5.5 Preliminary Design of Vijayawada Bypass

5.5.1 General

MoST has directed NHAI to carry out the implementation of the projects which ease serious traffic condition on NH5 and NH9, passing through Vijayawada city. Widening projects of NH5, from Vijayawada to Eluru, and NH9, from Vijayawada to Nandigama, are ongoing under ADB loans, and NH5 ,from Vijayawada to Chilakalurupet, is also on going under OECF loans.

A ring road project around Vijayawada city connecting NH5 and NH9 was proposed by the State PWD and the Vijayawada - Guntur - Tanali Urban Development Authority (VGTUDA).

The ring road route submitted to MoST by State PWD is as follows:

Reach I	Connecting Surayapalem village on NH9 to Atkuru village on NH5 (32.0 kms.)
Reach II	Connecting Purushottapatnam village on Reach I route to Km. 420/0 of M.V. section of NH5 (33.5 kms.)
Reach III	Connecting Nangalagiri village of NH5 to Surayapalem village of NH9 (21.0 kms.)

Another route proposed by VGTUDA is as follows:

Section I	Starts at Gollapudi village on NH9 and joins at Chinna Avutapalli village on NH5
Section II	Starts at Gollapudi village on NH9 and joins at Chinna Kakani village on NH5
Section III	Starts at Gudavalli village on NH5 and joins at Mangalagiri

As a result of discussions between MoST and the Study Team, the Vijayawada Bypass was agreed to apply the north arc of the ring road which was designated as Section I VGTUDA's proposal, which is very similar to the alignment of Reach I of MoST.

5.5.2 Major Controls

Vijayawada city is situated beside the Krishna River, in sedimentary flat plains. Therefore, there are no topographical obstructions along the alignment. As one of the control points, there is a marshalling yard on the right side near Sta. 5+000. The major control points are listed in Table 5-26.

Table 5-26 Major Controls of Vijayawada Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH9	To secure smooth connection
2	1+450	Railway	Bridge
3	2+540	River	Bridge
4	5+000	Marshalling	To be avoided
5	6+350	Hill	To be avoided
6	16+000	Pond	To be avoided
7	17+800	ODR	Bridge
8	18+000	Village(Mustabad)	To be avoided
9	19+000	Pond	To be avoided
10	21+000	Village(Purushottapatam)	To be avoided
11	24+740	River	Bridge
12	26+220	Railway	Bridge
13	27+500	Canal	Bridge
14	28+125	NH5	To secure smooth connection

5.5.3 Proposed Alignment

The proposed horizontal and vertical alignment was summarised in Tables 5-27 and 5-28. Developed drawings and design parameters were attached at the end of this section.

Table 5-27 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	22,759.2	81
Curve	4,566.4	16
Spiral (Clothoide)	800.0	3
Total	28,125.6	100

Table 5-28 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	18,700.0	66
0.3< G <=1.0	7,825.6	28
1.0< G <=2.0	1,600.0	6
Total	28,125.6	100

5.5.4 Major Structures

(1) Major Structures

Major structures proposed were summarised in Table 5-29, including two viaducts for crossing railways.

Table 5-29 Major Structures of Vijayawada Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	1+450	Railway	PC-Hollow	1@25=25
2	26+220	Railway	RC-I	1@36=36

(2) Summary of Structures

Table 5-30 summarises the structural planning in Vijayawada Bypass. Total length of throughway bridges is 162 m and the total length of the Culvert-box is 426 m.

Table 5-30 Summary of Structures in Vijayawada Bypass

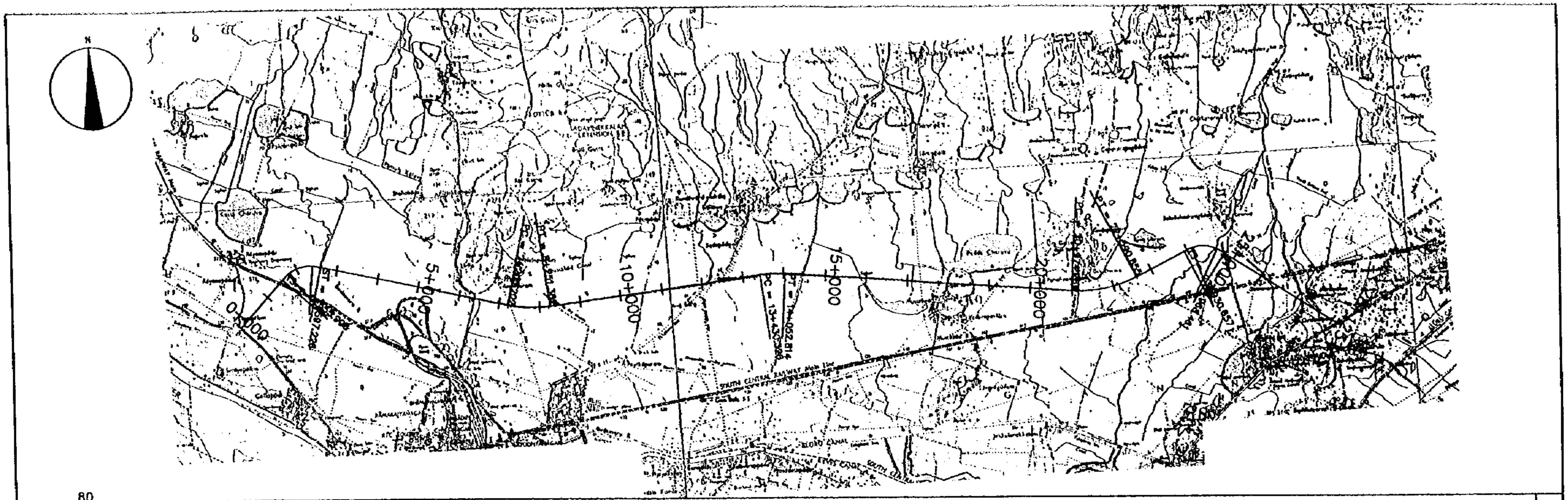
Type	Length (m)
Large Bridge (L>200m)	0
Medium&Short Bridge (200m>L)	162
Throughway Bridge Total	162
Culvert-box (L)	352
Culvert-box (S)	74
Culvert-box Total	426

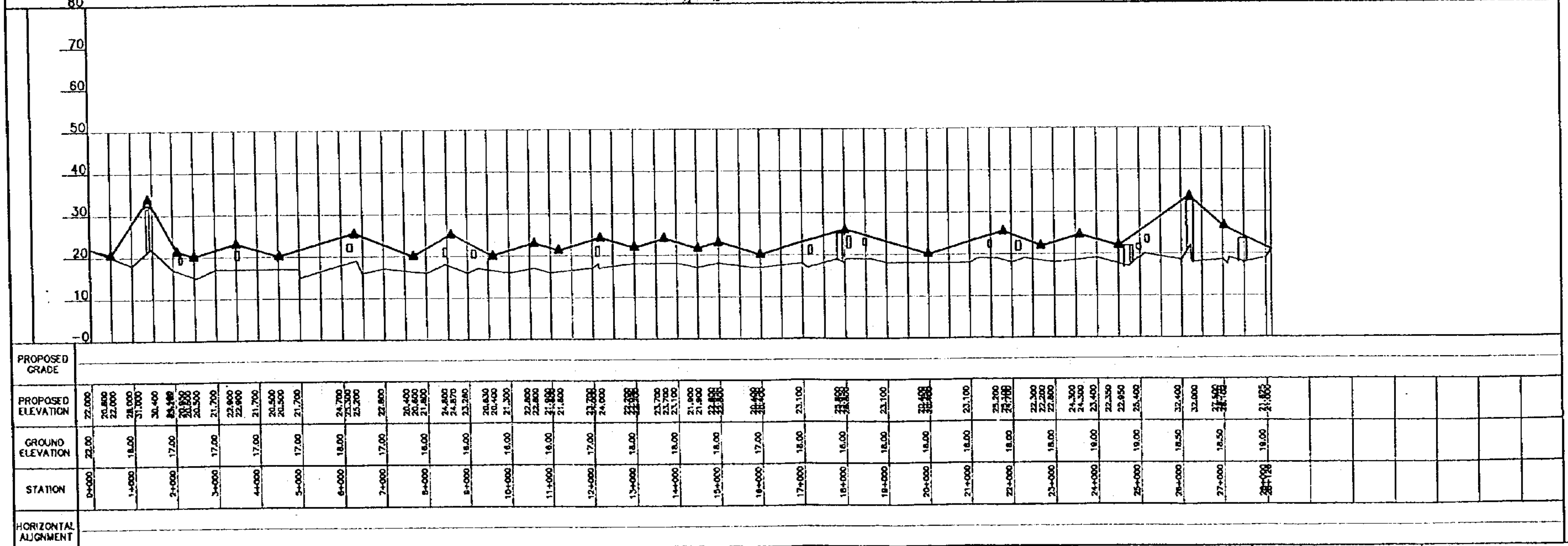
5.5.5 Major Quantities

Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-31.

Table 5-31 Major Quantities of Vijayawada Bypass

Item	Unit	Amount
Bypass Length	km	28.1
Earthwork Section	km	28.0
Structural Section	km	0.1
Earthwork Balance	m^3	-5,244,000
Fill	m^3	5,244,000
Cut	m^3	
Concrete	m^3	18,400
HYSD	ton	2,400
PC Strand	ton	43
Pavement		
AC	m^3	17,400
DBM	m^3	87,800
WMM	m^3	201,600
GSB	m^3	196,600





JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA	DWG TITLE : VIJAYAWARA BYPASS: PLAN & PROFILE	DWG SCALE : H = 1 : 100,000 V = 1 : 1,000	DWG NO. : 005

5.6 Preliminary Design of Kannur Bypass

5.6.1 General

Kerala State has several on-going bypass projects for the NH17, like the Kozhikode Bypass and also under construction of some improvement works of the existing NH17.

In Kannur area, a bypass route was planned by the State PWD before 10 years back. At that time, they carried out the survey work and the alignment design. However, the alignment was not feasible due to rapid change of land use. In this Pre-Feasibility Study, a new route was studied and proposed, taking consideration of the current land use conditions.

5.6.2 Major Controls

The project locates in a narrow area between NH17 and the Valapattanam River. There are some intricate higher areas and some basins, almost continuously. The difference of elevation between the beginning point and the end point is about 30 metres. Viaduct structures were required to cross over the railways at 10+800, a MDR near Sta. 7+820, where the cut works were required for the bypass, overpass viaducts were proposed to keep the function of existing roads. The major control points were listed in Table 5-32.

Table 5-32 Major Controls of Kannur Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH17	To secure smooth connection
2	1+320	ODR	Bridge
3	5+060	Village road	Bridge
4	7+820	MDR	Bridge
5	10+800	Railway	Bridge
6	11+140	NH17	To secure smooth connection

5.6.3 Proposed Alignment

At Sta. 1+700, the first horizontal curve changes the direction of the bypass to the right at an angle of 40 degrees. After this curve, the ODR14, which leads to the MDR14 through a bridge over the Valapattanam river, crossed above the bypass at the elevation of 24 m. Subsequently, the alignment has a right curve at an angle of approximately 40 degrees. After this curve until the end point of NH17 the alignment is linear.

For the crossing over the railway line at Sta. 10+800 and at the ODR at Sta. 10+750, a 405 m long viaduct was proposed from Sta. 10+500 to Sta. 10+905.

Table 5-33 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	9,623.7	87
Curve	716.9	6
Spiral (Clothoide)	800.0	7
Total	11,140.6	100

Table 5-34 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	7,400.0	66
0.3< G <=1.0	3,000.0	27
1.0< G <=2.0	740.6	7
Total	11,140.6	100

5.6.4 Major Structures

(1) Major Structures

Major structure proposed was summarised in Table 5-35.

Table 5-35 Major Structure of Kannur Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	10+500	Railway	RC-I	9@45=405

Figure 5-4 shows general plan of the railway crossing at Sta. 10+500.

2) Summary of Structures

Table 5-36 summarises the structural planning in Kannur Bypass. Total length of throughway bridges is 405 m and the total length of the Culvert-box is 128 m.

Table 5-36 Summary of Structures in Kannur Bypass

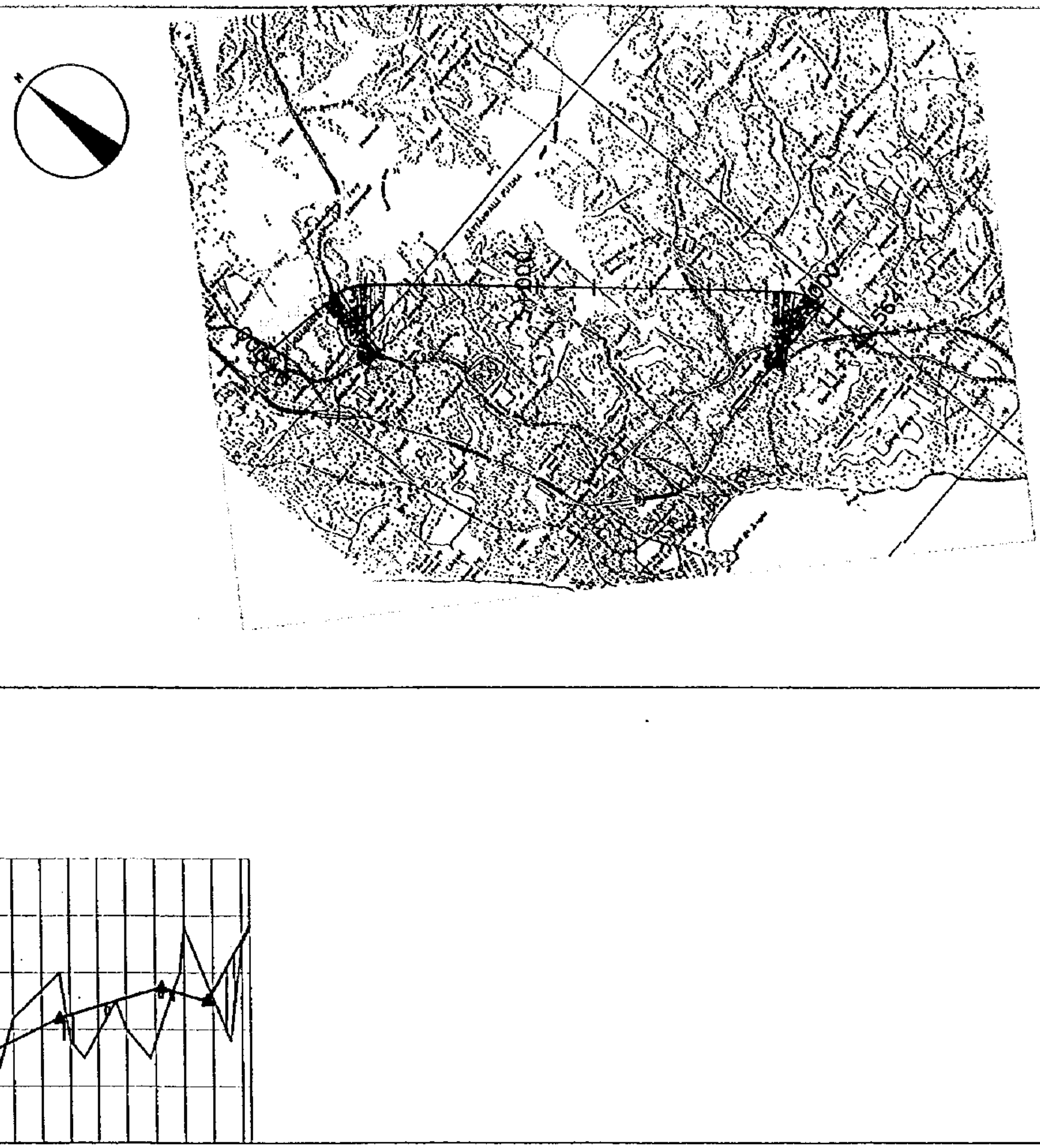
Type	Length (m)
Large Bridge (L>200m)	405
Medium&Short Bridge (200m>L)	0
Throughway Bridge Total	405
Culvert-box (L)	128
Culvert-box (S)	0
Culvert-box Total	128
Over-bridge (L)	68
Over-bridge (S)	34
Over-bridge Total	102

5.6.5 Major Quantities

Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-37.

Table 5-37 Major Quantities of Kannur Bypass

Item	Unit	Amount
Bypass Length	km	11.1
Earthwork Section	km	10.7
Structural Section	km	0.4
Earthwork Balance	m^3	-137,000
Fill	m^3	808,000
Cut	m^3	671,000
Concrete	m^3	20,700
HYSD	ton	2,500
PC Strand	ton	250
Pavement		
AC	m^3	6,600
DBM	m^3	33,500
WMM	m^3	77,000
GSB	m^3	75,100



PROPOSED GRADE																
PROPOSED ELEVATION	10.800	13.800	16.800	18.700 [illegible]	16.503 16.500	[illegible]	16.000	[illegible]	18.000	21.500 [illegible]	25.800	27.100 27.100	28.200 25.450	27.698	35.702 [illegible]	
GROUND ELEVATION	9.00	10.00	19.00	10.00		18.00	21.00	8.00	22.00	18.00	20.00		38.00		35.00	
STATION	0+000	1+000	2+000	3+000		4+000	5+000	6+000	7+000	8+000	9+000		10+000		11+000 11+[illegible]	
HORIZONTAL ALIGNMENT																

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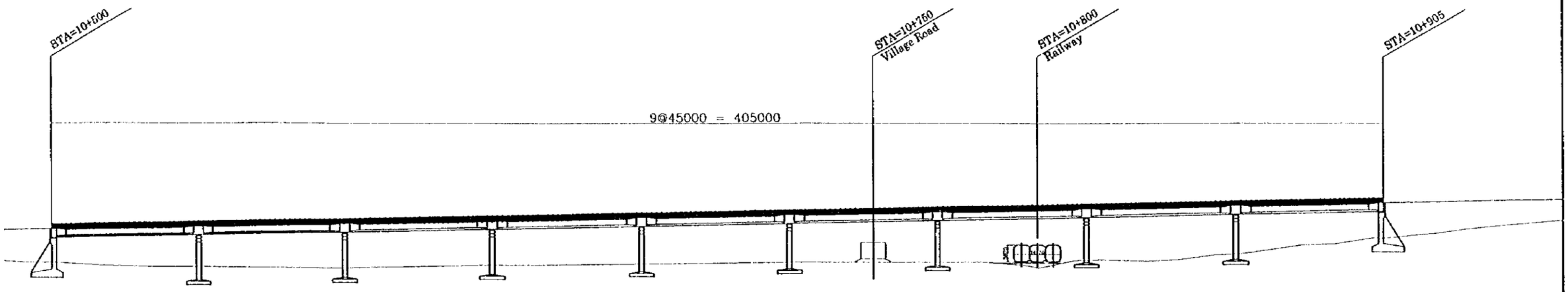
DWG TITLE : KANNUR BYPASS: PLAN & PROFILE

DWG SCALE : H = 1 : 100,000 V = 1 : 1,000

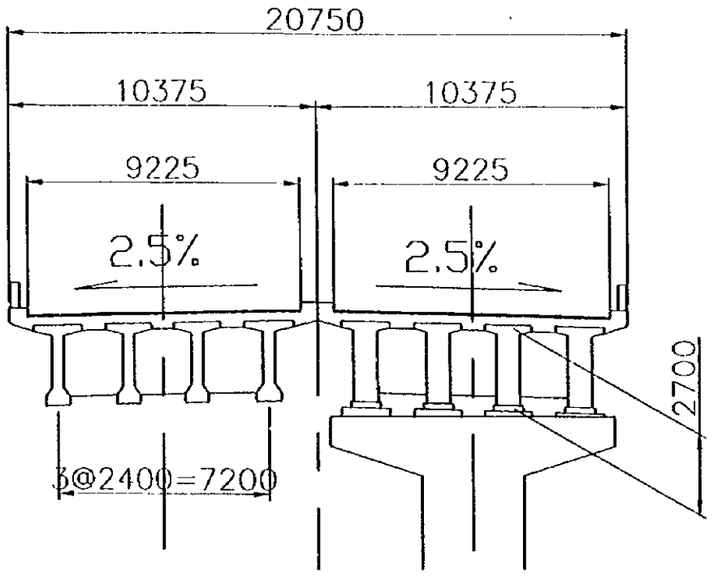
DWG NO. : 006

Side View Scale 1:1,200



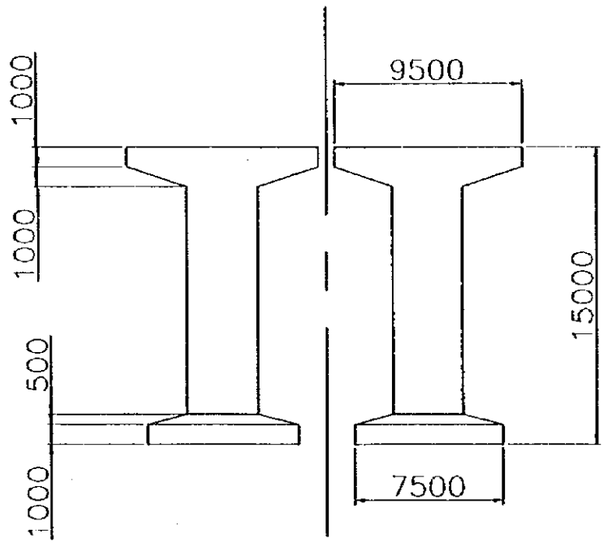
Cross Section Scale 1:200

(Center Span) (Above Pier)



Substructure Pier

Scale 1:300



Substructure Abutment

Scale 1:300

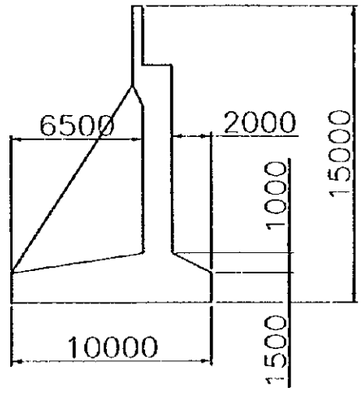


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FIGURE 5-4 Throughway Viaduct of Kannur Bypass

5.7 Preliminary Design of Nandura Bypass

5.7.1 General

In 1993, the State PWD made a comparison study on three alternatives; i.e. 1) southern bypass, 2) northern bypass, and 3) replacement of the bridge to wider one, to resolve the congestion problem in the town. The study concluded that construction of new bridge at 30 m down-stream of the existing one is an optimum alternative because of an economic point of view.

In this Pre-Feasibility Study, the southern route was reviewed since the Study Team has judges that the construction of new bridge is the most appropriate solution for the short term basis, but the construction of bypass is inevitable to ease the traffic congestion in long term. A project alignment was proposed by the Study Team, through discussions with MOST/PWD and site reconnaissance. The details of the proposed alignment was described below:

5.7.2 Major Controls

The project area is a part of Buldhara Plateau, and locates on plain agricultural land of black cotton soil. This soil quality has enabled the farmers to have rich harvest of good quality cotton, which is the major products of the area. The proposed bypass cross a minor river, Dyan Ganga.

Major control points along the project route was identified through the study on the scale of 1: 50,000 topographic map and field survey.

There are mainly agricultural fields and no special things to be avoid or preserved. The Dyan Ganga River and one MDR were the controls. The major control points were summarised in Table 5-38.

Table 5-38 Major Controls of Nandura Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH6	To secure smooth connection
2	2+500	Dyan Ganga	Bridge
3	3+380	MDR	Bridge
4	6+381	NH6	To secure smooth connection

5.7.3 Proposed Alignment

As there are no serious restrictions along the route and total length is approximately 6 kms., the horizontal alignment was formulated consists of single large curve, radius of 3,000 m between two tangents, which are not required any transitions and superelevations.

Regarding vertical alignment, it was applied gentle grades taking into account the two vertical controls, the river and MDR.

The proposed horizontal and vertical alignment was summarised in Tables 5-39 and 5-40. Developed drawing and design parameters were attached at the end of this section.

Table 5-39 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	5,202.1	82
Curve	1,179.1	18
Spiral (Clothoide)	----	
Total	6,381.2	100

Table 5-40 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	2,841.2	45
0.3< G <=1.0	3,540.0	55
Total	6,381.2	100

5.7.4 Major Structures

(1) Major Structures

One major structure proposed is shown in Table 5-41.

Table 5-41 Major Structures of Nandura Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	2+500	River	RC-T	5@15=75

(2) Summary of Structures

Table 5-42 summarises the structural planning in Nandura Bypass. Total length of throughway bridges is 109 m and the total length of the Culvert-box is 74 m.

Table 5-42 Summary of Structures in Nandura Bypass

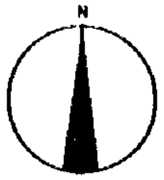
Type	Length (m)
Large Bridge (L>200m)	0
Medium&Short Bridge (200m>L)	109
Throughway Bridge Total	109
Culvert-box (L)	0
Culvert-box (S)	74
Culvert-box Total	74

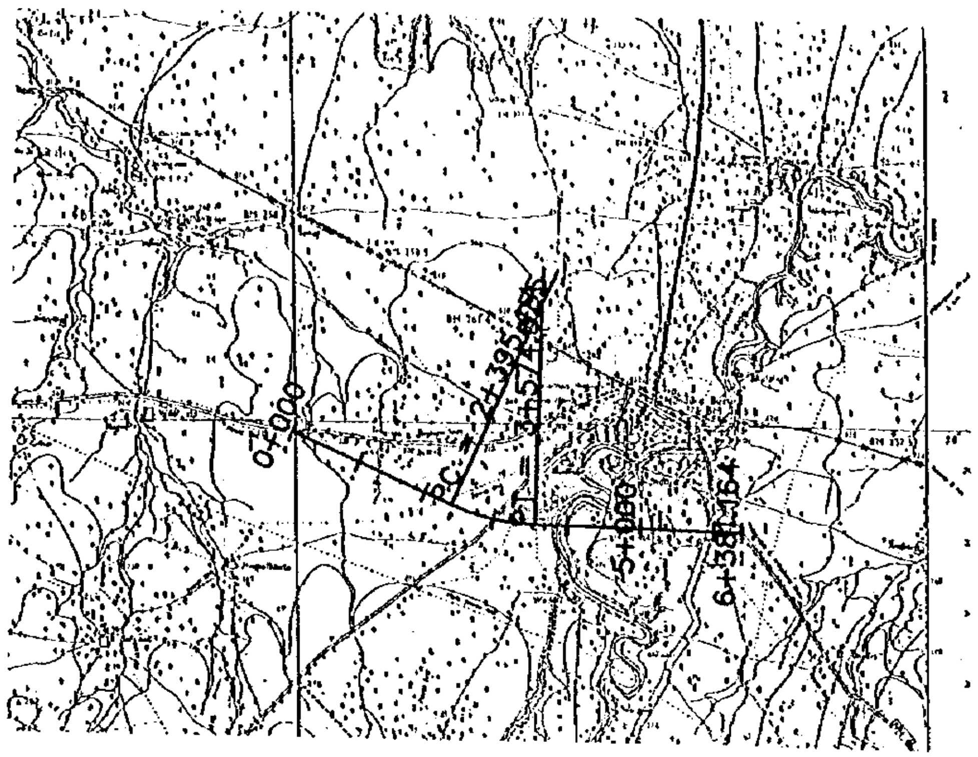
5.7.5 Major Quantities

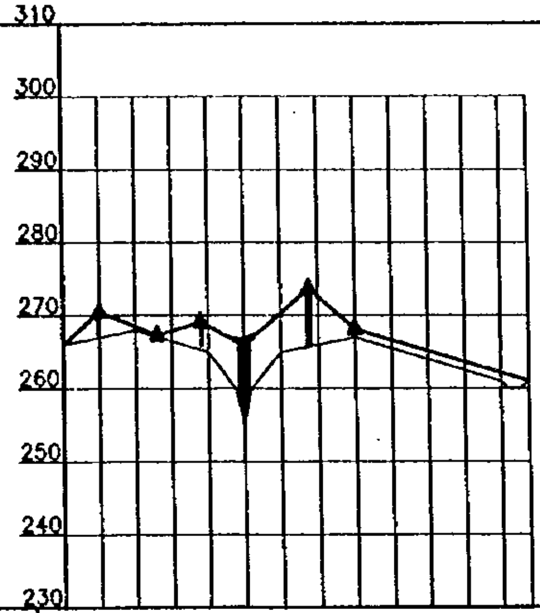
Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-43.

Table 5-43 Major Quantities of Nandura Bypass

Item	Unit	Amount
Bypass Length	km	6.4
Earthwork Section	km	6.3
Structural Section	km	0.1
Earthwork Balance	m^3	-366,000
Fill	m^3	394,000
Cut	m^3	28,000
Concrete	m^3	8,000
HYSD	ton	1,100
Pavement		
AC	m^3	3,900
DBM	m^3	19,800
WMM	m^3	45,400
GSB	m^3	44,200







PROPOSED GRADE											
PROPOSED ELEVATION	266.000	[illegible]	268.500	[illegible]	[illegible] 267.450	266.500 270.300	273.270 [illegible]	[illegible]	265.157	262.174	261.037
GROUND ELEVATION	266.00		268.00		265.00	265.00		257.00	264.00	261.00	
STATION	0+000		1+000		2+000	3+000		4+000	5+000	6+000	6+381
HORIZONTAL ALIGNMENT											

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DWG TITLE : NANDURA BYPASS: PLAN & PROFILE

DWG SCALE :
H = 1 : 100,000
V = 1 : 1,000

DWG NO. : 007

5.8 Preliminary Design of Khamgaon Bypass

5.8.1 General

In order to resolve still existing congestion problem, a bypass locates outside Khamgaon town was proposed by the State PWD and approved by MOST, September 1992. Then, the State PWD had conducted their engineering design and prepared the drawings.

In this Pre-Feasibility Study, the alignment prepared by the State PWD was reviewed. Applied horizontal alignment for the Study was almost same as the PWD alignment. The vertical alignment was modified to provide grade separations at the crossing point with the existing highway, based on the discussions with MOST/PWD and site reconnaissance. The details of the proposed alignment was described below:

5.8.2 Major Controls

According to the information from the State PWD, the proposed horizontal alignment which passes the fringe of future city area has been agreed by Khamgaon Municipality and secured for the construction, under the Municipality's monitoring not to build any permanent buildings. The major control points are summarised in Table 5-44.

Table 5-44 Major Controls of Khamgaon Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH6	To secure smooth connection
2	2+070	MDR, Waterway	Bridge
3	4+010,+240	Mini-bypass, SH	Bridge
4	4+000 - 5+000	Existing Mini-bypass	Use the alignment (1.0 Km)
5	7+140	Bordi River	Bridge
6	7+930	MDR	Bridge
7	8+200 - 9+800	Existing Mini-bypass	Use the alignment (1.6 Km)
8	9+000	Industrial Complex	To avoid but secure connection
9	10+887	NH6	To secure smooth connection

5.8.3 Proposed Alignment

The Study Team adopted the same horizontal alignment prepared by the State PWD, including an intention of the PWD to utilise a part of existing mini-bypass. The horizontal alignment includes two small curves of 360m radius, which is the

minimum value of the design speed of 100 km/hr.

Regarding vertical alignment, it was revised from the PWD alignment to provide grade separation structures with the crossings of existing highways/roads.

The proposed horizontal and vertical alignment was summarised in Tables 5-45 and 5-46. Developed drawing and design parameters were attached at the end of this section.

Table 5-45 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	7,691.8	71
Curve	3,195.3	29
Spiral (Clothoide)	-----	
Total	10,887.1	100

Table 5-46 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	2,180.0	20
0.3< G <=1.0	3,450.0	32
1.0< G <=2.0	4,737.1	43
2.0< G <=3.0	520.0	5
Total	10,887.1	100

5.8.4 Major Structures

(1) Major Structures

Major structures proposed are shown in Table 5-47.

Table 5-47 Major Structures of Khamgaon Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	2+070	ODR/Waterway	RC-T	3@15=45
2	4+100	MDR	RC-T	2@19=38
3	4+240	SH	RC-T	2@13=26

(2) Summary of Structures

Table 5-48 summarises the structural planning in Khamgaon Bypass. Total length of throughway bridges was 180 m and the total length of the Culvert-box was 143 m.

Table 5-48 Summary of Structures in Khamgaon Bypass

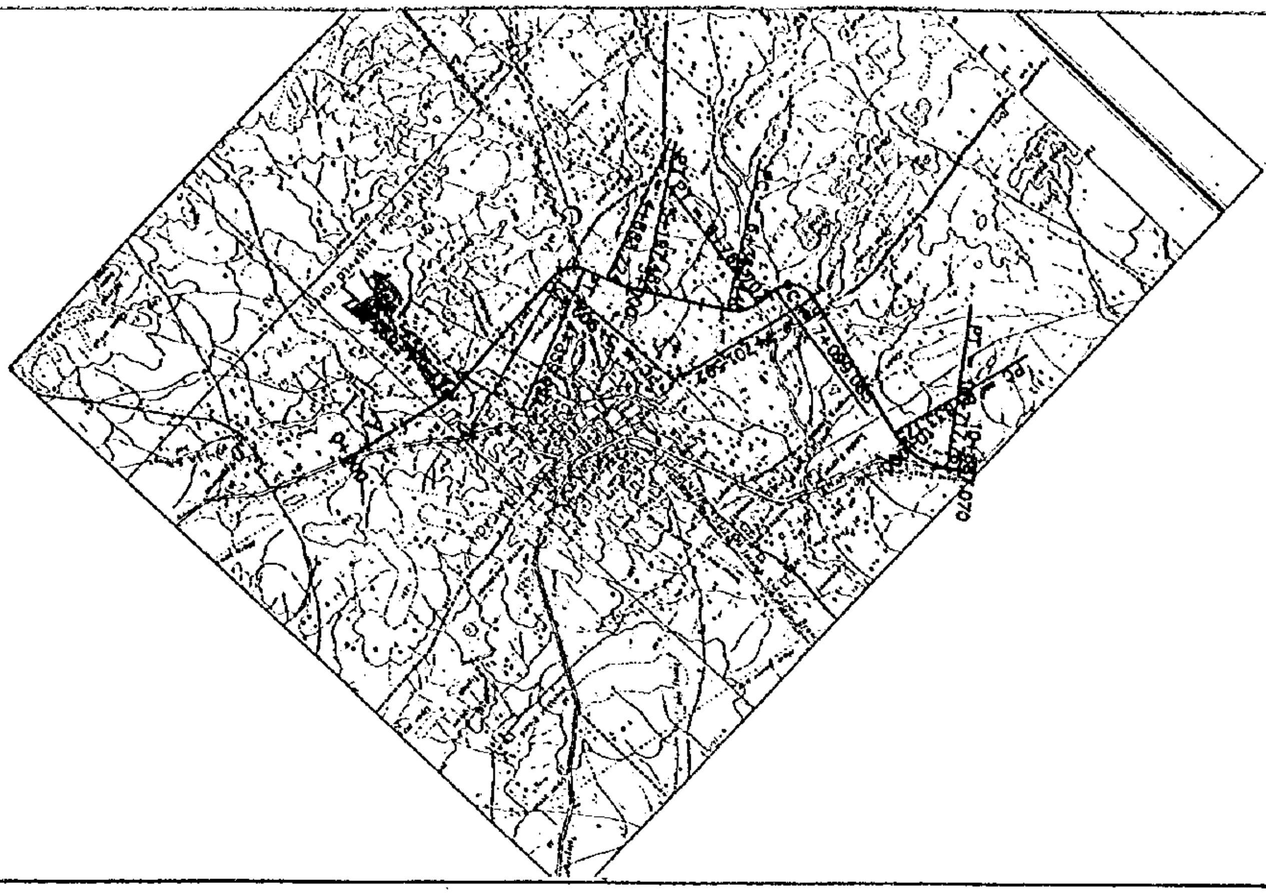
Type	Length (m)
Large Bridge (L>200m)	0
Medium&Short Bridge (200m>L)	180
Throughway Bridge Total	180
Culvert-box (L)	32
Culvert-box (S)	111
Culvert-box Total	143

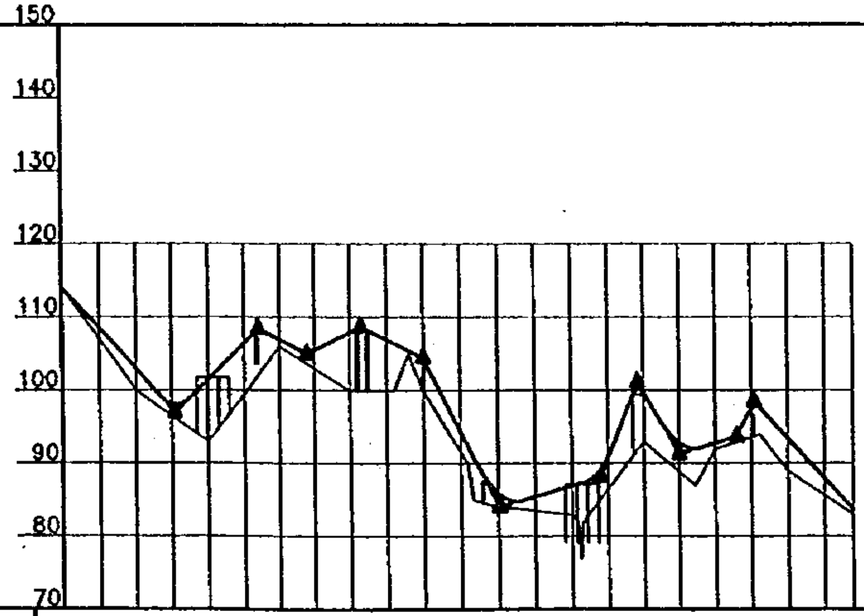
5.8.5 Major Quantities

Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-49.

Table 5-49 Major Quantities of Khamgaon Bypass

Item	Unit	Amount
Bypass Length	km	10.9
Earthwork Section	km	10.7
Structural Section	km	0.2
Earthwork Balance	m^3	-1,315,000
Fill	m^3	1,315,000
Cut	m^3	
Concrete	m^3	15,900
HYSD	ton	2,200
Pavement		
AC	m^3	6,600
DBM	m^3	33,500
WMM	m^3	77,000
GSB	m^3	75,100





PROPOSED GRADE												
PROPOSED ELEVATION	114.000	103.000	96.150 98.950 101.450	106.950 107.700 106.450	105.950 105.850 107.950	107.950 105.300 [illegible] 101.450	90.050 85.953	84.950 86.990 87.580	93.190 96.680 [illegible] 98.430	92.230 92.830	[illegible] [illegible] 97.430 93.470	83.712
GROUND ELEVATION	114.00	100.00	93.00	106.00	100.00	100.00	84.00	83.00	93.00	92.00	89.00	
STATION	0+000	1+000	2+000	3+000	4+000	5+000	6+000	7+000	8+000	9+000	10+000	10+667
HORIZONTAL ALIGNMENT												

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DWG TITLE :
KHAMGAON BYPASS: PLAN & PROFILE

DWG SCALE :
H = 1 : 100,000
V = 1 : 1,000

DWG NO. : 008

5.9 Preliminary Design of Bhopal Bypass

5.9.1 General

NH12 in Bhopal city is very congested because of the poor horizontal alignment. Two so-called link roads, were built approximately 10 years back which connect NH12 and east of SH18, and west of H18 independently. Subsequently the State PWD planned an extension of the link road. On the other hand, the Bhopal Development Plan approved by the State Government, has come into operation from June 1995. The Plan describes a proposed transportation network to serve both intra-city and inter-city movement.

State PWD has revised the extension plan of the link roads and re-proposed a bypass route in accordance with the Development Plan. The route runs outer fringe of city area and was aimed to function as "outer-ring-road" for through traffic.

In this Pre-Feasibility Study, an alignment was formulated and proposed through discussions with MOST/PWD and site reconnaissance. The details of the proposed alignment was described below:

5.9.2 Major Controls

The proposed alignment passes the fringe of the designated urban area which was specified by the Development Plan of land use in the region.

At the beginning 14 kms., the valleys exist toward the east. Along SH18 to Raisen town, there are some chicken farms. A water reservoir locates at left side of Sta. 19. Railway and village road crossings are nearby at Sta. 24+500. At Sta. 31, SH23 runs to northward. For the ending stretch, there are also some valleys for north side of the plateau. The major control points were summarised in Table 5-50.

Table 5-50 Major Controls of Bhopal Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH12	To secure smooth connection
2	1+000 - 14+000	Valleys at eastside	To be avoid
3	10+000	Residential Area	To be avoid
4	14+100	SH18	IC to be planned
5	14+100	Chicken Farms	To be avoid
6	19+000	Water Reservoir	To be avoid
7	25+500	Railway&Village Rd	Bridge
8	31+500	SH23	IC to be planned
9	32+000 - 40+000	Valleys at north side	To be avoid
10	40+317	NH12	To secure smooth connection

5.9.3 Proposed Alignment

Combination of large curves was used to avoid the valleys at east side and residential area at north-west side, from the beginning point to SH18. At the crossing point of SH18, with curve of 2,000 m radius, the alignment changes the direction approximately 90 degrees toward the north-west. For the northern half of the project, an tangent and curve of 10,000 m radius were applied avoiding the sporadic hamlets.

Regarding vertical alignment, it passes generally gentle hill slope. Cut section will be appeared for approximately 3 kms in total.

The proposed horizontal and vertical alignment was summarised in Tables 5-51 and 5-52.

Table 5-51 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	11,129.3	28
Curve	29,188.5	72
Spiral (Clothoide)	-----	
Total	40,317.8	100

Table 5-52 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	9,900.0	25
0.3< G <=1.0	22,137.8	55
1.0< G <=2.0	8,280.0	20
Total	40,317.8	100

5.9.4 Major Structures

(1) General

Due to hilly terrain condition from Sta. 5 to 13 approximately, one over-bridge was proposed. Five river crossing bridge were proposed because that the proposed alignment passes valleys located east side at the beginning and north side at the end section. Regarding the foundation, spread-type foundation was proposed, based on the site survey.

(2) Major Structures

Major structures proposed are summarised in Table 5-53, including two interchanges to be located, SH18 and SH23.

Table 5-53 Major Structures of Bhopal Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	10+500	Over-bridge	RC-T	2@17=34
2	14+100	SH18	RC-T	2@13=26
3	25+500	Railway	PC-Hollow	1@25+25
4	25+650	VR	RC-T	2@13=26
5	31+500	SH23	RC-T	2@13=26

(3) Summary of Structures

The structures proposed were summarised in Table 5-54. Total length of throughway bridges was 109 m and the total length of the Culvert-box was 74 m.

Table 5-54 Summary of Structures in Bhopal Bypass

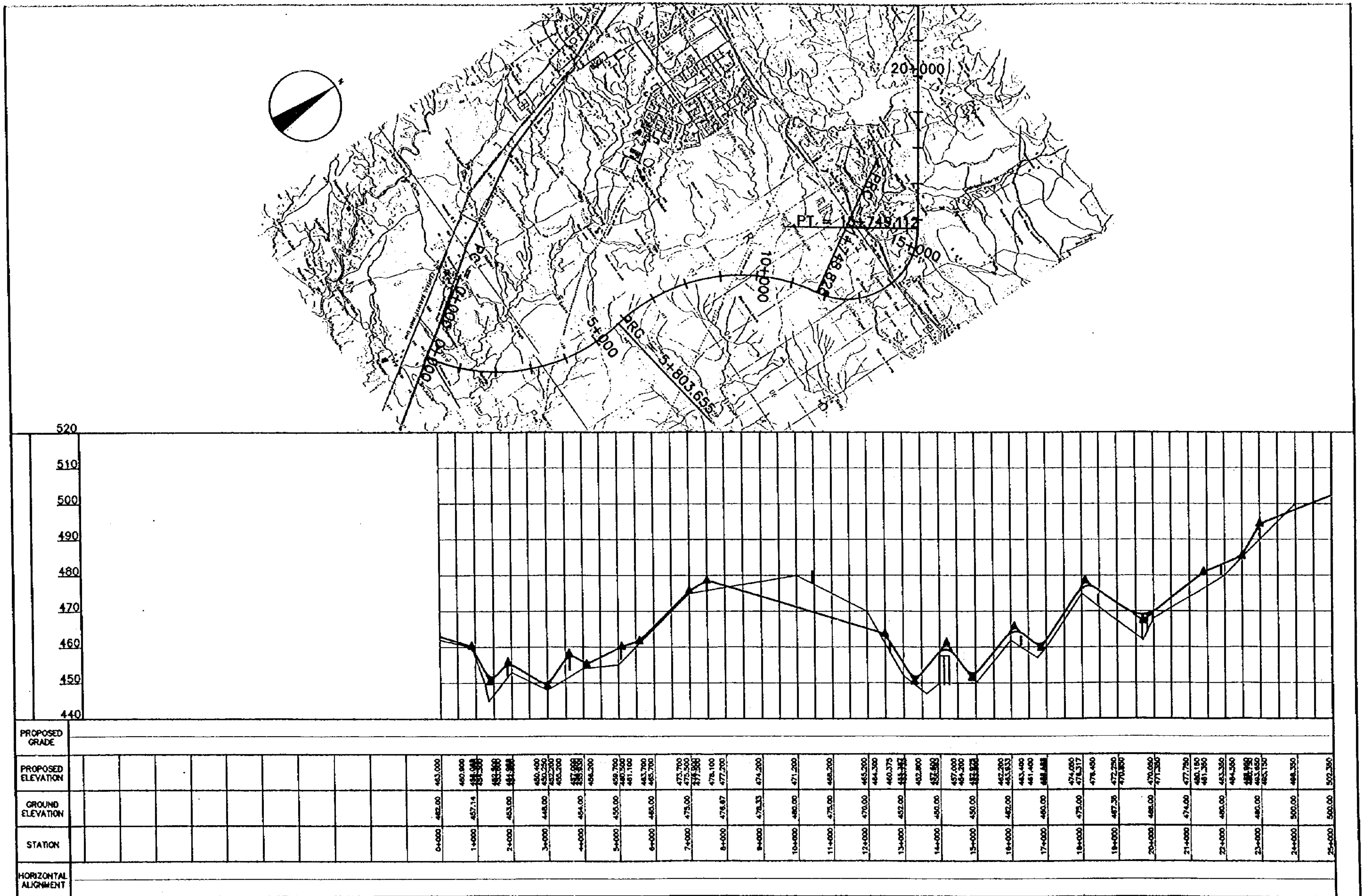
Type	Length (m)
Large Bridge (L>200m)	0
Medium&Short Bridge (200m>L)	253
Throughway Bridge Total	253
Culvert-box (L)	96
Culvert-box (S)	481
Culvert-box Total	577
Over-bridge (L)	0
Over-bridge (S)	34
Over-bridge Total	34

5.9.5 Major Quantities

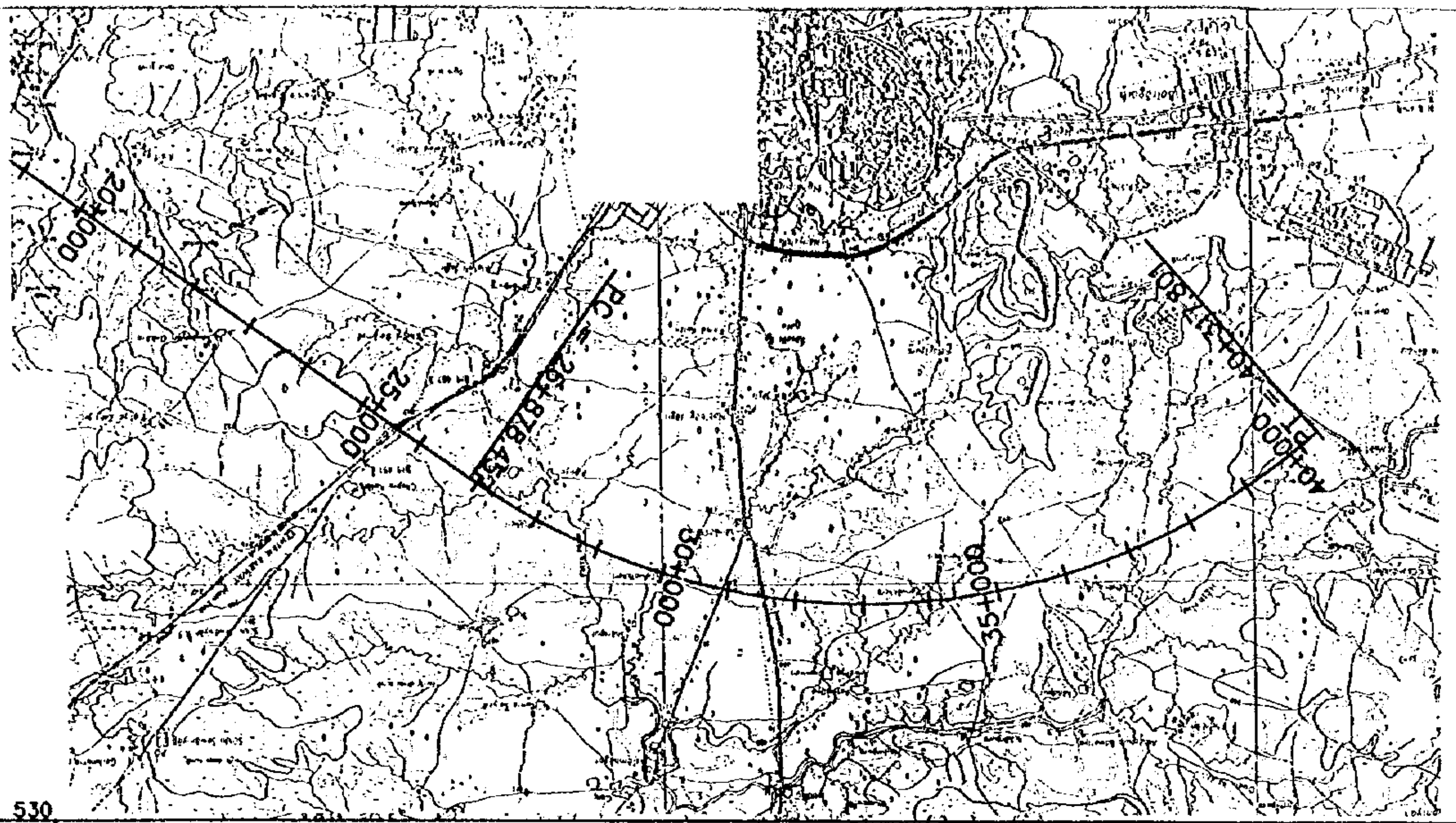
Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-55.

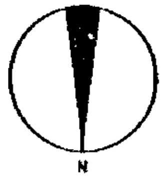
Table 5-55 Major Quantities of Bhopal Bypass

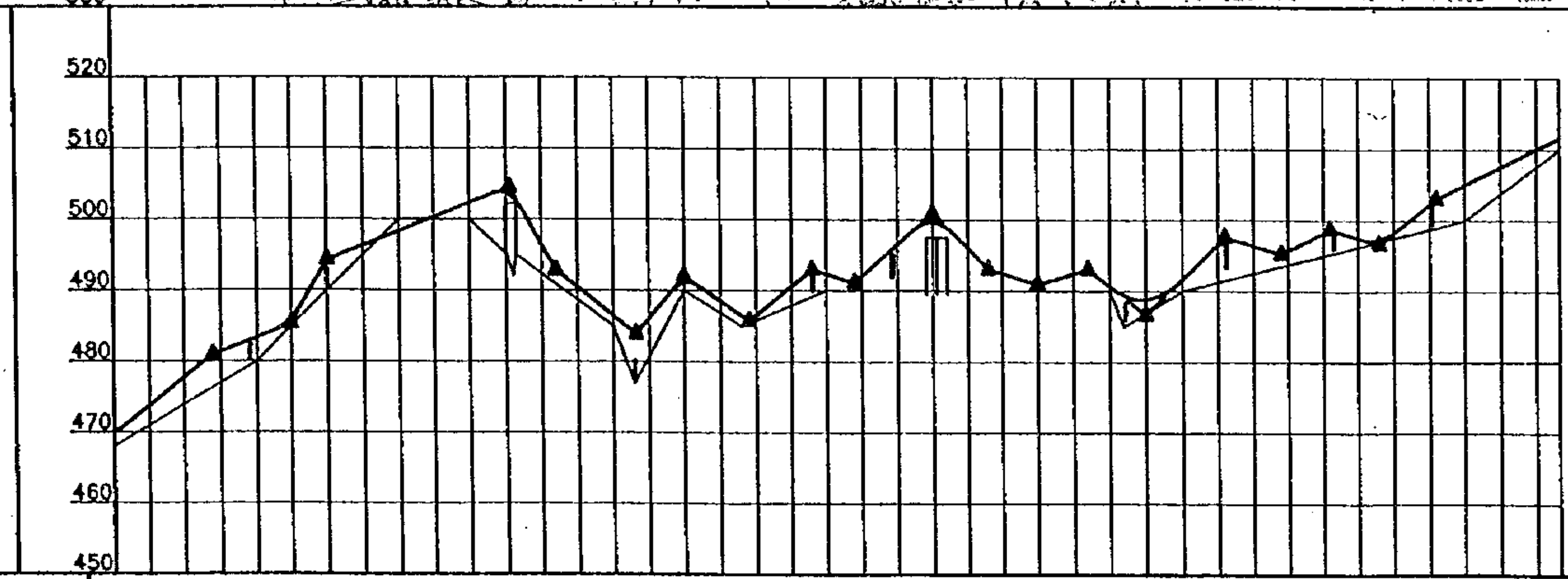
Item	Unit	Amount
Bypass Length	km	40.3
Earthwork Section	km	40.1
Structural Section	km	0.2
Earthwork Balance	m^3	- 1,923,000
Fill	m^3	3,335,000
Cut	m^3	1,432,000
Concrete	m^3	25,600
HYSD	ton	3,200
PC Strand	ton	21
Pavement		
AC	m^3	24,900
DBM	m^3	125,700
WMM	m^3	288,700
GSB	m^3	281,500



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA	DWG TITLE : BHOPAL BYPASS: PLAN & PROFILE	DWG SCALE : H = 1 : 100,000 V = 1 : 1,000	DWG NO. : 009 (1/2)







STATION	20+000	21+000	22+000	23+000	24+000	25+000	26+000	27+000	28+000	29+000	30+000	31+000	32+000	33+000	34+000	35+000	36+000	37+000	38+000	39+000	40+000	40+318
GROUND ELEVATION	468.00	474.00	480.00	480.00	500.00	500.00	492.35	488.00	490.00	485.83	490.00	490.00	490.00	490.00	490.00	490.00	492.50	495.00	497.50	500.00	507.50	

PROPOSED GRADE:

PROPOSED ELEVATION: 470.050, 471.350, 477.750, 480.150, 481.350, 483.350, 484.550, [illegible], 483.850, 485.130, 496.350, 502.350, 503.750, 500.950, [illegible], 492.050, 484.450, [illegible], 485.000, 489.650, 491.100, 490.850, 486.460, 486.560, 492.150, [illegible], [illegible], 491.400, 492.000, 488.560, [illegible], 488.050, 488.050, 484.050, 492.750, [illegible], [illegible], 492.600, [illegible], [illegible], 491.650, 495.650, 497.050, 494.450, 495.550, 495.750, 498.250, 488.450, 497.400, [illegible], 502.250, 503.550, 506.050, 510.050, 511.650

HORIZONTAL ALIGNMENT:

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA

DWG TITLE : BHOPAL BYPASS: PLAN & PROFILE

DWG SCALE : H = 1 : 100,000 V = 1 : 1,000

DWG NO. : 009 (2/2)

5.10 Preliminary Design of Gwalior Bypass

5.10.1 General

State PWD has been studied on several alternatives and, on the basis of technical and cost considerations, finally decided the present proposal which has been approved by MOST. A land-use survey has already conducted along the alignment, and survey stakes of centre-line has installed.

In this Pre-Feasibility Study, the definitive alignment was confirmed through discussions with MOST/PWD and site reconnaissance. The details of the proposed alignment was described below:

5.10.2 Major Controls

The proposed alignment passes through agricultural land (manly at the beginning and end), barren land and reserved forest area. It passes away from built-up area except near the starting point where the bypass will affect some residences(illegal occupation).

At the reserved forest area, the land is hilly and a number of valleys are exist. Tigra canal is only major waterway before the alignment climbing the hill. On the hillside there is no obstacles. Where descending from the hillside a narrow ridge, where the alignment should pass, exists. t the bottom of the hill, lake of "Raipur Kurd" should be avoided passing nearby. Hamlets sporadically located were also to be avoided passing. The Major control points were summarised in Table 5-56.

Table 5-56 Major Controls of Gwalior Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH3	To secure smooth connection
2	6+500	Tighara Canal	Bridge
3	8+000	Kulaith Village	To be avoid
4	12+500	Sojana Village	To be avoid
5	14+700	MDR to Dam	Bridge
6	18+000 - 21+000	Narrow Ridge	Should Pass
7	23+000	Lake "Raipur Kuro"	Bridge
8	25+600	Railway	Bridge
9	25+989	NH3	To secure smooth connection

5.10.3 Proposed Alignment

As a tentative stake of intersection point for centreline was already installed at the project site for carrying out the land-use survey, the horizontal alignment was

modified slightly, applying combination of larger curves.

Regarding vertical alignment, it was necessary to apply the maximum grade, 3.3 %, when the alignment passes through the hillside. Except the hillside, the viaduct which crosses over the railway to the ending point of the bypass, 2.5 % of descending grade was applied.

The proposed horizontal and vertical alignment was summarised in Tables 5-57 and 5-58.

Table 5-57 Summary of Horizontal Alignment

Design Element	Length (m)	Ratio (%)
Tangent	15,317.2	59
Curve	10,672.1	41
Spiral (Clothoide)	-----	
Total	25,989.3	100

Table 5-58 Summary of Vertical Alignment

Grade (%)	Length (m)	Ratio (%)
G <= 0.3	8,350.0	32
0.3< G <=1.0	18,600.0	40
1.0< G <=2.0	5,800.0	22
2.0< G <=3.0	389.3	1
G = 3.3	1,200.0	5
Total	25,989.3	100

5.10.4 Major Structures

(1) Major Structures

Major structures proposed were summarised in Table 5-59. Including one railway crossing.

Table 5-59 Major Structures of Gwalior Bypass

No.	Approx. Sta.	Description	Type	Span Arrangement (m)
1	6+520	Waterway/MDR	RC-T	3@15=45
2	25+600	Railway	PC-Hollow	1@6=16

(2) Summary of Structures

The structures proposed were summarised in Table 5-60. Total length of

throughway bridges was 109 m and the total length of the Culvert-box was 74 m.

Table 5-60 Summary of Structures in Gwalior Bypass

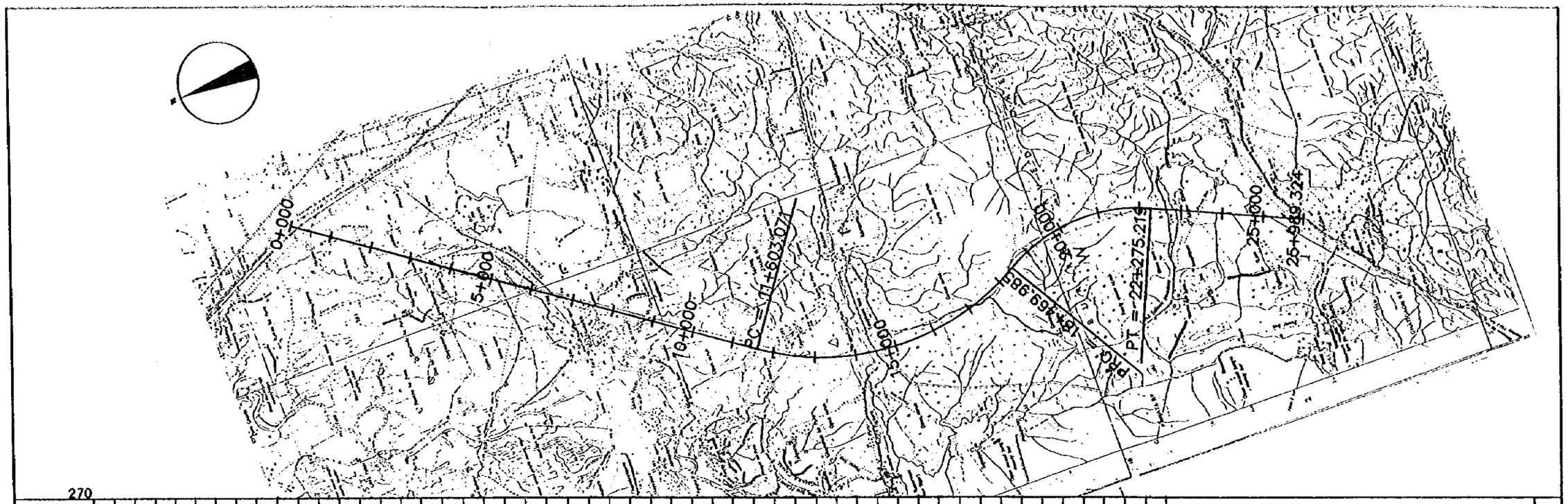
Type	Length (m)
Large Bridge (L>200m)	0
Medium&Short Bridge (200m>L)	192
Throughway Bridge Total	192
Culvert-box (L)	96
Culvert-box (S)	185
Culvert-box Total	281
Over-bridge (L)	0
Over-bridge (S)	34
Over-bridge Total	34

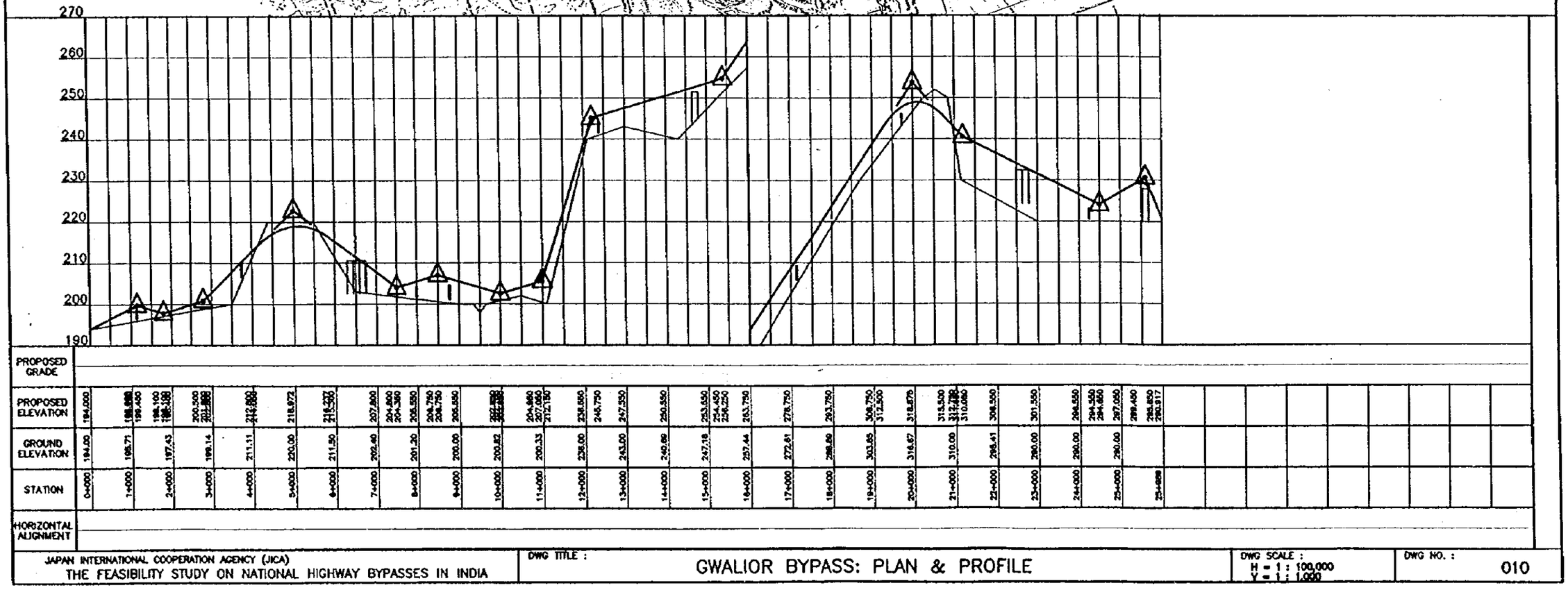
5.10.5 Major Quantities

Major quantities of proposed bypass in this Pre-Feasibility Study was summarised in Table 5-61.

Table 5-61 Major Quantities of Gwalior Bypass

Item	Unit	Amount
Bypass Length	km	26.0
Earthwork Section	km	25.8
Structural Section	km	0.2
Earthwork Balance	m^3	- 5,314,000
Fill	m^3	5,806,000
Cut	m^3	492,000
Concrete	m^3	19,100
HYSD	ton	2,400
PC Strand	ton	6
Pavement		
AC	m^3	16,000
DBM	m^3	80,900
WMM	m^3	185,800
GSB	m^3	181,100





JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA	DWG TITLE : GWALIOR BYPASS: PLAN & PROFILE	DWG SCALE : H = 1 : 100,000 V = 1 : 1,000	DWG NO. : 010

Pre-Feasibility Study

Chapter 1 *Socio-economic Conditions of the Study Area*
Chapter 2 *Traffic Survey and Analysis*
Chapter 3 *Future Traffic Demand Forecast*
Chapter 4 *Design Standards*
Chapter 5 *Preliminary Design of the Bypasses*

Chapter 6
Environmental Related Study

Chapter 7 *Preliminary Cost Estimates*
Chapter 8 *Preliminary Economic and Financial Analysis*
Chapter 9 *Project Implementation Plan*
Chapter 10 *Priority of the Bypasses*

6 Environmental Related Study

6.1 Initial Environmental Examination

6.1.1 Introduction

The environment is of special importance to the life of humans and other living creatures as well as to the economic, cultural and social development of the country, the nation and mankind as a whole.

In general, many developing countries formerly felt that environmental protection and development were incompatible and that to escape from poverty, their most pressing problem, priority had to be given to development, even at the cost of environmental destruction. Today, they address environmental problems, such as pollution in major cities etc., very seriously; the need to take account of environmental considerations in development projects is understood; and determined efforts are being made to tighten environmental laws and strengthen agencies charged with protecting the environment.

The items of Initial Environmental Examination (IEE) for each 10 sites, which resulted from the prior investigation, are shown in Table 6-1.

Table 6-1 The Items of IEE

Study area	Environmental items
Bareilly in Uttar Pradesh	(1) Hydrological situation, (2) Flora and fauna (3) Air pollution, (4) Noise and vibration
Patna in Bihar	(1) Hydrological situation, (2) Flora and fauna (3) Air pollution, (4) Noise and vibration
Keonjhar in Orissa	(1) Air pollution, (2) Noise and vibration
Balugaon in Orissa	(1) Air pollution, (2) Noise and vibration
Vijayawada in Andhra Pradesh	The investigation was not made on account of flood.
Kannur in Kerala	(1) Air pollution, (2) Noise and vibration
Nandura in Maharashtra	(1) Hydrological situation, (2) Air pollution (3) Noise and vibration
Khamgaon in Maharashtra	(1) Hydrological situation, (2) Air pollution (3) Noise and vibration
Bhopal in Madhya Pradesh	(1) Flora and fauna, (2) Air pollution (3) Noise and vibration
Gwalior in Madhya Pradesh	Investigation has not made yet because of new selected area.

6.1.2 Legislation

Regulations of environmental pollution in India dates from the beginning of 20th century when it was under British colonial rule. From about 1950, with the development of industries, State governments coped with the effects of a degraded

environment by enacting regulation laws. Taking the opportunity presented by the "United Nations Conference on the Human Environment" 1972, the Constitution was amended in 1976. The amended Constitution lays down basic principals of an environmental policy. The environmental policy of the Central Government is promoted by the Ministry of Environment and Forests (MoEF) which was established in 1980, consists of 22 departments; Forests Conservation, Wildlife Protection, Prevention and Control of Pollution, Environmental Impact Assessment, etc. MoEF serves as the focal point in the administrative structure of the Central Government for planning, promotion, and co-ordination of environmental and forestry program.

There are about 30 major enactments related to control of pollution now being administrated by the Central and State Governments. The enforcement of the Acts for Prevention and Control of Pollution of Water (1974), and Air (1981), as also in respect of Water Cess Act (1977) is carried out through the Central Pollution Control Board (CPCB). CPCB also co-ordinates activities of the 18 States Pollution Central Boards statutorily constituted in various States and Union Territories for nation-wide implementation of pollution control. For providing a single focus for all environmental issues in the country and to plug loopholes in the existing Acts, the Government of India enacted the Environment (Protection) Act, 1986. This Act empowers the Central Government to take all necessary measures for protecting the quality of environment, to lay down standards for discharge of environmental pollutants, etc. Still more, to implement decisions of the United Nations Conference on Environmental Development (1992), the National Environment Tribunal Act (1995) was enacted.

Regarding ecological resources, there are the Forest (Conservation) Act, 1980, the Forest (Conservation) Rules, 1981 and the Wild Life (Protection) Act, 1972 which have been inherited from each related Act introduced by the British Government in the 19th Century. To protect the vast forest resources and to protect, propagate or develop wildlife or its environment, reserved forest and sanctuary or National Park have been designated by the Central and State Governments.

6.1.2.1 Guidelines on Environmental Impact Assessment

India attaches great importance to Environmental Impact Assessment (EIA), as a means of promoting harmony among economic growth, social development and environmental management.

Implementation of the EIA is based on the Environment (Protection) Act, 1986 and the Environment (Protection) Rules, 1986. The publications related to the EIA for highway project are as follows:

- The Environmental Impact Assessment Notification, 1994 of MoEF
- Environmental Guideline for Rail/Road/Highway Project, 1989 of MoEF

- Guidelines for Environmental Impact Assessment of Highway Projects, 1989 of The Indian Road Congress

(1) Organisation of the Environmental Impact Assessment

MoEF has been assigned the responsibility of the EIA for development projects prior to site selection and investment decisions.

(2) Projects Subject to the Environmental Impact Assessment

Projects subject to the EIA are listed in Schedule I of The Environmental Impact Assessment Notification, 1994 of MoEF. For instance, highway bypass projects listed in the Schedule I are required to have a clearance from the Central Government.

(3) Procedure for the Environmental Impact Assessment

The project authorities in planning and carrying out the EIA shall submit the Environmental Impact Statement (EIS), Environmental Management Plan (EMP), Feasibility/Detailed Project Report and duly completed Questionnaire in accordance with the guidelines issued by MoEF. Road projects like this National Highway Bypasses project shall comply with Environmental Guidelines for Rail/Road/Highway Projects, 1989. The EIS should cover the following items:

i. A brief description of the project including its objectives;
ii. Description of the existing Environment;
iii. Identification of Impacts of the proposed project (adverse and beneficial);
iv. Evaluation of the impact;
v. Environmental Management Plan (EMP) which includes mitigation, protection and abatement measures;
vi. Consideration of Alternatives;
vii. Consideration of "No Change Alternative";
viii. Monitoring; and,
ix. Summary and Conclusions.

The EIA reports shall be evaluated and assessed by the Impact Assessment Agency (IAA), MoEF, and if deemed necessary, it may consult a Committee of Experts. In addition, the Indian Roads Congress (IRC) has also prepared the Guidelines for Environmental Impact Assessment of Highway Project (1989). The involved activities are indicated in the form of a flow diagram in Figure 6-1.

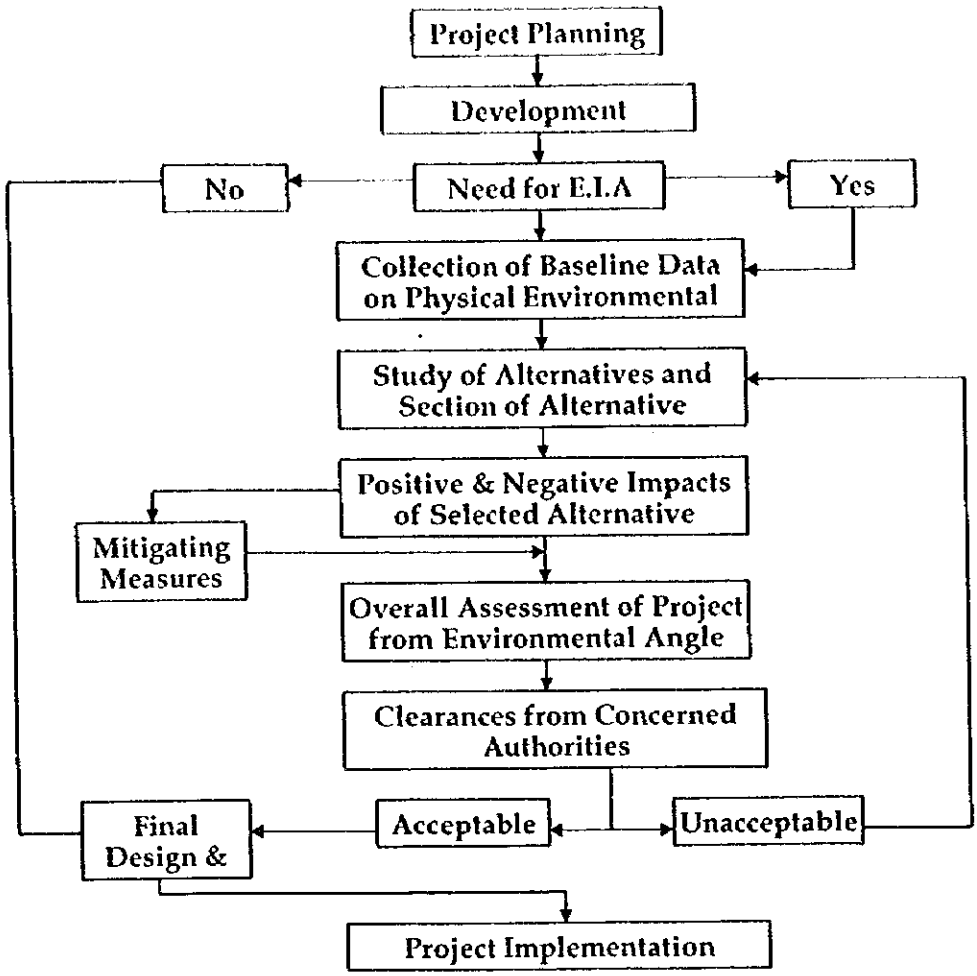


Figure 6-1 Flow Diagram for Environmental Assessment of Highway Projects

(4) Public Hearing

Public hearings could be called for in case of projects involving large displacement or having severe environmental ramifications.

(5) Penalties

Whoever fails to comply with or contravenes any of the provisions of the Environment Act, or the rules made or orders or directions issued thereunder, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years or with fine which may extend to a hundred thousand rupees, or with both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

6.1.2.2 Environmental Standards

(1) Air Quality

Any emission or discharge of environmental pollutants from the industries, operations or possessions shall not exceed the relevant concentration in ambient air as shown in Table 6-2.

Table 6-2 National Ambient Air Quality Standards (NAAQS)

Pollutant	Time weighted Average	Concentration in Ambient Air		
		Industrial Area	Residential, Rural and other area	Sensitive Area
Sulphur Dioxide (SO_2)	Annual Average*	80 ug/m³	60 ug/m³	15 ug/m³
	24 hours**	120 ug/m³	80 ug/m³	30 ug/m³
Oxides of nitrogen as NO_2	Annual Average*	80 ug/m³	60 ug/m³	15 ug/m³
	24 hours**	120 ug/m³	80 ug/m³	30 ug/m³
Suspended Particulate Matter (SPM)	Annual Average*	360 ug/m³	140 ug/m³	70 ug/m³
	24 hours**	500 ug/m³	200 ug/m³	100 ug/m³
Respirable Particulate Matter (size less than 10um) (RPM)	Annual Average*	120 ug/m³	60 ug/m³	50 ug/m³
	24 hours**	150 ug/m³	100 ug/m³	75 ug/m³
Lead (Pb)	Annual Average*	1.0 ug/m³	0.75 ug/m³	0.50 ug/m³
	24 hours**	1.5 ug/m³	1.00 ug/m³	0.75 ug/m³
Carbon Monoxide (CO)	8 hours**	5.0 mg/m³	2.0 mg/m³	1.0 mg/m³
	1 hour	10.0 mg/m³	4.0 mg/m³	2.0 mg/m³

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values shall be met 98% of the time in a year, 2a% of the time, it may exceed but not on two consecutive days.

Note 1. National Ambient Air Quality Standard: The levels of air quality necessary with an adequate margin of safety, to protect the publish health, vegetation and property.

2. Whenever and wherever two consecutive values exceeds the limit specified above for the respective category, it shall be considered adequate, reason to institute regular/continuous monitoring and further investigation.

Source: Schedule VII of The Environment (Protection) Rules, 1986.

Standards for emission of smoke, vapour, etc. from motor vehicles and mass emission standards for petrol driven vehicles are provided in Schedule IV, Annexure-I of The Environment (Protection) Rules respectively. To take one example of many, the Standards are shown in Table 6-3 and Table 6-4. Although emission level of NOx is provided for diesel driven vehicles (i.e. not for petrol driven vehicles).

Table 6-3 Standards for Emission of Smoke from Motor Vehicles

Mass of Carbon Monoxide (CO) Maxm. Grams per KWH	Mass of Hydro Carbons (HC) Maxm. Grams per KWH	Mass of Nitrogen Oxides (NOx) Maxm. Grams per KWH
14	3.5	18

Note : On and from the 1st day of April, 1992, all diesel driven vehicles shall be manufactured that they comply with the following levels of emissions under the Indian driving cycle.

Source: Schedule III of The Environment (Protection) Rules, 1986.

Table 6-4 Mass Emission Standards for Petrol Driven Vehicles

Type Approval Tests: Two and three Wheeler Vehicles		
Reference Mass, R(kg)	CO (g/km)	HC (g/km)
R ≤ 150	12	8
150 < R ≤ 350	12+{18(R-150)}/200	8+{4(R-150)}/200
350 < R	30	12
Type Approval Tests: Light duty vehicles;		
Reference Mass, Rw(kg)	CO (g/km)	HC (g/km)
Rw<1020	14.3	2.0
1020<Rw<1250	16.5	2.1
1250<Rw<1470	18.8	2.1
1470<Rw<1700	20.7	2.3
1700<Rw<1930	22.9	2.5
1930<Rw<2150	24.9	2.7
2150<Rw	27.1	2.9

Source: Annexure I of The Environment (Protection) Rules, 1986.

(2) Water Quality

General Standards for Discharge of Effluents are shown in Table 6-5.

Table 6-5 Items for General Standards for Discharge of Effluents

Sl. No.	Parameter	Standard			
		Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Areas
1.	Colour and Odour	See Note 1	-	See Note 1	See Note 1
2.	Suspended Solid, mg/l, Max.	100	600	200	(a) For process waste water-100. (b) Omission
3.	Particle size of suspended solids	Shall pass 850 micron IS Sieve	-	-	Omitted
5.	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature, ßC, Max.	Shall not exceed 5°C above the receiving water temperature	-	-	Shall not exceed 5°C above the receiving water temperature
7.	Oil and grease, mg/l, Max.	10	20	10	20
8.	BOD (5days at 20ßC), Max.	30	350	100	100
9.	COD, mg/l, Max	250	-	-	250
Etc. total 40 substances					

Note 1: All efforts should be made to remove colour and unpleasant odour as far as practicable.

Source: Schedule II of The Environment (Protection) Rules, 1986.

(3) Noise

The Ambient Air Quality Standards in respect of Noise are shown in Table 6-6. These values in India except industrial area are almost equal to the Japanese Standard.

Table 6-6 The Ambient Air Quality Standards in Respect of Noise

Area code	Category of Area	Limits in dBA Leq.	
		Day Time	Night Time
(1)	Industrial area	75	70
(2)	Commercial area	65	55
(3)	Residential area	55	45
(4)	Silence Zone	50	40

Note-1: Day time is reckoned in between 6 a.m. and 9 p.m.
Note-2: Night time is reckoned in between 9 p.m. and 6 a.m.
Note-3: Silence zone is defined as areas up to 100 metres around such premises as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority.
Note-4: Mixed categories of areas be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.
Source: Schedule III of The Environment (Protection) Rules, 1986.

Noise limits for automobiles (free field at one metre in dBA at the manufacturing stage) to be achieved by the year 1992 and domestic appliances and construction equipment at the manufacturing stage to be achieved by the year 1993 are shown in Table 6-7.

Table 6-7 Noise Limits for Automobiles

Sl. No.	Category	Standards dBA
46.	(a) Motorcycles, scooters and three wheelers	80
	(b) Passenger car	82
	(c) Passenger or commercial vehicles up to 4MT	85
	(d) Passenger or commercial vehicles 4MT and up to 12MT	89
	(e) Passenger or commercial vehicles exceeding 12MT	91
47.	(a) Window air-conditioners of 1 ton to 1.5 ton	68
	(b) Air-coolers	60
	(c) Refrigerators	46
	(d) Diesel generators for domestic purpose	85~90
	(e) Compactors(rollers) front loaders, concrete mixers, cranes(movable) vibrators and saws.	75

Source: Schedule III of The Environment (Protection) Rules, 1986.

In case of implementation of EIA for Highway, the following standards suggested by MoEF are provided in Environmental Guidelines for Rail/Road/Highway Projects, 1989.

Table 6-8 Standards for Noise Impact Assessment

Type of land use	Noise Level dBA	
	External*	Internal
- Residential	65	50
- Commercial	70	-
- Places of national importance where silence is of extraordinary importance e.g. Rajghat	55	-
- Places of Worship, School, Hospitals and Auditoriums etc.	65 if there is activity outdoor	50

* The noise levels indicated are Leq (h) i.e. hourly equivalents

1) Noise impact will also occur if there is substantial (>10dBA) increase in noise level over the existing levels.
2) The standards described shall be applicable during day time only i.e. from 6 a.m. to 9 p.m.
3) During night time i.e. 9 p.m. to 6 a.m., the average noise level or L_N shall not exceed 30 dBA.
   Additionally, Leq (h) shall not exceed 35 dBA. In other words, noise during any given hour should not exceed 35dBA.
4) Night time standards will apply to residences, hospitals and hotels only.
5) The noise impacts will be more appreciable for projects in urban and industrial areas in comparison to other areas.

6.1.2.3 Wildlife Conservation

Wildlife species are classified in the schedules from I to V of the Wild Life (Protection) Act, and objective species are provided according to each clause such as prohibition of hunting, conumerce in wild animals, etc.

As regards sanctuaries or National Park, no person shall destroy, exploit or remove any wildlife from these areas or destroy or damage the habitat of any wild animal or deprive any wild animal of its habitat within such areas except under and in accordance with a permit granted by the Chief Wild Life Warden and no such permit shall be granted unless the State Government, being satisfied that such destruction, exploitation or removal of wildlife from there is necessary for the improvement and better management of wildlife therein, authorises the issue of such permit.

6.1.3 Present Condition of the Project Sites

Physically India is divided into four relatively well defined regions - the Himalayan mountains, the Gangetic river plains, the southern (Deccan) plateau and the islands. The climate of India is dominated by the Asiatic monsoon, most importantly by rains from the south-west between June and October, and drier winds from the north between December and February. From March to May the climate is dry and hot. India has a rich variety of wetland habitats. The total area of wetlands (excluding rivers) in India is 58,286,000ha, 18.4% of the country, 70% of which comprises areas under paddy cultivation. One of India's most important wetland areas is Chilika lake, which has been designated under the Convention of Wetlands of International

Importance (Ramsar Convention). On the other hand, the panorama of Indian forests ranges from evergreen tropical rain forests to dry alpine scrub. Between the two extremes, the country has semi-evergreen rain forests, deciduous monsoon forests, thorn forests, etc. Therefore, India contains a great wealth of biological diversity in its forests and wetlands.

Present conditions of the natural environment in each project area are enumerated below.

6.1.3.1 Bareilly Bypass

The district of Bareilly is a gently sloping alluvium plain. The proposed bypass alignment passes entirely through plain agricultural land without disturbing human settlement. The lands are fertile and well irrigated. The soil is generally moist and in ordinary seasons, there is little demand for irrigation for the spring crops such as wheat, rice, grain and pulses.

The climate is largely influenced by its proximity to the hills, but in general, it is cold in winter and hot in summer with temperature ranging from 5°C and 44°C. The annual rainfall is about 800 mm.

The alignment will crosses some canals and drainage. Except these, there is no interception of any other natural river/stream in the project area.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural lands, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.2 Patna Bypass

The greater part of the project area consists of Gangetic alluvium, i.e., silt brought down for ages by the Ganga river. The proposed bypass alignment passes through plain agricultural land, with sporadic hamlets here and there.

The climate of this area is the same as that of Bareilly. The annual mean temperature ranges from 2°C and 45°C. the annual rainfall is about 992 mm.

The Patna district stretches eastwards from the confluence of the Sone river and the Ganga river. Sone river runs nearly whole of its width on the west separating it from

the district of Shahabad; Ganga river runs along the whole length on the north separating the district from the Tirhut Division. Construction of bridge may cause some changes in the hydrology around its location.

The air quality data monitored at Bihar Bhawan, Shastri Nagar in year 1993 & 1994 as per report (95~96) prepared by Central Pollution Control Board, Delhi, is given as follows:

Pollutants	Annual Mean Concentration Range ($\mu g/m^3$)	Standard ($\mu g/m^3$)
SO_2	0~30	80
NO_2	0~30	80
SPM	>210	200
CO	Not available	2000

The above location is in the vicinity of the proposed bypass. It is classified as residential and rural area. The concentration of SO_2 and NO_2 are well within the standard, but that of SPM exceeds the standard.

No specific information on the noise level in the project area is available. On the other hand, a round-the-clock level of 75 dB was recorded in silent zone of inner city by the Bihar State Pollution Control Board.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.3 Keonjhar Bypass

The proposed bypass alignment passes through plain and agricultural/barren land. Neither human settlement nor any other structure is involved.

The highest maximum temperature recorded at Sambalpur (the near observatory) was 47°C and lowest minimum 4°C. The annual average rainfall is about 1572 mm.

Bypass alignment crosses a small stream (Nallah). Except this, there is no stream or water body in the project area.

No air quality data in the vicinity of the project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which are designated in the project area. Almost no tree/vegetation along exist along the proposed alignment.

6.1.3.4 Balugaon Bypass

The proposed bypass alignment passes through paddy fields without notified human settlement. The alignment is away from built-up area and away from Chilika Lake (about 1.5 km near the starting point and at other places more than 2 km).

The mean daily maximum temperature in May (the hottest month) is 38°C. Maximum rainfall is during June to November when monthly rainfall reaches up to 200~450 mm.

Balugaon is at the edge of Chilika Lake, the largest lagoon of Asia and designated wetland under Ramsar Convention. The lacustrine eco-system of the Chilika Lake will not be affected directly by the proposed bypass, as it is located far away from the lake. Conversely, the construction of the bypass will contribute not only to reducing the emission of pollutants from vehicles on the existing NH5 but also to mitigating the impacts caused by NH5 on the ecosystem of the lake.

There are a few small streams, which the proposed alignment crosses.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.5 Vijayawada Bypass

The proposed bypass alignment passes through open agricultural land away from built-up areas and hills. There is mainly paddy field without irrigation, and approximately 50% of the area is wet land.

The mean daily maximum temperature is 37°C and daily minimum is 28°C. The average annual rainfall is 962 mm.

Vijayawada is situated on the left bank of Krishna river and the alignment passes further left of Vijayawada city and does not intercept this river anywhere. However, it crosses one small river and a canal.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.6 Kannur Bypass

The proposed bypass alignment passes through coconut garden land and paddy fields. It crosses a number of village roads and residences. There is undulated land with moderate gradient.

The area has humid climate with oppressive hot seasons and plentiful rains well distributed throughout the year. Maximum temperature recorded 1996~97 was 35°C to 37°C and minimum was 25°C to 27°C. the average annual rainfall is 3430 mm.

Kannur is situated on the west coast of the country and is one of the major towns of Kerala State. Though there are a large number of rivers and streams in and around Kannur, the alignment does not intercept any major river/stream.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

No endangered species of flora and fauna exist in the project area. Regional trees in the project area belong to tropical evergreen type.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.7 Nandura Bypass

Nandura area is a part of Buldhana Plateau. The proposed bypass alignment passes through plain agricultural land of black cotton soil. This soil quality has enabled the farmers to have rich harvest of good quality cotton, which is the main trade of the area. Private properties do not lie in the way of the alignment.

The mean daily maximum temperature is 38°C and minimum is 4°C. The annual rainfall varies between 700~850 mm.

The bypass alignment crosses a small river, by the name of "Dyan Ganga" which flows towards Jalgaon-Jamod and joins Purna river, which ultimately joins Tapi river at Adilabad. This river flooded Nandura Guest House in 1959.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.8 Khamgaon Bypass

Khamgaon area is a part of Buldhana Plateau.The proposed bypass alignment passes entirely through moderately sloped agricultural land with black cotton soil. The area is well known for cotton cultivation as the black soil is most suitable for this crop. There is no structure/building in the way of the alignment.

The climate of this area is about the same as that of Nandura.

There is no river or stream which the alignment crosses in the project area.

No air quality data in the vicinity of project area is available. As the major portion of the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.9 Bhopal Bypass

Geologically Bhopal lies on Malwa Plateau at a general height of 500 m above the sea level. The proposed bypass alignment passes through plain agricultural land mostly growing wheat and barley (winter crops) and wherever conditions are favourable, summer crops like paddy etc. are also grown. There are a few hamlets here and there.

The climate is relatively temperate and dry except in Monsoons. The temperature

ranges between 10°C and 44°C. The annual rainfall is about 1240 mm.

There is no interception of any natural water course in the project area.

The air quality data monitored at Hamidia road in year 1993 as per report (95~96) prepared by Central Pollution Control Board, Delhi, is given as follows:

Pollutants	Annual Mean Concentration Range ($\mu g/m^3$)	Standard ($\mu g/m^3$)
SO_2	0~30	80
NO_2	0~30	80
SPM	>210	200
CO	Not available	2000

The above location is in the vicinity of the proposed bypass. It is classified as residential and rural area. The concentration of SO_2 and NO_2 are well within the standard, but that of SPM exceeds the standard.

No specific information on the noise level in the project area is available. However, an average noise level of 60 dB was recorded in Hamidia road of urban city by the Madhya Pradesh Pollution Control Board.

There are mainly agricultural fields, therefore, no endangered species of flora and fauna exist in the project area.

There is neither any forest area nor any wildlife sanctuary or National Park which falls in the project area.

6.1.3.10 Gwalior Bypass

Gwalior district lies at junction of the Malwa plateau in the south, west and the vast plain in the north, east. The proposed bypass alignment passes through agricultural land (mainly in the beginning and end), barren land and reserved forest area. It passes away from built-up area except near the starting point where the bypass will affect some residences (illegal occupation).

Maximum temperature is about 43°C and minimum is about 2°C. The average annual rainfall is 733 mm.

There are a number of rivers in the area. All these rivers become full and active during the rainy season and in summer, they generally dry up entirely. For this reason, many a river could not be utilised for irrigation or navigation. Sank river flows near the project area. Tigra Dam has constructed on this river. Bypass alignment crosses Tigra canal. Except this, no other major stream/water body exist in the project area.

No air quality data in the vicinity of project area is available. As the major portion of

the bypass passes through open fields in rural area, the air quality in the project area is expected to be good.

No specific information on the noise level in the project area is available.

There are mainly some shrubs and Khair trees here and there. Animals found in the forest are generally grazing cattle and deer. No endangered species of flora and fauna exist in the project area.

About 12 km length of the alignment passes through forest land (mostly Raipur Reserved Forest). No wildlife sanctuary or National Park is involved in the project area. Nearly 70% of these forest is of poor quality since it mainly consists of either shrubs or grass. It is of dry and deciduous variety. Raipur reserved forest mainly comprises the Khair trees (Acacia catechu) and shrubs. The Khair trees are of stunted growth and the quality of Khair is not found suitable for the manufacture of Kattha. These are, therefore, mainly used as a fuel. Ber and Palas shrubs occur on the stony soil. As most part of the forest consists of either sporadic trees with stunted growth or shrubs, which becomes thick during rainy season, no clear felling is involved. However, at least, an equal area of land should be provided by the State Government to compensate the loss of forest land due to construction of the proposed bypass.

6.1.4 Environmental Evaluation

6.1.4.1 Soil erosion

The alignments of Kannur and Gwalior bypasses traverse through hilly areas. In general, construction activities of a road in the hills may have a potential for creating conditions conductive to landslides in the first few years of construction by reason of sandy soil and heavy rainfall in India. Therefore, the length of the bypasses to be constructed in the hilly areas will be kept bare minimum so that disturbance to the natural surroundings is least, and its alignments will avoid large-scale cuttings and follow the lie of the land as far as possible. The cut slopes will be suitably protected by breast walls, provision of flat stable slopes, construction of catch-water and intercepting drains, vegetative cover in accordance with "Recommended Practice for Treatment of Embankment Slopes for Erosion Control"; IRC: 56-1974.

6.1.4.2 Hydrological situation

Some new crossings are planned over the river such as Sone river in Patna. Therefore, the feasibility study needs to assess the impact on the changes of water flow and riverbed under construction.

6.1.4.3 Ecological resources

The proposed alignments no where traverse through sensitive ecosystem such as

mangrove swamps, wet-lands, sanctuaries, virgin forests, etc. Although Gwalior bypass passes through some reserved forest area but the same is totally devoid of any standing forest crop. It is of degraded forest types (i.e. thorny shrubs and bushes). However, deforestation for bypass construction should be bare minimum and strict control must be exercised in consultation with the forest authorities. Compensatory afforestation in the ratio of 1:3 should be the general rule (i.e. for 1 hectare of deforestation, 3 hectares must be afforestation as roadside plantation or as wood lots along the road if sufficient lands is not available for the road site plantation). It is necessary to investigate the forest composition etc. in accordance with the guideline. In general, afforestation of roadside land should be carried out to a sufficient distance on ether side of the bypass. Strip forests suitable for the site conditions for a minimum distance of 30 m on the either side of the road boundary should be provided.

Wildlife will be affected in a manner similar to forestry, i.e. through habitat loss and encroachment. However, the proposed bypasses nowhere pass through sanctuaries and National Park. There are no endangered species in the project areas. Serious impact caused by the bypasses on the other wildlife is not anticipated.

6.1.4.4 Landscape

An aesthetically designed, constructed and maintained highway is pleasing to the eye and enhancing the environmental quality. Though almost all proposed alignments pass through the agricultural/barren land, even then comprehensive afforestation on both sides of the bypass should be properly planned according to Manual on Landscaping of Roads, IRC:SP: 21-1979. The function of greenery in highway planning is to improve the scenery, conserve the natural environment, enhance traffic safety and prevent disasters. Therefore, it is necessary for promoting greening activities to plan the arrangement in harmony with the surrounding rural scenery.

Borrowing earth from roadside borrow pits for embankment construction has been a common practice in India. Quite often the pits are dug in irregular shapes and left without any provision for drainage. This not only makes the road unpleasant but also causes water stagnation with concomitant adverse effort on the road and the environment. It is, therefore, necessary that the borrow pits should be dug in regular shape and provided with drainage arrangement.

6.1.4.5 Air pollution

It is important for achieving air pollutant reduction to plan smooth traffic flow and decrease of traffic volume expected by dispersion of traffic volume. As a result of the proposed bypasses, traffic will flow more smoothly and running speed will rise in the inner city. The relation between vehicle velocity and emission volume is shown in Figure 6-2. The emission coefficient is related to velocity and especially large

diesel-engine vehicles affect ambient condition. According to the result calculated approximately, total emission of NOx from motor vehicles in the proposed condition will reduce it by 30~90% along the National Highway of the inner city, and by 10~30% in total volume including bypass compared with the no change case in the future status. Tables 6-9 to 6-18 show the calculation results of prospected emission intensity for each 10 bypass in 2002. Therefore, this study will contribute to improvement of air pollution in the area. Regarding the neighbourhoods of the alignment with human settlements such as in Kannur bypass, ambient is likely to deteriorate due to construction of the bypass. Therefore, it is necessary to take steps to cope with the impact caused by emission gas on the surrounding residents.

On the other hand, some plants are able to absorb and fix air pollutants. For instance, a 7 m-wide greenbelt with trees on both sides has the ability to absorb 5% of NOx emitted from a traffic volume of 30,000 vehicles per day. Figure 6-3 shows that a row of trees along a roadway has the effect of promoting diffusion by disturbing the air flow.

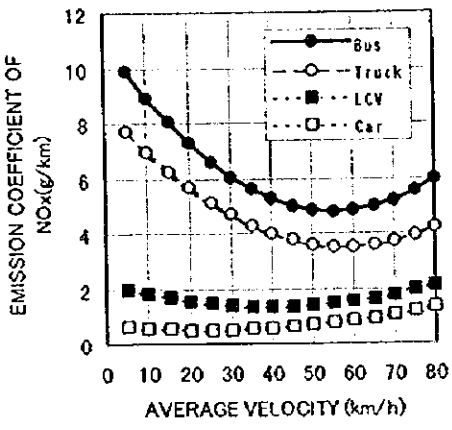


Figure 6-2 Relation between Vehicle Velocity and Emission Volume (Using Emission Coefficient of 1985 in Kawasaki

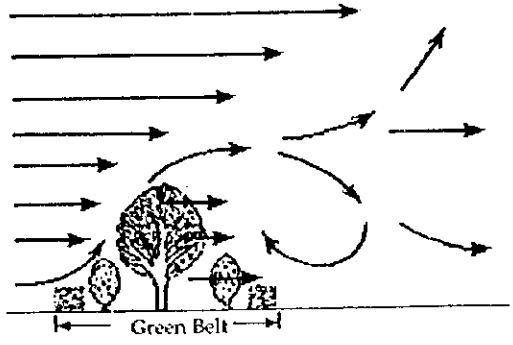


Figure 6-3 Function of Diffusion Concerning Greenbelt with Trees

Table 6-9 Calculation conditions of Air Pollution (NOx) Bareilly Bypass

Situation	Description	NH			23.0 km	Bypass			31.1 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without	Traffic Volume (unit)	3843	2374		6522	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
2002	Emis. Intensity (g/km)	1993	17303	0	36942	-	-	-	-
	Total Emis. Intensity (kg)				1,293.5				-
With	Traffic Volume (unit)	3184	1739		4000	2752	1633		5034
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
2002	Emis. Intensity (g/km)	1647	10555	0	18726	5625	9786	0	21175
	Total Emis. Intensity (kg)				711.3				1,137.8
	Whole Emis. Intensity (kg)								1,849.1
		Reduced Ratio in NH			0.550	Reduced Ratio in City			1.430

Table 6-10 Calculation conditions of Air Pollution (NOx) Patna Bypass

Situation	Description	NH			64.8 km	Bypass			49.8 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without	Traffic Volume (unit)	2059	662		3455	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
2002	Emis. Intensity (g/km)	1068	4821	0	19571	-	-	-	-
	Total Emis. Intensity (kg)				1,649.8				-
With	Traffic Volume (unit)	1145	306		1254	2123	762		4458
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
2002	Emis. Intensity (g/km)	592	1854	0	5871	4340	4566	0	18753
	Total Emis. Intensity (kg)				539.0				1,377.4
	Whole Emis. Intensity (kg)								1,916.4
		Reduced Ratio in NH			0.327	Reduced Ratio in City			1.162

Table 6-11 Calculation conditions of Air Pollution (NOx) Keonjhar Bypass

Situation	Description	NH			6.0 km	Bypass			8.5 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without	Traffic Volume (unit)	1043	168		3048	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
2002	Emis. Intensity (g/km)	541	1221	0	17266	-	-	-	-
	Total Emis. Intensity (kg)				114.2				-
With	Traffic Volume (unit)	924	150		2547	119	18		501
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
2002	Emis. Intensity (g/km)	478	907	0	11925	243	108	0	2108
	Total Emis. Intensity (kg)				79.9				20.9
	Whole Emis. Intensity (kg)								100.8
		Reduced Ratio in NH			0.700	Reduced Ratio in City			0.883

Table 6-12 Calculation conditions of Air Pollution (NOx) Balugaon Bypass

Situation	Description	NH			15.0 km	Bypass			15.4 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	866	284		4090	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	449	2070	0	23165	-	-	-	-
	Total Emis. Intensity (kg)				385.3				-
With 2002	Traffic Volume (unit)	670	192		2562	196	92		1528
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	346	1165	0	11993	401	551	0	6428
	Total Emis. Intensity (kg)				202.6				113.6
	Whole Emis. Intensity (kg)								316.2
		Reduced Ratio in NH			0.526	Reduced Ratio in City			0.821

Table 6-13 Calculation conditions of Air Pollution (NOx) Vijayawada Bypass

Situation	Description	NH			34.0 km	Bypass			28.1 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	2286	1442		7861	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	1186	10510	0	44527	-	-	-	-
	Total Emis. Intensity (kg)				1,911.6				-
With 2002	Traffic Volume (unit)	2074	1323		6351	212	119		1510
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	1073	8030	0	29734	433	713	0	6352
	Total Emis. Intensity (kg)				1,320.4				210.7
	Whole Emis. Intensity (kg)								1,531.1
		Reduced Ratio in NH			0.691	Reduced Ratio in City			0.801

Table 6-14 Calculation conditions of Air Pollution (NOx) Kannur Bypass

Situation	Description	NH			14.0 km	Bypass			11.1 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	5617	2207		2906	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	2914	16085	0	16458	-	-	-	-
	Total Emis. Intensity (kg)				496.4				-
With 2002	Traffic Volume (unit)	3817	1772		1279	1800	436		1628
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	1974	10755	0	5986	3680	2613	0	6848
	Total Emis. Intensity (kg)				262.0				145.9
	Whole Emis. Intensity (kg)								407.9
		Reduced Ratio in NH			0.528	Reduced Ratio in City			0.822

Table 6-15 Calculation conditions of Air Pollution (NOx) Nandura Bypass

Situation	Description	NH			7.4 km	Bypass			6.4 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	1266	571		5045	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	656	4162	0	28575	-	-	-	-
	Total Emis. Intensity (kg)				247.1				-
With 2002	Traffic Volume (unit)	355	181		194	911	390		4851
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	183	1099	0	906	1862	2337	0	20406
	Total Emis. Intensity (kg)				16.2				157.5
	Whole Emis. Intensity (kg)								173.7
		Reduced Ratio in NH			0.066	Reduced Ratio in City			0.703

Table 6-16 Calculation conditions of Air Pollution (NOx) Khamgaon Bypass

Situation	Description	NH			9.3 km	Bypass			10.9 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	1254	612		6443	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	650	4461	0	36494	-	-	-	-
	Total Emis. Intensity (kg)				386.9				-
With 2002	Traffic Volume (unit)	379	303		739	875	309		5704
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	196	1839	0	3460	1788	1852	0	23992
	Total Emis. Intensity (kg)				51.1				301.2
	Whole Emis. Intensity (kg)								352.3
		Reduced Ratio in NH			0.132	Reduced Ratio in City			0. 910

Table 6-17 Calculation conditions of Air Pollution (NOx) Bhopal Bypass

Situation	Description	NH			28.7 km	Bypass			40.3 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	3556	866		5088	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	1844	6308	0	28819	-	-	-	-
	Total Emis. Intensity (kg)				1,061.1				-
With 2002	Traffic Volume (unit)	2596	629		3290	778	197		1419
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	1343	3818	0	15404	1590	1181	0	5970
	Total Emis. Intensity (kg)				590.2				352.3
	Whole Emis. Intensity (kg)								942.5
		Reduced Ratio in NH			0. 556	Reduced Ratio in City			0. 888

Table 6-18 Calculation conditions of Air Pollution (NOx) Gwalior Bypass

Situation	Description	NH			31.5 km	Bypass			26.0 km
		Car	Bus	LCV	Truck	Car	Bus	LCV	Truck
Without 2002	Traffic Volume (unit)	2974	1089		9071	-	-	-	-
	Average Speed (km/h)	20	20		20	-	-	-	-
	Emis. Coefficient (g/km/unit)	0.52	7.29	2.17	5.66	-	-	-	-
	Emis. Intensity (g/km)	1542	7937	0	51384	-	-	-	-
	Total Emis. Intensity (kg)				1,917.2				-
With 2002	Traffic Volume (unit)	2170	935		3608	804	154		5459
	Average Speed (km/h)	30	30		30	100	80		80
	Emis. Coefficient (g/km/unit)	0.52	6.07	2.17	4.68	2.04	5.99	2.17	4.21
	Emis. Intensity (g/km)	1122	5675	0	16891	1644	923	0	22964
	Total Emis. Intensity (kg)				746.2				663.8
	Whole Emis. Intensity (kg)								1,410.0
		Reduced Ratio in NH			0. 389	Reduced Ratio in City			0. 735

6.1.4.6 Water pollution

Building of a new bridge (as on Sone river) makes the water muddy during construction of foundations. Therefore, it is necessary to do this work in a manner which minimises water pollution. Similarly, during construction of road embankment, it is necessary to minimise the impact caused by muddy water on account of rainfall on surrounding fields by establishment of temporary drainage and sand basin.

6.1.4.7 Noise

Noise is one of the major factors resulting from traffic pollution. Especially in the inner city, undisciplined use of motorcycles and auto-rickshaw prevents smooth traffic flow, and poor traffic manners cause frequent use of horns. For achieving noise reduction, it is important to plan for smooth flow of traffic and take steps to reduce the traffic volume by diverting it. As a result of the construction of the proposed bypasses, traffic congestion in cities will considerably decrease but proper regulation of smooth flow of traffic will still be necessary leading to reduction in noise level. Regarding the neighbourhoods of the alignment with human settlements such as in Kannur bypass, sound environment is likely to deteriorate due to construction of the bypass. Therefore, it is necessary to take steps to cope with the impact caused by traffic noise on the surrounding residences.

6.1.5 Screening/Scoping

The objective of the study is to solve the traffic congestion caused by the inflow of through traffic on the National Highway that traverses the cities by diverting the through traffic. Therefore, the bypasses are proposed to detour the cities in order to help in the smooth flow of through traffic and to ease the traffic congestion in the cities.

According to the prior investigation, the following serious impacts were anticipated:

- Change of flux caused by piers of bridge: Patna Bypass
  Potential sites: Bareilly Bypass; Khamgaon Bypass; Nandura Bypass

- Breeding obstruction: Bareilly Bypass
  Unknown sites: Patna Bypass; Bhopal Bypass

- Wetlands: Bhopal Bypass (unknown)

- Air pollution: All project sites

- Noise and Vibration: All project sites

The results of Initial Environmental Examination are as follows:

- For change of flux, it is necessary to investigate the water quality, change of flow etc. and to implement the proper construction work in the EIA.

- For breeding obstruction, valuable species have not found out in this IEE. Therefore, it is evaluated that serious impact will not be anticipated. The proposed site of Bhopal Bypass does not pass through wetlands. However, the project site of Gwalior includes the reserved forest area (in revenue records) but at present there is no forest crop. It is ecologically degraded area, and road side plantation in the area is required to improve its ecology. Though valuable fauna and flora have not been found, it is necessary to have interaction with authorities concerned in the EIA.

- For air pollution, some residences as a subject for environmental protection exist in the vicinity of Kannur Bypass, but the other bypasses pass mainly through agricultural or barren land. However, it is necessary to implement the EIA in consideration of future situation.

- For noise and vibration pollution also, the same considerations apply as for air pollution.

Except the above-mentioned items, the occurrence of serious environmental impacts on the natural environment is not anticipated.

Screening and Scoping for each Environmental Evaluation Items in accordance with guidelines of JICA are summarised in Table 6-19 and Table 6-20 to 6-29 respectively.

Table 6-19 Screening Check List

Environmental items		Content	Evaluation										Remarks(Basis)
			Baroilly	Patna	Keonjhar	Balugaon	Vijayawada	Kannur	Nandura	Khamgaon	Bhopal	Gwalior	
Natural Environment													
1	Topography and geology	Change of valuable topography and geology by digging or fill	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: Valuable topography and geography do not exist.
2	Soil erosion	Flow of surface soil by rainwater after land development and forest felling	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: Forest and slanting surface do not exist in the project area.
3	Groundwater	Pollution by drainage or leach water by digging construction	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: Ground water will not be pumped.
4	Hydrological situation	Change of flux and riverbed by reclamation and inflow of drainage	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO: Construction in major river will not be planned. YES: Construction in major river will be planned.
5	Coast and sea area	Change of beach erosion and vegetation by a change of reclamation or sea condition	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: There are no sea areas.
6	Flora and fauna	Breeding obstruction and extinction of species by a change of an inhabitable condition	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO: Habitat of valuable flora and fauna do not exist in the project area.YES: Reserved forest land
7	Climate	Change of temperature and wind conditions by the large-scale land development and architecture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: Large-scale felling and construction of high buildings will not be planned.
8	Landscape	Change of topography by land development and harmonious obstruction by structural objects	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: There are mainly plain agricultural fields.
Environmental Pollution													
9	Air pollution	Pollution by emission gas and dust from vehicles	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES: Impact by emission gas from motor car will occur.
10	Water pollution	Pollution by inflow of earth and sand and industrial water waste	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO: Construction in major river will not be planned.YES: Construction in major river will be planned.
11	Soil contamination	Pollution by dust and asphalt emulsion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: There will be no action causing soil contamination.
12	Noise and vibration	Occurrence of noise and vibration by vehicles	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES: Impact by noise and vibration by vehicles will occur.
13	Ground subsidence	Subsidence by change of ground and fall of groundwater level	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: Construction causing ground subsidence will not be involved
14	Offensive odors	Occurrence of exhaust gas and offensive odors	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO: There is no factors of producing offensive odors
Comprehensive assessment: Is it necessary to implement on IEE or EIA for the development project ?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	For detailed design of Environmental Management Plan (EMP) and EIA is necessary.

Table 6-20 Scoping Check List **Bareilly Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Table 6-21 Scoping Check List **Patna Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	B	Effect of construction of a bridge over the Sone River should be studied.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	B	Construction in the river may contaminate natural water temporarily.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Classification of evaluation: A- Serious impact will be anticipated; B- Impact will be more or less anticipated; C- Unknown (it is necessary to investigate); D- No impact will be anticipated.

Table 6-22 Scoping Check List — **Keonjhar Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Table 6-23 Scoping Check List — **Balugaon Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Classification of evaluation: A- Serious impact will be anticipated; B- Impact will be more or less anticipated; C- Unknown (it is necessary to investigate); D- No impact will be anticipated.

Table 6-24 Scoping Check List — Vijayawada Bypass

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Table 6-25 Scoping Check List — Kannur Bypass

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Classification of evaluation: A- Serious impact will be anticipated; B- Impact will be more or less anticipated; C- Unknown (it is necessary to investigate); D- No impact will be anticipated.

Table 6-26 Scoping Check List — Nandura Bypass

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Table 6-27 Scoping Check List — Khamgaon Bypass

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Classification of evaluation: A- Serious impact will be anticipated; B- Impact will be more or less anticipated; C- Unknown (it is necessary to investigate); D- No impact will be anticipated.

Table 6-28 Scoping Check List **Bhopal Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	D	Valuable flora and fauna do not exist in the project area.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Table 6-29 Scoping Check List **Gwalior Bypass**

		Evaluation	Grounds
Natural Environment			
1	Topography	D	Valuable topography and geography do not exit.
2	Soil erosion	D	Large-scale changes of lands such as forest felling will not be involved.
3	Groundwater	D	Construction causing contamination of groundwater will not be planned.
4	Hydrological situation	D	Construction in the major river will not be planned.
5	Coast/sea area	D	There is no sea area.
6	Flora/fauna	B	Alignment passes through reserved forest land.
7	Climate	D	Large-scale felling and construction of high building will not be planned.
8	Landscape	D	No cultural and historical sites exist in the area.
Environmental Pollution			
9	Air pollution	B	Air pollution level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
10	Water pollution	D	Constructions in major river/stream will not be involved.
11	Soil contamination	D	There will be no action, which causes soil contamination.
12	Noise/Vibration	B	Traffic noise level in urban area may be lightened by the reduction of traffic congestion, however, that in the project area will rise.
13	Ground subsidence	D	Construction causing ground subsidence will not be planned.
14	Offensive odours	D	There is no factors producing offensive odours.

Classification of evaluation: A- Serious impact will be anticipated; B- Impact will be more or less anticipated; C- Unknown (it is necessary to investigate); D- No impact will be anticipated.