FEASIBILITY REPORT

Four laning of Chitrakoot - Kothi Section of NH 135BG from km 0.000 to km 55.000 (Package-I) under Bharatmala Pariyojana in the State of Uttar Pradesh and Madhya Pradesh

1.0 INTRODUCTION

The National Highway Authority of India (NHAI) under the Ministry of Road Transport & Highways (MoRT&H), Government of India has been entrusted with the assignment of Development of Economic Corridors, Inter-Corridors, Feeder Routes and Coastal Roads under **Bharatmala Pariyojana** primarily to improve freight movement in Country. With a view to this, it has been proposed to conduct a "Consultancy Services for Preparation of Detailed Project Report for up-gradation of selected stretches as Feeder road comprising of SH-9, SH-10 and SH-11 of Madhya Pradesh and SH-275 of Maharashtra through BOT / Hybrid Annuity / EPC mode (Lot-I/Madhya Pradesh/ Package-6)".

MoRTH, Government of India has declared **new National Highway (NH-135BG)** vide Gazette Notification dated 5th December 2017. NH-135BG starts from its junction with NH-35 (old NH-76) near Chitrakoot in the State of Uttar Pradesh connecting Majhgawa, Satna and terminating at its junction with NH-30 (old NH-7) near Maihar in the State of Madhya Pradesh. Total length of the existing road is 121.350 km. NHAI has decided to up-gradation of **Chitrakoot to Maihar (NH-135BG)** (old SH-11). Based on the major components of works and construction cost, the **proposed project road has been divided into 3 packages** (**Figure-1**) for the implementation of civil works contracts.

The Proposed project road is part of the newly declared NH, **Chitrakoot to Kothi Section of NH-135BG** from km 0.000 to km 55.000 (**Package-I**) in the State of Uttar Pradesh and Madhya Pradesh. Total length of the existing stretch is about 56.587 Km and **length of proposed project road is 55.0 km**.

2.0 SCOPE OF CONSULTANCY SERVICES

The scope of service, inter-alia, covers the following main activities:

a) The improvement of the existing road to 4-lane road and where provision of the short bypasses, service roads, modification of alignments etc.
b) The Land Acquisition details to be furnished as per the Revenue Records/Maps for the processing of the Land Acquisition. The Land Acquisition details to include the 3a, 3A and 3D draft notification for the acquisition of land.
c) Identification of possible locations and design of toll plazas, wayside amenities, provision of service roads and fencing, wherever necessary to improve efficiency and safety.
d) The scope of services includes the items indicated in the Letter of Invitation and in TOR. The Study shall include suitable proposals for the widening/improvement of the existing road and the strengthening of the carriageways as required in the appropriate time to maintain the Level of Service (LOS) over the design period.

Figure -1 Index Map showing Chitrakoot to Maihar (NH-135BG) (old SH-11)

e) Environmental Impact Assessment and Environmental Management Plan and Rehabilitation and Resettlement Studies to be carried and in line with the requirements of Govt. of India or the lending agencies like ADB/World Bank/JICA, etc.
f) The Bid Documents to be prepared for the EPC/PPP Contracts or any other mode for each of the DPR Assignment.
g) The General Scope of Services consists of the following:
   - Review of the available Reports and other information about the Project Road and Project Influence Area;
   - Environmental & Social Impact Assessment;
   - Detailed Reconnaissance;
   - Identification of the Possible Improvements in the existing alignment including the provision of bypasses for the congested locations;
   - Traffic Studies including Traffic Surveys and Axle Load Survey and Demand Forecasting for the next thirty years;
   - Inventory and Condition Surveys for road including Bridges;
   - Detailed Topographical Surveys using LiDAR equipped with minimum Engineering Grade System;
   - Pavement Investigations;
   - Sub grade Investigations;
   - Identifications of the Sources of Construction Materials;
   - Detailed Design of Roads including the Horizontal and Vertical Alignment;
   - Detailed Design of Structures;
   - Identifications of the Type and Design of Intersections;
   - Design of Drainage System;
   - Value Engineering;
   - Preparation of the Bill of Quantities (BOQ) and Project Costing;
   - Economic and Financial Analysis;
   - Contract Packaging and implementation Schedule;
   - Preparation of Detailed Plan, Profile and other Drawings;
   - Financial Viability of Project for implementation; and
   - Preparation of the Detailed Project Report

3.0 DESCRIPTION OF EXISTING ALIGNMENT

The proposed project road (Package-I) originates from the existing NH-35 (old NH-76) at Chakla Rajrani village of Chitrakoot district (Km. 0+000) in the State of Uttar Pradesh and ends at Nayagaon village of Satna District (Km. 55+000) in the State of Madhya Pradesh. The Latitude & Longitude of start and end points are 25°12'59.5" N & 80°52'46.40" E and 24°46'59.496" N & 80°47'19.649" E respectively.

Chitrakoot to Majhgawa Section: This section starts from the junction of NH-35 (Old NH 76 at Km 278+330) at Chakla Rajrani village of Chitrakoot in Uttar Pradesh. About 4.8 km length of road traverses in Chitrakoot district of Uttar Pradesh where widening to 4 lane with footpath is under-construction. Chitrakoot Dham is a religious place and the

existing alignment is passing through the congested market area with restricted right of way and substandard geometries.

Start point at Chitrakoot (On NH 76)

Under-construction 4 lane at Km 1+500

Then the alignment enters Madhya Pradesh and traverses southward parallel to Mandakini River follows existing SH 11. The lane configuration of the project road up to Mahatama Gandhi Chitrakoot Gramodaya (MGCG) University is 4 lane and 2 land divided carriageway with Rigid Pavement. Beyond University the existing road is single / 2 lane standard. Widening to 2 lane standard in this stretch is in progress. The under construction Hanuman Dhara Bypass on East side takes up from Km 9+000. This bypass is being developed by Madhya Pradesh Road Development Corporation (MPRDC) for a length of 8.98 km.

4 lane divided section at km 5+300

Congested market area

After km 14+000, the road traverses through the forest area up to Km 28+000. It may be noted that Satna-Majhgawa-Chitrakoot section was awarded to M/s Topworth Tollways Pvt. Ltd for a length of 74.132 km. As informed by Madhya Pradesh Road Development Corporation (MPRDC) official, due to non-performance, the agreement was terminated in 2015 and the balance work has been taken up on EPC mode. The widening to 2 lane standard of the stretch from Majhgawa to Chitrakoot is under progress on EPC Mode. The stretch from Chitrakoot to Majhgawa and Kothi Bypass is under construction.

After the built up area of Chitrakoot, the alignment crosses forest area for a length of about 14 km. The alignment crosses Bagadara River at km 23.46 (tributary of Mandakini) and Mandakini River at km 33.210. The alignment traverses further southward in plain terrain up to Km 36 and then again protected forest area. The newly

constructed 2 lane Majhgawa bypass starts at Km 37+700 and traverses on west site of Majhgawa and meets near Km 2+00 of Majhgawa-Satna section (Existing SH Km 40).

View of single lane road in forest area

Under-construction road near km 20

Recent done Bituminous work

Majhgawa - Kothi Section: The existing Majhgawa bypass ends near existing Km 40 and then the alignment runs parallel to Railway line. Then the project road passes through forest area up to Km 55 and this package ends in village Nayagaon near Kothi just before the crossing of SH 52.

End point of existing Majhgawa Bypass.

Junction of SH 52 near Kothi village

The existing road in the above stretch passes through plain and rolling terrain with majority section of 2 lane and intermediate flexible pavement carriageway except in built up area where a small stretch of rigid pavement is exists. The geometry of the above

sections is not conforming to IRC Standard. Some salient features of the Project road are given in **Table 1-1.**

Table 1 - 1 Details of Existing Lane Configuration

Sl. No.	Description	Chitrakoot - Majhgawa Section	Majhgawa - Kothi Section
1	Length (Km)	42.00	14.587
2	4 Lane	6.22	0
3	2 lane+ Paved Shoulder	1.01	0
4	2 Lane	22.62	14.587
5	Intermediate Lane	2.86	0
6	Single Lane	9.29	0
7	Pavement type (Km)	Flexible-35.98	Flexible-14.587
		Rigid-3.62	
		Earthen-2.4 (Under construction)	

Road Geometry: The existing road geometry except built up sections, Railway crossing and village sections in route conform to IRC standard. Further the stretch falls within forest area is having substandard geometries.

Existing Right of Way (RoW): The existing RoW varies between **25 m to 30 m**. However, in forest area, the existing carriage way width has been considered as ROW since, ROW is not marked in revenue map.

Following has been observed during the field survey of the existing road:

- Road side land use is predominantly agricultural and forest
- Out of total 25 curves, there are 17 substandard curves
- Due to poor maintenance, lots of pot holes observed in the project road.
- Edge breaks, undulations, pot holes and patching distress on the existing pavement in some sections due to the recent floods.
- There are 15 minor bridges and 91 culverts (45 hume pipe culverts, 36 slab culverts, 9 box culverts and 1 arch culvert) on the project road.
- There are about 51 existing junctions (8 major and 43 minor) on the project road.
- Major settlements en-route is Chitrakoot Dham, Majhgawa and Kothi
- Except the under-construction part of the existing road, overall Pavement riding quality of the road in the section seems average except few locations where it is found poor. Road roughness (IRI) is varying between 1.69 m/km to 26.22 m/km.
- Along the existing project road, there are 9 educational institutions (4 on the right side and 5 on the left side), 49 religious places (28 on the right side and 21 on the left side) and medical facilities at 3 places (2 on the right side and 1 on the left side).

3.1 Forest along the Existing Road

The existing road is passing through the forest area of Satna Forest Division. Joint site

visits were carried out with the forest officials of Satna Forest divisions to identify the location of forests along the project road. **27.275 km** stretch of the existing road is passing through Protected Forest. Locations of Forest along the project road as per existing chainage are presented in **Table 1-2.**

Joint Site Visit with the Forest Officials

Table 1 - 2 Location of Forest along the Existing Road

SN	Existing Ch. Km		Length (Km)	Side	Forest Type	Forest Range	Forest Division
	From	To					
1.	11+500	12+790	1.290	Both	PF	Chitrakoot	Satna
2.	12+790	12+965	0.175	LHS	PF	Chitrakoot	Satna
3.	13+500	14+265	0.765	LHS	PF	Chitrakoot	Satna
4.	14+370	27+360	12.990	Both	PF	Chitrakoot	Satna
5.	27+360	27+455	0.095	LHS	PF	Chitrakoot	Satna
6.	27+600	27+900	0.300	LHS	PF	Chitrakoot	Satna
7.	36+030	37+825	1.795	Both	PF	Maghgawa	Satna
8.	37+825	38+145	0.320	RHS	PF	Maghgawa	Satna
9.	38+145	38+740	0.595	Both	PF	Maghgawa	Satna
10.	41+500	41+560	0.060	RHS	PF	Maghgawa	Satna
11.	41+560	41+900	0.340	Both	PF	Maghgawa	Satna
12.	41+900	42+550	0.650	RHS	PF	Maghgawa	Satna
13.	44+135	45+680	1.545	Both	PF	Maghgawa	Satna
14.	45+680	47+450	1.770	Both	PF	Maghgawa	Satna
15.	47+450	47+500	0.050	LHS	PF	Maghgawa	Satna
16.	50+675	53+630	2.955	Both	PF	Maghgawa	Satna
17.	53+630	54+720	1.090	RHS	PF	Maghgawa	Satna
18.	54+720	55+210	0.490	Both	PF	Maghgawa	Satna
Total Length (Km)			**27.275**				

Note: PF = Protected Forest

Source: Field Survey carried out by ICT

4.0 TRAFFIC SURVEY AND ANALYSIS

4.1 Planning of the Traffic Survey

During the reconnaissance survey of the project road in April 2017, the possibility of diversion to or from the project road, if there was any, were duly examined while identifying the traffic survey locations. Traffic survey locations were identified in conjunction with the surrounding road network of the project road stretches. The network was also verified by visiting all the associated road junctions and links so as to assess the traffic levels and logistics that will be required for traffic surveys. To capture traffic flow characteristics and travel pattern of users passing through the project road and other characteristics related to miscellaneous requirements of the ToR, the following primary traffic surveys were planned and conducted.

- Automatic Traffic Classified Count / Manual Classified Traffic Volume Count
- Junction Volume or Intersection Turning Movement Count (TMC)
- Origin-Destination and Commodity Movement Survey (OD)
- Speed and Delay Survey
- Pedestrian / Cross Movement Count
- Road Safety Assessment

Traffic survey stations were selected considering the following parameters:

- The station should represent homogeneous traffic section
- The station should be outside urban area and local traffic influence
- The station should be located in a reasonably level section of the road with good visibility (preferably straight section).

The finalized survey location maps are presented in **Figure-2**, schematically shown in line diagrams in **Figure-3** and details are given in **Table 1-3**.

Table 1 - 3 Locations of Traffic Surveys

Sl No	Type of Survey	Code	Existing Chainage	Location	Number of Location
1	Turning Movement Count Survey (TMC)	TMC 1	0+000 km	NH 76 & NH 135 BG (old SH 11) Intersection at Chitrakoot	2
		TMC 2	37+500 km	NH 135 BG (old SH 11) & Majhgawa Road Intersection	
2	Automatic Classified Traffic Volume Count (7 Days, 24 hours)	ATCC 1	48+000 km	North of Kothi Junction	1
3	Manual Classified Traffic Volume Count (1 Day, 24 hours)	MCC 3		At Nagod junction on NH 75 & SH 56	1
4	Origin Destination (OD)	OD 3		At Nagod junction on NH 75 & SH 56	1

Sl No	Type of Survey	Code	Existing Chainage	Location	Number of Location
5	Pedestrian Volume Count (PC)	PC 1	0+000 km	NH 76 & NH 135 BG (old SH 11) Intersection at Chitrakoot	1
6	Speed and Delay		Full Stretch		

4.2 Identification of Homogeneous Sections

The project road has been divided into homogeneous road sections on the basis of traffic generation and dispersal nodes located along the alignment as seen during the reconnaissance carried out as well as the observed traffic flows. Homogeneous sections have been identified for the purpose of traffic analysis, presentation of traffic, traffic forecast and also to examine different strategies for tolling. Based on the traffic generation and dispersal nodes the Chitrakoot – Majhgawa – Satna - Maihar road has been divided into three homogeneous sections. **Table 1-4** gives the details of the homogeneous sections defined for the study.

Table 1 - 4 Homogeneous Sections of Project Highway

Homogeneous Section (HS)	Pkg.	Existing Chainage (km)		Design Chainage (km)		Length (km)	AADT (PCUs) in 2017
		From	To	From	To		
HS-1	I & II	0+000 (Chitrakoot)	59+750 (SH-52 Intersection at Kothi)	0+000	58+200	58.2	2,840
HS-2	II	59+750 (SH-52 Intersection at Kothi)	81+900 Panna-Satna Road (NH 75 junction)	58+200	80+800	22.6	4,708
HS-3	III	81+900 Panna-Satna Road (NH 75) junction	121+350 (Ghanta Ghar Chowk, Maihar)	80+800	119+535	38.735	7,040

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

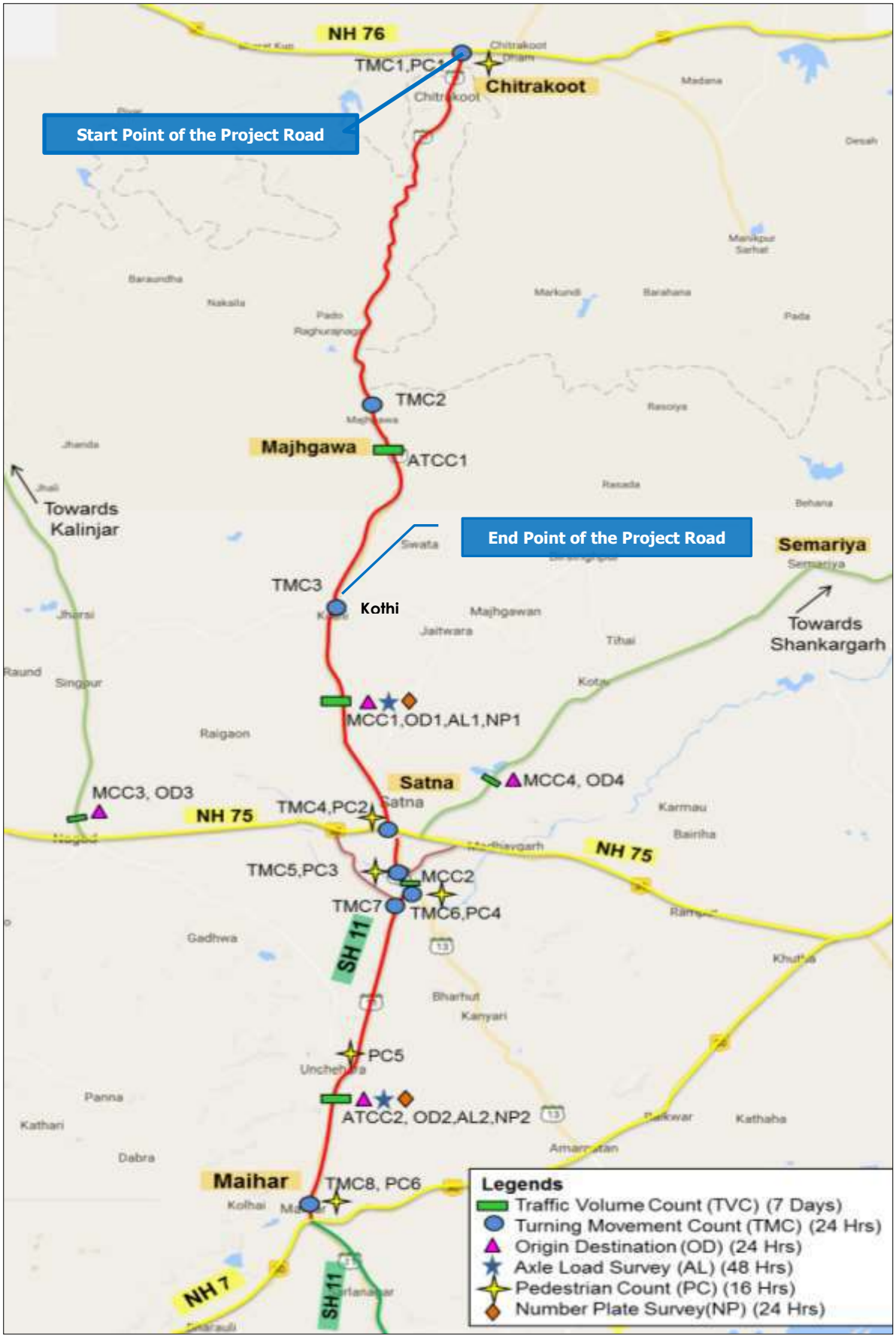

Figure-2 Map Showing Traffic Survey locations

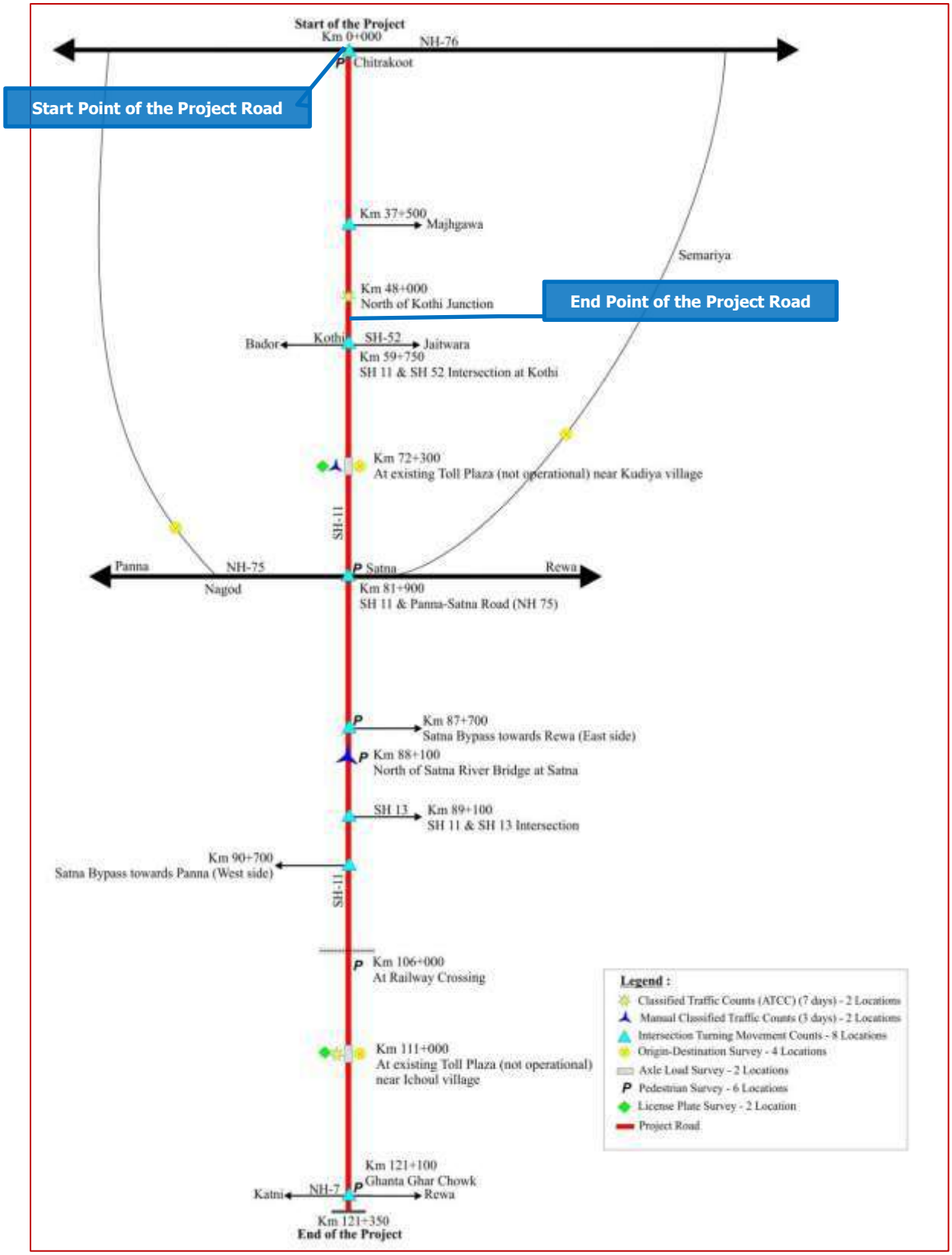

Figure-3 Line Diagram for Traffic Survey Locations (Existing chainage)

4.3 Speed and Delay Survey

A speed and delay survey using the moving car observer method was carried out by dividing the each project road corridor in to different section. This survey provides data for assessing running speed, journey speeds signifying any unreasonable congestion levels. Journey speed is the effective speed of a vehicle between two points. It is determined by the distance between two points divided by the total time taken by the vehicle to complete the journey, including all delays incurred en-route. Running speed is the average speed maintained by a vehicle over given course while the vehicle is in motion. The summary of the speed and delay analysis is given in **Table 1-5.**

Table 1 - 5 Summary of Speed and Delay Analysis

Stretch No.	Existing Chainage		Stretch Name	Average Running Speed (kmph)	Average Journey Speed (kmph)
	From	To			
1	0+000	14+200	Start of road to Start of distressed section of road at Chitrakoot	26.63	28.82
2	14+200	28+900	Start of distressed section to the End of Distressed section of Road	29.43	29.40
3	28+900	48+300	End of distressed section to Hirondhi Village	77.60	77.60
4	48+300	59+700	Hirondhi Village to Kothi Junction	45.60	45.60

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

The results for Chitrakoot-Kothi road section indicate that the average journey speed is varying between 28.82 kmph to 77.60 kmph. Speed below 30 kmph was observed in the forest area of Chitrakoot because of the bad road condition.

4.4 Pedestrian Count Survey

Pedestrian Count Survey was carried out for 12 hours (8:00 AM to 8:00 PM) at various major intersections and railway crossings, where considerable pedestrian movements were observed. For each approach road of an intersection, along and across movements were counted as per the need of the existing situation. The corresponding total daily pedestrian flows and peak hour pedestrian flows in the junction are presented in **Table 1-6.**

Table 1 - 6 Pedestrian Flows per Day at Major Intersections

Existing Chainage	Location	Arm	Daily Flow		Peak Hour Flow	
			Across	Along	Along	Across
Km 0+000	NH 76 & NH 135 BG (old SH 11) Intersection at Chitrakoot	Bandha	1016	1811	205	274
		Satna Side	406	1197	75	231
		Allahabad	1251	1774	247	321

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

4.5 Traffic Forecast

Elasticity of Transport Demand (ETD) technique is used in traffic forecast, which is based on historical growth in vehicle registration and trend of the economy in the area. Traffic growth rate is estimated for different modes of traffic that are likely to use the project road in future. The likely diverted, induced and generated traffic has been added to arrive at the future traffic for each of the homogeneous sections. The projected traffic for each of the homogeneous sections is presented in **Table 1-7**.

Table 1 - 7 Projected Annual Average Daily Traffic on NH 135BG

Year	Total Tollable Vehicles	Total Tollable PCUs	Total PCUs	Total Vehicles
Annual Average Daily Traffic on HS 1 (Package I & II)				
2017	1374	2131	2840	2584
2021	1948	2986	3930	3598
2025	5771	10671	13032	10030
2030	8527	15590	18985	14754
2035	11743	21285	25879	20279
2040	15251	27453	33370	26339
2045	19255	33995	41554	33522
2050	1374	2131	2840	2584
Annual Average Daily Traffic on HS 2 (Package II)				
2017	2157	3217	4708	4694
2021	3046	4479	6536	6629
2025	7352	12778	16918	14780
2030	10868	18648	24669	21848
2035	14971	25429	33630	30114
2040	19454	32786	43389	39195
2045	24646	40729	54311	50122
2050	31160	50345	67768	64068
Annual Average Daily Traffic on HS 3 (Package III)				
2017	2807	5066	7040	6130
2021	3963	7077	9758	8620
2025	6545	12345	16428	13884
2030	9691	18090	23961	20484
2035	13362	24731	32699	28235
2040	17373	31943	42221	36749
2045	21957	39570	52729	46959
2050	27677	48718	65595	59973

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

4.6 Capacity and Level of Service Analysis

The widening proposals based on the IRC: SP: 73-2015 and IRC: SP: 84-2014 are given in **Table 1-8** below.

Table 1 - 8 Year-wise Improvement Proposal Based on IRC Codes

Homogeneous Section	Recommendations		
	2–lane with paved shoulder	4–lane with paved shoulder	6–lane with paved shoulder
HS 1	2022	2029	
HS 2	2021	2025	2047
HS 3	2021	2026	2047

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

As per MoRT&H MO. no NH-12019/6/2012-P&M dated 05.10.2012, minimum final level for widening /development of a NH should be 2 lane with Paved shoulder.
Further, as per the circular issued by Ministry of Road Transport and Highways SR&T (Roads), RW/NH-33044/37/2015/S&R(R) dated 26th May 2016; all the roads with traffic more than 10000 PCUs are to be proposed for four laning.

Considering this Homogenous sections 1, **Chitrakoot to Kothi stretch** (**Package-I**) would require 4 laning from the year 2029. However; as per Office Memorandum of MoRTH dated 3rd May 2018, the minimum lane configuration for all inter corridors and feeder route shall be 4 lane. Hence, **4 lane with paved shoulder configuration has been proposed for the entire stretch.**

Table 1 - 9 Proposed Improvement Proposal

Road Name	Stretches & Design Chainage	Improvement type in the opening year
Chitrakoot – Maihar	Chitrakoot to Kothi (Package-I) (Km 0+000 to Km 55+000)	4 lane with paved shoulder

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.0 ALIGNMENT IMPROVEMENT PROPOSAL

During the course of the detailed site investigations, the Consultant examined both the option of improvement & widening of the existing road and also the possibility of Re-alignments / Bypasses for some built up stretches which are difficult to widen due to Engineering and other constraints and the collective details are explained below.

5.1 Improvement and Widening of Existing Road

The consultants have carried out detailed topographic survey of the existing alignment along with other engineering investigations.
As enumerated in Section 3.0 of this report, the existing road is deficient in geometrics and improving the geometrics will involve higher social unrest due to dismantling of road side structures. Further, there are some major bottlenecks for widening and improvement of existing road.
The project road is carrying medium to heavy traffic and become eligible for capacity augmentation to four lanes. With existing geometrics, terrain and involvement of R&R constraints, it is not feasible to widen the existing road to four lanes.
Considering the above facts, it is apparent that improvement & widening the existing

road will be possible for some length and not for the entire length. Hence some alternative proposals of Re-alignments / Bypasses have been explored. The Consultant has accordingly worked out the alternative proposals and is described in the following sections:

The evaluation criterion for widening proposals is as follows:

- ***Technical Considerations*** – Geometric, movement of traffic during construction, earthwork, cross drainage works, junction layout, relocation of existing utilities, bypasses, construction costs, and maintenance costs.
- ***Environmental Consideration*** – land use change, location of water bodies, river / canal / stream crossing, location of protected areas / critically polluted areas / eco-sensitive areas / forest etc.
- ***Social Consideration*** - Area of land acquisition, type of land acquisition, location of religious places / educational institutions / medical amenities / drinking water sources, resettlement and rehabilitation problems and costs.

5.2 Possible Re-alignments / Bypasses

Chitrakoot is a famous religious place and during religious festival, it was observed that, the congestion situation is serious. Traffic movement along the existing road is very critical. Due to presence of market and religious structures along existing road widening is not feasible. Widening along existing will involve large scale demolition and will create social unrest .Improvement along existing as per IRC codal provision may not be feasible and will involve large scale demolition of structures. Hence to avoid these hindrances for improvement a bypass option has been proposed. Further, during the presentation and discussion on 5th Dec 2017 at PIU, Katni and 8th Dec 2017 with the State Govt. stake holders (RO, MoRTH, Bhopal, CE, NH and GM, MPRDC, it was finally decided to provide **bypass at Chitrakoot**.

Within a short stretch of 3.5 km (existing km 28+500 to Km 32+000) near village **Pindra**, there are 8 substandard horizontal curves having radius of 75m 100m and 180m and habitation are along the existing road with building line clearance of 31m. Improvement along existing road including curve improvement will involves demolition of structures. Hence to avoid such demolitions a small **realignment** of length 3.35 km has been proposed.

At Km 32+500 (design Km 31+300) the alignment crosses Mandakini river and traverses in Uttar Pradesh for a length of 1 km. Due to presence of habitation and the river is running parallel to the existing road. The existing horizontal radiuses are about 60 and 160m between Km 32+600 to Km 34+450(existing). Improvement along existing is not feasible on right side. Hence to avoid such constraints realignment of about 1.6 length km has been proposed. The details of bypass and realignment are tabulated in **Table 1-10** below:

Table 1 - 10 Possible Locations of Realignments / Bypasses

Sl. No.	Existing Chainage (Km)		Design Chainage (Km)			Remarks
	Start	End	Start	End	Length	
1	0+000	10+800	0+000	11+13	11.13	Chitrakoot Bypass
2	28+500	32+000	27+450	30+800	3.350	Realignment at Pindra Village
3	32+600	34+450	31+400	33+000	1.600	Realignment

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.3 Recommended Alignment

Taking into account the above major improvements, the recommended improvement proposal for the project highway is indicated in **Table 1-11** below. A key plan showing the recommended alignment from Chitrakoot to Kothi (Km 0+000 to Km 55+000) is given in **Figure-4**.

Table 1 - 11 Recommended Improvement Proposal for the Project Highway

Sl. No.	Existing Alignment (Km)			Design Alignment (Km)		
	From	To	Length	From	To	Length
1	0+000	56+587	56.587	0+000	55+000	55.00

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

The recommended alignment passes 9.1 Km (4 stretches) in Chitrakoot district of Uttar Pradesh whereas 45.9 Km stretch in Satna district of Madhya Pradesh.

5.4 Proposed RoW and Widening Details

In reference to the MoRT&H office memorandum dated 3rd May 2018 and further discussion on 14th July 2018 in NHAI HQ, the width of Proposed Right of Way (PROW) outside forest area has been kept as **70 m** in general. **In forest area, a minimum 32m and maximum 40m right of way has been adopted.** At location of major & minor junction, bus bays, truck lay bye, way side amenities, entry exit of VUP / Flyovers and interchange extra land to be provided in addition to above mentioned ROW as per the actual Design requirement.

Considering the need to minimize land acquisition in majority section eccentric widening has been adopted. A summary of widening details is given in **Table 1-12** below and chainage wise widening scheme has been presented in **Table 1-13**.

Table 1 - 12 Summary of Proposed Widening Scheme

Widening Length (Km)			Bypass (Km)	Realignment (Km)	Curve Improvement (Km)	Total Length (Km)
Concentric	Eccentric Left	Eccentric Right				
0.740	11.245	15.670	11.130	4.950	11.265	**55.000**

Figure-4 Recommended Alignment

Table 1 - 13 Details of Proposed Widening Scheme

SL No	Design Chainage (km)		Length (m)	Widening / Construction Scheme
	From	To		
1.	00+000	11+130	11130	New Construction (**Chitrakoot Bypass**)
2.	11+130	11+600	470	Eccentric Left Widening (Reconstruction)
3.	11+600	11+950	350	New Construction (Curve Improvement)
4.	11+950	12+200	250	Eccentric Left Widening (Reconstruction)
5.	12+200	12+800	600	New Construction (Curve Improvement)
6.	12+800	13+900	1100	Eccentric Left Widening (Reconstruction)
7.	13+900	14+250	350	New Construction (Curve Improvement)
8.	14+250	14+850	600	Eccentric Left Widening (Reconstruction)
9.	14+850	15+800	950	New Construction (Curve Improvement)
10.	15+800	15+920	120	Eccentric Right Widening (Reconstruction)
11.	15+920	16+770	850	Eccentric Left Widening (Reconstruction)
12.	16+770	16+970	200	Eccentric Right Widening (Reconstruction)
13.	16+970	17+600	630	Eccentric Left Widening (Reconstruction)
14.	17+600	19+300	1700	New Construction (Curve Improvement)
15.	19+300	19+450	150	Eccentric Left Widening (Reconstruction)
16.	19+450	19+640	190	New Construction (Curve Improvement)
17.	19+640	19+880	240	Eccentric Left Widening (Reconstruction)
18.	19+880	19+950	70	Concentric Widening (Reconstruction)
19.	19+950	20+350	400	Eccentric Left Widening (Reconstruction)
20.	20+350	20+550	200	New Construction (Curve Improvement)
21.	20+550	20+740	190	Eccentric Left Widening (Reconstruction)
22.	20+740	20+860	120	Concentric Widening (Reconstruction)
23.	20+860	20+970	110	Eccentric Left Widening (Reconstruction)
24.	20+970	21+300	330	New Construction (Curve Improvement)
25.	21+300	21+600	300	Eccentric Left Widening (Reconstruction)
26.	21+600	21+900	300	New Construction (Curve Improvement)
27.	21+900	22+300	400	Eccentric Left Widening (Reconstruction)
28.	22+300	22+400	100	Eccentric Right Widening (Reconstruction)
29.	22+400	22+700	300	Eccentric Left Widening (Reconstruction)
30.	22+700	23+080	380	New Construction (Curve Improvement)
31.	23+080	23+200	120	Eccentric Left Widening (Reconstruction)
32.	23+200	23+600	400	New Construction (Curve Improvement)
33.	23+600	23+700	100	Eccentric Right Widening (Reconstruction)
34.	23+700	23+950	250	New Construction (Curve Improvement)
35.	23+950	24+850	900	Eccentric Left Widening (Reconstruction)
36.	24+850	25+000	150	New Construction (Curve Improvement)
37.	25+000	25+300	300	Eccentric Right Widening (Reconstruction)
38.	25+300	25+500	200	New Construction (Curve Improvement)
39.	25+500	25+750	250	Eccentric Left Widening (Reconstruction)
40.	25+750	26+000	250	New Construction (Curve Improvement)
41.	26+000	26+200	200	Eccentric Left Widening (Reconstruction)
42.	26+200	26+400	200	Eccentric Right Widening (Reconstruction)

SL No	Design Chainage (km)		Length (m)	Widening / Construction Scheme
	From	To		
43.	26+400	27+450	1050	Eccentric Left Widening (Reconstruction)
44.	27+450	30+800	3350	New Construction (**Realignment**)
45.	30+800	31+350	550	Concentric Widening
46.	31+350	31+400	50	Eccentric Left Widening (Reconstruction)
47.	31+400	33+000	1600	New Construction (**Realignment**)
48.	33+000	33+875	875	Eccentric Left Widening (Reconstruction)
49.	33+875	34+800	925	New Construction (Curve Improvement)
50.	34+800	34+900	100	Eccentric Left Widening (Reconstruction)
51.	34+900	35+400	500	New Construction (Curve Improvement)
52.	35+400	35+800	400	Eccentric Left Widening (Reconstruction)
53.	35+800	36+270	470	New Construction (Curve Improvement)
54.	36+270	36+370	100	Eccentric Right Widening (Reconstruction)
55.	36+370	36+750	380	New Construction (Curve Improvement)
56.	36+750	37+250	500	Eccentric Right Widening (Reconstruction)
57.	37+250	37+700	450	New Construction (Curve Improvement)
58.	37+700	37+900	200	Eccentric Right Widening (Reconstruction)
59.	37+900	38+500	600	New Construction (Curve Improvement)
60.	38+500	39+810	1310	Eccentric Left Widening (Overlay)
61.	39+810	39+900	90	Eccentric Right Widening (Reconstruction)
62.	39+900	40+200	300	New Construction (Curve Improvement)
63.	40+200	40+300	100	Eccentric Right Widening (Reconstruction)
64.	40+300	40+600	300	New Construction (Curve Improvement)
65.	40+600	41+080	480	Eccentric Right Widening (Reconstruction)
66.	41+080	41+680	600	Eccentric Right Widening (Overlay)
67.	41+680	41+880	200	Eccentric Right Widening (Reconstruction)
68.	41+880	42+780	900	Eccentric Right Widening (Overlay)
69.	42+780	43+800	1020	Eccentric Right Widening (Reconstruction)
70.	43+800	44+300	500	New Construction (Curve Improvement)
71.	44+300	46+175	1875	Eccentric Right Widening (Reconstruction)
72.	46+175	46+950	775	Eccentric Right Widening (Overlay)
73.	46+950	47+150	200	Eccentric Right Widening (Reconstruction)
74.	47+150	48+650	1500	Eccentric Right Widening (Overlay)
75.	48+650	48+800	150	Eccentric Right Widening (Reconstruction)
76.	48+800	53+210	4410	Eccentric Right Widening (Overlay)
77.	53+210	53+450	240	New Construction (Curve Improvement)
78.	53+450	53+750	300	Eccentric Right Widening (Reconstruction)
79.	53+750	55+000	1250	Eccentric Right Widening (Overlay)

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.5 Typical Cross Sections

Based on the traffic projection, capacity and the design standards, typical cross-sections applicable for various sections of the project road have been prepared. These typical

sections have been prepared separately for various alternatives like reconstruction, rehabilitation, Built-up areas, Bypasses / realignments and Grade separated sections etc. (**Table 1-14**). Typical cross sections are given at the end of this Feasibility Report.

Table 1 - 14 Details of Typical Cross Sections

Sl. No.	Description	TCS No.
1	4 lane divided carriageway (Reconstruction -Concentric widening)	TCS - 1
2	4 lane divided carriageway (Reconstruction –Right side widening)	TCS - 2
3	4 lane divided carriageway (Overlay –Right side widening)	TCS - 3
4	4 lane divided carriageway (Reconstruction –Left side widening)	TCS - 4
5	4 lane divided carriageway (Overlay –Left side widening)	TCS - 5
6	4 lane divided carriageway (rural section - bypass / realignment/curve improvement)	TCS - 6
7	4 lane divided carriageway (Box cut in realignment)	TCS - 7
8	4 lane divided carriageway with both side slip road (Grade separated approaches)	TCS - 8
9	4 lane divided carriageway (Reconstruction in Box cut Concentric widening)	TCS - 9
10	4 Lane divided carriageway with both side slip road (VOP approaches)	TCS – 10
11	4 Lane divided carriageway with one side slip road (VOP approaches)	TCS – 11
12	6 Lane divided carriageway in forest/ restricted area (Reconstruction - Concentric widening)	TCS – 12
13	6 Lane divided carriageway in forest/ restricted area (Reconstruction –Left side widening)	TCS – 13
14	6 Lane divided carriageway in forest/ restricted area (Box cut –Left side widening)	TCS – 14
15	6 Lane divided carriageway in forest/ restricted area (Reconstruction – Right side widening)	TCS – 15
16	6 Lane divided carriageway in forest/ restricted area (Box cut –Right side widening)	TCS – 16
17	6 Lane divided carriageway in forest/ restricted area (Bypass / realignment/curve improvement)	TCS – 17
18	6 Lane divided carriageway in forest/ restricted area (Box cut in Bypass / realignment/curve improvement)	TCS – 18

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.6 Geometric Design Standards

General Considerations

a) This section lays down the standards for Geometric Design and general features for upgrading the existing roads to 2 lane and 4 laning divided carriageway configuration.
b) The Geometric Design of the Project Highway shall conform to the standards set out in this chapter as a minimum.
c) The uniformity of the Design Standards shall be maintained throughout the length.

d) Existing Horizontal Curves, which are found deficient in radius, layout, transition lengths or super-elevation shall be corrected to the specified standards. Similarly deficiencies in the vertical alignment shall also be addressed.

Geometric Design Standards for the Project Road have been drafted based on the following Guidelines:

- Manual of Specification and Standards for Two Laning of Highways with Paved Shoulder (IRC:SP:73-2015)
- Manual for safety in Road Design by Government of India, Ministry of Road Transport & Highways (Road Wing –September 1998)
- Manual of Specification & Standards for Four Laning of Highways Through Public Private Partnership (IRC:SP:84-2014)
- Manual on Road Safety Audit (IRC:SP:88-2010)
- NHAI circular No. 11014/11/2016-HR-I dated 12.06.2017.
- Other IRC Guidelines/Manuals and
- All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC: 71.

The Design Standards for the 2 lane/4 lane Highway Alignment Design are broadly drawn up in **Table 1-15** below. The horizontal and vertical Alignment Design for the improvement of the Project Highway has been done keeping these Standards in view.

Table 1 - 15 Design Standards for 4 Lane Highway

S. No.	Design Specification	Unit	Proposed Design Standards		
1	Design Speed	Km/hr	Plain & Rolling		Mountainous& Steep
	Ruling		100		60
	Minimum		80		40
2.	ROW	M	4- Lane- 70m		
3.	Lane Width (for Multilane Highway)	M	3.50		
4	Median Width (4 Lane Highways)	M	Plain & Rolling Terrain		Mountainous & Steep Terrain
			Raised	Depressed	Raised
	(a) Open Country		5.0	7.0	2.5
	(b) Built Up Area		2.5	NA	2.5
	(c) Approach to Grade Separated Structures		5.0	NA	2.5
5(a)	Shoulder Width (Plain & Rolling Terrain)	M	Paved		Earthen
	(a) Open Country		1.5		2.0
	(b) Built Up Area		4-Lane-2.0m		-
	(c) Approaches to Grade Separators		2.0		-
	(d) Approaches to Bridges		1.5		2.0

S. No.	Design Specification	Unit	Proposed Design Standards	
5(b)	Shoulder Width (Mountainous and Steep Terrain (Hilly Area) (a) Open Country	M	Paved	Earthen
	(i) Hill Side		1.5	-
	(ii) Valley Side		1.5	1.0
	(b) Built Up Area & Approaches to Grade Separators/Bridges		Paved	Earthen
	(i) Hill Side		0.25+1.5 (Raised)	-
	(ii) Valley Side		0.25+1.5 (Raised)	-
6.	Camber	%		
	Carriageway		2.5	
	Paved Shoulders Earthen Shoulder		2.5 3.0	
7.	Gradients a) Plain and Rolling b) Mountainous and Steep	%	Ruling	Limiting
			2.5	3.3
			5.0	6.0
8.	Super elevation a) For radius of curvature 400m/250m and above for 100kmph/80kmph b) For radius of curvature less than 400m/250m for 100kmph/80kmph	%	5.0 7.0	
9.	Minimum Horizontal Curve Radius	M	Plain & Rolling	Mountainous & Steep
	Desirable		400	250
	Absolute		150	75
10.	Sight Distance	M	100 km /hr	80km / hr
	Stopping Sight Distance		180	130
	Intermediate Sight Distance		360	260
11.	Minimum Vertical Curve Length (SSD case) Crest Sag		73.6A 41.5A	
12.	Widening at curve locations	M		
	75-100 m		0.9	
	101-300 m		0.6	

Note: A in the above table is the algebraic difference in grades expressed as percentage

5.7 Pavement Design

The pavement design has been carried out using various IRC publications. Different options of flexible pavement such as CTB, RAP and conventional along with rigid option of pavement design had been evaluated. 30 year design life for rigid pavement and 15 year for flexible pavement has been considered. As per MoRT&H circular RW/NH-35072/05/2018 – S&R (P&B) dated 24th August, 2018, VG -40 Bitumen has been considered for DBM and BC.

Based on the LCCA, **rigid pavement has been recommended for main carriageway** in case of new construction and reconstruction including toll plaza location. As per IRC: SP 84, flexible pavement of 10 MSA has been considered for slip roads. The recommended pavement structure for new construction / reconstruction and overlay is presented in **Table 1-16**.

Table 1 - 16 Recommended Pavement Structure for New Construction / Reconstruction and Overlay

Design Chainage (km)		Design Traffic for Flexible	Design Traffic for Rigid*	Design CBR (%)	Recommended pavement structures for new construction of eccentrically placed additional 2-lanes, new bypasses/ realignments and full depth reconstruction stretches				Recommended overlay on existing flexible pavement		Flexible Pavement Composition for Widening of Existing Carriageway				
From	To				PQC (mm)	DLC (mm)	Drainage Layer (mm)	Separation Layer (mm)	BC (mm)	DBM (mm)	BC (mm)	DBM (mm)	WMM (mm)	GSB Drainage Layer (mm)	GSB Separation Layer (mm)
0+000	4+300	30	2,84,00,020	8	240	150	100	150	Under construction		40	75	250	100	150
4+300	10+300	30	2,84,00,020	8	240	150	100	150	40		40	75	250	100	150
10+300	14+200	30	2,84,00,020	8	240	150	100	150	40	50	40	75	250	100	150
14+200	25+500	30	2,84,00,020	8	240	150	100	150	Reconstruction**		40	75	250	100	150
25+500	57+600	30	2,84,00,020	8	240	150	100	150	40	50	40	75	250	100	150

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.8 Hydrological Design and Recommendations

Data collected from the site were collated and studied along with the Google Earth Imageries. The Design Approach has been formulated through careful examination of the field data collected and the following additional pieces of data:

- Local inquiries, road / culvert inventory, HFL, history of flooding/ overtopping, mean annual rainfall, regional runoff coefficient,
- Survey of India Toposheets – land use, soil type, cover condition and slope
- 30m, SRTM Digital Elevation Model (DEM) to analyze the river catchment characteristics in GIS platform.
- Rainfall / runoff data published in "Flood Estimation Report for Subzones 1(c), 1(d) and 3(f)"– Isopluvial maps for design storms of 24 hour duration with 25 year and 100 year return period.
- Visual inspection – bed level, clearance, HFL, Overtopping, vegetation cover, flood plain, blockage/sedimentation, flow direction, terrain, embankment height, scour.

Hydro-Meteorologically Homogenous Sub zones: For estimation of Design Flood, The Central Water Commission (CWC) has divided the whole Geographical Territory of India into 26 distinct hydro-meteorologically homogenous Subzones. The proposed project area comes under three Subzones 1(c) and 1(d).

Table 1 - 17 Subzone for Project Section

Project Road	CWC Subzone
Km 0 to Km 43 of Chitrakoot –Maihar Road	Subzone 1(c)
Km 43 to Km 55 of Chitrakoot –Maihar Road	Subzone 1(d)

Design Rainfall: Relevant data have been taken from the Flood Estimation Reports of concern subzones of CWC. The **Tables 1-18** shows the 24-hr maximum point rainfall values (from Isopluvial Maps of different Return Periods) generally adopted for the study area:

Table 1 - 18 Adopted Rainfall Data for Rewa –Shahdol Road

Chainage Km		100 Yr. 24 hr. Rainfall (mm)	25 Yr. 24 hr. Rainfall (mm)
0+000	55+000	320	240

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Basin Parameters: The watersheds of the rivers / streams at the proposed crossing points have been delineated with the help of Google Earth Imagery and ArcGIS 10 Software. The watershed area, fall in height, total and segmental stream lengths and corresponding elevations have also be determined with the help of GIS Software.

Estimation of Design Flood

- Determination of Design Discharges have been done in line with the stipulations of IRC-5:2015, IRC-SP:13-2004 and standard engineering practices.

- For streams having catchment areas more than 25 sq. km, SUH Method as stipulated in the Flood Estimation Report of CWC has been followed.
- For catchment areas less than 25 Sq. Km, Rational Method in general has been followed. Empirical Methods (Catchment Area Method using Dicken's Formula), without any assigned return period, has been used as a check for the adopted Design Flood.
- For catchment area more than 5000 Sq. Km. is divided into sub basin areas and SUH method has been applied to calculate design flood of each sub basin. The estimated design flood of each individual sub basin is then routed to bridge location by Muskingum channel routing method.
- Slope Area Method demands accurate information regarding HFL at the particular crossing point. During site visit, sincere efforts were made to collect reliable information regarding Highest Flood Levels (at proposed crossing point) of memorable past.
- However, HFL information received from local enquiries are not reliable enough to be used for determination of design discharges for the bridges. Therefore, the design discharge has not been estimated using slope area method.

Design Return Period: The following table summarizes the return period to be adopted for design of bridges:

Table 1 - 19 Summary of the Return Period adopted for Bridge Design

Sl. No.	Design Parameter	Adopted Return Period Flood
1.	Waterway for Bridges	100 Years
2.	HFL for Bridges	100 Years
3.	Scour for foundation design	100 Year Flood multiplied by suitable factor, based on catchment area.
4.	Design of Roadside Drains / Culverts	25 Years (both for rural and urban areas) and checked for 50 year Return Period Flood.

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

The information about the catchment characteristics, river behaviour, morphology and other hydraulic data for bridges have been collected from the site visit and have been analysed and studied to determine the adequacy of waterway of existing bridges proposed to be retained and/or new bridges to be constructed as per provisions of IRC: 5-2015 and IRC: SP-13 - 2004. The hydrological details of all existing bridges are summarized and given in **Table 1-20.**

Table 1 - 20 Hydrological and Hydraulic Calculation summary of Bridges

S. No.	Design Ch. (Km) Draft DPR	Catchment Area (sq.km)	100 Yr. 24 hr. rainfall (mm)	Discharge (Cumec)	Clear Waterway Provided (m)	Retain/ New/ Replaced	Recommendation as per Hydrological Study
1	8+650	11	320	134	35	New	New Bridge
2	16+540	0.63	320	19	6.2	Retained	Hydrologically Adequate
3	17+980	21.6	320	224	35	New /realignment	New Bridge

S. No.	Design Ch. (Km) Draft DPR	Catchment Area (sq.km)	100 Yr. 24 hr. rainfall (mm)	Discharge (Cumec)	Clear Waterway Provided (m)	Retain/ New/ Replaced	Recommendation as per Hydrological Study
4	18+915	1.38	320	36	6.7	Retained	Hydrologically Adequate
5	20+910	0.39	320	13	6.2	Retained	Hydrologically Adequate
6	21+750	1.8	320	51	9	New	New Bridge
7	22+785	68.45	320	751	56	Replaced	Hydrologically Inadequate
8	24+927	4.97	320	92	20	New	New Bridge
9	26+770	1.6	320	42	14	New	New Bridge
10	31+480	8.2	320	100	8.5	Retained	Hydrologically Adequate
11	31+950	174.13	320	844	70	New /realignment	New Bridge
12	35+120	1.37	320	53	10	New	New Bridge
13	35+725	0.26	320	10	5.7	Retained	Hydrologically Adequate
14	38+255	17.57	320	239	15	Retained	Hydrologically Adequate
15	39+885	1.33	320	41	7	Retained	Hydrologically Adequate
16	42+050	4.49	320	90	10	Retained	Hydrologically Adequate
17	45+280	2.21	320	47	20	New	New Bridge
18	45+980	1.63	320	39	16	New	New Bridge
19	49+422	9.15	320	101	7.5	Retained	Hydrologically Adequate
20	53+460	45.9	320	504	22	Retained	Hydrologically Adequate

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.9 Improvement Proposals for Bridges and Structures

Out of the **15 existing bridges** on the project road:

- 2 existing bridges are proposed to be abandoned due to construction of bypasses
- 3 existing bridges are proposed to be replaced with new 6-lane bridges
- 5 existing bridges are proposed to be replaced with new 4-lane bridges
- 1 existing bridge is to be replaced with new 4-lane bridge along with service road
- 2 existing bridges are proposed to be retained with widening and with additional new 3-lane bridges,
- 1 existing bridge is proposed to be retained with widening with additional 2-lane bridge and
- 1 existing bridge is proposed to be retained without widening

Further, 3 new 6-lane bridges and 4 new 4-lane bridges are also proposed. Thus the **total numbers of bridges** on this stretch of project road are **20**.

Table 1 - 21 Existing Bridges to be Replaced with new 4 lane / 6 lane Bridges

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1	Minor Bridge	18+120	17+965	2x12.0	2x16.0	New 6 lane Bridge
2	Minor Bridge	19+370	18+915	2x12.0	2x16.0	New 6 lane Bridge
3	Minor Bridge	23+460	22+785	2x12.0	2x16.0	New 6 lane Bridge
4	Minor Bridge	32+680	31+477	2x8.5	2x12.5	New 4 Lane bridge
5	Minor Bridge	33+210	31+950	2x8.5	2x12.5	New 4-lane bridge
6	Minor Bridge	37+300	35+725	2x8.5	2x12.5	New 4-lane bridge
7	Minor Bridge	41+445	39+885	2x8.5	2x12.5	New 4-lane bridge
8	Minor Bridge	55+049	53+460	2x8.5	2x12.5	New 4-Lane bridge

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 22 Existing Bridge to be Retained and Additional 2 lane Bridges to be provided

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1.	Minor Bridge	43+445	42+050	8.50	12.50	Existing bridge to be retained without widening with addl. 2-lane bridge of 12.5m width

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 23 Existing Bridges to be Widened and Additional 3 lane Bridges to be provided

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1.	Minor Bridge	16+620	16+540	12.00	16.00	Existing bridge to be widened from 8.2m to 16m with addl. 3-lane bridge of 16m width
2.	Minor Bridge	21+500	20+910	12.00	16.00	Existing bridge to be widened from 8.2m to 16m with addl. 3-lane bridge of 16m width

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 24 Existing Bridges to be Widened and Additional 2 lane Bridges to be provided

Sl. No.	Type of Structure	Existing Chainage (Km.)	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1.	Minor Bridge	50+990	49+422	8.50	12.50	Existing bridge to be widened from 8m to 12.5m with addl. 2-lane bridge of 12.5m width.

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 25 Existing Bridge to be replaced with new 4 lane bridge along with service road

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Main carriageway		Service road bridge		Remarks
				Carriageway Width (m)	Deck Width (m)	Carriageway Width (m)	Deck Width (m)	
1	Minor Bridge	39+830	38+295	2x7	2x11.5	2 x 7	2 x 10.80	New 4 Lane bridge with bridges on both service roads

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 26 New 4 lane Bridges on Bypass or Realigned Stretches of Project Road

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1	Minor Bridge	-	8+650	2x8.5	2x12.5	New 4 lane Bridge
2	Minor Bridge	-	35+120	2x8.5	2x12.5	New 4-lane bridge
3	Minor Bridge	-	45+280	2x8.5	2x12.5	New 4-lane bridge
4	Minor Bridge	-	45+980	2x8.5	2x12.5	New 4-lane bridge

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 27 New 6 lane Bridges on Bypasses or Realigned Stretches of Project Road

Sl. No.	Type of Structure	Existing Chainage	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1	Minor Bridge	22+472	21+815	2 x 12.0	2 x 16.0	New 6 lane Bridge
2	Minor Bridge	25+625	24+927	2 x 12.0	2 x 16.0	New 6 lane Bridge
3	Minor Bridge	27+475	26+775	2 x 12.0	2 x 16.0	New 6 lane Bridge

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Interchange: The project road starts from the existing NH 35, 1 interchange has been proposed at design Ch. 0+000.

Apart from above, there are 2 Vehicular Underpasses, 7 Light Vehicular Underpasses, 2 Small Vehicular Underpasses and 1 Vehicular Overpass are proposed on project road as shown in **Table 1-28**.

Table 1 - 28 Details of VUPs, LVUPs, SVUPS & VOP

Sl. No.	Type of Structure	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
1	VUP	2+526	2x7.0	2x11.0	New 4-Lane VUP
2	LVUP	4+760	2x7.0	2x11.0	New 4-Lane LVUP
3	SVUP	6+110	2x7.0	2x11.0	New 4-Lane SVUP
4	LVUP	7+475	2x7.0	2x11.0	New 4-Lane LVUP
5	VUP	10+225	2x7.0	2x11.0	New 4-Lane VUP
6	LVUP	12+880	2x7.0	2x11.0	New 4-Lane LVUP

Sl. No.	Type of Structure	Design Chainage	Carriageway Width (m)	Total Deck Width (m)	Remarks
7	LVUP	14+035	2x7.0	2x11.0	New 4-Lane LVUP
8	LVUP	30+655	2x7.0	2x11.0	New 4-Lane LVUP
9	SVUP	32+535	2x7.0	2x11.0	New 4-Lane SVUP
10	LVUP	38+490	2x7.0	2x11.0	New 4-Lane LVUP
11	LVUP	50+015	2x7.0	2x11.0	New 4-Lane LVUP
12	VOP	33+090	2x7.0	2x11.0	New 4-Lane VOP

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.10 Proposed Culvert

Based on the hydrological assessment, existing minor cross drainage structures, canal crossings and drainage flow, **102 culverts** have been proposed. The summary of recommended culverts for the project road is presented in **Table 1-29**.
In addition to above **37 HP Culverts** are proposed for cross drainage at junction locations.

Table 1 - 29 Summary of Recommended Culverts

Description	Type of Culverts		
	Hume Pipe	Slab	Box
New Culvert	0	0	49
Widening of existing culverts	14	3	7
Reconstruction of existing culverts	0	0	29
Total	**14**	**3**	**85**

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.11 Major & Minor Junctions

In addition to VUPs and LVUPs, for smooth merging & diverging of cross road traffic, at grade intersections has been proposed at other locations. The details of Major & Minor Junction for improvement have been given in **Table 1-30** and **Table 1-31**.

Table 1 - 30 Details of Major Junction for Improvement

Sr. No.	Existing chainage	Design Chainage	Junction Type	Road Leading to	
				Left	Right
1	-	0+000	T	Karwi	Banda
2	-	2+526	+	Chitrakoot	Shivrampur
3	-	4+760	+	Katma Mohalla	Ranipur
4	-	6+110	+	Khoohi	Sagrampur
5	-	7+475	+	Khoohi	Chak Bhupat
6	10+050	10+305	Y	Chitrakoot	Mahiar
7	12+560	12+880	T	-	Samaria Jgannath
8	13+820	14+035	T	Sati Anusuiya	-
9	29+750	30+655	T	Pindra	-
10	31+695	32+535	T	Pindra	-

Sr. No.	Existing chainage	Design Chainage	Junction Type	Road Leading to	
				Left	Right
11	-	33+090	+	Village Road	Existing Road
12	40+035	38+490	+	Majhgawa	Umariha
13	48+030	46+475	T	Chandai	-
14	51+570	50+015	T	-	Bhargawa
15	57+160	53+820	T	Nayagaon	-

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Table 1 - 31 Details of Minor Junction for Improvement

Sl. No.	Existing Chainage	New Design Chainage	Junction Type	Road Leading to	
				Left	Right
1	-	1+590	+	Sitapur Mafi	Khutaha
2	-	3+460	+		
3	-	7+000	+	Khoohi	Sagrampur
4	-	9+580	+	Janki Kund	Balapur Mafi
5	14+245	14+430	T		Tendhee patmaniya
6	34+540	33+090	T	Itwa Tudaila	
7	45+375	43+820	T	Birsinghpur	
8	47+950	46+400	T		Hiraundi
9	48+850	47+300	T		Koldari
10	51+860	50+300	T	Sagra	
11	52+875	51+300	T	Sagra	
12	54+020	52+470	T	Amiliya	
13	54+570	53+010	T	Village road	
14	55+380	53+820	T	Nayagaon	

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.12 Toll Plaza

The site for toll plaza location was carefully selected based on guidelines laid out in IRC standards. As per the guidelines given in MCA and toll policy, the distance between two toll plazas shall be at least 60 km apart and in reference with NHAI Circular dated 12th June 2017, minimum 8 lane (i.e. 7+1 on both side) configure of toll plaza has been proposed. Based on these criteria **one toll plaza** (2 x 8 lane) **has been proposed at Km 39+485** (Village Majhgawa). General Layout of Toll Plaza is given below:

- Lane Width = 3.2 m in general and 4.5 m for oversize vehicles.
- Booth Island (a) Width = 1.9 m (b) minimum Length = 35m.
- Transition – 1 in 10 has been provided from two-lane section/four lane section to the widened width at Toll Plaza on either side.
- Provision of Future expansion: The office building shall be located taking into consideration of future expansion

5.13 Passenger Wayside Amenity

As per MoRTH Guidelines dated 12th December 2012 for providing **"Research and**

Test (ResT) reaches along National Highways", 1 passenger wayside amenity at every 50 km, will be established. Rest area provides useful services to the road user. These facilities provide services to the users who desire to stop for rest, refreshment, information and fuelling or for some emergency requirement. Rest Areas shall have facilities such as parking, toilet, rest areas, restaurants, fuel station, telephones, emergency medical aid facilities and Traffic aid Post etc. Location of wayside amenities is as follows:

Table 1 - 32 Location of Way Side Amenities

Sl. No.	Chainage	Side	Village Name
1	12+580	RHS	Rajaula
2	48+530	LHS	Kathauta

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.14 Truck Lay Bye

Based on site observations of existing informal truck laybyes, the following locations are considered for proposed truck laybys. It is presented in **Table 1-33**.

Table 1 - 33 Location of Truck Lay bye

Design Chainage (Km)	Side	Village
51+790	LHS	Ragala
51+620	RHS	

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.15 Bus Byes

16 Bus bays on this package are identified to address the need of people living for boarding and alighting of passengers along the project roads as detailed below.

Table 1 - 34 Location of Bus Byes

S. No	Design Chainage	Side	S. No	Design Chainage	Side
1	4+535	RHS	9	14+255	LHS
2	4+980	LHS	10	14+255	RHS
3	7+335	RHS	11	30+905	LHS
4	7+640	LHS	12	30+905	RHS
5	10+085	RHS	13	38+698	LHS
6	10+395	LHS	14	38+698	RHS
7	12+655	LHS	15	49+800	LHS
8	13+080	RHS	16	50+215	RHS

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.16 Slip Roads

The project road is passing through number of ribbon developments / urban settlements which contribute heavy movements of local and non-motorized traffic along with the long distance (through) traffic. The profile of speed along the project road has shown

reductions in speed levels in such locations. To address the need of the local habitants and to maintain the uniform speed profile of straight traffic after segregation of local traffic underpasses have been proposed to cross and access the National Highway. At underpass locations, slip road has been proposed. In accordance to the MoRT&H memorandum dated 3rd May 2018, the width of slip road / service road has been kept as 10m (Carriageway 9m with 1m shoulder). The details locations of the proposed slip roads are given in **Table 1-35**.

Table 1 - 35 Location of Slip Roads

S. No	From	To	Length (Km)	LHS	RHS
1	2+070	2+990	0.920	9.0	9.0
2	4+420	5+100	0.680	9.0	9.0
3	7+060	7+920	0.860	9.0	9.0
4	9+610	10+840	1.230	9.0	9.0
5	12+420	13+320	0.900	9.0	9.0
6	13+640	14+400	0.760	9.0	9.0
7	30+245	31+020	0.775	9.0	9.0
8	32+535	32+950	0.415	9.0	-
9	32+950	33+875	0.925	9.0	9.0
10	38+145	38+810	0.665	9.0	9.0
11	49+650	50+400	0.750	9.0	9.0
Total Length (Km)			**8.880**		

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

5.17 Street Lighting

Street Lighting shall be provided at the following locations conforming to IRC:SP:73-2015 (Manual of Specifications & Standards for Two Laning of Highways with Paved Shoulder) and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership).

- Toll Plaza Area
- Way Side Amenities
- Truck Lay byes
- Bus Bays and Bus Shelters
- Grade Separated structures, Interchanges, Flyovers, Underpasses and Overpasses.
- Built-up Sections on the Project Highway both in the median of the main carriageway and on the service road on either side.

5.18 Traffic Control Devices and Road Safety Works

The Traffic Control Devices and Road Safety Works shall consist of the following:

Road Signs:

- Three types of road signs shall generally be provided (such as Mandatory / Regulatory, Cautionary / Warnings, and informatory signs.
- Locations of Signs shall conform to IRC:67-2012, Section 800 of MOR&TH Specifications, and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership) and Manual of Specification & Standards for Expressways (IRC:SP:99-2013)
- Proper signs shall be provided for main carriageway, service and slip roads, toll plaza and other project highway facilities. Clustering and proliferation of road signs shall be avoided for enhancing their effectiveness.

Road Markings:

- Road Markings shall be of hot applied thermoplastic materials with glass reflectorizing beads.
- Road markings shall conform to IRC:35-1977 and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership) and Manual of Specification & Standards for Expressways (IRC:SP:99-2013)

Road Delineators: These are roadway indicators, hazard markers and object markers and shall conform to IRC 79-1981.

Reflective Pavement Markers (Road Studs) shall be provided to improve the visibility in night time and wet weather conditions. The locations and details of road studs shall conform to IRC:SP:73-2015 (Manual of Specifications & Standards for Two Laning of Highways with Paved Shoulder) and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership).

Roadside and Median Safety Barriers:

a) Semi-rigid type barrier at the edge of formation shall be provided at all embankments with height 3.0m or more with delineating reflectors fitted on them. These barriers shall also be provided along all curves having radii up to 450m for complete length of curves including transitions and 20m further before and after the curve.
b) Semi rigid barrier and flexible barrier shall not be installed upon a structure.
c) Steel barriers shall be provided in non-built-up sections, whereas concrete barriers shall be provided in built up sections.
d) Rigid barriers shall also be provided at the following locations:
    - Where embankment is retained by a retaining structure
    - On valley side of highway in mountainous and steep terrain.
    - Between main carriageway and footpath in bridges.

6.0 CONTRACT PACKAGING

Based on the major components of works and considering the total cost of a package, total 3 packages has been identified for the implementation of civil works contracts. The details of the proposed construction packages are given in **Table 1-36**.

Table 1 - 36 Details of Proposed Construction Packages of NH 135 BG

Existing Length (Km)	Packaging Details				Location	
	Pkg. No	From	To	Length (Km)	From	To
121.350	I	0+000	55+000	55.000	Chitrakoot	Kothi
	II**	55+000	76+960	21.960	Kothi	Satna
	III**	80+800	119+535	38.735	Satna	Maihar

*** Note:* ***Separate Feasibility Report & Form-1 has been prepared for Package-II & III***

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

7.0 LAND ACQUISITION

According to the preliminary data collection total land to be acquired for improvement of this section is **268.834 hectares**, Out of which **196.47 ha** is **private land** and need to be acquired for the project. The area is excluding the area that already lies with NHAI in terms of existing roads falling in the alignment. All the information, which has been reported here are on the basis of preliminary data collected from the field and analysed by professional expert. Land acquisition details will be updated when the final data of land owners will be obtained from the joint field verification. Census survey of the owners of affected structures are carried out to identify the persons who would be affected by the proposed project and to make an inventory of their assets, which would be the basis of calculation of compensation. Summary of land acquisition are given in **Table 1-37**.

Table 1 - 37 Summary of Land Acquisition

Sl. No.	Type of Land	Area (in Ha)
1	Private	196.47
2	Govt.	72.364
Total		**268.834**

Source: preliminary assessment of land acquisition

8.0 INITIAL SOCIAL IMPACT ASSESSMENT

Initial social impact assessment is carried out to identify impact of properties, land, impacts on the community and settlement to provide the basic information to the engineering design team to make any changes in the initial technical design. The thrust of this integration is to minimize the adverse impacts, if any, with the best possible engineering solutions at the most appropriate cost. It defines the magnitude of social impact on properties and households including PAPs. The main features of the impact

assessment on the population and properties along the project roads are summarized here as follows.

- Total number of structures to be affected is **155,** which includes private, religious, community and Government properties.
- The total number of private properties to be affected due is 123, out of which 27 are commercial properties, 9 are res-cum-commercial, 67 are residential, 7 are others type of properties and 3 are boundary wall.
- All the 123 project-affected households (PAHs) excluding the number of land holders are to be get affected by this package of project.
- Out of total 123 households nearly 12.20% (15 in numbers) is SC and 8.94% (11 in numbers) is ST families.
- There are 20 government properties, 11 religious properties resources and 1 village gate to be affected.
- 95.93% of the structures will be fully impacted.
- Most of the structures that have been enumerated during social survey within proposed ROW are Pucca (38.21%) in nature followed by Semi-pucca 38.21%. 20.33% are Kutcha and 3.25% of structures which are Kiosk in nature.
- **Most of the affected households are non-titleholders** (60.16%).
- The project will effect on the source of income of project affected households who are mainly involved agriculture and business activities.

The R&R budget for the widening of existing road worked out for Package-I is approx. Rs. **347.50 Crores**, which includes the cost of land and structure, relocation or enhancement of religious, government and community structures and R & R Assistance given to affected people.

Table 1 - 38 Summary of Social Impacts

Sl. No.	Impacts	Number
1	Total land acquisition including Govt. Land (in hectare)	72.364
2	Total private land acquisition requirements (in hectare)	196.47
3	Total number of structures affected of all categories (Private+ Government.+ Religious + Community)	155
4	Total Number of SC/ST households affected	26
5	Total number of Affected Persons (Aps)	562
6	Total number of private structures affected [TH (76) + NTH (47)]	123
7	Total number of Govt. properties	20
8	Total number of CPRs including Religious properties affected	12
9	Fully Displaced	118
10	Losing Residential Structures (TH) fully impacted	43

Source: Census Survey, ICT New Delhi 2018

9.0 DIVERSION OF FOREST LAND

Proposed project road originates from the existing NH-76 (new NH-35) at Chakla Rajrani village of Chitrakoot district (Km. 0+000) in the State of Uttar Pradesh and ends at Nayagaon village of Satna District (Km. 55+000) in the State of Madhya Pradesh. 8.860 km stretch of the project road is in Uttar Pradesh and remaining 46.140 km is in Madhya Pradesh. Total Forest land required to be diverted for the proposed project is **91.9260 ha**, out of which 2.0935 ha is located in Chitrakoot District of Uttar Pradesh and 89.8325 ha land is located in Satna district of Madhya Pradesh.

Forest in Uttar Pradesh: A junction will be developed at the crossing between NH-135 BG with NH-76 (start point of the project road). The road side plantations along existing NH-76 (Banda Allahabad Section) are declared as Protected Forests vide notification dated 20.02.1960. Hence, forest clearance under Forest Conservation Act, 1980 is required to be obtained for development of this stretch. The proposed junction development will involve diversion of **2.0935 ha** of Roadside Protected Forest land in Chitrakoot District of Uttar Pradesh. Chainage wise details are presented in **Table 1-39**.

Table 1 - 39 Details of Protected Forest Land to be diverted in Uttar Pradesh

Design Ch.		District	Tehsil	Village	Legal status	Forest Area (Ha.)
From	To					
276+370	276+790	Chitrakoot	Karvi	Bhabhai Choubey Jagir	Roadside Protected Forest	0.8380
276+790	277+730	Chitrakoot	Karvi	Chakla Rajrani		1.2555
					Total Forest Area	**2.0935**

Forest in Madhya Pradesh: The proposed project will involve diversion of 89.8325 ha forest land falls under the jurisdiction of the Satna Forest Division. Details of forest areas in Madhya Pradesh are presented in **Table 1-40**.

Table 1 - 40 Details of Protected Forest area to be diverted in Madhya Pradesh

Design Ch.		District	Tehsil	Village	Legal status	Forest Area (Ha.)
From	To					
08+680	14+160	Satna	Majhgawan	Rajaula	PF	6.4274
14+700	18+000	Satna	Majhgawan	Pathra	PF	7.8235
18+000	26+075	Satna	Majhgawan	Parwaniya	PF	16.3041
26+075	28+100	Satna	Majhgawan	Judehi	PF	1.8835
33+000	37+300	Satna	Majhgawan	Rampurwa	PF	16.3862
39+700	43+680	Satna	Majhgawan	Parewa	RF	12.064
43+680	45+975	Satna	Majhgawan	Chaurehi	PF & RF	10.1507
49+100	49+430	Satna	Majhgawan	Dalela	PF	1.4452
49+430	49+925	Satna	Majhgawan	Bhargawa	PF	2.2489

Design Ch.		District	Tehsil	Village	Legal status	Forest Area (Ha.)
From	To					
49+925	50+300	Satna	Birsinghpur	Pachour	PF	1.8834
50+300	53+130	Satna	Raghuraj Nagar	Sagra	PF	11.0469
53+130	53+485	Satna		Moharia	PF	1.5591
53+485	53+600	Satna		Nayagaon	PF	0.6096
					Total forest land to be diverted	**89.8325**

Note: PF = Protected Forest; RF = Reserved Forest

10.0 COST ESTIMATE

Total project cost is **Rs. 1,026.54 Crore** and total cost includes contingencies, supervision charges, administrative charges, cost of resettlement and rehabilitation, land acquisition cost, environmental cost and shifting of utilities. The Civil Cost and Total Project Cost are presented in **Table 1-41**.

Table 1 - 41 Package wise Civil Cost and Total Project Cost

Sl. No.	Description	Amount in Rs.
A)	Total Civil Cost	**6,12,98,45,091.00**
B)	Add Contingencies @ 3% on (A)	18,38,95,353.00
C)	Construction Supervision Charges @ 3% on (A)	18,38,95,353.00
	Sub Total (A+B+C)	**6,49,76,35,797.00**
D)	Resettlement and Rehabilitation costs I/C Land	3,47,53,00,000.00
E)	Environment cost	10,86,05,500.00
F)	Shifting of utilities	18,38,95,353.00
	Grand Total (A+B+C+D+E+E)	**10,26,54,36,650.00**
	Total Project Cost	**Rs. 1026.54 Crore**
	Per km Cost	**Rs. 18.66 Crore**

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

11.0 ECONOMIC AND SENSITIVITY ANALYSIS

The **Economic Analysis** has been carried out for appreciating the viability of proposed investment in the improvement of the project road and are presented in **Table 1-42.**

Table 1 - 42 Results of Economic Analysis

Project Name	EIRR (%)	NPV (Rs. in million)
NH 135BG	13.22%	1847.24

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Sensitivity Analysis: Sensitivity Analysis or 'What if Analysis' is done to check the robustness of the project under various adverse conditions and its effect on economic

viability of the project due to change in the level of the key input factors, including construction cost, variation in traffic etc. The sensitivity of the EIRR and NPV has been studied under the following change in conditions are presented in **Table 1-43.**

Scenario – I : Base Costs + 15% and Base Benefits
Scenario – II : Base Costs + Base Benefits - 15%
Scenario – III : Base Costs + 15% and Base Benefits - 15%

Table 1 - 43 Results of Sensitivity Analysis

Description	EIRR (%)
Scenario – I	11.84%
Scenario – II	11.69%
Scenario – III	10.46%

Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi

Conclusion: From the above tabulated results of Economic and Sensitivity analysis, it can be observed that, the project is viable in base case but is sensitive to increase in cost by 15% and reduction in traffic by 15% or both as it falls marginally below the threshold of 12% in all the three cases. The low viability is due to low volume of initial traffic as it reaches the Design Service Volume of 4-lane only by 2031 i.e after 10 years of opening.

However when the intangible benefits are considered, it is expected that the project shall be substantially viable. The Implementation of the project road is highly desirable for the economic development of the region considering the stretch as feeder route for the economic corridor and macro level as well. Hence, development of the project roads should be taken up for implementation without any delay in view of full realization of benefits to the road users and the community along the Project influence area.

12.0 FINANCIAL ANALYSIS

Financial Analysis of the project road has been carried out for concession period of 15 years on Hybrid Annuity mode. The results of analysis are given in **Table 1-44**.

Table 1 - 44 Results of Financial Analysis

Base Civil Construction Cost	Rs. 612.98 Crore
Civil Construction Cost escalated upto bid due date	Rs. 612.98 Crore
Estimated Project Cost	Rs. 1026.54 Crore
% of basic CCC to EPC	5.25%
Estimated Bid Project Cost	Rs. 739.00 Crore
Estimated Project Life Cycle Cost	Rs. 603.76 Crore
Variation in Estimated Project Cost	18.30%

Equity IRR	15.04%
Project IRR	13.01%
NPV of Equity IRR	Rs. 21.44 Crore
NPV of Project IRR	Rs. 15.16 Crore
NPV of Gross Revenue of the Concessionaire (Annuity + O&M)	Rs. 451.51 Crore
Average Debt Service Coverage Ratio	1.45
First Year O&M Cost	8.44

Based on the Financial Analysis carried out, the following conclusion can be made:

- Estimated Bid Project Cost as per HAM Mode of Implementation would be **Rs. 739 Crore** with a construction period of **24 months** and concession period of 15 years (excluding construction period). The project IRR is about 15.04% in hybrid annuity mode with concession period of 15 years. Hence, the Project is viable as per HAM.

13.0 PROJECT BENEFIT

Direct Benefits: Major benefits that are likely to accrue from the project road include:

- Stimulus for further development in the region along with increase in employment opportunities;
- Improved road network benefiting the local people including businessmen, traders, merchant, tourists and long distance motorists;
- Reduction in travel time, distance as well as transportation cost will be reduced;
- Boost for socio-economic and tourism development along the project road;
- Income of vulnerable and poor people will be increased;
- Facilitate the provision of extension and social services by the government, NGOs and other voluntary institutions;
- Possible employment of semi-skilled and unskilled people living along the project road alignment and its adjoining villages during the construction and operational period; and
- Better driving conditions and road safety.

Indirect Benefits: As quantified above, the most direct beneficiaries of this project roads are road users, i.e., the population living along project road, vehicle owners, as well as passengers traveling in private and public transport etc.. There will be benefit from reduced transportation costs and travel times between the connected cities and regions, and much improved traveling comfort. However, the communities located along the project corridor will also get economic benefit indirectly mainly because of two main reasons;

a) During the construction period a large number of skilled and unskilled workers will be employed by private contractors, resulting in important income generation. Unskilled workers will be recruited from the area for physical works, resulting in direct income generation for this group in the area of the project road.

b) Private contractors and consultants will get benefit from the contracts that will arise from project execution and from the subsequent operation and maintenance of these roads. Both women and men are expected to benefit from the improved mobility, safety and access to markets and services along the project corridor. However, in terms of safety benefits women and children will be benefitted from the increased pedestrian safety generated by the project, since they tend to constitute the majority of pedestrians in settlements along the project road, in order to access social services, markets and shopping stores. On the other hand, men will mostly benefit from those road safety improvements that address safety risks for drivers and vehicle occupants, which in their majority are men.

Finally, specific beneficiaries will include the rural and urban poor, unemployed, small and petty traders, shop owners, chemists, medical practitioners, fertilizer agents, fruit and vegetable sellers, tea stalls, hotels, restaurants, Dhabas, tyre repairing and mechanics shops, garages, godowns, vendors, hawkers, kiosks, rural artisans, farmers, cultivators, industrial workers and women etc.

14.0 CONCLUSIONS AND RECOMMENDATION

Based on the findings of this study the following recommendations are made:

- To avoid congestion habitation area and to upgrade the safety of the road user bypass / realignments for a length of 23.42 km and curve improvement for a length of 7.2 km has been recommended.
- Considering the projected traffic, importance of connectivity between two National Highway as well as two states, the project roads have been recommended for up-gradation to 4 lane with paved shoulder configuration.
- Based on the LCCA and availability of cement within the close vicinity, rigid pavement for a design life of 30 year is recommended.
- A conventional pavement material of BC, DBM, WMM and GSB is recommended on slip road.
- 16 Bus bays (8 Locations) on the project road has been recommended to address the need of the people living along the stretch.
- To facilitate the truck traffic truck lay bye near proposed toll plaza is necessary for this industrial area and two lay byes have been proposed.
- The project road is recommended to be implemented under Hybrid Annuity Mode (HAM) mode under Govt. of India funding.

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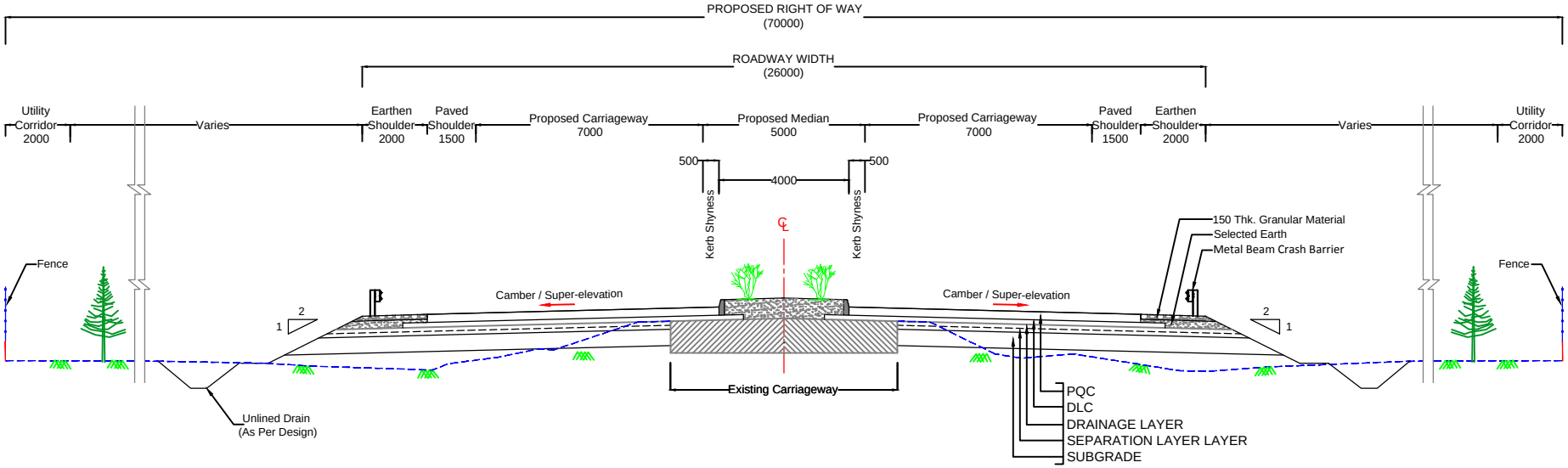


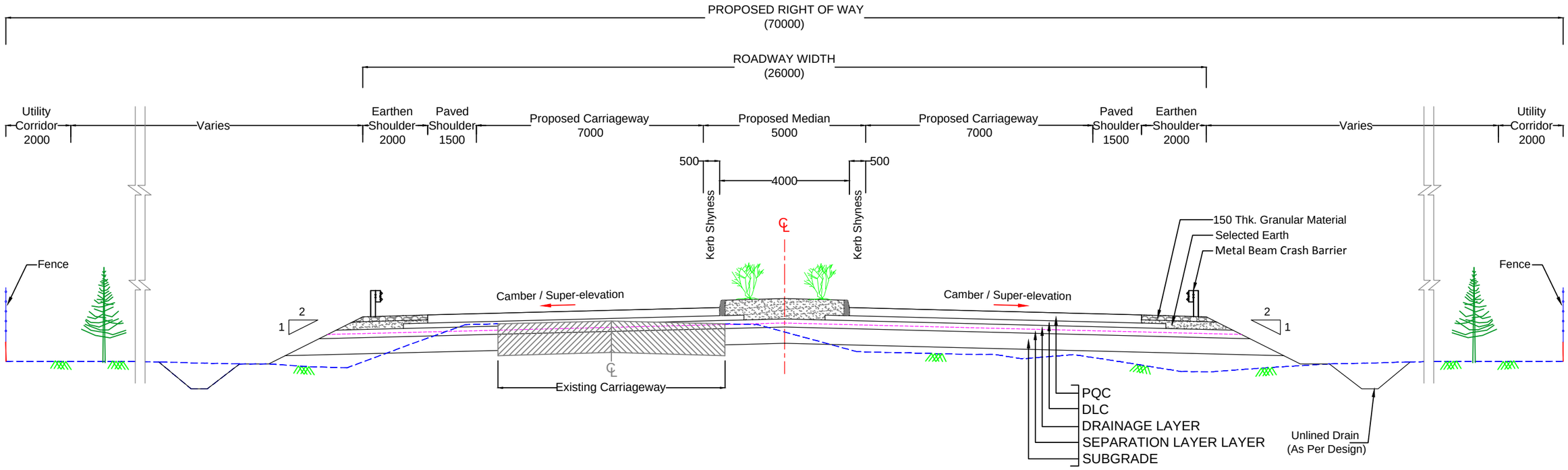
TCS - 1

4 - LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION - CONCENTRIC WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	R0 / November - 2018 / Initial Drawing		
						Revisions / Date / Description / Checked by		
						Revisions		Rev.
					HBisht (Prepared by) / Jogesh (Designed by) / B.K.Swain (Checked by) / Sanjay Singh (Approved by)	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 01		R0
						Paper Size A2 Sheet		



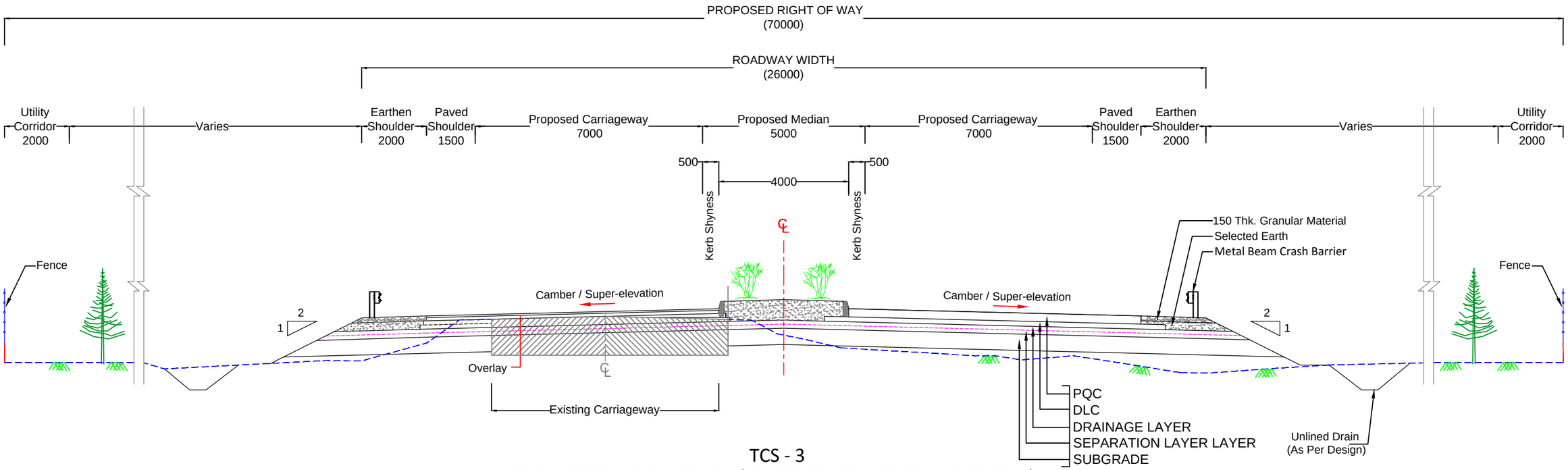
TCS - 2

4 - LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION - RIGHT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252				R0 / November - 2018 / Initial Drawing
					HBisht (Prepared by)	Jogesh (Designed by)	B.K.Swain (Checked by)	Sanjay Singh (Approved by)	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 02 — Paper Size A2 Sheet — Rev. R0



TCS - 3

4- LANE DIVIDED CARRIAGEWAY (OVERLAY - RIGHT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	R0 | November - 2018 | Initial Drawing Revisions | Date | Description | Checked by Revisions | Rev. R0 DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 03 Paper Size A2 Sheet

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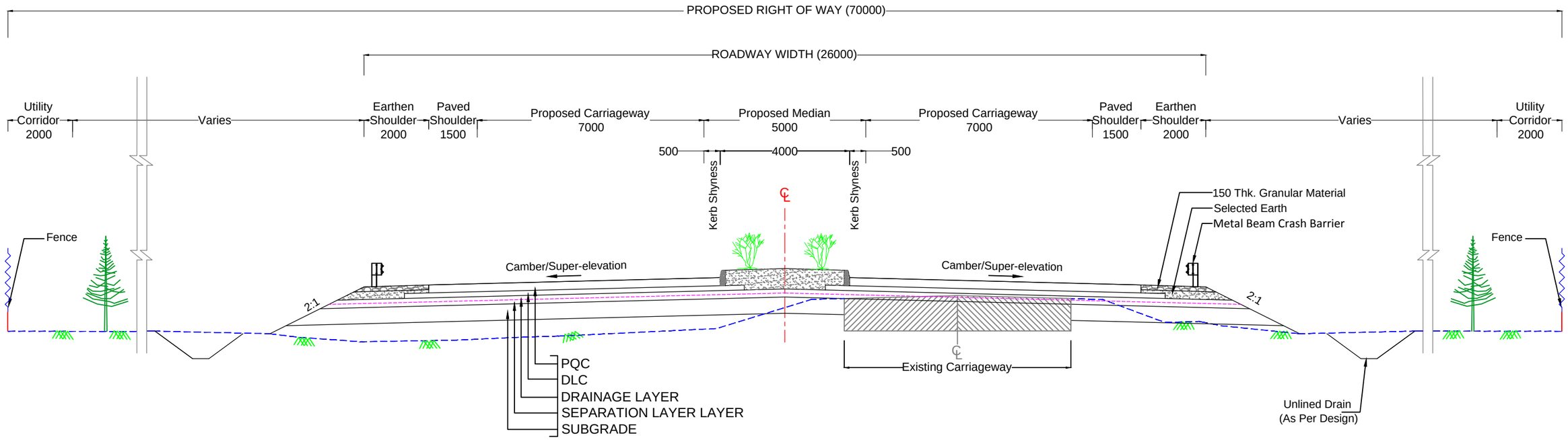
HBisht	Jogesh	B.K.Swain	Sanjay Singh



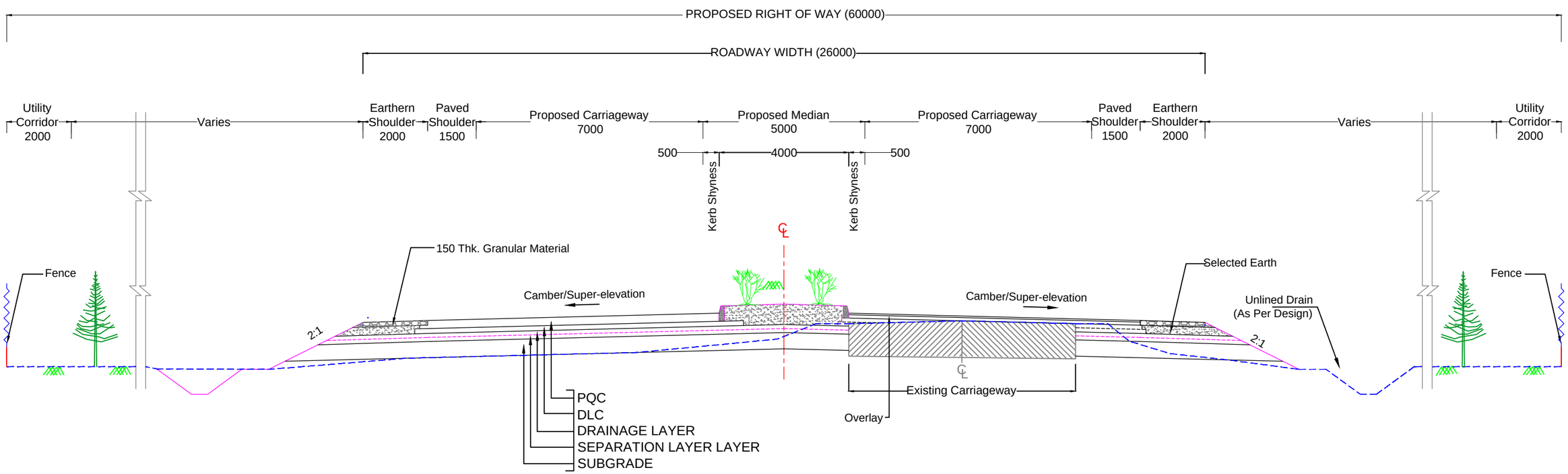
TCS - 4

4 LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION LEFT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	HBisht (Prepared by)	Jogesh (Designed by)	B.K.Swain (Checked by)	Sanjay Singh (Approved by)	R0 | November - 2018 | Initial Drawing Revisions | Date | Description | Checked by Revisions Rev. R0 DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 04 Paper Size A2 Sheet



TCS - 5

4 LANE DIVIDED CARRIAGEWAY (OVERLAY - LEFT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252				R0 / November - 2018 / Initial Drawing
					HBisht (Prepared by)	Jogesh (Designed by)	B.K.Swain (Checked by)	Sanjay Singh (Approved by)	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 05
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Revisions	Date	Description	Checked by
		Revisions	Rev.
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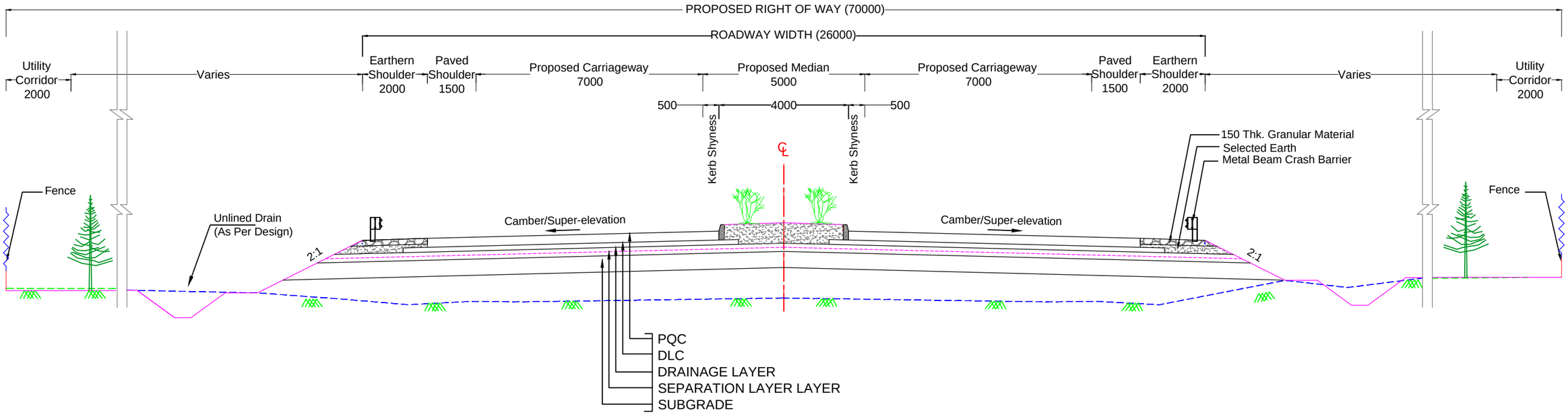

TCS - 6
4 LANE DIVIDED CARRIAGEWAY (RURAL SECTION BYPASS/REALIGNMENT/CURVE IMPROVEMENT)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	R0	November - 2018	Initial Drawing	
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						Revisions			Rev. R0
					HBisht Prepared by	Jogesh Designed by	B.K.Swain Checked by	Sanjay Singh Approved by	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 06
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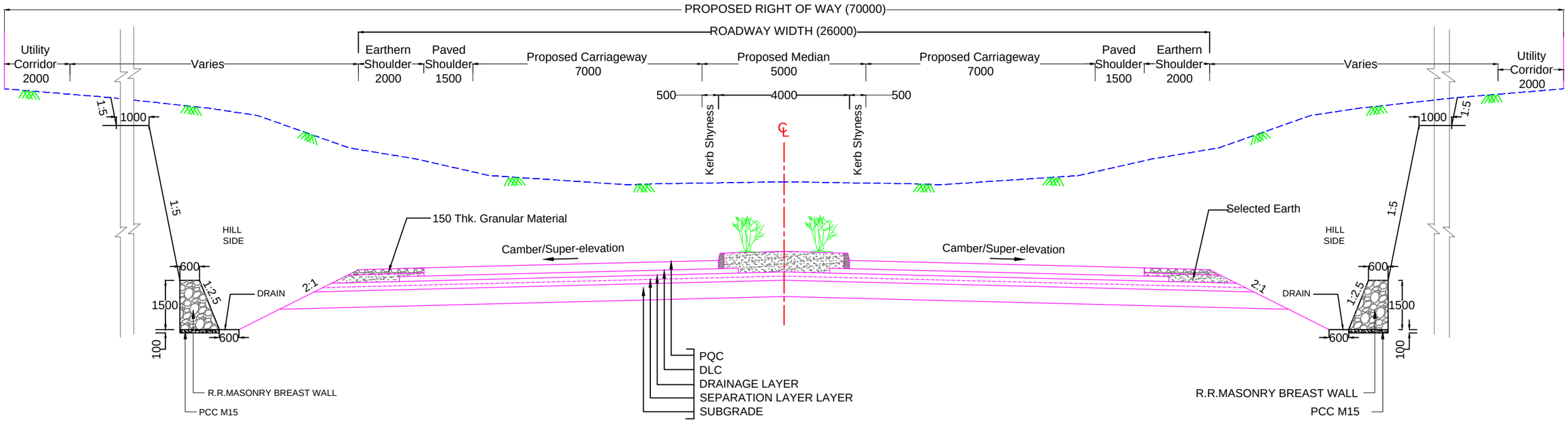

TCS -7

4 LANE DIVIDED CARRIAGEWAY (BOX CUT IN REALIGNMENT)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252				R0 / November - 2018 / Initial Drawing
					HBisht	Jogesh	B.K.Swain	Sanjay Singh	Revisions / Date / Description / Checked by
					Prepared by	Designed by	Checked by	Approved by	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 07 — Rev. R0
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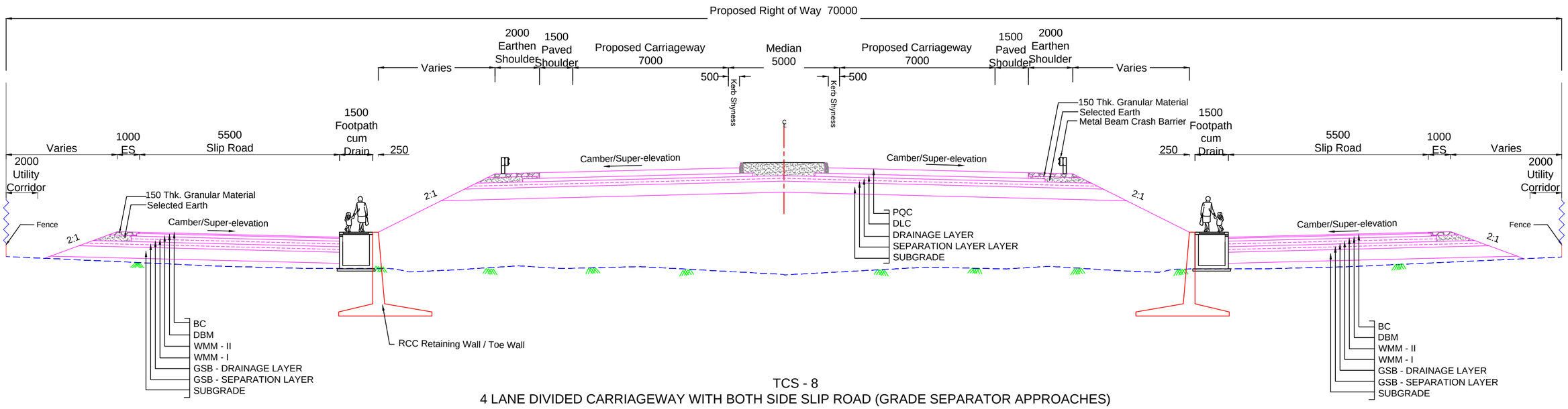

TCS - 8

4 LANE DIVIDED CARRIAGEWAY WITH BOTH SIDE SLIP ROAD (GRADE SEPARATOR APPROACHES)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	R0	November - 2018	Initial Drawing	
						Revisions	Date	Description	Checked by
						Revisions			Rev.
					HBisht (Prepared by)	Jogesh (Designed by)	B.K.Swain (Checked by)	Sanjay Singh (Approved by)	DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 08 — R0
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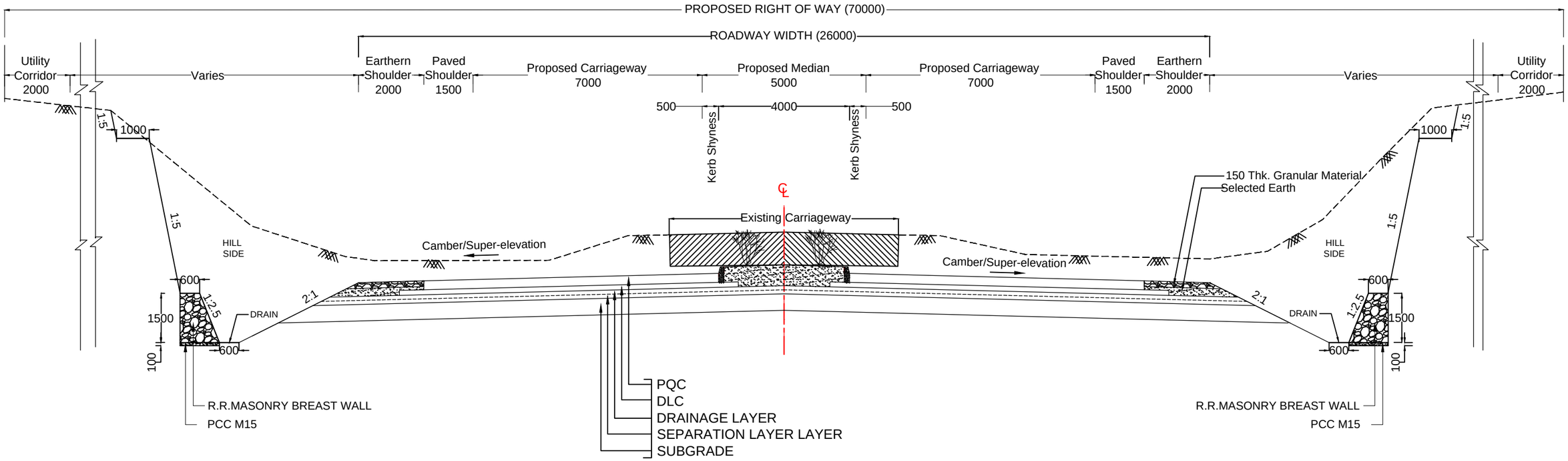


TCS - 9

4 LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION BOX CUT - CONCENTRIC WIDENING)

Notes :-

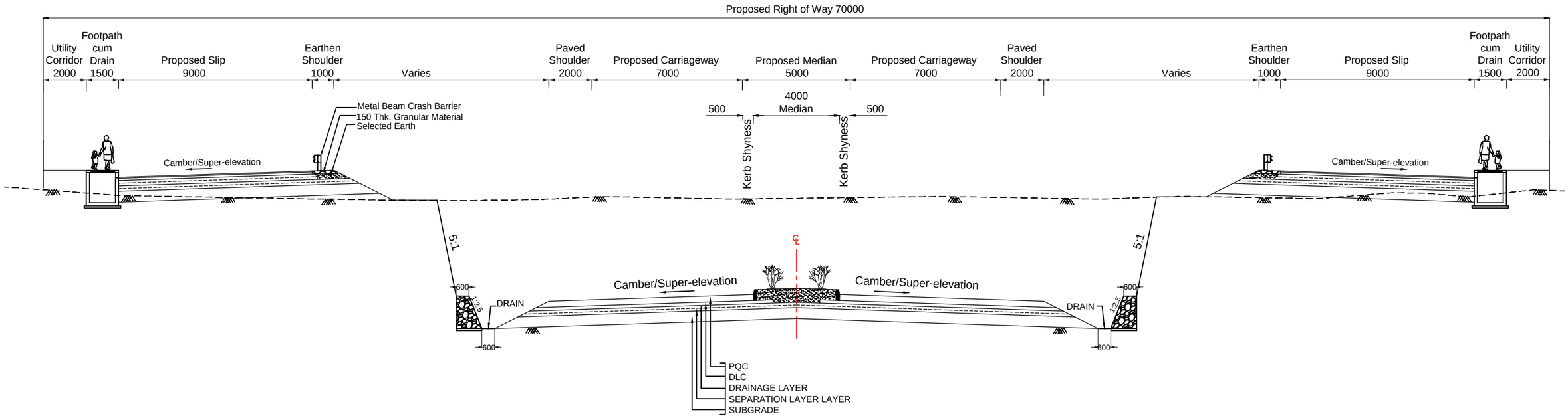
1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 HBisht | Jogesh | B.K.Swain | Sanjay Singh

Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions — Rev. R0

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 09



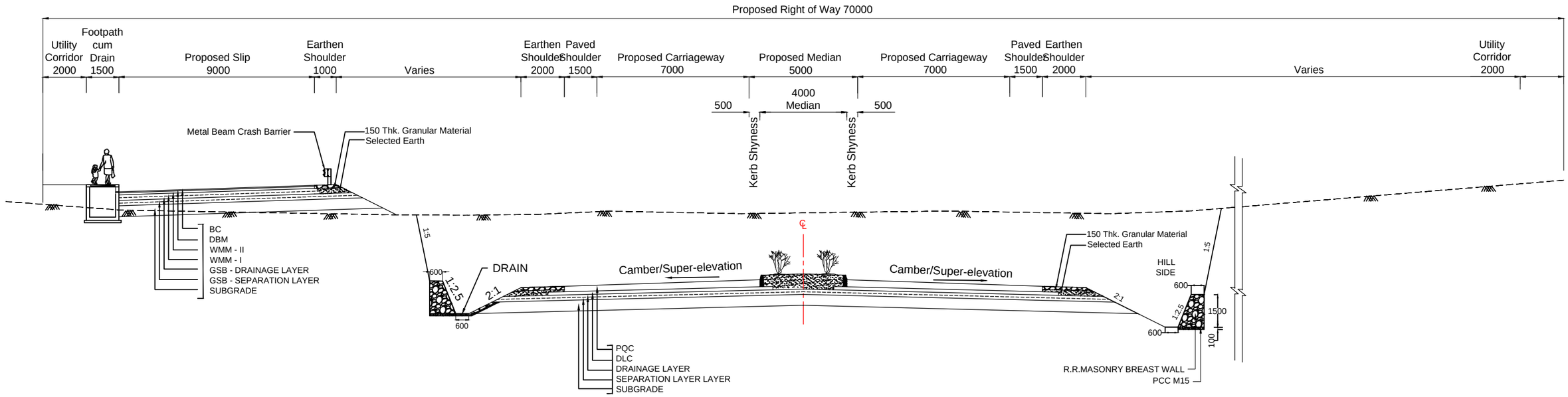
TCS - 10

4 LANE DIVIDED CARRIAGEWAY WITH BOTH SIDE SLIP ROAD (VOP APPROACHES)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be Provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 HBisht Jogesh B.K.Swain Sanjay Singh	R0 November - 2018 Initial Drawing Revisions Date Description Checked by Revisions Rev. DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 10 R0



TCS - 11

4 LANE DIVIDED CARRIAGEWAY WITH ONE SIDE SLIP ROAD (VOP APPROACH)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be Provide as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

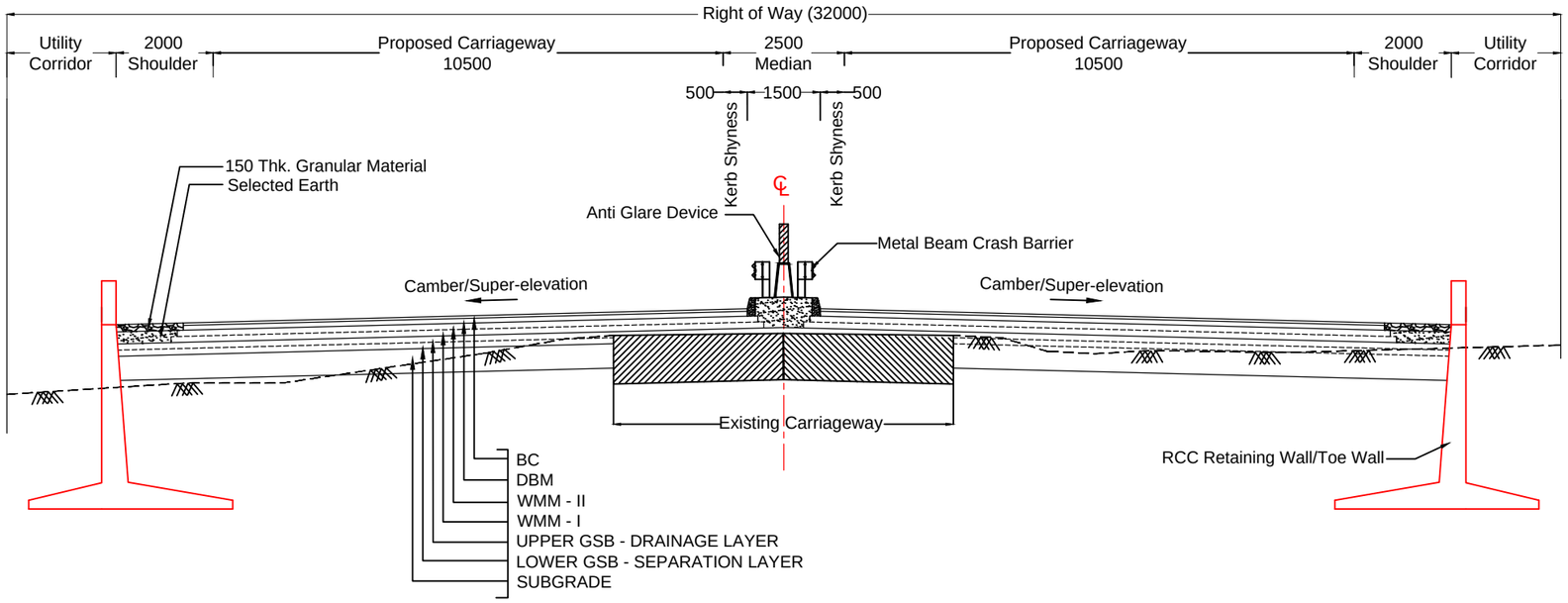
Drawing Name :- Feasibility Report Typical Cross Section

Intercontinental Consultants & Technocrats Pvt Ltd,
A-8, Green Park, New Delhi - 110016
Ph : 4086-3000, Fax 2685-5252

HBisht	Jogesh	B.K.Swain	Sanjay Singh

Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 11 — Rev. R0



TCS - 12

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICTED AREA (RECONSTRUCTION - CONCENTRIC WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

Intercontinental Consultants & Technocrats Pvt Ltd,
A-8, Green Park, New Delhi - 110016
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Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 12

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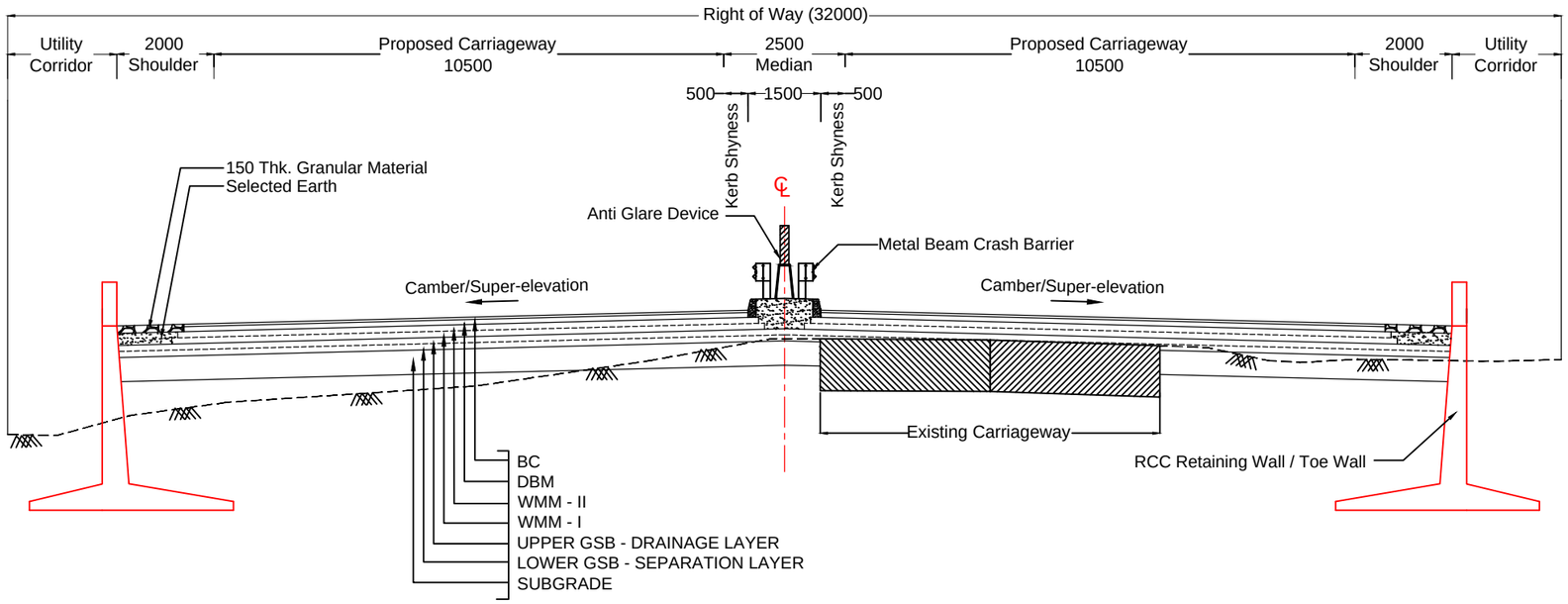

TCS - 13

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICTED AREA (RECONSTRUCTION - LEFT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

Intercontinental Consultants & Technocrats Pvt Ltd,
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Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions Rev. R0

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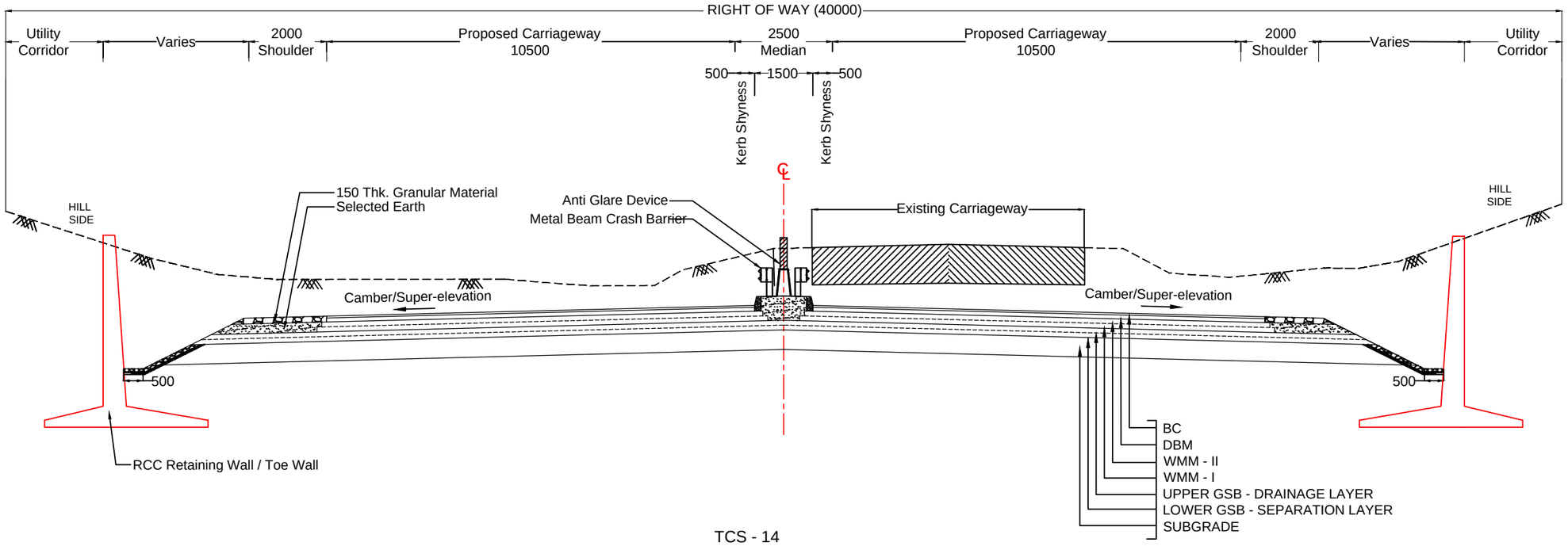

TCS - 14

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICT AREA (BOX CUT LEFT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

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Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions Rev. R0

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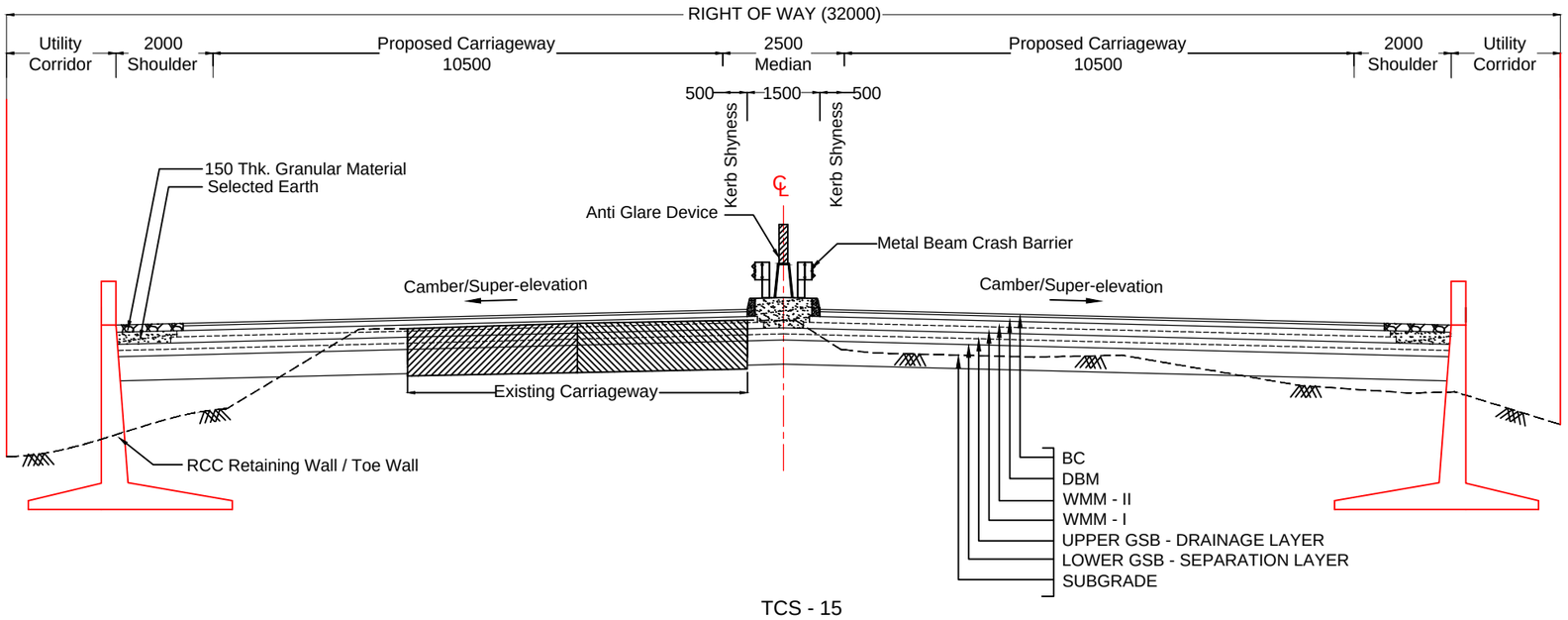

TCS - 15

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICT AREA (RECONSTRUCTION - RIGHT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

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Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions — Rev. R0

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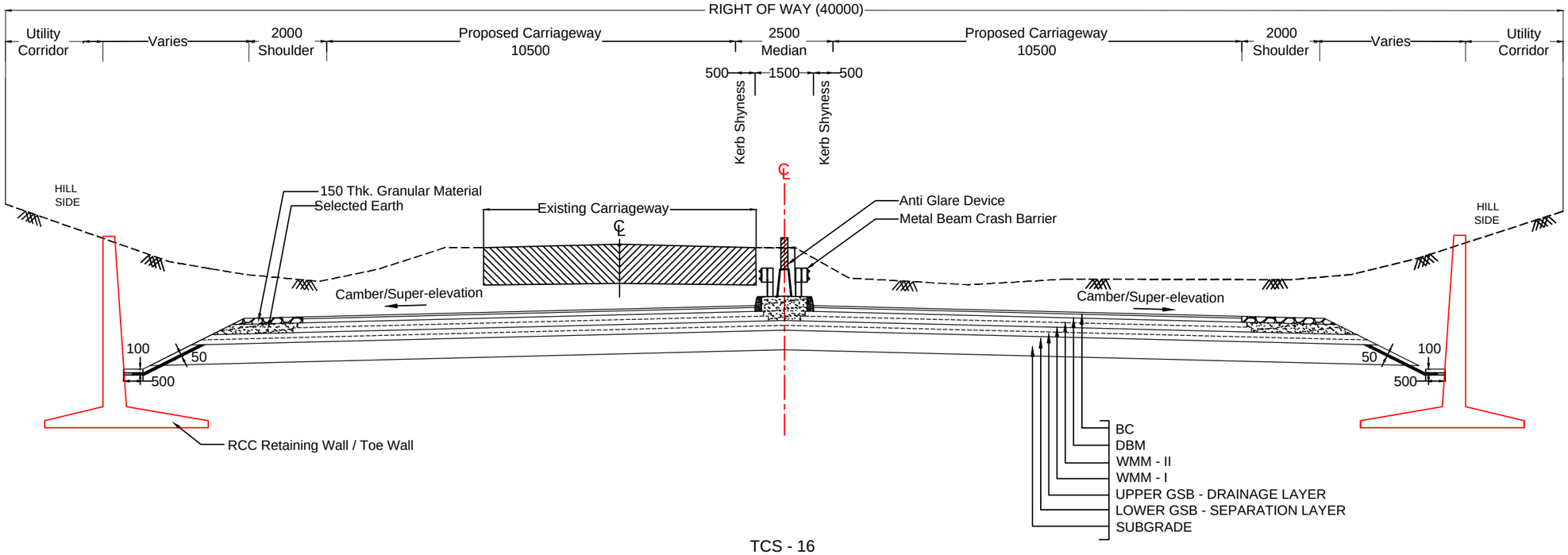


TCS - 16

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICT AREA (BOX CUT - RIGHT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

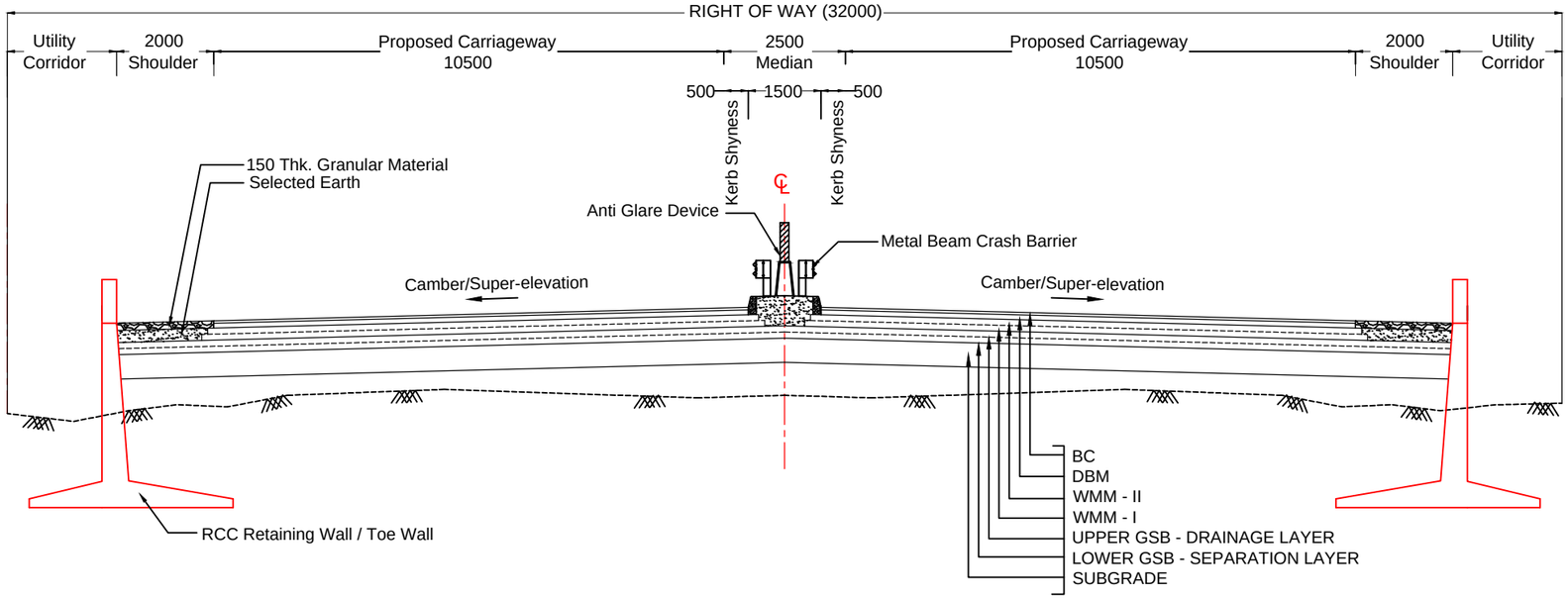
Intercontinental Consultants & Technocrats Pvt Ltd,
A-8, Green Park, New Delhi - 110016
Ph : 4086-3000, Fax 2685-5252

HBisht | Jogesh | B.K.Swain | Sanjay Singh

Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions — Rev. R0

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 16



TCS- 17

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICTED AREA (BYPASS / REALIGNMENT / CURVE IMPROVEMENT)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

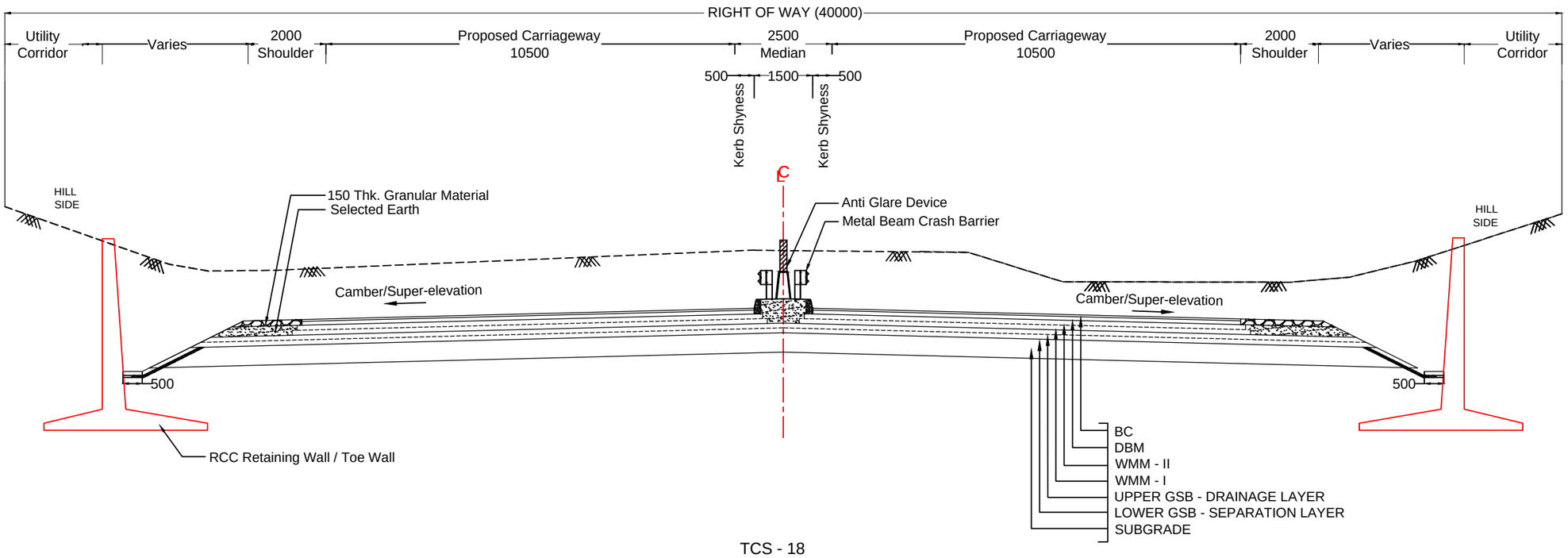
Intercontinental Consultants & Technocrats Pvt Ltd,
A-8, Green Park, New Delhi - 110016
Ph : 4086-3000, Fax 2685-5252

HBisht	Jogesh	B.K.Swain	Sanjay Singh

Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions Rev.

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 17 R0



TCS - 18

6 LANE DIVIDED CARRIAGEWAY IN FOREST / RESTRICTED AREA (BOX CUT IN REALIGNMENT / CURVE IMPROVEMENT)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

Scale :- Not to Scale

Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)

Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000

Drawing Name :- Feasibility Report Typical Cross Section

Intercontinental Consultants & Technocrats Pvt Ltd,
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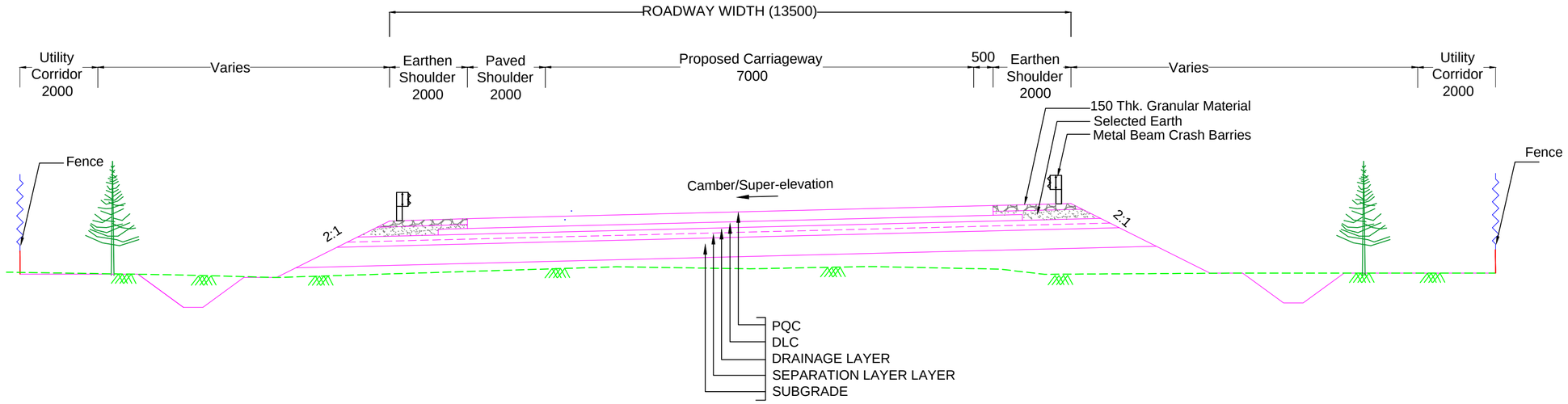
Ph : 4086-3000, Fax 2685-5252

HBisht	Jogesh	B.K.Swain	Sanjay Singh

Revisions	Date	Description	Checked by
R0	November - 2018	Initial Drawing	

Revisions Rev.

DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 18 R0



TCS -19
2 LANE CARRIAGEWAY (LOOP / RAMP)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Toe Wall/ Retaining wall shall be provided as per Design.

NATIONAL HIGHWAYS AUTHORITY OF INDIA	Scale :- Not to Scale	Project Title :- Consultancy Services for Preparation of DPR for Development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to Improve the Efficiency of Freight Movement in India. (Lot-1 / Madhya Pradesh / Package - 6)	Package - I : NH-135BG (Chitrakoot - Kothi) km 0+000 to km 55+000	Drawing Name :- Feasibility Report Typical Cross Section	Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252	R0 / November - 2018 / Initial Drawing Revisions / Date / Description / Checked by Revisions / Rev. R0 DRAWING No: NHAI/LEEP/MP-6/CM-CK/TCS/ 19	
					HBisht (Prepared by) / Jogesh (Designed by) / B.K.Swain (Checked by) / Sanjay Singh (Approved by)	Paper Size A2 Sheet	