inter Corridors And Feeder Routes To Improve The Efficiency Of Freight Movement In India Under Bharatmala Pariyogana Lot-1 (Ii. Dhudnoi to Dainadubi)

Sr. No.	Existing Chainage	Design Chainage	Type of Proposal	Type of Structure	Span Arrangement (m)	Overall Width (m)	CA (km^2)
1	4+150	4+150	Reconstruction	Minor Bridge	1x25	16.00	1.70

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VII

Name of Project :- Consultancy Services For Development Of Economic Corridors, Inter Corridors And Feeder Routes To Improve The Efficiency Of Freight Movement In India Under Bharatmala Pariyogana Lot-1 (Ii. Dhudnoi to Dainadubi)

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

1. Introduction:

The length of a bridge, depth of foundation & formational level are dependent on the maximum recorded quantum of water or flood discharge which has passed through the river or the channel over which the bridge is proposed and as such the design discharge is very important not only from economic consideration but also from safety or stability consideration. Therefore, the design discharge, which might be the recorded discharge during the past 50-100 years, shall be ascertained very carefully.

The following methods are used for the estimation of flood discharge:

1. Peak Run-off from catchment by using Empirical Formulae.
2. Peak Run-off from catchment and other characteristics of rainfall by using Rational Method.
3. Flood discharge from Cross-Sectional Area-Velocity Method as observed on the stream at the bridge site.

2. Codes Referred for Design Purpose:

IRC: 5 - 2015	Standard Specifications and Code of Practice for Road Bridges Section - I, General Features of Design
IRC: SP: 13 - 2004	Guidelines for the design of small bridges & culverts

3. Abstract of Hydraulic Calculation:

Catchment Area		=	1.697	Sq.km.
Design Discharge		=	49.07	m^3/s
Required Linear Waterway		=	33.62	m
Provided Effective Linear Waterway		=	23.64	m
Design Velocity		=	4.31	m/s
Lowest Bed Level		=	61.027	M
Max. Scour Level		=	61.027	M
Highest Flood Level	(Observed)	=	65.564	M
Highest Flood Level	(Designed)	=	65.714	M
Formation Level		=	68.814	M

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

4. Dickens Formula to Calculate Peak Run-off from Catchment:

Area of Catchment	A	=	169.70 Ha
Dickens Constant	C_D^*	=	22
Discharge	$C_D \times (A)^{3/4}$	=	32.71 m^3/s

5. Rational Formula to Calculate Peak Run-off from Catchment:

Area of Catchment		A	=	169.70 Ha
Length of Longest Stream		L	=	12.44 km
The Fall in Level between source and site		H	=	134.78 m
Co-efficient of Runoff	*(Refer IRC:SP:13-2004, Table 4.1)*	P	=	0.80
100 Years - 24 Hour Rainfall	*(Refer Plate-10 of subzone 2(b))*		=	40.00 cm
100 Years - 1 Hour Rainfall	*(39% of 24 Hour Rainfall)*	I_o	=	15.60 cm
Mean Intensity fraction	*(Refer IRC:SP:13-2004, Fig. 4.2)*	f	=	0.99
Concentration time	$t_c = (0.87 \times L^3 / H)^{0.385}$		=	2.64 hrs.
Critical Intensity of Rainfall	$I_c = I_o (2 / t_c + 1)$		=	8.58 cm/hr
Discharge	$0.028\ P\ f\ A\ I_c$		=	32.28 m^3/s

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

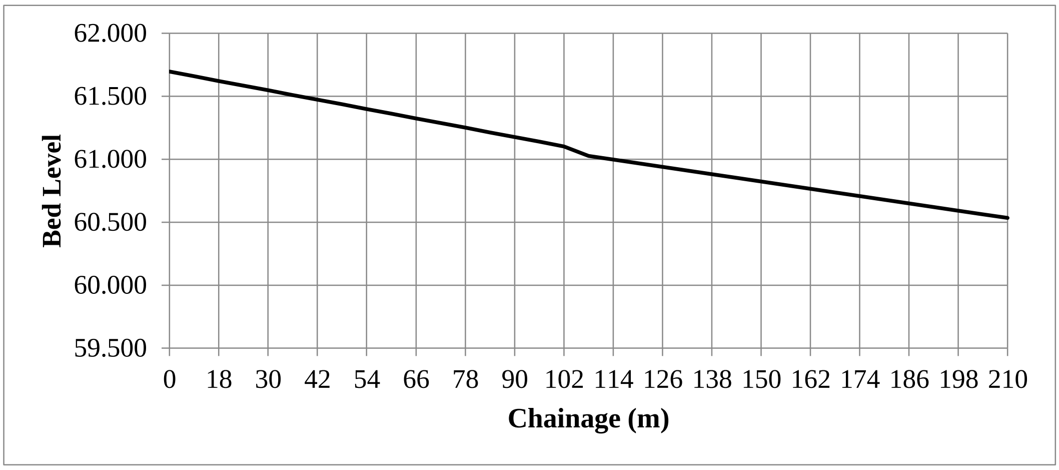
6. Cross-Sectional Area-Velocity Method to Calculate Flood Discharge:

Since the bridge is provided across a defined stream, we estimate flood discharge from the conveyance factor & slope of the

From the survey data & local enquiry, we fix the observed H.F.L. = 65.564 M

Longitudinal Section of River/Stream :

Chainage	R. L.	
0	61.696	Upstream
12	61.659	
18	61.622	
24	61.585	
30	61.547	
36	61.510	
42	61.473	
48	61.436	
54	61.399	
60	61.362	
66	61.324	
72	61.287	
78	61.250	
84	61.213	
90	61.176	
96	61.139	
102	61.101	
108	61.027	Bridge
114	60.998	
120	60.969	
126	60.940	
132	60.911	
138	60.882	
144	60.853	
150	60.824	
156	60.795	
162	60.766	
168	60.737	
174	60.708	
180	60.679	
186	60.650	
192	60.621	
198	60.592	
204	60.563	
210	60.534	Downstream



Location	H.F.L.	Bed Level	Interval
At Bridge Location	65.564	61.027	0.00
At U/S from Bridge Location	66.233	61.696	108.00
At D/S from Bridge Location	65.071	60.534	102.00

From the longitudinal section of the stream, the Bed Slope is obtained as S = 0.0055
Rugosity co-efficient according to bed material n = 0.035
(Refer IRC:SP:13-2004,Table 5.1)

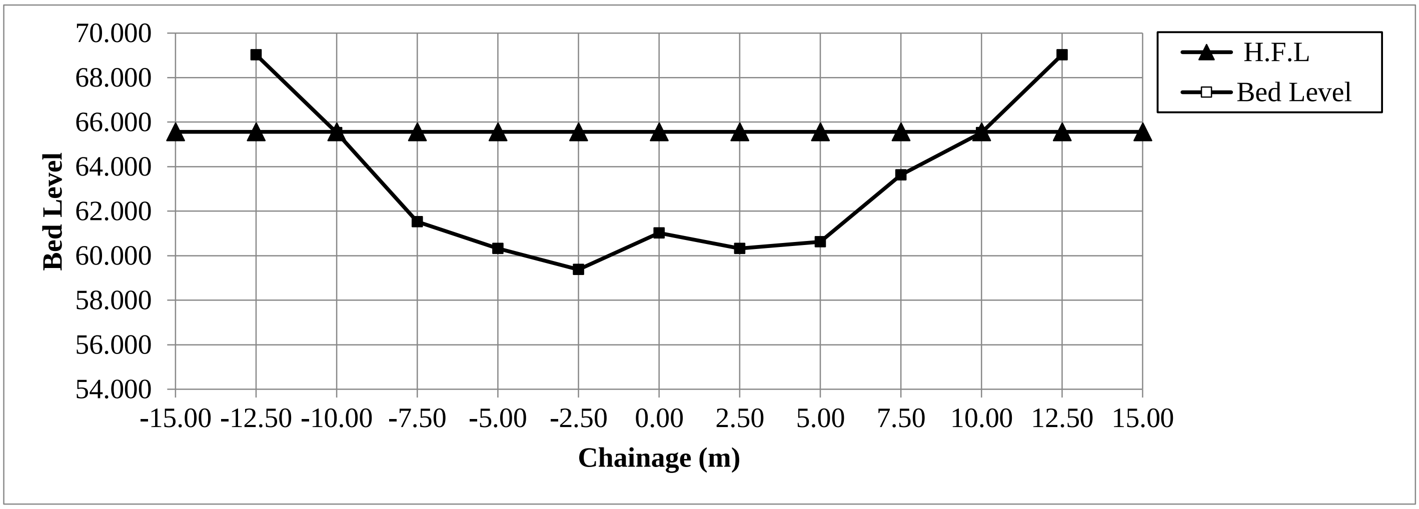
GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

Cross-Section at Bridge Location :

Chainage (m)	H.F.L	Bed Level	Distance (m)	Depth Below H.F.L. (m)	Vertical Difference (m)	Perimeter (m)	Area (m^2)
-15.00	65.564						
-12.50	65.564	69.027					
-10.00	65.564	65.527	2.50	0.037	0.037	2.50	0.05
-7.50	65.564	61.527	2.50	4.037	4.000	4.72	5.09
-5.00	65.564	60.327	2.50	5.237	1.200	2.77	11.59
-2.50	65.564	59.377	2.50	6.187	0.950	2.67	14.28
0.00	65.564	61.027	2.50	4.537	1.650	3.00	13.41
2.50	65.564	60.327	2.50	5.237	0.700	2.60	12.22
5.00	65.564	60.627	2.50	4.937	0.300	2.52	12.72
7.50	65.564	63.627	2.50	1.937	3.000	3.91	8.59
10.00	65.564	65.527	2.50	0.037	1.900	3.14	2.47
12.50	65.564	69.027					
15.00	65.564						
	Average =	**63.268**		**3.576**	**Total =**	**27.82**	**80.41**



Discharge Calculation by Area Velocity method (Using Mannings formula)

Hydraulic Radius		$R = A / P$	=	2.89
Slope of River Bed		S	=	0.0055
Rugosity Co-efficient		n	=	0.035
Therefore,	Velocity	$V = R^{2/3} \times S^{1/2} / n$	=	4.31 m/sec
and	Discharge	**$Q = A \times V$**	=	**346.78 m^3/s**

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Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

7. Linear Waterway Calculation:

Discharge Calculated by Dicken's Formula = 32.71 m^3/s
Discharge Calculated by Rational Formula Formula = 32.28 m^3/s
Discharge Calculated by Cross-Sectional Area-Velocity Method = 346.78 m^3/s

As per IRC:SP:13-2004, Clause 6.2.1*, Design Discharge (Q) = **49.07 m^3/s**
*The highest of these values should be adopted as the design discharge Q, provided it does not exceed the next highest

As per Design Discharge, Linear Water Way Required (4.8 x $\sqrt{Q}$) = **33.62 m**
Bank to bank distance = **30.00 m**

Considering all the above parameters, We are proposing a High Level Bridge, details of which are given below:

Type of Bridge : R.C.C. Solid slab
Span Arrangement = 1 Span(s) of 25 m.
No. of Spans = 1
Overall Span Length = 25.00 m
Bearing Center to Deck End = 0.40 m
Effective Span (center to center of bearings) = 24.20 m
Total Bridge Length (between inner faces of dirt wall) = **25.00 m**
No. of Expansion Gap at bridge portion = 2
Expansion Gap between two adjacent span = 0.02 m
Total Bridge Length (i/c Expansion Gap) = **25.04 m**
No. of Piers = 0
Thickness of One Pier = 1.00 m
No. of Abutments = 2
Distance from dirt wall inner face to Abutment inner face = 0.70 m
Total Obstruction caused due to Sub-Structure = 1.40 m
Provided Effective Linear Waterway = 23.64 m
Clear Vertical Height = 7.19 m
Provided Area of Opening = 169.90 m^2
Velocity of Stream = 4.31 m/sec
Quantum of Discharge which can be passed through Provided Opening = 732.71 m^3/s
Hence Safe
Required Linear Waterway = 33.62 m
Percentage of Obstruction caused due to Sub-Structure = 6.42 %

Here the obstruction caused by sub-structure is 6.42%. However, the obstruction caused to the discharge by the approach roads and bridge structure itself should not be more than 30%. Hence, the proposed linear waterway is in order.

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Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

8. Fixation of Formation Level:

Highest Flood Level (H.F.L.) = **65.564 M**

Afflux = 0.150 m

Designed Highest Flood Level (De. H.F.L.) = **65.714 M**

Vertical Clearance * *(Refer IRC:SP:13-2004,Table 12.1)* = 2.500 m

Soffit Level **(De. H.F.L. + Afflux + Vertical Clearance)** = **68.214 M**

Depth of Top Slab+Girder = 0.550 m

Wearing Course on Deck Slab = 0.050 m

Formation Level as per hydarulic **(Soffit Level + Depth of S.S. + Wearing Course)** **=** **68.814 M**

Formation Level due to Profile correction **69.060 m**

* *Note: Vertical Clearance is taken more than the value specified in IRC:SP:13-2004,Table 12.1 to match the deck level to the*

GLOBAL INFRA SOLUTIONS
BHOPAL

Annexure-VII

Hydraulic Calculation of Minor Bridge at Chainage 4+150 M.

9. Scour Depth Calculation :

Design Discharge = 49.07 m^3/s
%age Increment over Des. Discharge *(Refer IRC:78-2014, Clause 703.1.1)* = 30 %
Incremented Design Discharge *(for scour calculation only)* = 63.79 m^3/s
Provided Effective Linear Waterway = 23.64 m

Scour Depth Calculation :-

D_b = Inc. Design Discharge / Eff. Waterway = 2.70 $m^3/sec/m$
K_{sf} = Silt Factor *(Refer IRC:78-2014, Clause 703.2.2.1)* = 1.75
d_{sm} = Mean Scour Depth *(As per IRC:78-2014, Clause 703.2)*
d_{sm} = $1.34 \times (D_b^2 / K_{sf})^{1/3}$ = 2.155 m
d_{sm} = [(HFL - LBL) / 1.27 Criteria] = 3.572 m
Mean Scour Depth (d_{sm}) *(Max. of above two values)* = 3.572 m

Highest Flood Level (H.F.L.) = 65.564 M
Normal Scour Level (H.F.L.-d_{sm}) = 61.992 M
Max. scour depth = ($1.27 \times d_{sm}$) = 4.537 m
Max. Scour level * = 61.027 M
Avg. Bed Level = 63.268 M
Min. Foundation Level # = 59.027 M
or upto Rock Lvl

# *Note: Foundation levels are calculated on the basis of maximum scour level. Final foundation levels are subjected to availability of*

GLOBAL INFRA SOLUTIONS
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Annexure-VIII

TYPE - 01

TYPICAL CROSS SECTION FOR 2 - LANE WITH PAVED SHOULDER HIGHWAY OVERLAY WIDENING

(BUILT-UP SECTION WITH)

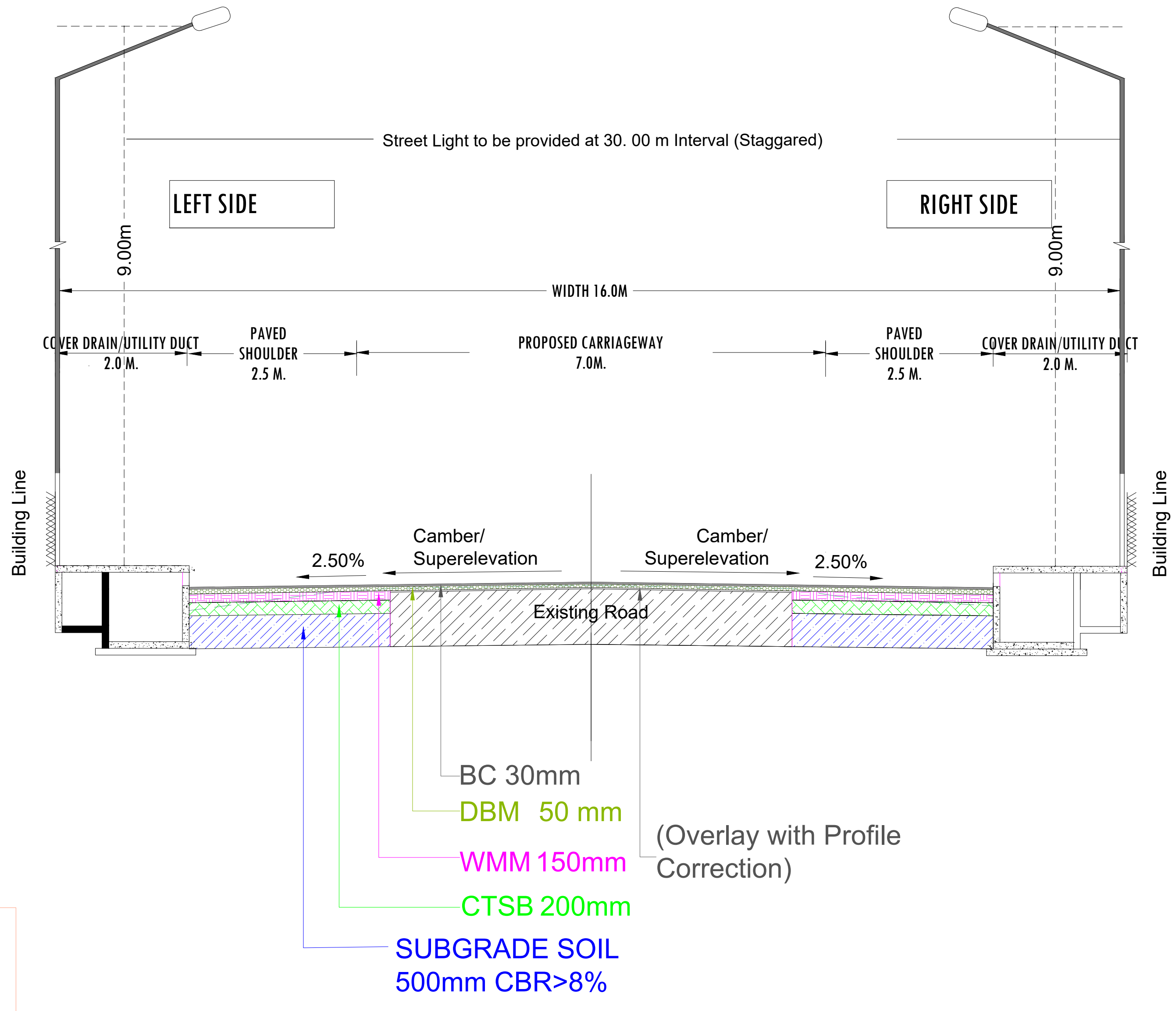
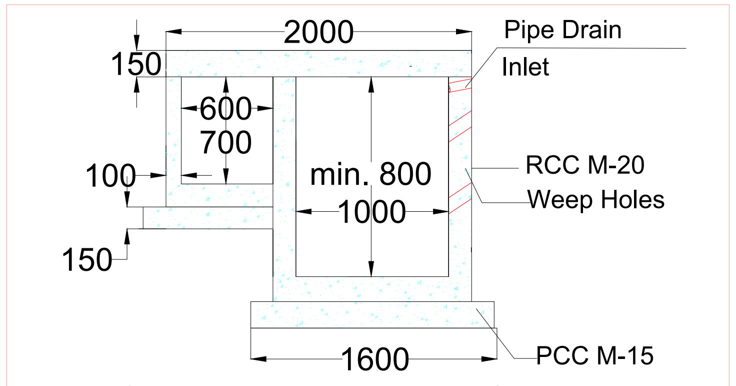

Street Light to be provided at 30. 00 m Interval (Staggared)
LEFT SIDE
RIGHT SIDE
9.00m
9.00m
WIDTH 16.0M
COVER DRAIN/UTILITY DUCT 2.0 M.
PAVED SHOULDER 2.5 M.
PROPOSED CARRIAGEWAY 7.0M.
PAVED SHOULDER 2.5 M.
COVER DRAIN/UTILITY DUCT 2.0 M.
Building Line
Building Line
2.50%
Camber/ Superelevation
Camber/ Superelevation
2.50%
Existing Road
BC 30mm
DBM 50 mm
WMM 150mm
CTSB 200mm
SUBGRADE SOIL 500mm CBR>8%
(Overlay with Profile Correction)

Fig. 2.9 Modified
As per IRC SP 73: 2018


2000
Pipe Drain
Inlet
150
600
700
min. 800
100
1000
RCC M-20
Weep Holes
150
1600
PCC M-15

Details of Footpath cum Drain with Utility Service Duct

NOTES:

1. ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DIMENSIONS SHALL NOT BE SCALED OFF FROM THE DRAWING. ONLY WRITTEN DIMENSION SHALL BE FOLLOWED

Sr. No.	Chainage From (Km.)	Chainage To (Km.)	Length (Km)	TCS Type
1	0.040	0.650	0.610	1
2	0.650	1.360	0.710	1
3	1.700	2.160	0.460	1
4	2.400	3.390	0.990	1
5	4.230	4.525	0.295	1
6	4.525	4.600	0.075	1
7	5.530	5.900	0.370	1
8	8.250	8.415	0.165	1
	Total Length		3.675	

REV.	DATE	REVISIONS

NATIONAL HIGHWAYS & INFRASTRUCTURE
DEVELOPMENT CORPORATION LTD.
PTI BUILDING, 4 PARLIAMENT STREET
SANSAD MARG AREA, NEW DELHI -110001

DESIGN CONSULTANT:
Global Infra Solutions
in JV with **Krishna Techno Consultant.**
F-2, E-8/11A, Global Tower, Trilanga, Bhopal -462039
e: globalinfrasolutions.bpl@gmail.com **web:** globalinfrasolutions.org

PROJECT:
CONSULTANCY SERVICES FOR PREPARATION OF DPR FOR ECONOMIC CORRIDORS, INTER CORRIDORS AND FEEDER ROUTES TO IMPROVE THE EFFICIENCY OF FREIGHT MOVEMENT IN INDIA UNDER BHARATMALA PARIYOJNA (LOT-01) -(PKG-1B)- DUDHNOI-DAINADUBI ROAD (NH-217) IN THE STATE ON MEGHALAYA.

SCALE:
Not to scale
Dimensions as mentioned

TITLE:
TYPICAL CROSS SECTION

CLIENT APPROVAL:
SIGNATURE:
DWG NO:- GIS/1B/NHIDCL/FS/TCS

DRAWN:	CHECKED:	DESIGNED:	APPROVED:
LK	SJ	SC	LA

Annexure-VIII

TYPE - 02

TYPICAL CROSS SECTION FOR 2 - LANE WITH PAVED SHOULDER HIGHWAY OVERLAY WIDENING

(BUILT-UP SECTION WITH)

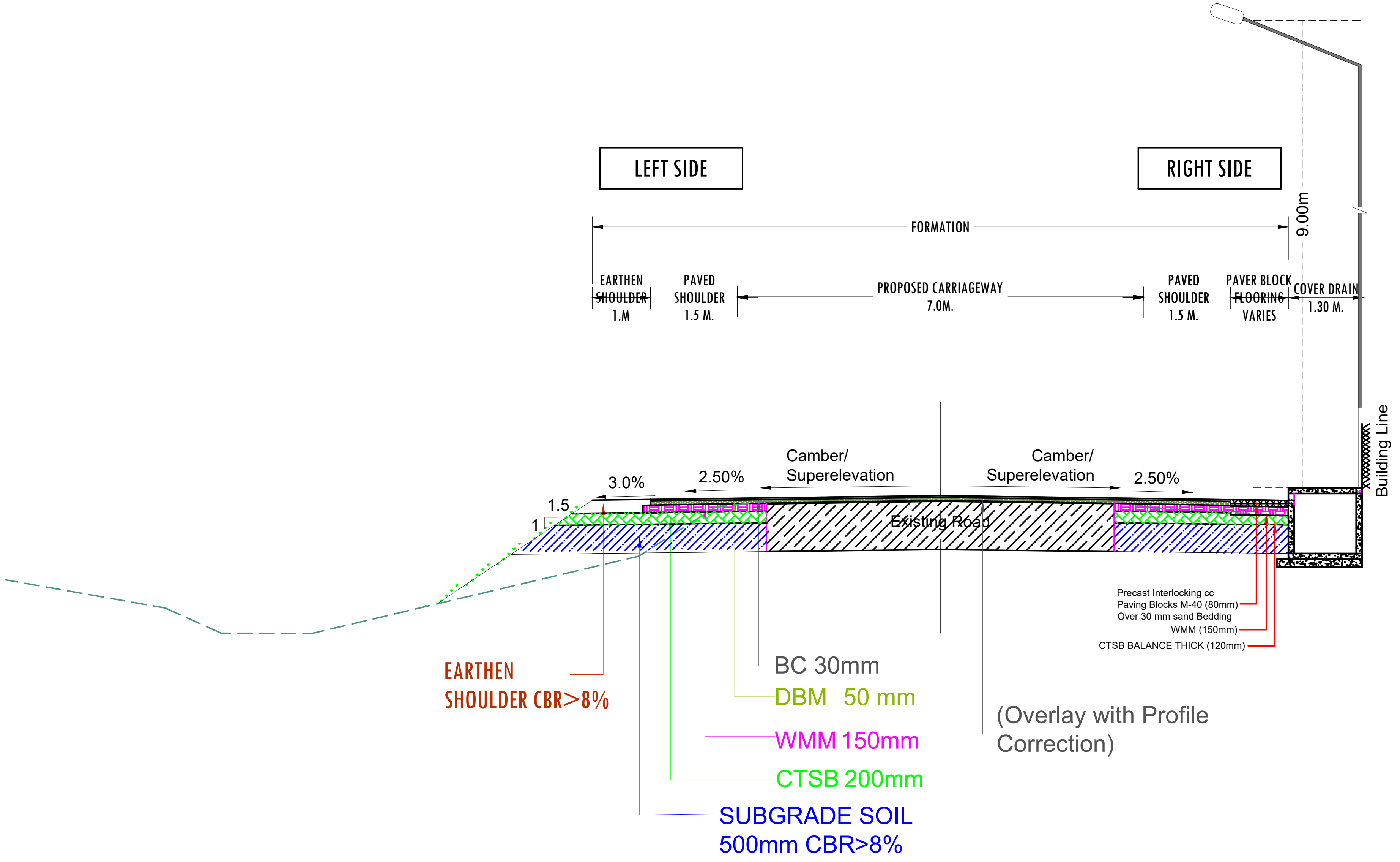

LEFT SIDE
RIGHT SIDE
FORMATION
9.00m
EARTHEN SHOULDER 1.M
PAVED SHOULDER 1.5 M.
PROPOSED CARRIAGEWAY 7.0M.
PAVED SHOULDER 1.5 M.
PAVER BLOCK FLOORING VARIES
COVER DRAIN 1.30 M.
Building Line
Camber/ Superelevation
Camber/ Superelevation
3.0%
2.50%
2.50%
1.5
1
Existing Road
Precast Interlocking cc Paving Blocks M-40 (80mm) Over 30 mm sand Bedding
WMM (150mm)
CTSB BALANCE THICK (120mm)
EARTHEN SHOULDER CBR>8%
BC 30mm
DBM 50 mm
WMM 150mm
CTSB 200mm
SUBGRADE SOIL 500mm CBR>8%
(Overlay with Profile Correction)

Fig. 2.9 Modified
As per IRC SP 73: 2018

NOTES:

1. ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DIMENSIONS SHALL NOT BE SCALED OFF FROM THE DRAWING.
   ONLY WRITTEN DIMENSION SHALL BE FOLLOWED

Sr. No.	Chainage From (Km.)	Chainage To (Km.)	Length (Km)	TCS Type
1	2.160	2.400	0.240	2
2	3.390	3.550	0.160	2
3	4.600	4.720	0.120	2
	Total Length		**0.520**	

REV.	DATE	REVISIONS

NATIONAL HIGHWAYS & INFRASTRUCTURE
DEVELOPMENT CORPORATION LTD.
PTI BUILDING, 4 PARLIAMENT STREET
SANSAD MARG AREA, NEW DELHI -110001

DESIGN CONSULTANT:
Global Infra Solutions
in JV with **Krishna Techno Consultant**.
F-2, E-8/11A, Global Tower, Trilanga, Bhopal -462039
e: globalinfrasolutions.bpl@gmail.com **web:** globalinfrasolutions.org

PROJECT:
CONSULTANCY SERVICES FOR PREPARATION OF DPR FOR ECONOMIC CORRIDORS, INTER CORRIDORS AND FEEDER ROUTES TO IMPROVE THE EFFICIENCY OF FREIGHT MOVEMENT IN INDIA UNDER BHARATMALA PARIYOJNA (LOT-01) -(PKG-1B)- DUDHNOI-DAINADUBI ROAD (NH-217) IN THE STATE ON MEGHALAYA.

SCALE:
Not to scale
Dimensions as mentioned

TITLE:
TYPICAL
CROSS SECTION

CLIENT APPROVAL:
SIGNATURE:

DWG NO:- GIS/1B/NHIDCL/FS/TCS

DRAWN:	CHECKED:	DESIGNED:	APPROVED:
LK	SJ	SC	LA

Annexure-VIII

TYPE - 03

TYPICAL CROSS SECTION FOR 2 - LANE WITH PAVED SHOULDER HIGHWAY OVERLAY WIDENING (OPEN COUNTRY -PLAIN TERRAIN)

BANKING SECTION
HEIGHT LESS THAN 3m

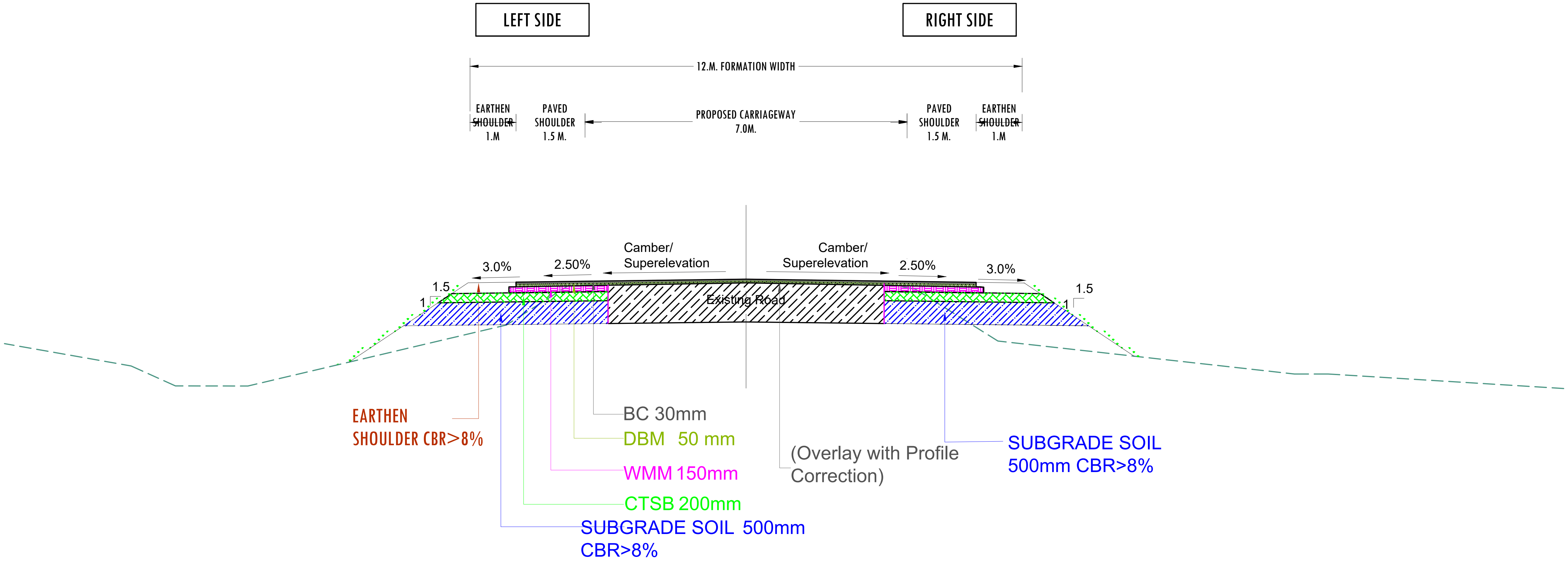

LEFT SIDE
RIGHT SIDE
12.M. FORMATION WIDTH
EARTHEN SHOULDER 1.M
PAVED SHOULDER 1.5 M.
PROPOSED CARRIAGEWAY 7.0M.
PAVED SHOULDER 1.5 M.
EARTHEN SHOULDER 1.M
Camber/ Superelevation
Camber/ Superelevation
3.0%
2.50%
2.50%
3.0%
1.5
1
1.5
1
Existing Road
EARTHEN SHOULDER CBR>8%
BC 30mm
DBM 50 mm
WMM 150mm
CTSB 200mm
SUBGRADE SOIL 500mm CBR>8%
(Overlay with Profile Correction)
SUBGRADE SOIL 500mm CBR>8%

Fig. 2.9 Modified
As per IRC SP 73: 2018

Sr. No.	Chainage From (Km.)	Chainage To (Km.)	Length (Km)	TCS Type
1	1.360	1.700	0.340	3
2	3.550	3.650	0.100	3
3	4.720	5.200	0.480	3
4	5.900	8.250	2.350	3
	Total Length		3.270	

NOTES:

1. ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DIMENSIONS SHALL NOT BE SCALED OFF FROM THE DRAWING.
   ONLY WRITTEN DIMENSION SHALL BE FOLLOWED

REV.	DATE	REVISIONS

NATIONAL HIGHWAYS & INFRASTRUCTURE
DEVELOPMENT CORPORATION LTD.
PTI BUILDING, 4 PARLIAMENT STREET
SANSAD MARG AREA, NEW DELHI -110001

DESIGN CONSULTANT:
Global Infra Solutions
in JV with **Krishna Techno Consultant**.
F-2, E-8/11A, Global Tower, Trilanga, Bhopal -462039
e: globalinfrasolutions.bpl@gmail.com web: globalinfrasolutions.org

PROJECT:
CONSULTANCY SERVICES FOR PREPARATION OF DPR FOR ECONOMIC CORRIDORS, INTER CORRIDORS AND FEEDER ROUTES TO IMPROVE THE EFFICIENCY OF FREIGHT MOVEMENT IN INDIA UNDER BHARATMALA PARIYOJNA (LOT-01) -(PKG-1B)- DUDHNOI-DAINADUBI ROAD (NH-217) IN THE STATE ON MEGHALAYA.

SCALE:
Not to scale
Dimensions as mentioned

TITLE:
TYPICAL CROSS SECTION

CLIENT APPROVAL:
SIGNATURE:
DWG NO:- GIS/1B/NHIDCL/FS/TCS

DRAWN:	CHECKED:	DESIGNED:	APPROVED:
LK	SJ	SC	LA

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VIII

TYPE - 04

TYPICAL CROSS SECTION FOR 2 - LANE WITH PAVED SHOULDER HIGHWAY (OPEN COUNTRY -PLAIN TERRAIN)

BANKING SECTION
HEIGHT LESS THAN 3m

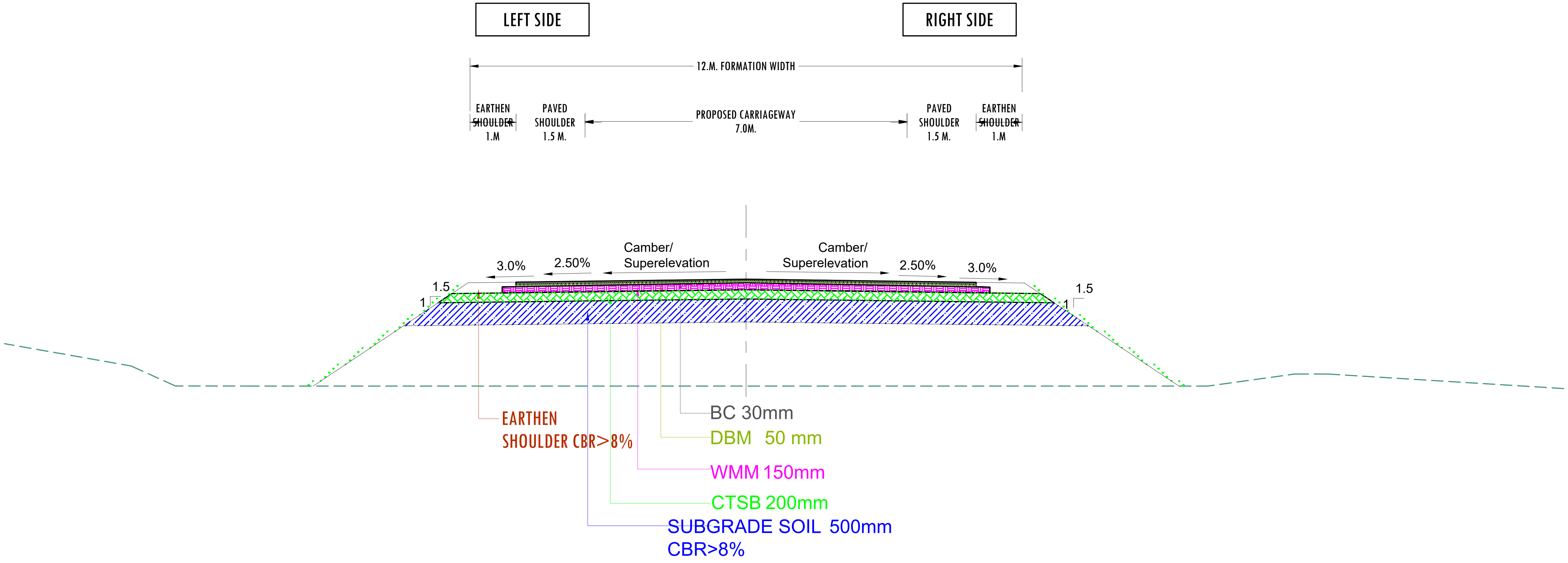

LEFT SIDE
RIGHT SIDE
12.M. FORMATION WIDTH
EARTHEN SHOULDER 1.M
PAVED SHOULDER 1.5 M.
PROPOSED CARRIAGEWAY 7.0M.
PAVED SHOULDER 1.5 M.
EARTHEN SHOULDER 1.M
Camber/ Superelevation
Camber/ Superelevation
3.0%
2.50%
2.50%
3.0%
1.5
1
1.5
1
EARTHEN SHOULDER CBR>8%
BC 30mm
DBM 50 mm
WMM 150mm
CTSB 200mm
SUBGRADE SOIL 500mm CBR>8%

Fig. 2.9 Modified
As per IRC SP 73:
2018

NOTES:

1. ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DIMENSIONS SHALL NOT BE SCALED OFF FROM THE DRAWING.
   ONLY WRITTEN DIMENSION SHALL BE FOLLOWED

Sr. No.	Chainage From (Km.)	Chainage To (Km.)	Length (Km)	TCS Type
1	3.650	3.740	0.090	4
2	3.900	4.230	0.330	4
3	5.200	5.380	0.180	4
	Total Length		**0.600**	

REV.	DATE	REVISIONS

NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.
PTI BUILDING, 4 PARLIAMENT STREET
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DESIGN CONSULTANT:
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e: globalinfrasolutions.bpl@gmail.com **web:** globalinfrasolutions.org

PROJECT:
CONSULTANCY SERVICES FOR PREPARATION OF DPR FOR ECONOMIC CORRIDORS, INTER CORRIDORS AND FEEDER ROUTES TO IMPROVE THE EFFICIENCY OF FREIGHT MOVEMENT IN INDIA UNDER BHARATMALA PARIYOJNA (LOT-01) -(PKG-1B)- DUDHNOI-DAINADUBI ROAD (NH-217) IN THE STATE ON MEGHALAYA.

SCALE:
Not to scale
Dimensions as mentioned

TITLE:
TYPICAL CROSS SECTION

CLIENT APPROVAL:
SIGNATURE:
DWG NO:- GIS/1B/NHIDCL/FS/TCS

DRAWN:	CHECKED:	DESIGNED:	APPROVED:
LK	SJ	SC	LA

GLOBAL INFRA SOLUTIONS BHOPAL

Annexure-VIII

TYPE - 05

TYPICAL CROSS SECTION FOR 2 - LANE WITH PAVED SHOULDER HIGHWAY
(OPEN COUNTRY -PLAIN TERRAIN)

CUTTING SECTION

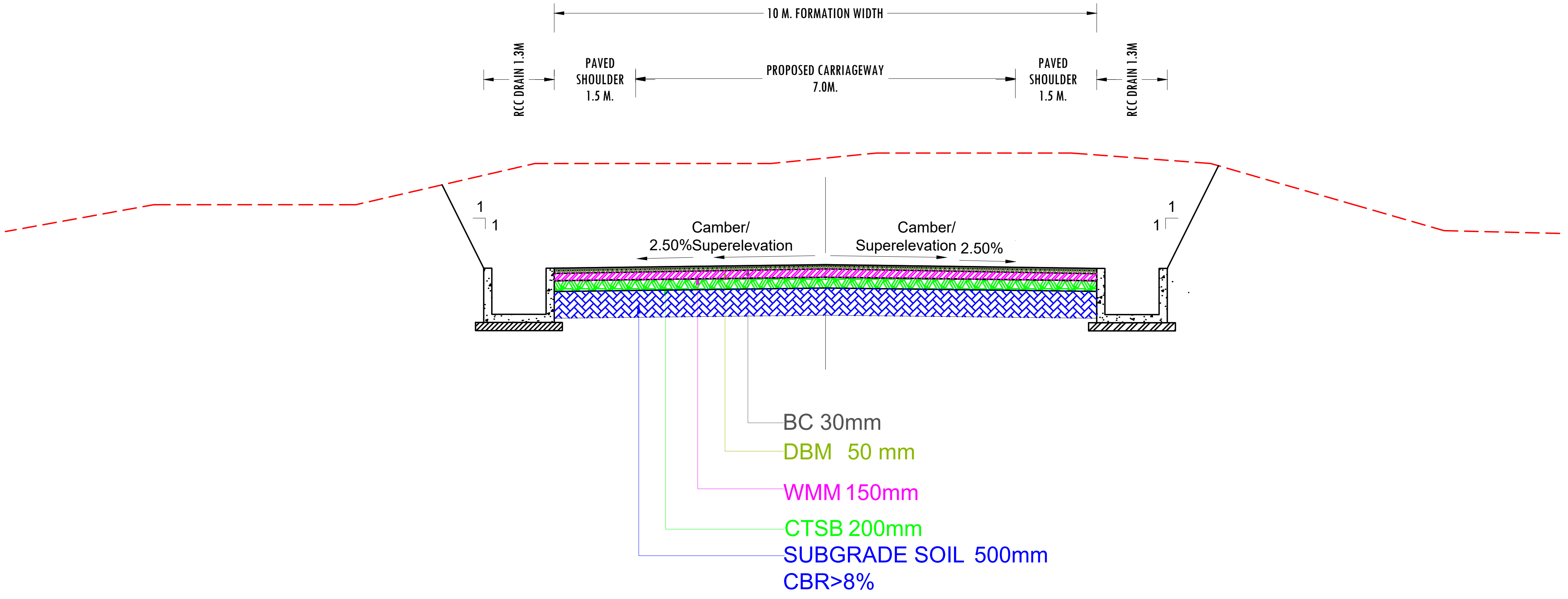
10 M. FORMATION WIDTH
RCC DRAIN 1.3M
PAVED SHOULDER 1.5 M.
PROPOSED CARRIAGEWAY 7.0M.
PAVED SHOULDER 1.5 M.
RCC DRAIN 1.3M
1
1
Camber/ 2.50%Superelevation
Camber/ Superelevation 2.50%
1
1
BC 30mm
DBM 50 mm
WMM 150mm
CTSB 200mm
SUBGRADE SOIL 500mm
CBR>8%

Fig. 2.9 Modified
As per IRC SP 73:
2018

NOTES:

1. ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DIMENSIONS SHALL NOT BE SCALED OFF FROM THE DRAWING.
   ONLY WRITTEN DIMENSION SHALL BE FOLLOWED

Sr. No.	Chainage From (Km.)	Chainage To (Km.)	Length (Km)	TCS Type
1	3.740	3.900	0.160	5
	Total Length		0.160	

REV.	DATE	REVISIONS

NATIONAL HIGHWAYS & INFRASTRUCTURE
DEVELOPMENT CORPORATION LTD.
PTI BUILDING, 4 PARLIAMENT STREET
SANSAD MARG AREA, NEW DELHI -110001

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PROJECT:
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SCALE:
Not to scale
Dimensions as mentioned

TITLE:
TYPICAL
CROSS SECTION

CLIENT APPROVAL:
SIGNATURE:
DWG NO:- GIS/1B/NHIDCL/FS/TCS

DRAWN:	CHECKED:	DESIGNED:	APPROVED:
LK	SJ	SC	LA

GLOBAL INFRA SOLUTIONS BHOPAL