3.7 Preliminary Design of Kannur Bypass

The proposed Kannur Bypass was originally planned by the State PWD around 10 years back. Due to rapid change of land use in recent, a new route was studied and proposed by this Study, taking consideration of the current land use conditions.

The proposed bypass is located in a narrow area between NH17 and the Valapattanam River, starting from Km. 150 on NH17 and extends up to Km. 161. 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 3-17.

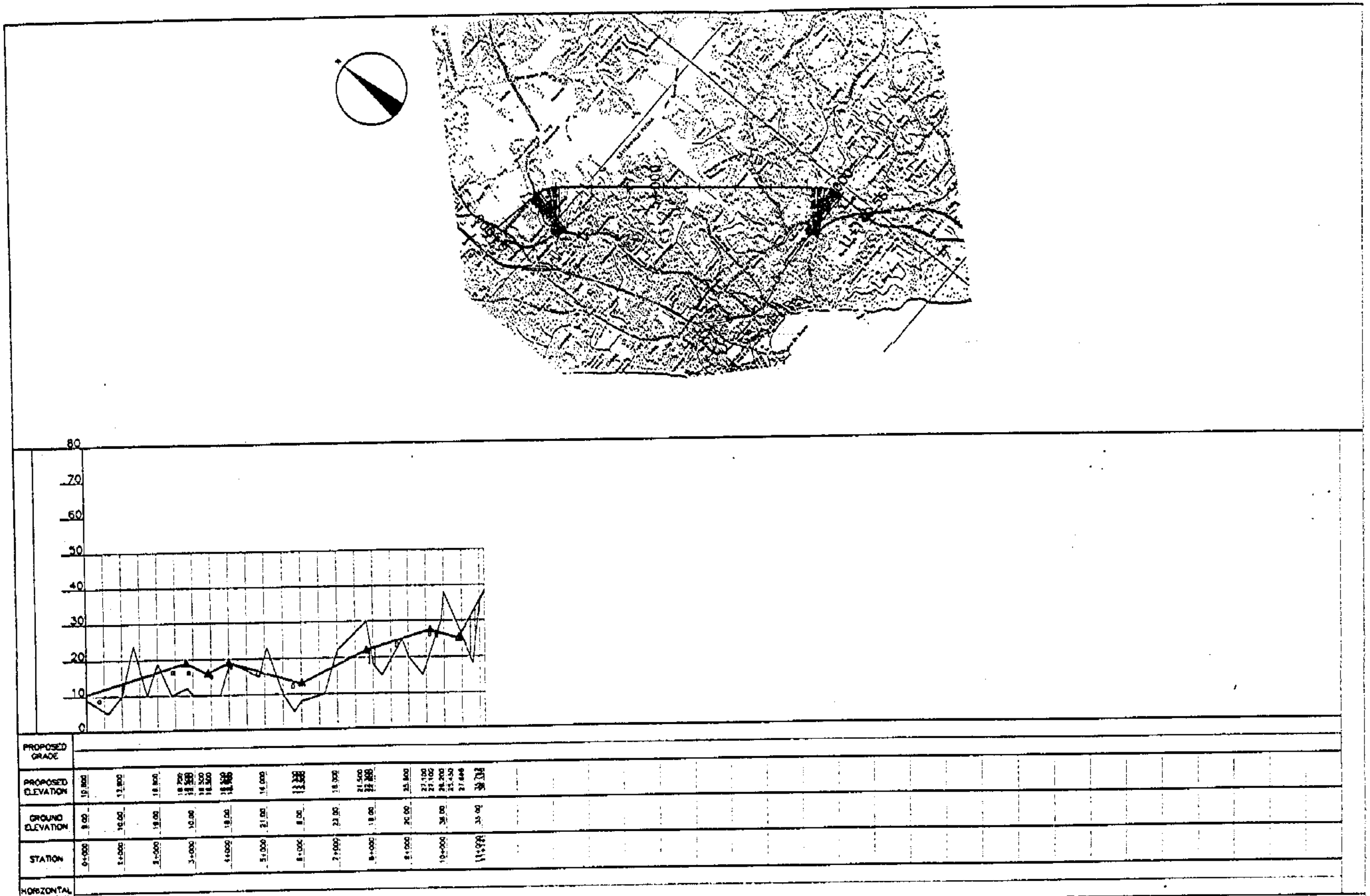
Table 3-17 Major Controls of Kannur Bypass

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

Proposed major structures and estimated major quantities of Kannur Bypass were listed in Tables 3-18 and 3-19, respectively. Figure 3-8 presents the proposed plan and profile of the bypass.

Table 3-18 Major Structures of Kannur Bypass

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



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

DWG TITLE : KANNUR BYPASS: PLAN & PROFILE

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

DWG NO. : 006

Table 3-19 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

3.8 Preliminary Design of Nandura Bypass

In 1993, the State PWD made a comparison study on three alternatives; i.e., 1) southern bypass, 2) northern bypass, and 3) widening/replacement of the existing bridge on NH6, to resolve the congestion problem in the town. The comparison study concluded that construction of new bridge at 30 m down-stream of the existing one is an optimum alternative from the economic point of view.

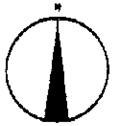
In this Pre-Feasibility Study, the aforementioned southern alternative route was selected to review as Nandura Bypass. Although it was judged that the construction of new bridge will the most appropriate solution for the short term basis, but the construction of bypass will be inevitable to ease the traffic congestion in long term basis.

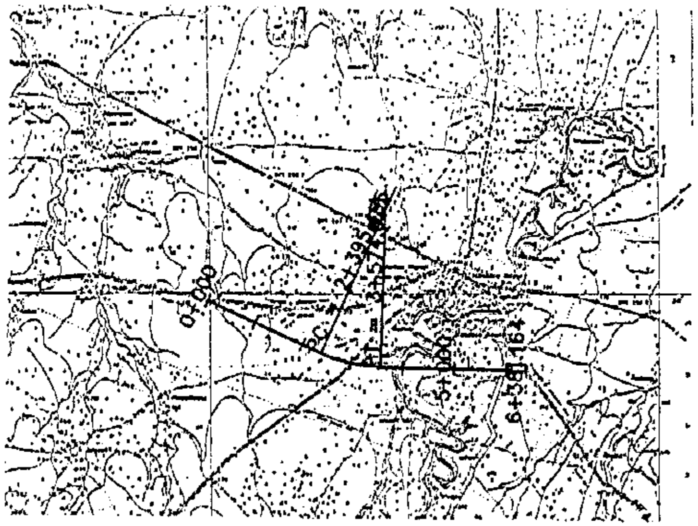
There are no serious restrictions along the proposed alignment, which has approximately 6 km of total length. Table 3-20 shows the findings of major controls of Nandura bypass.

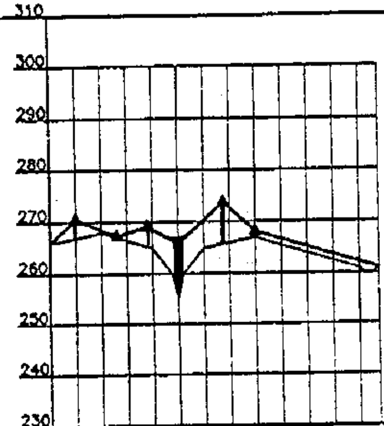
Table 3-20 Major Controls of Nandura Bypass

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

Major structure proposed for the bypass, and estimated work quantities were listed in Tables 3-21 and 3-22 respectively. Figure 3-9 illustrates the proposed plan and profile of Nandura Bypass.







PROPOSED GRADE								
PROPOSED ELEVATION	266.000	[illegible]	[illegible]	[illegible]	[illegible]	266.157	262.174	261.037
GROUND ELEVATION	266.00	268.00	265.00	268.00	267.00	264.00	261.00	
STATION	0+000	1+000	2+000	3+000	4+000	5+000	6+000	6+381
HORIZONTAL ALIGNMENT								

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

DWG TITLE : NANDURA BYPASS: PLAN & PROFILE

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

DWG NO. : 007

Table 3-21 Major Structures of Nandura Bypass

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

Table 3-22 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

3.9 Preliminary Design of Khamgaon Bypass

In order to ease the heavy traffic congestion in the Khamgaon City area, the State PWD proposed Khamgaon Bypass, which runs southern fringe of the city area, and approved by MOST, September 1992. In this Pre-Feasibility Study, the alignment prepared by the State PWD was reviewed and updated. This alignment plan includes the utilisation of a part of the existing mini-bypass.

Table 3-23 shows the identified major controls for the design.

Table 3-23 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

The proposed major structures and major work quantities were shown in Tables 3-24 and 3-25, respectively. The proposed plan and profile of Khamgaon Bypass was given in Figure 3-10.

KHAMGAON BYPASS: PLAN & PROFILE
DWG TITLE :
DWG SCALE : H = 1 : 100,000 V = 1 : 1,000
DWG NO. : 002
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA
HORIZONTAL ALIGNMENT
STATION
GROUND ELEVATION
PROPOSED ELEVATION
PROPOSED GRADE
150
140
130
120
110
100
90
80
70

Table 3-24 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

Table 3-25 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

3.10 Preliminary Design of Bhopal Bypass

NH12 in Bhopal City is very congested highway because of its 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, to ease the traffic condition. Subsequently the State PWD planned an extension of this link road.

The Bhopal Development Plan was approved by the State Government, and come effective from June 1995. This Plan proposed a transportation network to serve both intra-city and inter-city movement. State PWD has amended the link road extension plan as Bhopal Bypass 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.

Table 3-26 shows the major controls within the project area, required for the establishment of the optimum alignment design by the Study.

BHOPAL BYPASS: PLAN & PROFILE
DWG TITLE :
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA
DWG SCALE : H = 1 : 100,000 V = 1 : 1,000
DWG NO. 009 (1/2)
HORIZONTAL ALIGNMENT
STATION
GROUND ELEVATION
PROPOSED ELEVATION
PROPOSED GRADE
PC
PRC
PT
5+000
10+000
20+000

BHOPAL BYPASS: PLAN & PROFILE
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA
DWG SCALE : H = 1 : 100,000 V = 1 : 1,000
DWG NO. 009 (2/2)
DWG TITLE :
HORIZONTAL ALIGNMENT
STATION
GROUND ELEVATION
PROPOSED ELEVATION
PROPOSED GRADE
20+000
25+000
30+000
35+000
40+000
PC = 28+878.452
530
520
510
500
490
480
470
460
450

Table 3-26 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

Proposed major structures for the bypass were summarised in Table 3-27. Table 3-28 shows the estimated major work quantities, and Figure 3-11 shows the proposed plan and profile of Bhopal Bypass.

Table 3-27 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

Table 3-28 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

3.11 Preliminary Design of Gwalior Bypass

The Gwalior Bypass scheme was proposed by the State PWD, and the sanction of the MoST was already give. A land-use survey was conducted along the PWD's original

alignment. In this Pre-Feasibility Study, the alignment design was carried out based on the original one. In order to propose the definitive plan, the site reconnaissance was conducted. Table 3-29 shows the identified major controls in the project area.

Table 3-29 Major Controls of Gwalior Bypass

No.	Approx. Sta.	Description	Requirements
1	0+000	NH24	To secure smooth connection
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

Major structures proposed were summarised in Table 3-30, including one railway over bridge.

Table 3-30 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

Major quantities of proposed bypass in this Pre-Feasibility Study were summarised in Table 3-31. Figure 3-12 shows the proposed plan and profile of Gwalior Bypass

Table 3-31 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

GWALIOR BYPASS: PLAN & PROFILE
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA
DWG TITLE :
DWG SCALE : H = 1 : 100,000 V = 1 : 1,000
DWG NO. : 010
HORIZONTAL ALIGNMENT
STATION
GROUND ELEVATION
PROPOSED ELEVATION
PROPOSED GRADE
0+000
5+000
10+000
15+000
20+000
25+000
26+049.324
PC = 11+603.071
PT = 22+275.215
270
260
250
240
230
220
210
200
190

4. Environmental Related Study

4.1 Initial Environmental Examination

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

Aiming the realisation of project bypasses, Initial Environmental Examination was conducted. The items of Initial Environmental Examination (IEE) for each 10 sites, which resulted from the prior investigation, are shown in Table 4-1.

Table 4-1 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.

Based on the field reconnaissance, and succeeding environmental evaluation, screening and scoping for each Environmental Evaluation Items were prepared. Table 4-2 presents the checking list.

Table 4-2 Summary of Screening Check List

Environmental items		Content	Evaluation										Remarks(Basis)
			Bareilly	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.

4.2 Social Environmental Study

Social Environment (SE) studies of the 10 bypass locations are based on the adoption of a transparent environmental and social policy and have the overall objectives of:

- Enhancement of quality of life and environment in and around the project locations.
- Prevent and minimise adverse environmental and social situations.
- Mitigate possible negative environmental and social impacts.

For each bypass site, the geographical boundaries of the study zone were fixed by a one-km wide zone, half km on either side of the centre of bypass road. The following sequence of SE studies were carried out.

(1) Collection and Analysis of Available Information
   a) Legal and institutional setting in India concerning social aspects.
   b) Preliminary information about the bypass.
   c) Community Life, Social Aspects and Economic Activities

(2) Participatory field investigations and surveys

Field investigations and surveys were carried out at each of the 10 bypass locations to supplement and validate information collected in the above task (1). In particular, the following were considered:

a) Identification of specific land acquisition requirements
b) Identification of project affected persons, their location and kind of impact
c) Prediction of likely social impacts due to the bypass project and evaluation of the consequences
d) Identification of specific needs of marginal and vulnerable groups
e) Identification of alternatives for mitigation of adverse social impacts, including bypass alignment considerations and sites for resettlement, if any.
f) Preliminary selection of preferred alternative for mitigation of adverse social impacts
g) Collection of socio-economic data and determining public opinion and public consultation

Table 4-3 shows the summary of SE studies.

Table 4-3 Summary of Socioeconomic Characteristics and Results of Public Consultations at the Bypass Locations

Aspect	Bareilly	Patna	Keonjhar	Balugaon	Vijayawada	Kannur	Nandura	Khamgaon	Bhopal	Gwalior
Land Use	Prime agricultural lands	agricultural use	Agricultural land	Predominantly rainfed agriculture	agricultural use	Mixed gardens and paddy land; some areas built up	Agricultural use	Agricultural and Government land	Private agricultural land and Government land	agricultural land (small holdings) and forest land
Caste Profile	17% SC/ST population	SC/ST: 20%	Majority SC/ST (92%)	Majority non-SC/ST; some SC in Chilka area	non-SC/ST: 76%	Low SC/ST population (6%)	SC/ST: 12%	SC/ST: 11%	27% SC/ST population	15% SC/ST population
Literacy rate	23%	30%	43%	50%	44%	82%	56%	50%	32.60%	25%
Occupation Profile	Majority cultivators and agricultural labourers; small and marginal farmers predominate (90%) having farm holdings less than 2 ha.	Majority agricultural labourers and cultivators (83%); dependency on agriculture high	Majority agricultural labourers (51%) and cultivators (21%) with small holdings; dependency on agriculture very high	Majority cultivators and agricultural labourers; small and marginal farmers predominate (90%) having farm holdings less than 2 ha.	Majority agricultural labourers (55%) and cultivators (13%)	Majority in manafacturing or processing jobs; dependency on agriculture negligible; however marginal farmers predominate (80%)	Majority agricultural labourers (56%) and cultivators (21.3%); dependency on agriculture high (cotton is a major commercial crop)	Majority agricultural labourers (38%) and cultivators (25%); dependency on agriculture high (cotton is a major commercial crop)	Agricultural labourers (39%) and Cultivators (37%); majority large holding farmers; small holding farmers only 18%	Majority in agriculture (cultivators 63% and labourers 17.4%); dependency on agriculture very high
Working Population	25%	28%	30.4%	27%	44%	25%	46%	47%	36%	29%
Average Family Size	6.6	6.5	5.4	5.8	4.2	6.7	5.1	4.5	5.7	7.5
Public Facilities Affected	None	5 irrigation wells and a mango orchard may be affected	None	cattle grazing land; school/temple land loss near Pranadeipur village	None	Alignment not finalised yet	None	None	Alignment not finalised yet	None
Public Consultations	Loss of land acceptable as community benefits are well perceived	Bypass road welcome; no resistance expected	STs expect to lose their means of livelihoodand split of their communities if their land is acquired;	Anxiety over loss of livelihood due to loss of fertile agricultural lands	Bypass road welcome; no resistance expected	Positive attitude; resistance not expected	Bypass road welcome; no resistance expected	Bypass road welcome; no resistance expected	Not conducted as alignment is not fixed yet	Loss of only source of livelihood cause for anxiety; land severance expected
Severance of land and communities	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur	expected to occur
Perceived Social Benefits	Reduction in accidents and improved economic opportunities	Increased business and economic opportunities	economic value of land will go up; opportunities for roadside businesses	Reduction in accidents and improved economic opportunities	Increased business and economic opportunities	Improved road safety and economy of the region	Prevent road accidents; improve overall business activities	Prevent road accidents; improve overall business activities		Road safety, faster development of villages and increased employment oppurtunities
Land Acquisition	Resistance not expected; however large number of families (400) expected to lose land	Difficulties not expected	Strong resistance from STs expected; land acquisition from tribals a sensitive issue; Orissa's R & R policies need to be adhered to.	Resistance/ difficulties perceived or expected in some locations	Difficulties not expected	Very high cost estimated due to compensation for built structures and high cost of land	Difficulties not expected	Difficulties not expected	Large farm holders; difficulties not perceived	Unauthorised encroachments at beginning of alignment. Resistance expected from marginal farmers in Kulaith village (60 families)
Unit cost of land to be acquired (lakh Rs./ha)	2.25~3.00	2.25~3.00	1.75	2.5 : irrigated; 1.25 : un-irrigated	6.2~7.5	3.7~6.2#	3.7	3.7	3~6	3~6

Total land acquisition cost is estimated at 35 crore Rs. based on Kerala PWD estimates using the unit agricultural land cost, an unit cost for acquiring built plots between 6.2 to 8.7 lakh Rs. / ha, and a right of way of 45 m

5. Preliminary Cost Estimates

The construction costs of the proposed bypasses were estimated on the basis of "MOST Standard Data Book for Analysis of Rates", and "Schedule of Rates" of Governments, in accordance with the following basic assumptions and conditions.

(1) The project cost is based on the prices in the month of July 1997
(2) The exchange rate of currency is:
US$1.0=Rs. 35.97 as of July mid 1997

(3) All project costs is estimated in Local Currency.
(4) Construction period will be:
- 2 years (when the proposed route length is within 10 km)
- 3 years (when the proposed route length is more than 10 km)
- 4 years for Patna
(5) Except the Patna Bypass, construction will be complete by the end of 2001.
(6) Cost for preparatory work is Lump sum of 30 million Rupees.

The project cost was estimated based on the following basic assumptions and conditions.

(1) Administration charge was assumed as 15% of direct construction cost, which includes Contingency charge, Quality control, and Agency charge, etc.
(2) Engineering and Supervision cost was assumed as 10% of direct construction cost.
(3) Initial maintenance and operation cost was assumed as 2% of direct construction cost.
(4) Land acquisition cost was investigated in project areas as shown in Table 5-1. For this Pre-Feasibility Study, 30% extra cost was added, taking into consideration of possible compulsory acquisition.

Table 5-1 Land Acquisition Cost Data

Project Area	Unit	Land Cost
Bareilly	Rs./ha	300,000
Patna	Rs./ha	300,000
Keonjhar	Rs./ha	175,000
Balugaon(Irrigated)	Rs./ha	250,000
Balugaon(Un-Irrigated)	Rs./ha	125,000
Vijayawada	Rs./ha	750,000
Kannur (Agricultural area)	Rs./ha	620,000
Kannur (Hausing area)	Rs./ha	870,000
Nandura	Rs./ha	370,000
Khamgaon	Rs./ha	370,000
Bhopal	Rs./ha	600,000
Gwalior	Rs./ha	600,000

(5) Compensation cost was assumed as 20% of land acquisition cost except Kannur Bypass. Compensation cost for Kannur Bypass was estimated separately based on the obtained data from the project site.

(6) Contingencies were assumed as 10% of administration charge and cost for engineering and supervision services.

Table 5-2 shows the estimated direct construction cost and project cost for the bypasses.

Table 5-2 Summary of Cost Estimates

Unit : Rs.

Bypass Name	Total Road Length (Km)	Direct Construction Cost	Project Cost
Bareilly	31.1	1,276,103,000	1,879,362,000
Patna	49.9	3,425,331,000	4,923,724,000
Keonjhar	8.5	314,370,000	453,253,000
Balugaon	15.4	365,603,000	552,559,000
Vijayawada	28.1	1,300,741,000	2,054,426,000
Kannur	11.1	608,165,000	1,464,531,000
Nandura	6.4	239,037,000	359,483,000
Khamgaon	10.9	479,057,000	711891000
Bhopal	40.3	1,361,518,000	2,175,863,000
Gwalior	26.0	1,396,539,000	2,121,407,000

6. Preliminary Economic and Financial Analysis

6.1 Economic Analysis

In order to examine economic viability of the Projects, economic internal rate of return (EIRR) and net present value (NPV) were calculated with the evaluation period up to 20 years after the commissioning. It is understood that the EIRR shows the economic efficiency and NPV shows the scales of economic value of the Projects for the national economy.

(1) Economic Cost

Construction and operation/maintenance costs estimated were financial costs. To convert the financial costs to the economic costs, 0.8 was uniformly multiplied in Pre-feasibility Study.

(2) Economic Benefits

Construction and operation of bypasses will result in many types of economic and social benefits for the road users as well as the residents along the existing roads and the bypasses. However quantification of most of the mentioned benefits is very difficult or requires extensive studies, monetary values of only the following two items, a) and b), were counted.

- Benefits to road users and operators born by operation of the bypasses
  a. Saving in vehicle operation costs (VOC)
  b. Saving in travel time of passengers and commodities

Table 6-1 shows the results of economic analysis in terms of EIRR and NPV.

Table 6-1 EIRR and NPV

Name of Bypass	EIRR %		NPV (12% discount) Rs. million	
	VOC saving only	with Travel Time saving	VOC saving only	with Travel Time saving
1. Bareilly	46.8%	112.1%	6,639	30,349
2. Patna	27.9%	49.7%	6,094	22,545
3. Keonjhar	2.9%	11.6%	-176	-10
4. Balugaon	11.7%	23.0%	-9	554
5. Vijayawada	23.7%	43.2%	2,115	9,996
6. Kannur	18.8%	57.4%	599	8,447
7. Nandura	28.6%	50.2%	471	1,550
8. Khamgaon	20.0%	36.8%	389	1,772
9. Bhopal	21.6%	56.9%	1,295	10,620
10. Gwalior	19.7%	34.5%	926	3,194

6.2 Financial Analysis

Financial internal rate of return (FIRR) on total investment, including that for lands acquisition, was calculated to examine financial viability of the Project. Evaluation period for financial analysis was considered to extends up to 20 years after the commissioning of each bypass. No residual value after the evaluation period was counted in the financial analysis.

For the financial analysis, an inflation rate of 10 % was applied for future years of construction and operation/maintenance. The revenue was also estimated with the same rate of inflation, assuming the revision of the toll rates once in three years. Revenue from toll collection was counted as financial benefits of the Projects. Other probable benefits from tenants or advertisement, etc., was not counted.

The estimated FIRR on total investment of the proposed bypasses were listed in Table 6-2.

Table 6-2 FIRR on Total Investment

Bypass Name	FIRR	Bypass Name	FIRR
1. Bareilly	25.9%	6. Kannur	7.4%
2. Patna	14.2%	7. Nandura	19.0%
3. Keonjhar	Negative	8. Khamgaon	20.1%
4. Balugaon	13.0%	9. Bhopal	20.9%
5. Vijayawada	18.6%	10. Gwalior	16.9%

7. Project Implementation Plan

In order to realise the proposed bypass projects, the possible implementation options, including the implementation by BOT basis, were established as the follows:

Option A : BOT exclusively by private investment on highway improvement only

Option B : BOT with strong Government support (All Government Supports must be granted.)

Option C : BOT accompanying en-route real estate development supportive to the project viability

Option D : Semi-Private, Semi-Public (Partial project implementation by the Government with actual expenditure of public funds precedent to the private participation afterwards)

Option E : Public works (Conventional public-sector implementation of the road project)

Then, reflecting the outcomes from Social Environmental Study and Financial Analysis, the project implementation types for the proposed ten bypasses could be concluded as follows:

1.	Bareilly Bypass	by Option A
2.	Patna Bypass	by Option B and/or C, or D
3.	Keonjhar Bypass	by Option E
4.	Balugaon Bypass	by Option B and/or C, or D
5.	Vijayawada Bypass	by Option E
6.	Kannur Bypass	by Option B and/or C
7.	Nandura Bypass	by Option B and/or C
8.	Khamgaon Bypass	by Option A
9.	Bhopal Bypass	by Option A
10.	Gwalior Bypass	by Option B and/or C

8. Priority of the Bypasses

Regarding the scale of bypasses to be selected for the Feasibility Study, the following two aspects was applied as a guideline.

1 Maximum three bypasses, and
2 Their combined bypass length would not exceed about 60 km

In order to select the bypasses to be forwarded to the second phase of the Study (Feasibility Study), the following aspects were applied as the scoring criteria for the determination of the priority of the project 10 bypasses:

Scoring criteria	Score
1. Congestion rate in 2002 on NH without a bypass scheme	30
2. Economic Internal Rate of Return (EIRR) of the project	20
3. Degree of adverse Environmental Impact by the project	10
4. Degree of adverse Social Impact by the project	10
5. Condition of land acquisition	10
6. Engineering feasibility	6
7. Degree of ontribution to the National Highway Development Plan	10
8. Required period for implementation	4
Full Score	100

The Table 8-1 below gives a scoring results by the above mentioned Scoring Method.

Table 8-1 Scoring Result

Scoring Criteria \ Name of Bypass	1 Bareilly Bypass	2 Patna Bypass	3 Keonjhar Bypass	4 Balugaon Bypass	5 Vijayawada Bypass	6 Kannur Bypass	7 Nandura Bypass	8 Khamgaon Bypass	9 Bhopal Bypass	10 Gwalior Bypass	Full Score
1 Congestion Rate in 2002	2.02	1.07	0.81	1.04	0.97	1.40	1.06	1.45	2.03	2.06	
Score	30	2	0	1	0	12	2	14	30	30	30
2 Estimated EIRR (%)	112.1	49.7	11.6	23.0	43.2	57.4	50.2	36.8	56.9	34.5	
Score	20	9	1	3	7	11	9	6	10	5	20
3 Environmental Impact	7	5	9	8	9	5	9	10	8	8	10
4 Social Impact	6	8	4	6	8	8	8	8	8	6	10
5 Condition of Land acquisition	5	10	5	5	10	0	10	10	10	5	10
6 Engineering feasibility	6	3	6	6	6	3	6	6	6	6	6
7 Contribution to the NH Development Plan	10	5	10	10	10	5	10	10	5	10	10
8 Implementation period	4	0	4	4	4	2	4	4	4	4	4
Total	88	42	39	43	54	46	58	68	81	74	100
Remark : Bypass Length in km	31.1	49.8	8.5	15.4	28.1	11.1	6.4	10.9	40.3	26.0	

According to the scoring result, the top priority was given to Bareilly Bypass, the second to Bhopal Bypass and the third to Gwalior Bypass. These three bypasses were forecasted to have traffic over two times of road capacity in 2002. Referred to the expected scale of bypasses to be selected for the Feasibility Study, it was recommended to select two bypasses, Bareilly Bypass and Gwalior Bypass. Based on the preliminary design in the Pre-Feasibility Study, the total length of these two bypasses will be approximately 31.1 +26.0 = 57.1 km.

Summary of Feasibility Study

9 Socio-economic Conditions of the Study Area

9.1 Population

Population of the Uttar Pradesh State was 139 million in 1991 and the Bareilly District had population of 2.8 million. Urban population of the Bareilly city has increase from 438,000 in 1981 to 617,000 in 1991 with 3.5% of an average annual increase rate.

The Madhya Pradesh State had a population of 66 million in 1991 and the Gwalior District had 1.4 million population. Urban population of the Gwalior city was about 718,000 in 1991. An average annual rate of increase from 1981 to 1991 was at 2.5%.

9.2 Labour Force Structure

The participation rates of the Uttar Pradesh State and Bareilly District were at 30 % and 29% respectively in 1991. About 65%~73% of labour population are engaged in the agriculture sector.

The participation rate of the Madhya Pradesh State and Gwalior District was 38% and 29% respectively in 1991. Although about 77% of labour population of Madhya Pradesh State are engaged in the agriculture sector, that rate of the Gwalior District was only 47%. Instead, the commercial and service sector showed a higher share (32%) than that of State average.

9.3 Net State Domestic Product (NSDP)

Average annual growth rates of NSDP of the Uttar Pradesh and Madhya Pradesh States were at 4.0% and 4.7% respectively for the last ten years (1985/86 - 1995/96). The agriculture sector shows lowest growth rates in both States. Secondary sector of the Madhya Pradesh State expanded its share by a remarkable growth rate of 8.1% per annum.

Table 9-1 Average Annual Growth Rate of NSDP
(1985/86 - 1995/96)

Sector	Uttar Pradesh	Madhya Pradesh
Primary	2.9% p.a.	2.8% p.a.
Secondary	4.7%	8.1%
Tertiary	5.0%	5.7%
NSDP	4.0%	4.7%

10 Supplemental Traffic Survey and Future Traffic Demand Forecast

10.1 Supplemental Traffic Survey

Supplemental traffic surveys were carried out for the Feasibility Study on the

selected two bypasses, Bareilly and Gwalior, covering the following five types of survey:

(1) Classified traffic volume survey (24 hours, 3 days)
(2) Roadside O-D survey (12 hours, 2 days)
(3) Speed-delay survey (3 time bands, 3 days)
(4) Axle load survey (1 day)
(5) Opinion survey on toll bypass

The Average Annual Daily Traffic (AADT) was estimated as an average of the results of count surveys conducted in the Pre-Feasibility Study (May 1997) and Feasibility Study (November 1997).

Table 10-1 Average Annual Daily Traffic (AADT)

Bypass Name	Survey Location Bareilly	AADT (Fast vehicles/day)
Bareilly	NH24 (km 235)	9,600
	SH 37 (km 14)	7,000
	SH 33 (km 42)	7,700
	NH 24 (km252)	10,300
	NH 24 (km 260)	8,400
Gwalior	NH 3 (km 103)	7,100
	NH 3 (km 115)	7,100
	NH 3 (km 133)	6,900

10.2 Future Traffic Demand Forecast

The present O-D matrices were revised based on newly collected O-D data and calculated AADT above. Reviewing the future Net State Domestic Product (NSDP) of Uttar Pradesh and Madhya Pradesh States, it was decided to apply the same traffic growth rates as adopted in the Pre-Feasibility Study. Future traffic demands on the proposed bypasses were forecast through assigning the future O-D matrices to future road network and results are shown in Tables 10-2 and 10-3.

Traffic demands on the Bareilly Bypass will be 6,000~10,400 vehicles/day in 2002 and 13,300~21,200 vehicles/day in 2012. Traffic demands on the Gwalior Bypass will be 4,500 vehicles in 2002 and 9,000 vehicles in 2012.

Table 10-2 Future Traffic Projection at Bareilly Bypass Area

(Vehicles/day)

Year	Vehicle Type	Case						
		Without Bypass		With Bypass				
		National Highway		National Highway		Bypass		
		N(W)	S (E)	N(W)	S (E)	N(W)	Centre	S(E)
	(Link No.)	46-61	33-47	46-61	33-47	41-42	40-41	39-40
2002	Car	3,512	4,245	1,981	2,954	1,531	2,775	1,294
	Bus	2,359	1,532	1,306	893	1,053	1,238	639
	Truck	5,697	7,123	2,723	3,826	2,974	4,550	3,317
	2 Whls.	2,391	4,633	1,407	3,877	984	1,843	756
	Total	13,959	17,533	7,417	11,550	6,542	10,406	6,006
	Total (PCU)	28,876	32,527	14,772	19,050	14,104	21,061	13,540
	Congestion ratio	2.06	2.32	1.06	1.36	0.27	0.40	0.26
2012	Car	6,681	7,760	2,468	4,480	4,213	5,415	3,332
	Bus	4,325	2,426	1,529	1,120	2,796	2,466	1,395
	Truck	10,636	10,882	2,699	4,807	7,937	9,649	6,537
	2 Whls.	4,741	9,068	1,842	6,992	2,899	3,695	2,084
	Total	26,383	30,136	8,538	17,399	17,845	21,225	13,348
	Total (PCU)	53,935	52,218	16,073	25,757	37,862	43,608	28,170
	Congestion ratio	3.85	3.73	1.15	1.84	0.72	0.83	0.53

Table 10-3 Future Traffic Projection at Gwalior Bypass Area

(Vehicles/day)

Year	Vehicle Type	Case				
		Without Bypass		With Bypass		
		National Highway		National Highway		Bypass
		N(W)	S (E)	N(W)	S (E)	
	(Link No.)	44-50	38-45	44-50	38-45	42-43
2002	Car	2,654	2,186	2,343	1,875	311
	Bus	873	797	749	673	124
	Truck	6,763	6,684	2,780	2,701	3,983
	2 Whls.	2,133	1,141	2,070	1,078	63
	Total	12,423	10,808	7,942	6,327	4,481
	Total (PCU)	26,629	25,200	13,965	12,536	12,664
	Congestion ratio	1.90	1.80	1.00	0.90	0.24
2012	Car	5,423	4,470	4,795	3,842	628
	Bus	1,678	1,531	1,458	1,311	220
	Truck	13,582	13,422	5,582	5,422	8,000
	2 Whls.	4,560	2,434	4,427	2,301	133
	Total	25,243	21,857	16,262	12,876	8,981
	Total (PCU)	53,483	50,546	28,129	25,192	25,355
	Congestion ratio	3.82	3.61	2.01	1.80	0.48

11 Field Investigation

11.1 Geodetic Survey

The Geodetic Survey for the project areas was carried out including items below:

1) Control Points Survey;
2) Centre Line Survey;
3) Longitudinal Profile Survey;
4) Cross-sectional Survey; and
5) Topographical Survey of the proposed bypasses.

The Control Points Survey was initially executed by applying Global Positioning System (GPS). Cement concrete pillars were embedded on the ground at the position of the Control Points. There are 35 numbers of the points at Bareilly site, and 29 numbers at Gwalior site. These pillars were co-ordinated by using GPS receivers to establish planimetric co-ordinates.

Then, after the establishment of control points by GPS, the survey centreline was established based on the Universal Transverse Mercator (UTM) co-ordinates system. Based on the survey centreline, Centre Line Survey, Longitudinal Profile Survey, Cross-sectional Survey and Topographical Survey was carried out with the co-ordinate system.

11.2 Geotechnical Survey

The geotechnical survey and collection of geotechnical data for the project areas was carried out including items below:

1) Field investigation of project areas;
2) Borehole drilling with Standard Penetration Test;
3) Laboratory test for both of sample from boreholes and test-pits;
4) Analysis of the test result; and
5) Summarise the survey result and propose of the design parameters.

Borehole drilling with Standard Penetration Tests (1 m depth interval) were conducted at 16 bore holes, totalling 400 m long. SPT Sampler was applied, 18 inches long and 1.5 inches of internal diameter, in order to obtain soil samples from bore holes. The code of American Society of Testing and Materials (ASTM), in relation to Indian Standards (IS), was applied to the laboratory test.

Taking both the field investigation and the result of laboratory test into account, the geotechnical condition of the project was analysed, and finally geotechnical design parameters for structure design, pavement design and construction programme were proposed.

11.3 Hydrological Survey

The hydrological survey and collection of hydrological information for the project areas was carried out for the following items:

1) The study of catchment areas;
2) Study of previous flood condition;
3) Study of existing water channel;
4) Collection of climatological & hydrological data; and
5) Hydrological analysis.

Based on the output of this hydrological survey, determination of bridge height, determination of dimension required for conduit, highway drainage design, etc. were carried out.

11.4 Environmental Impact Assessment (Natural Environmental Aspects)

Based on the output of IEE (Screening Check List) conducted in the Pre-Feasibility Study, Environmental Impact Assessment was carried out for the Bareilly Bypass and Gwalior Bypass.

The environmental quality evaluation was conducted using Battelle Environmental Evaluation System (BEES) which is a widely accepted method for civil construction projects. The evaluation procedure was as follows.

1st Existing Environment and Baseline Survey
2nd Prediction of Impact
3rd Evaluation of Environmental Impact
4th Find out the mitigation measures, set up implementation of it, and monitor the achievement

Evaluation of Environmental Impact by the project was summarised in Tables 11-1 and 11-2.

Table 11-1 Environmental Evaluation Summary of Bareilly Bypass

Environmental Category	Wt. (PIU)	Baseline (EIU) (A)	Project With EMP (EIU) (B)	Change in EIU (B-A)
Ecological environment	300	183.56	158.16	-25.40
Environmental pollution	300	256.60	189.60	-67.00
Aesthetics	200	101.30	102.00	-0.70
Human interest	200	88.000	102.000	14.000
Total	1,000	629.46	551.76	-77.70

Table 11-2 Environmental Evaluation Summary for Gwalior Bypass

Environmental Category	Wt. (PIU)	Baseline (EIU) (A)	Project With EMP (EIU) (B)	Change in EIU (B-A)
Ecological environment	300	163.100	148.924	-14.176
Environmental pollution	300	245.000	197.500	-47.500
Aesthetics	200	103.500	95.000	-8.500
Human interest	200	88.000	102.000	14.000
Total	1,000	599.600	543.424	-56.176

According to the evaluation, it was pointed out that the both bypass projects will give negative impacts on ecological environment, environmental pollution and aesthetic, but there will be improvement in case of human interest. In overall sense, the negative impact is very mild and can be termed as negligible.

Based on the evaluation result, the environmental management plans for the project bypasses were proposed. This includes the appropriate mitigation measures, proposal to set up a responsible organisation to implement the mitigation measures, and proposal for monitoring/management system.

11.5 Environmental Impact Assessment (Social Environmental Aspects)

The Environmental Impact Assessment (Social Environmental Aspects) was conducted within the geographical boundaries of the study zone, a 200 m wide zone, 100 m on either side of the centre of bypass road alignment. The assessment involves the following activities.

(1) Collection and Analysis of Available Information
(2) Field Surveys and Participatory Consultations

Field surveys and participatory consultations were conducted for:

a) Identification of specific land acquisition and related issues.
b) Identification of public facilities affected.
c) Identification of PAPs and their social and economic characteristics.
d) Prediction of likely impacts and determination of mitigation measures
e) Identification of impacts on vulnerable social groups like scheduled tribes and scheduled castes.
f) Collection of socio-economic data, and determining public opinion and conduct of consultations to promote public awareness and acceptability for the project.

According to the assessment result, it can be concluded that by effectively implementing the proposed mitigation measures, negative environmental impacts can be controlled and managed adequately.

12 Design for the Feasibility Study

12.1 Design Standards

12.1.1 Geometric Design Standards for Throughway

Changes and modification were derived from 1) the further study of each value referring to AASHTO/JRSO to satisfy requirements of the proposed bypasses; 2) the further study of road drainage system in India; and 3) results of natural conditions survey, as follows.

- Crossfall of outer shoulder was changed to 3 % from 2.5%, according to "IRC Special Publication 42, Guidelines on Road Drainage, 1994"
- Minimum radius of horizontal curve was changed to 410 m from 360 m by referring the value of coefficient of side friction in AASHTO for safety side
- Maximum superelevation was changed to five (5) % from seven (7) % take into account of the stability of heavy commercial vehicles
- Minimum longitudinal gradient for drainage was changed into 0.30 % from 0.50 % referring AASHTO/JRSO

12.1.2 Geometric Design Standards for Interchange

As two interchanges were proposed for Bareilly Bypass, the geometric standards for the interchange were established based on the AASHTO standards, and referring to the Japanese standards (JRSO). Table 12-1 shows the summarised geometric design for the interchange ramp. Figure 12-1 shows the typical cross sections of the interchange ramps.

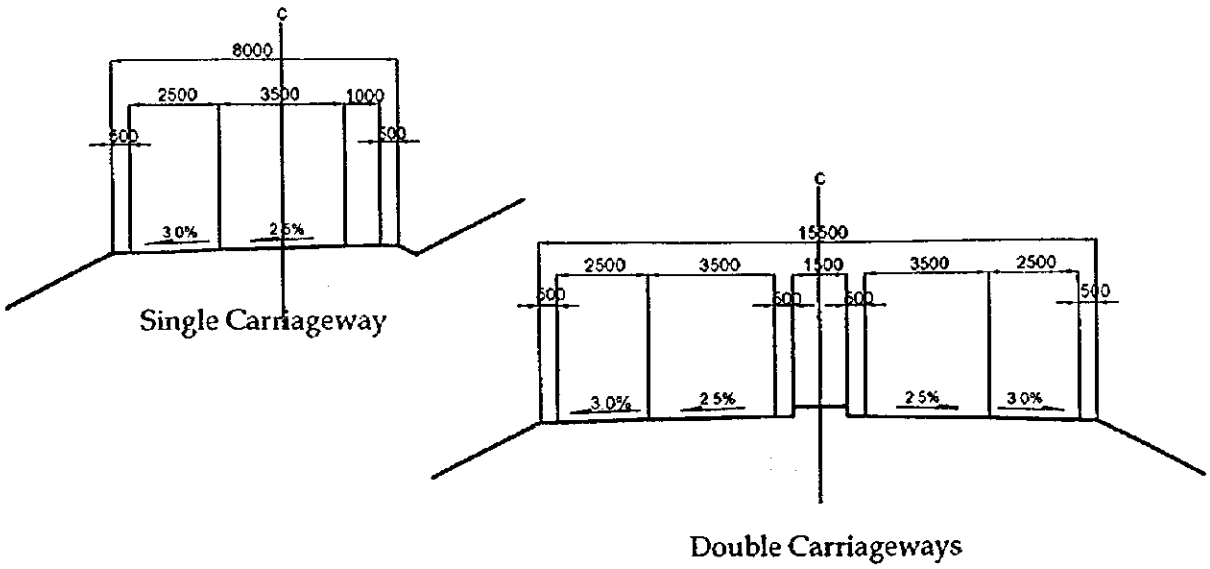


Figure 12-1 Typical Cross Section of Interchange Ramps

Table 12-1 Geometric Design Standards for Interchange Ramps

Design Speed of Throughway (km/Hr)		100
Throughway Alignment between Interchange		
Minimum Radius of Curve (m)		410
Maximum Grade (%)		3.3
Minimum Vertical Curve Radius (m)	(Summit)	10000
	(Valley)	4500
Design Speed of Ramp (km/Hr)		40
Ramp Type & Width		
Carriageway Width (m)		3.50
Shoulder Width (m)		
Single Carriageway	(Left)	1.00
	(Right)	2.50
Dual Carriageway	(Right)	2.50
Median Width (m)		2.50
Clearance Limit (m)		5.00
Minimum Radius Of Curve (m)		50
Minimum Parameter Of Transition (m)		35
Minimum Radius Without Transition (m)		140
Sight Distance (m)		40
Maximum Grade (%)		6.0
Vertical Curve Min. Radius (m)	(Summit)	450
	(Valley)	450
Min. Length (m)		35
Geometry At Nose		
Minimum Radius(m)		200
Minimum Transition(m)		70
Deceleration Lane		
Type		Parallel
Length Of Deceleration Lane (m)		90
Tapered Lane(m)		60
Acceleration Lane		
Type		Parallel
Length Of Acceleration Lane (m)		180
Tapered Lane(m)		60

12.2 Design of Bareilly Bypass

As general, the following basic data were obtained and/or prepared for the alignment design of project bypasses.

(1) Topographic Map of Survey of India (Scale 1:50,000/250,000)
(2) Topographic Map prepared by the geodetic survey of the Study
(3) Digital ASCII data of topographic survey by the geodetic survey of the Study
(4) Satellite Photographs obtained from National Remote Sensing Agency (NRSA)
(5) Photographs taken during the field reconnaissance

In order to review the alignment proposed at the Pre-Feasibility Study, and re-identify the major controls, detailed field investigations were carried out. Table 12-2 shows the finally identified major controls for the design.

Table 12-2 Major Controls of Bareilly Bypass

No.	STA	Side	Description
1	0	---	NH24
2	1.5	Left	Village(Tihulla)
3	3.2	Left	Pond and Trees
4	2.8	Left	Village(Hamipur)
5	2.8	Right	Village(Khana Gauntiya)
6	4.2	Right	Village(Pardhauli)
7	5.5	Left	Village(Bibiapur Kasimnagar)
8	6	Right	Village(Bibiapur)
9	6.5	Left	Village(Ata)
10	7.9	---	Deonarain River
11	8.5	Right	Village(Belwa)
12	9	---	SH 37
13	9.1	---	Railway
14	10.2	Right	Village(Bhura)
15	10.2	Left	Village(Didar Patti)
16	10.3	Left	Village(Gauntiya)
17	11.5	Left	Village(Saidpur)
18	12	Right	Borrow pit
19	13.6	---	SH33
20	13.7	Right	Village(Khera)
21	14.3	---	Nakatia River
22	14.4	Left	Village(Aspur Khubchan)
23	15	Right	Village(Kumura)
24	15	Left	Major Canal
25	17.2	Left	Village(Ahladpur)
26	16.8	Right	Village(Rupapur)
27	18	Right	Village(Kalari)
28	18.7	Right	Village(Lalpur)
29	20	Right	Village(Itaua)
30	20.5	Right	Village(Ramunagar)
31	21	Left	Village(Kachhauli)
32	21.5	Right	Village(Ramunagar Gauntya)
33	22.9	---	MDR
34	23	Right	Village(Nawadia Jhada)
35	24.5	Left	Village(Bithri Chainpur)
36	25	Right	Village(Bhimpur)
37	25.3	---	Major Village Road
38	25.6	Right	Village(Kishapur)
39	26	Left	Village(Alampur)
40	26.4	---	Major Canal
41	26.9	Right	Village(Undia)
42	27.4	Right	Village(Gauntiya Shamnagar)
43	27.5	Left	Village(Tahtajpur)
44	28	Right	Village(Jarathpur)
45	28.5	Left	Village(Nagaria)
46	29.5	Right	Village(No Name)
47	30		NH24

In order to establish the pavement design for the bypass, distribution of commercial traffic by directional and by lanes were studied. Based on the traffic projection and the Vehicle Damage Factor (VDF), 4.44 was assigned, cumulative equivalent standard Axle Loads in Millions (MSAL) for Bareilly Bypass was calculated as shown in Table 12-3.

Table 12-3 Million Equivalent Standard Axle Loads (MSAL)

No.	Bypass	Directional Traffic (C)	Growth Rate(%/yr)	Design Life	VDF	MSAL
1	Section 1	1,510	25.60%	10	4.44	83
2	Section 2	2,171	21.04%	10	4.44	95
3	Section 3	1,484	4.05%	10	4.44	29

As conclusion, the design MSAL value was determined as 90 for the feasibility study. The total thickness of the pavement was determined as 800 mm. Table 12-4 shows the composition of the structural design of pavement.

Table 12-4 Pavement Composition in Bareilly Bypass

No.	Depth (mm)	Acc. Depth (mm)	Sign	Description
1	40	40	AC	Asphalt Concrete
2	160	200	DBM	Dense Bituminous
3	300	490	WMM	Wet Mix Macadam
4	300	800	GSB	Granular Sub-Base

Bareilly Bypass has two crossing points with the existing State Highway. It crosses SH37 at Sta. 9+040, and SH33 at Sta. 13+610. To enable the access from the existing SH to the bypass, interchanges at each crossing points were proposed. From, mainly, the economical viewpoint, the Y-shape type with at-grade intersection was proposed. Figure 12-2 and 12-3 show the proposed layout of the interchanges.

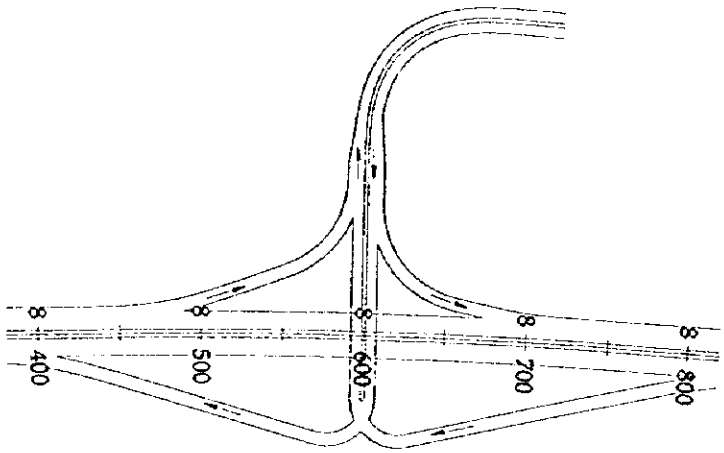


Figure 12-2 Proposed Layout for SH37 Interchange

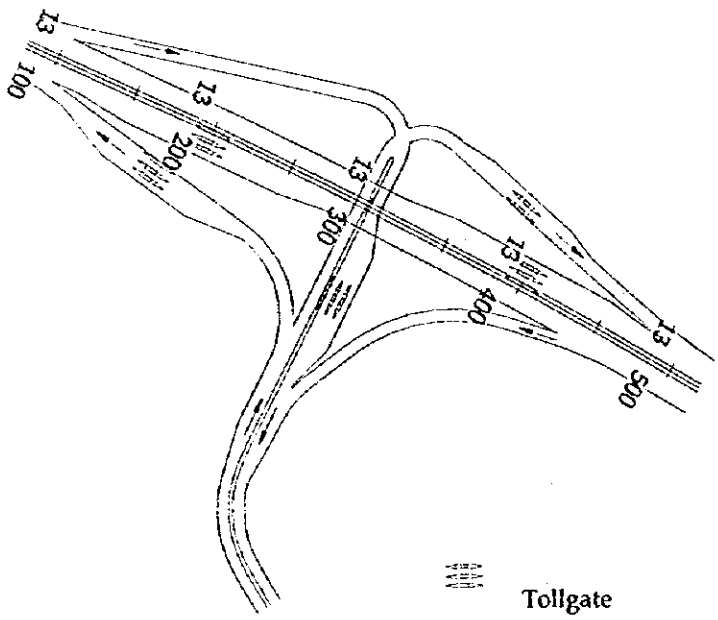


Figure 12-3 Proposed Layout for SH33 Interchange

Proposed major structures (bridges/viaduct), and major work quantities were summarised in Tables 12-5 and 12-6. Figure 12-4 shows the alignment layout of Bareilly Bypass.

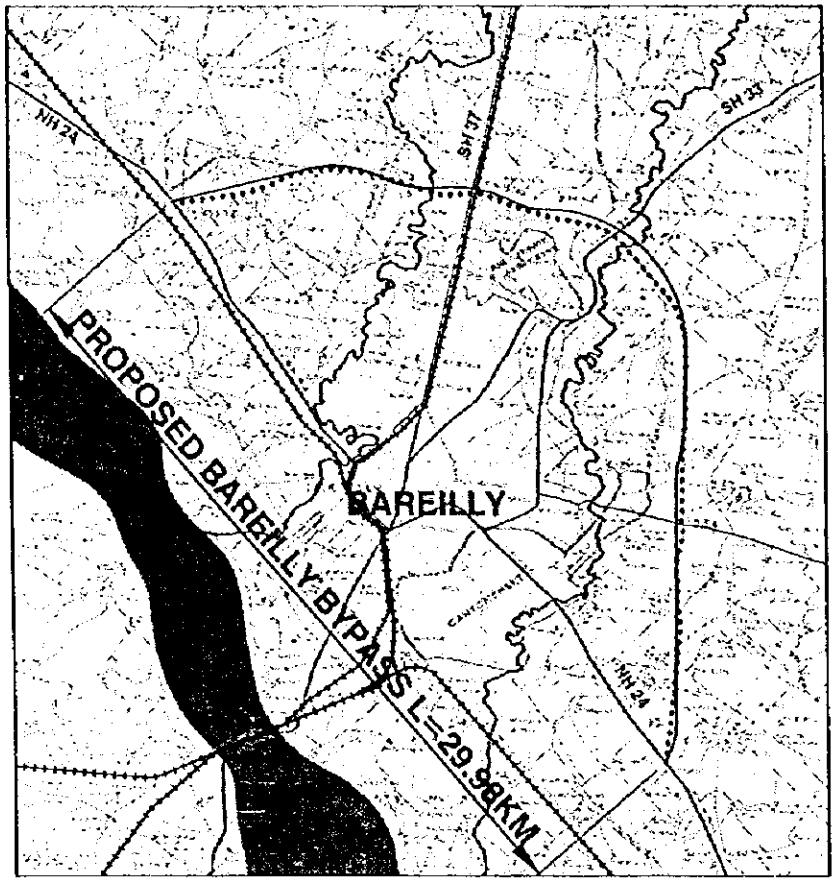
Table 12-5 Summary of Proposed Major Structures

STA	Applied Structure	Remarks
1+990	RC-Slab, 2 @ 9.0 = 18.0m	Village Road, Major Canal
6+280	RC-Slab, 2 @ 9.0 = 18.0m	Village Road, Major Canal
7+900	RC-T beam, 15.0+ 19.0+15.0 = 49.0m	Deonarain River
8+700	RC-T beam, 2 @ 15.0 = 30.0m	For Interchange
9+040~9+110	PC Hollow, 22.0+25.0+22.0 = 69.0m	SH37, Railways, Cart Track
12+970	RC-Slab, 2 @ 9.0 = 18.0m	Village Road, Major Canal
13+300	RC-T beam, 2 @ 15.0 = 30.0m	For Interchange
13+610	RC-T beam, 2 @ 15.0 = 30.0m	SH33
14+270	RC-T beam, 15.0+19.0+15.0 = 49.0m	Nakatia River
15+200	RC-Slab, 2 @ 9.0 = 18.0m	Major Canal, Cart Track
22+900	RC-T beam, 1 @ 13.0 =13.0m	District road
25+200	RC-Slab, 2 @ 9.0 = 18.0m	Village Road, Major Canal
26+360	RC-Slab, 2 @ 9.0 = 18.0m	Village Road, Major Canal

Table 12-6 Major Work Quantities

Item	Unit	Amount
Bypass Length	km	29.976
Earthwork Section	km	29.623(98.8%)
Structure Section	km	0.353(1.2%)
Earthwork Balance		-2,584,340
Fill	m^3	2,584,340
Cut	m^3	0
Pavement		
AC	m^3	24,305
DBM	m^3	97,219
WMM	m^3	182,286
GSB	m^3	182,286
Service Road	km	60,41
Slope Protection	m^2	424,200
Drainage		
Kerb	m	31,500
Berm	m	3,400
Side Ditch	m	31,980
Vertical Drain	m	24,000
Utility Relocation		
HTL	m	900
Power Line	m	3,510
Telecom. Line	m	920
Well/Pump	m	28

Route Map of Bareilly Bypass



Legend

————	Proposed by the Feasibility Study
.....	Proposed by the State PWD
NH24/SH33/SH37	National/State Highway
————	Other Road
++++++++	Railways
~~	River

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Figure 12-4 Alignment Layout of Bareilly Bypass

12.3 Design of Gwalior Bypass

Based on the detailed field investigations, the alignment proposed in the Pre-Feasibility Study was reviewed and major controls for further design was identified as listed in Table 12-7.

Table 12-7 Major Controls of Gwalior Bypass

No.	STA	Side	Description
1	0	---	NH3
2	0.2	---	Railway (Narrow Gauge)
3	0.7	Right	Village(Niraoli)
4	1.5	Left	Village(Gajupura)
5	2.4	Left	Waste Water Pond
6	2.7	Left	Village(Jinaoh)
7	2.8	Left	Distillery
8	3.5	---	Major Village Road
9	5	Right	Rocky Hill(Reserved Forest Area)
10	7.7	---	Major Canal
11	8	Right	Village(Kulalth)
12	9.4	---	Major Village Road
13	10.3	---	Natural River
14	12.8	---	Natural River
15	12.9	Right	Village(Ral ka pura)
16	13.4	Left	Village(Sojina)
17	13.6	Left	Lake
18	15	Left	Village(Banjara ka pura)
19	15.2	---	Valley(Cultivation Area)
20	15.8	---	Major Village Road(Reserved Forest Area)
21	15.8-18.5	Left	Village Road(Reserved Forest Area)
22	17	Left	Valley(Reserved Forest Area)
23	19.7	Right	Valley(Reserved Forest Area)
24	20	Left	Hill(Reserved Forest Area)
25	20.5	Left	Valley(Reserved Forest Area)
26	21	Left	Valley(Reserved Forest Area)
27	22.5	Right	Valley(Reserved Forest Area)
28	23.1	Right	Hill(Reserved Forest Area)
29	23.4	Left	Hill(Reserved Forest Area)
30	24.2	Left	Lake(Raipur Kurd)
31	24.2	Right	Village(Raipur Kurd)
32	25.6	---	Major Canal
33	26.1	---	Railway (Broad Gauge)
34	26.5	---	NH3

Based on the axle-load survey in the project area, VDF of 6.69 was adopted for the pavement design. On the basis of the traffic projection and VDF, MSAL for Gwalior Bypass was calculated as shown in Table 12-8.

Table 12-8 Million Equivalent Standard Axle Loads (MSAL)

Directional Traffic (C)	Growth Rate (%/yr)	Design Life	VDF	MSAL
1,540	18.23%	10	6.69	89

As conclusion, the design MSAL value was determined as 90 for the pavement design. The total thickness of the pavement was determined as 800 mm. Table 12-9 shows the composition of the structural design of pavement.

Table 12-9 Pavement Composition in Gwalior Bypass

No.	Depth (mm)	Acc. Depth (mm)	Sign	Description
1	40	40	AC	Asphalt Concrete
2	160	200	DBM	Dense Bituminous
3	300	490	WMM	Wet Mix Macadam
4	300	800	GSB	Granular Sub-Base

Proposed major structures (bridges/viaduct), and major work quantities were summarised in Tables 12-10 and 12-11. Figure 12-5 shows the alignment layout of Gwalior Bypass.

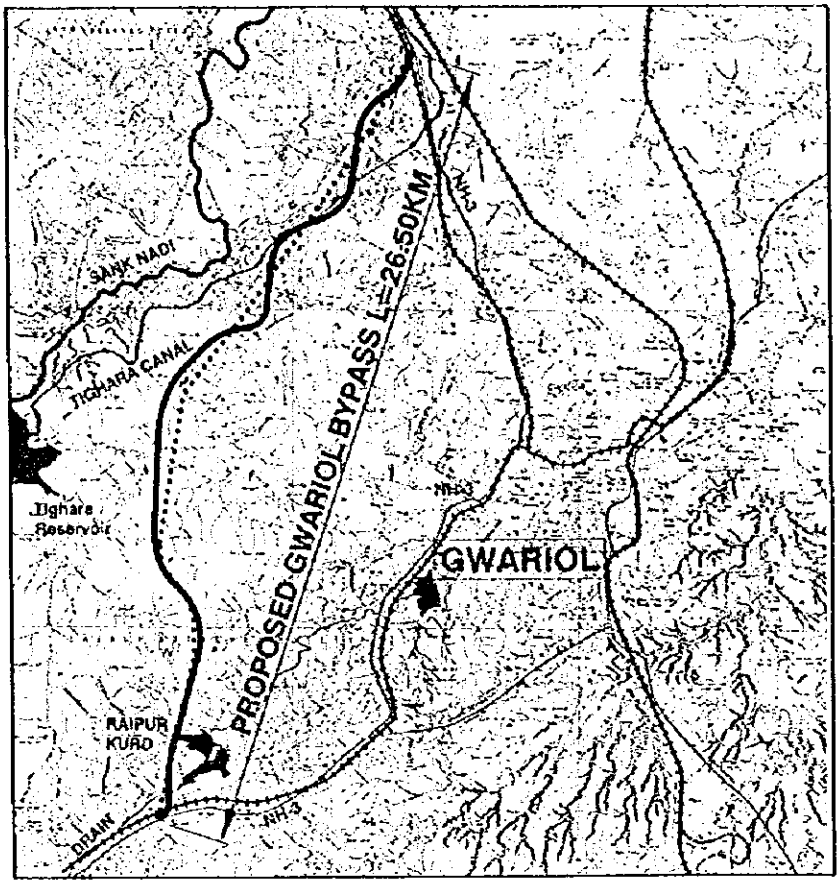
Table 12-10 Summary of Proposed Major Structures

STA	Applied Structure	Remarks
7+760	RC-Slab, 2 @ 9.0 = 18.0m	Major Canal
10+340	PC-Hollow, 1 @ 25.0 = 25.0m	River (Bandha nala)
12+720	RC-T beam, 14.0+19.0+14.0 = 47.0m	River (Rai ka Pura)
25+650	RC-Slab, 3 @ 10.0 = 30.0m	River (Raipur Tighara nala)
26+100	PC-Hollow, 1 @ 17.0 = 17.0m	Railways

Table 12-11 Major Work Quantities

Item	Unit	Amount
Bypass Length	km	26.497
Earthwork Section	km	26.360(99.5%)
Structure Section	km	0.137(0.5%)
Earthwork Balance		-1,335,328
Fill	m^3	1,686,172
Cut	m^3	350,844
Pavement		
AC	m^3	20,138
DBM	m^3	75,516
WMM	m^3	151,033
GSB	m^3	151,033
Service Road	km	24.87
Slope Protection	m^2	323,200
Drainage		
Kerb	m	19,600
Berm	m	800
Side Ditch	m	32,270
Vertical Drain	m	15,110
Transversal Drain	m	1,908
Utility Relocation		
HTL	m	200
Power Line	m	1,590
Telecom. Line	m	1,590
Well/Pump	m	10

Route Map of Gwalior Bypass



Legend

———	Proposed by the Feasibility Study
.....	Proposed by the State PWD
NH3	National Highway
———	Other Road
++++++++	Railways
~~	River, Canal, Drain

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) THE FEASIBILITY STUDY ON NATIONAL HIGHWAY BYPASSES IN INDIA	Drawing Title : Figure 12-5 Alignment Layout of Gwalior Bypass

13 Construction Programme

The Scope of Works provided for this Feasibility Study specifies the year of 2002 as the target year (short term) for the completion of construction of high priority projects. In order to enable the construction start, it was understood that the following procedures should be carried out, beforehand.

(1) Further detailed engineering design (assumed one year).
(2) Process to obtain the project sanction.
(3) Process to select the civil work contractor.
(4) Land acquisition and compensation.

Judging from the above required procedures, the construction period for the proposed bypass was assumed as 3 years, from 1999 to 2002.

The number of workable days were estimated for the two bypass project areas, based on the number of rainy days and amount of rainfall. The estimated workable days were as follows.

Bareilly Bypass : 253 days
Gwalior Bypass : 263 days

As the both bypass projects have no particular structures which require high construction technology or time consuming construction period, the earthwork and the pavement work was judged as a critical-path to accomplish the project with in 3 years. Considering the required construction period and workable days in the region, tentative construction schedule were proposed as shown in Tables 13-1 and 13-2.

Table 13-1 Tentative Construction Schedule of Bareilly Bypass

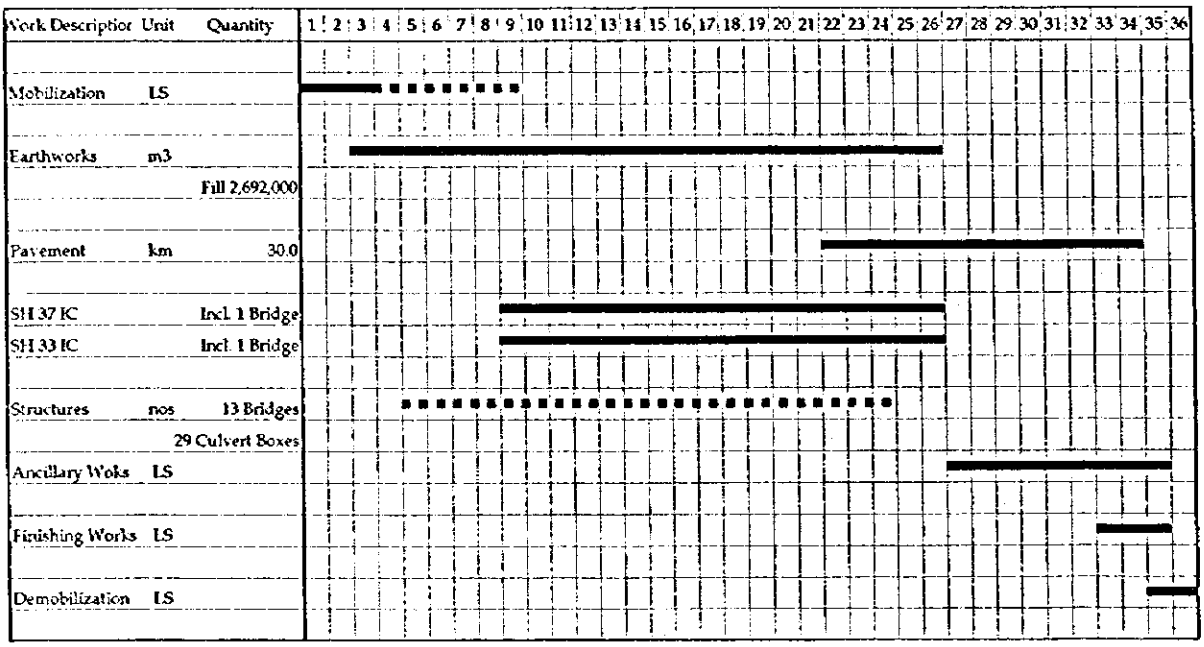
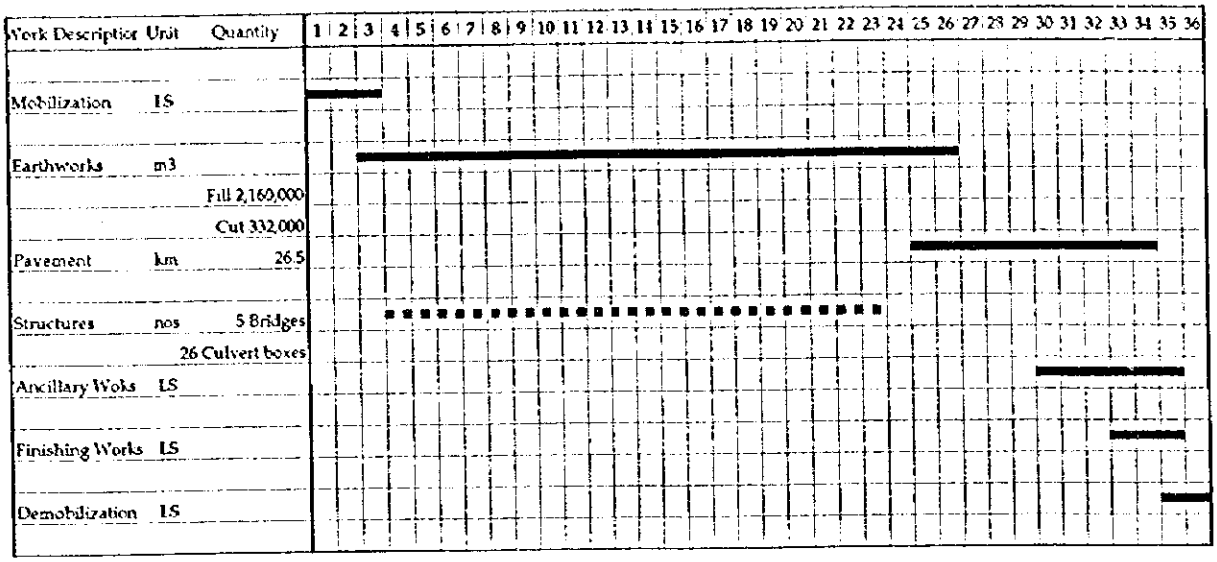


Table 13-2 Tentative Construction Schedule of Gwalior Bypass



14 Toll Collection System

There are two types of toll collecting system, the Open Toll System and the Closed Toll System. For the project bypasses, the closed toll system was recommended. Figures 14-1 and 14-2 show the proposed arrangement of toll collection facilities for bypasses.

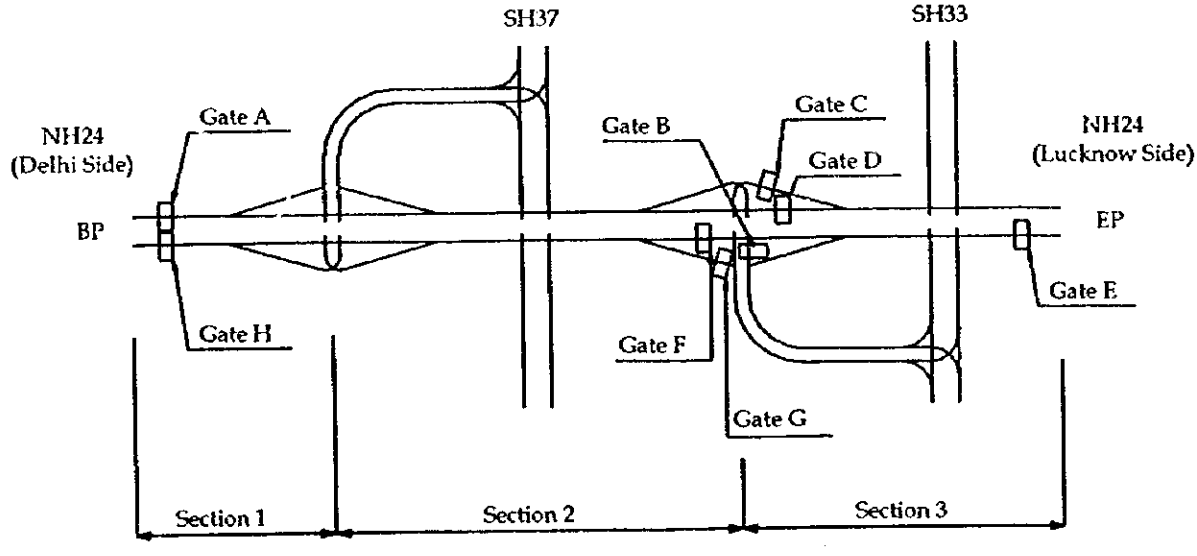


Figure 14-1 Proposed Arrangement of Toll Barrier/Tollgate for Bareilly Bypass

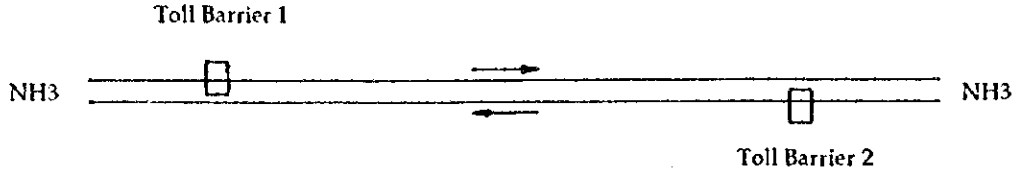


Figure 14-2 Proposed Arrangement of Toll Barrier for Gwalior Bypass

In this Feasibility Study, the following toll rates in 1997 price were assumed as the very basic condition of the study for future traffic demand forecast and economic/ financial analysis.

Vehicle Type	Toll Rate (Rs./km) in 1997 price
Cars/Jeep/Van	1.00
Light Commercial Vehicle	1.75
Truck and Bus	3.50
Heavy Construction machinery	7.50
Two wheelers	0.50

Based on the above unit toll rates in 1997 price, the applied toll rate in 2002, when the proposed bypass is expected to open to the public, was proposed as shown in Table 14-1.

Table 14-1 Toll Rate at the Bypass Opening in 2002

Unit : Rs. (2002 price)

Vehicle Type	Bareilly Bypass (L=30.0 km)	Gwalior Bypass (L=26.5 km)
Car	44	36
Light Commercial Vehicle	76	64
Truck/Bus	153	128
Two Wheelers	21	18

In case of the Bareilly Bypass, there are three sections. Therefore, the tolls for traffic using each section of the bypass would be as shown in the Table 14-2.

Table 14-2 Toll Rate of Bareilly Bypass at the Bypass Opening in 2002

Vehicle Type	Section 1 BP→ SH37	Section 2 SH37→ SH33	Section 3 SH33→ EP	Section 2 & 3 SH37→ EP	BP→ EP
Car	13	6	25	31	44
Light Commercial Vehicle	22	11	43	54	76
Truck/Bus	45	22	86	108	153
Two Wheelers	6	3	12	15	21

15 Operation and Maintenance System

15.1 General Plan of an Operation and Maintenance (O/M) Station

The standard spatial requirement for an O/M station was assumed as below:

- Building for offices 1,500 sq. m.
- Building for machines 500 sq. m.
- Building for garages 1,000 sq. m.
- Warehouse 500 sq. m.
- Parking spaces 8,000 sq. m.

15.2 Personnel for an O/M Station

Personnel composition required for operation and maintenance of a 24-hour open toll road was proposed as shown in Table 15-1.

Table 15-1 Personnel Composition of an O/M Station

	Managers	Clerical/ Engineers	Tech. Specialists	Labourers
Management	O	O		
Administration		O		
Civil Eng. Maintenance	O	O	O	O
Equipment Maint.		O	O	O
Toll Collection	O	O		
Security		O	O	
Others				O

15.3 Equipment for an O/M Station

The equipment required for such a typical O/M station as mentioned above would be assumed as shown in Table 15-2.

Table 15-2 Maintenance Equipment for an O/M Station

Item	Quantity	Item	Quantity
Sedans	3	Tow Trucks	1
Vans	4	Sweepers	1
Light Trucks	1	Portable Generators	4
Heavy Trucks	2	Power Mowers	5
Water Trucks	1	Chain Saws	1
Lift Trucks	1	Tampers	1
Sign Trucks	4	Miscellaneous Hand Tools	Lump sum

15.4 Operation and Maintenance Activities

The require operation and maintenance activities after the commencement of the

bypass under the toll system, the following items were considered.

(1) Toll Collection

(2) Road Maintenance

A. Routine maintenance
- Road cleaning
- Minor repairs of earthworks
- Bridge repairs
- Repairs of traffic control devices
- Pavement repairs
- Vegetation control such as weeding of slopes and medians, trimming of over-grown trees
- Facility maintenance such as maintenance/renewal of lighting, power system, communication, and equipment
- Inspection such as regular daily inspection by patrol cars of road conditions, periodic on-foot visual inspection of structures, extra inspection of the road under unusual conditions for prevention of emergencies

B. Periodic maintenance
- Pavement overlay: pavement resurfacing or overlay in the interval depending upon the traffic volume and composition
- Bridge repainting: repainting of steel bridges in the interval depending upon climatic and geographical conditions

16 Cost Estimates

16.1 Construction Cost Estimates

In order to establish the updated unit cost for the Feasibility Study the following three components of unit costs were analysed.

(1) Labour Cost

Latest information of Labour Costs was obtained from PWD Bareilly, PWD Gwalior and local contractors in Gwalior. "Schedule of Rates of Govt. of Maharashtra", "Schedule of Rates For National Highways Wing, Bihar" and "Delhi Schedule of Rates" were also reviewed for the reference.

(2) Machinery and Equipment cost

In order to calculate the hire charge cost of Machinery and Equipment, formula in "Hand Book on Road Construction Machinery, MoST 1985" were adopted. Latest cost of Machinery and Equipment were enquired from manufacturer/importers in Delhi.

(3) Material Cost

Latest information of Material Costs was obtained form PWD Bareilly, PWD Gwalior and local contractors in Gwalior. "Schedule of Rates In National Highway Zone P.W.D. Madhya Pradesh", "Schedule of Rates of Govt. of Maharashtra", "Schedule of Rates For National Highways Wing, Bihar" and "Delhi Schedule of Rates" were also revised for the reference.

The construction cost estimates was carried out in accordance with the following basic assumption and conditions.

(1) The project cost was based on the prices in the month of March 1998 (FY 1997)

(2) The exchange rate of currency was:
US$1.0=Rs. 39.15 (Average in February, 1998)

(3) Ratio of local/foreign portion of major construction materials were discussed with and recommended by the Most.

(4) Cost for preparatory work was assumed as Lump sum amount of 30 million Rupees.

(5) Contractor's profit and overhead charges were assumed as follows:
- 15% of Labour Cost
- 10% of hire charge of Machinery and Equipment
- 10% of Material Cost

Direct Construction Cost of Bareilly Bypass and Gwalior Bypass were estimated as shown in Tables 16-1 and 16-2, respectively.

Table 16-1 Direct Construction Cost of Bareilly Bypass

Item	Rs.	Local Portion Rs.	Foreign Portion US$	Ratio
1 Preparatory work	30,000,000	30,000,000	0	2.8%
2 Earthwork	178,972,500	159,622,700	494,200	16.9%
3 Pavement	351,318,400	330,365,500	535,200	33.1%
4 Culvert	42,603,800	42,492,600	2,800	4.0%
5 Bridge/Viaduct	218,740,600	216,420,000	59,300	20.6%
6 Toll gate	68,484,900	64,548,100	100,600	6.5%
7 Service road	134,938,400	129,205,300	146,400	12.7%
8 Drainage	16,721,700	16,327,500	10,100	1.6%
9 Utility Diversion	13,099,300	12,886,000	5,400	1.2%
10 Road appurtenances	3,482,400	3,482,400	0	0.3%
11 Horticulture	1,766,900	1,736,900	800	0.2%
12 Environmental Mitigation Measures	500,000	500,000	0	0.0%
Total of direct cost	1,060,628,900	1,007,587,000	1,354,800	

Table 16-2 Direct Construction Cost of Gwalior Bypass

Item	Rs.	Local Portion Rs.	Foreign Portion US$	Ratio
1 Preparatory work	30,000,000	30,000,000	0	3.8%
2 Earthwork	286,891,600	255,971,800	789,800	35.9%
3 Pavement	261,282,800	244,125,300	438,300	32.7%
4 Culvert	49,685,900	49,539,600	3,700	6.2%
5 Bridge/Viaduct	73,143,800	72,466,900	17,300	9.2%
6 Toll gate	26,910,200	25,500,400	36,000	3.4%
7 Service road	44,448,100	42,116,500	59,600	5.6%
8 Drainage	15,185,800	14,911,700	7,000	1.9%
9 Utility Diversion	6,751,700	6,596,100	4,000	0.8%
10 Road appurtenances	2,892,600	2,892,600	0	0.4%
11 Horticulture	1,613,300	1,589,200	600	0.2%
12 Environmental Mitigation Measures	500,000	500,000	0	0.1%
Total of direct cost	799,305,600	746,209,900	1,356,200	

16.2 Project Cost Estimates

The project cost estimates was carried out in accordance with the following basic assumption and conditions.

(1) Administration charge was assumed as 15% of direct construction cost, which includes Contingency charge, Quality control and Agency charge, etc.

(2) Engineering and Supervision cost was assumed as 10% of direct construction cost.

(3) Land Acquisition Cost for Bareilly Bypass

Based of the information given by the Environmental Impact Assessment (Social Environmental Aspects), the Land Acquisition Cost in the project area was judged as Rs. 300, 000 per ha as average. The required land area, subject of the land acquisition, was 255.8 ha. Additional 30% cost was added as solatium.

(4) Land Acquisition Cost for Gwalior Bypass

Based of the information given by the Environmental Impact Assessment (Social Environmental Aspects), the Land Acquisition Cost in the project area was judged as Rs. 188,800 per ha as average. The required land area, subject of the land acquisition, was 101.1 ha (deducted 104 ha of forest area and 6.4 ha of government land). Additional 30% cost was added as solatium.

(5) Compensation cost for private properties, etc. was assumed as 20% of land acquisition cost. In addition to this, an amount of Rs. $3{,}000 \times 10^3$ was included

as a cost for compensatory afforestation in Gwalior Bypass.

(6) Contingencies inclusive of physical and price contingencies were assumed as 10% of direct construction cost, administration charge, engineering & supervision services, and maintenance equipment cost.

Project Cost of Bareilly Bypass and Gwalior Bypass was estimated as shown in Table 16-3 and 16-4, respectively.

Table 16-3 Project Cost of Bareilly Bypass

Item	Amount in Rs.	Remark
1 Direct Construction Cost	1,060,629,000	
2 Administration Charge	159,094,000	1×15%
3 Engineering & Supervision	106,063,000	1×10%
4 Maintenance Equipment Cost	8,643,000	
5 Land Acquisition Cost	99,778,000	+30% as solatium
6 Compensation	15,350,000	
7 Contingencies	133,443,000	(1~4)×10%
Total of Project Cost	1,583,000,000	

Table 16-4 Project Cost of Gwalior Bypass

Item	Amount in Rs.	Remark
1 Direct Construction Cost	799,306,000	
2 Administration Charge	119,896,000	1×15%
3 Engineering & Supervision	79,931,000	1×10%
4 Maintenance Equipment Cost	8,643,000	
5 Land Acquisition Cost	24,825,000	+30% as solatium
6 Compensation	6,819,000	
7 Contingencies	100,778,000	(1~4)×10%
Total of Project Cost	1,140,198,000	

16.3 Operation and Maintenance Cost Estimates

Operation Cost was estimated based on the following components:

(1) Personnel
(2) Toll machine maintenance and repair
(3) Utilities and other operation expenses
(4) Overhead cost for corporate management

Staffing requirements for an O/M station was assumed in the structure as shown in Table 16-5. The annual cost for each category of professional rankings in 1997 price was also assumed in the Table.

Table 16-5 Matrix of Staffing Requirement for O/M Station

	Management		Administrative		Maintenance	
	Top Level	Mid Level	Supervisory	Clerical/ Engineers	Specialist	Common
Annual Remuneration Cost (Rs)	310,000	230,000	160,000	80,000	80,000	20,000
Management	O	O		O		
Administration.			O	O		
Civil Eng. Maintenance		O	O	O	O	O
Equipment Maintenance			O	O	O	O
Toll Collection		O	⊙	⊙		
Security			O	O	O	
Others						O

The manpower required for toll collection at the administrative level (marked as ⊙ in the above table) was assumed to be dependent on the traffic volume to handle, while requirements for all of the rest are not affected.

Maintenance Cost was estimated from the following two categories.

A Routine maintenance
- (1) Highway routine maintenance
- (2) Equipment maintenance and fuel
- (3) Lighting

B Periodic maintenance

The estimated Operation & Maintenance Cost was summarised in Table 16-6.

Table 16-6 Operation & Maintenance Cost per Annum

Unit: Rs. $\times 10^3$ in 1997 price

	Bareilly Bypass	Gwalior Bypass
Operation Cost		
Traffic volume independent	4,688	4,082
Traffic volume dependent	6,490	1,581
Maintenance Cost		
Routine maintenance cost	3,622	3,488
Periodic maintenance cost	113,900	100,690

17 Economic and Financial Analysis

17.1 Economic Analysis

Based on the updated data of future traffic demand forecast, civil work construction cost/project cost, and reviewed VOC, etc. the economic analysis give the results in terms of EIRR and NPV as shown in Table 17-1.

Table 17-1 EIRR and NPV

Name of Bypass	EIRR %		NPV (12% discount) Rs. million	
	VOC saving only	with Travel Time saving	VOC saving only	with Travel Time saving
1. Bareilly	45.3%	100.3%	5,888.0	23,048.4
2. Gwalior	45.9%	85.4%	2,877.1	7,893.6

17.2 Financial Analysis

Financial Internal Rate of Return on Total Investment (FIRR-ROI) and Net Present Value (NPV) at discount rate of 20% was estimated as shown in Table 17-2.

Table 17-2 FIRR and NPV

Bypass Name	FIRR (ROI)	NPV (Rs.)
1. Bareilly	22.0%	206.14×10^6
2. Gwalior	21.2%	88.82×10^6

The Study expected the project bypass be implemented by BOT basis. The financial viability from the viewpoint of implementing entities was carried out as follows.

(1) Implementing Entity

A Special Purpose Vehicle (SPV) was assumed as the implementing entity for each of the bypasses with the concession of 30 years of operation.

(2) Capital Costs for the SPV

The costs such as land acquisition, clearance of right-of-way, were deducted for the estimation of capital costs for the SPV.

(3) Equity and Loan

The capital cost would be funded or financed to the SPV in the form of equity or loan. An equity/loan ratio of 1:2 was assumed. As for the long-term loan to cover the capital expenditure, an interest rate of 20% per annum with the repayment in 15 years was assumed. Short-term loan to cover the yearly deficit in operation and repayment of long-term loan was also applied with the interest of 18% per annum.

(4) Depreciation

Depreciation followed the straight-line method, assuming the life expectancy as listed below.

a) Road, bridge, toll booth : 20 years
b) Overlay : 6 years

(5) Tax on the SPV

Corporate tax on the SPV was assumed to be totally exempted in the initial five years from when the SPV starts to generate profits. In subsequent five years, exemption of 30% of the corporate tax was assumed. For the years later, 35% of the net profits (before tax) without any surcharge were calculated as corporate taxes.

(6) Sensitivity Analysis

Sensitivity tests were made with the following variation of important factors.

a) GOI/NHAI Capital Grant (40%)
b) Interest on Long-term Loan (15%, 10%)
c) Toll Rate (+20%)

Table 17-3 to 17-6 show the result of the financial indicators in view of implementing entities for Bareilly Bypass and Gwalior Bypass.

Table 17-3 Major Financial Indicators for the SPV-Bareilly Bypass

Financial Internal Rate of Return on Equity (FIRR-ROE)	%	20.0%
First Years of Surplus		
- Annual Surplus in Net Profit/Loss	Fiscal year	2007
- Annual Surplus in Cash Flow	Fiscal year	2010
Maximum Annual Short-term Loan	Fiscal year	2007
	Rs. million	796.29

Table 17-4 Financial Sensitivity Tests for the SPV-Bareilly Bypass

Indicators	Unit	GOI/NHAI Grant	Interest of Long-term Loan		Toll Rate
		40%	15%	10%	+20%
FIRR-ROE	%	26.1%	22.3%	25.1%	23.2%
First Years of Surplus					
- Surplus in Profit/Loss	Fiscal year	2006	2004	2003	2005
- Surplus in Cash Flow	Fiscal year	2006	2006	2003	2008
Maximum Short-term Loan	Fiscal year	2004	2003	2002	2004
	Rs. million	41.33	165.79	1.05	356.45

Table 17-5 Major Financial Indicators for the SPV-Gwalior Bypass

Financial Internal Rate of Return on Equity (FIRR-ROE)	%	18.0%
First Years of Surplus		
- Annual Surplus in Net Profit/Loss	Fiscal year	2008
- Annual Surplus in Cash Flow	Fiscal year	2012
Maximum Annual Short-term Loan	Fiscal year	2007
	Rs. million	788.55

Table 17-6 Financial Sensitivity Tests for the SPV-Gwalior Bypass

Indicators	Unit	GOI/NHAI Grant	Interest of Long-term Loan		Toll Rate
		40%	15%	10%	+20%
FIRR-ROE	%	23.6%	20.5%	23.1%	21.5%
First Years of Surplus					
- Surplus in Profit/Loss	Fiscal year	2006	2005	2003	2006
- Surplus in Cash Flow	Fiscal year	2008	2008	2003	2009
Maximum Short-term Loan	Fiscal year	2007	2005	2002	2007
	Rs. million	123.74	149.00	4.17	310.89

In addition to the above assessment, the minimum requirement of the followings were also analysed:

Option 1 : Minimum requirement of GOI/NHAI Capital Grant to the SPV with the 20 years concession period, in order to attain 20% of FIRR-ROE.

Option 2 : Minimum requirement of concession years with 40% of GOI/NHAI Capital Grant to the SPV, in order to attain 20% of FIRR-ROE.

Table below shows the result of the analysis for above Option 1 and Option 2.

Table 17-7 Minimum Requirement to attain 20% of FIRR-ROE

Bypass Name	Option 1 Required Capital Grant Ratio (Amount)	Option 2 Required Concession Period
Bareilly Bypass	13.5% (Rs. 246.4×10^6)	12 years
Gwalior Bypass	29.0% (Rs. 399.7×10^6)	15 years

18 Implementation Programme

The basic policy for the implementation of the two bypass projects was assumed as the adoption of a BOT scheme, as seemingly suggested by GOI. Including the implementation of the project by pure BOT basis, the following implementation options were assessed.

(1) BOT scheme with/without Government supports
(2) Public sector implementation of the detailed design with JICA Grant Aid and the construction under the OECF loan
(3) Public sector implementation of both the detailed design and construction under the OECF loan
(4) Partial public sector implementation with/without JICA and/or OECF schemes precedent to BOT implementation of supplementary construction and O/M.

Judging from the estimated financial indicator for the implementing entities, and assessment on the above implementation options, the Bareilly Bypass Project would

be financially feasible on a BOT basis if some support is duly offered as already set forth in "Guidelines for Private Investment in National Highway Projects". The tentative project implementation schedule on a BOT basis was proposed as shown in Figure 18-1.

On the contrary, Gwalior Bypass was judged to be critically feasible as a BOT basis. It may be suggested to give subsidy from the public sector. GOI may be requested to construct a part of major civil works prior to the implementation by BOT.

Figure 18-2 will represents the most practical implementation schedule by BOT basis for the Gwalior Bypass. In case the bypass implementation was supposed as not successful by a BOT basis exclusively, then GOI will be requested to pursue the budgetary arrangement. One of the ways of this is to utilise foreign/international loans. In this case, combination of major civil works construction by GOI utilising foreign/international loans, and the balance construction by private sectors may be the second best option, as shown in Figure 18-3.

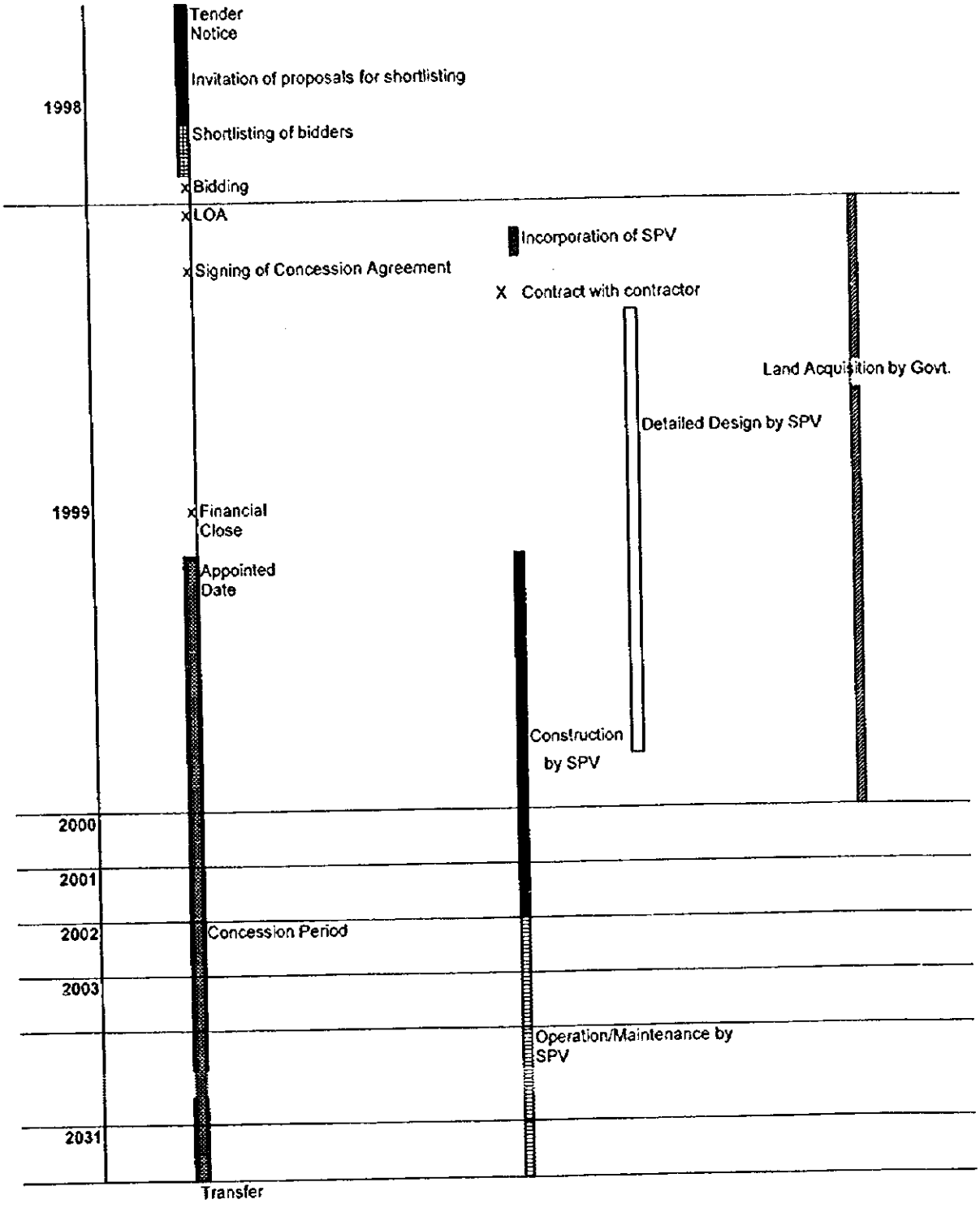


Figure 18-1 Implementation Schedule for Bareilly Bypass on a BOT Basis

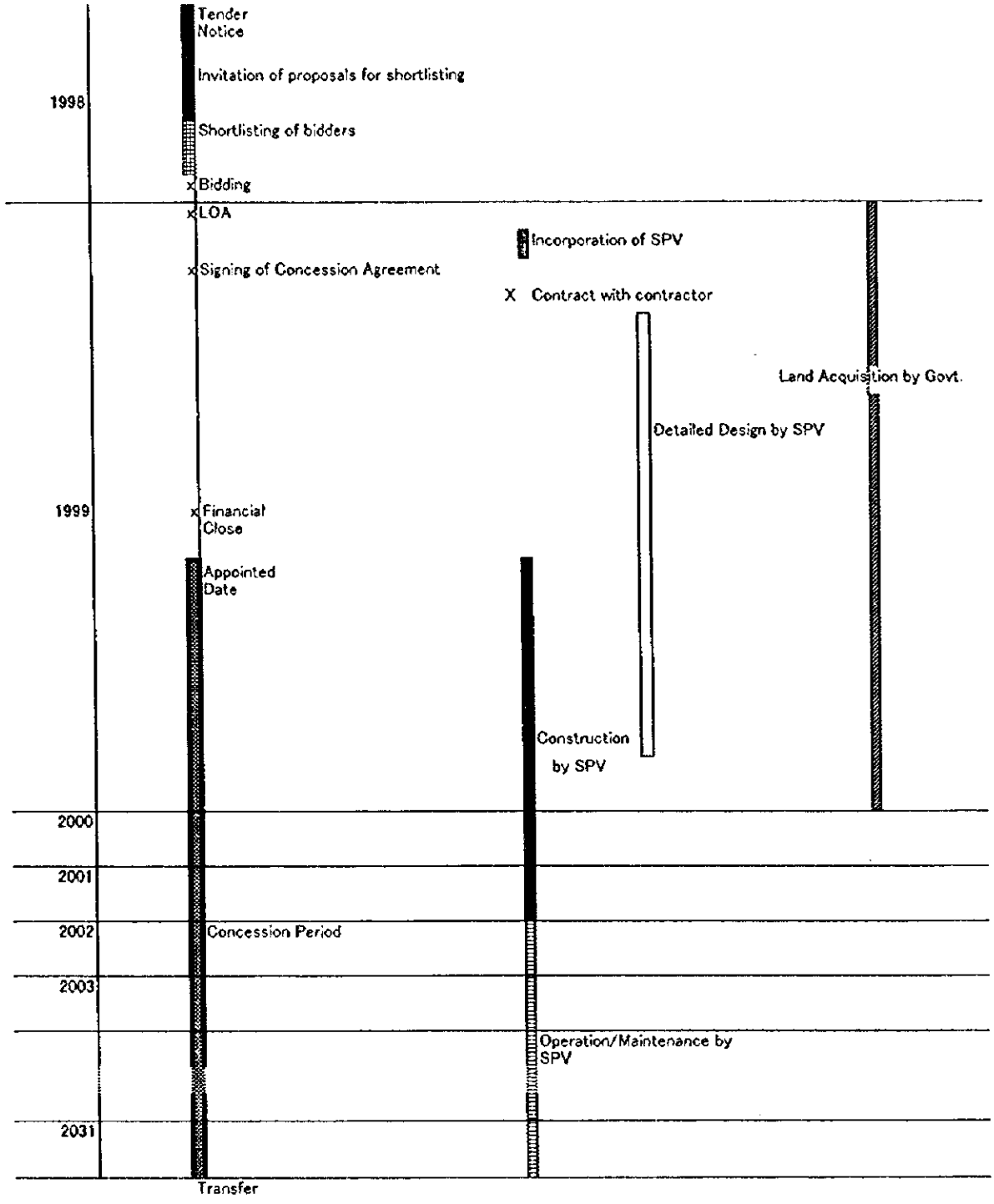


Figure 18-2 Implementation Schedule for Gwalior Bypass on a BOT Basis

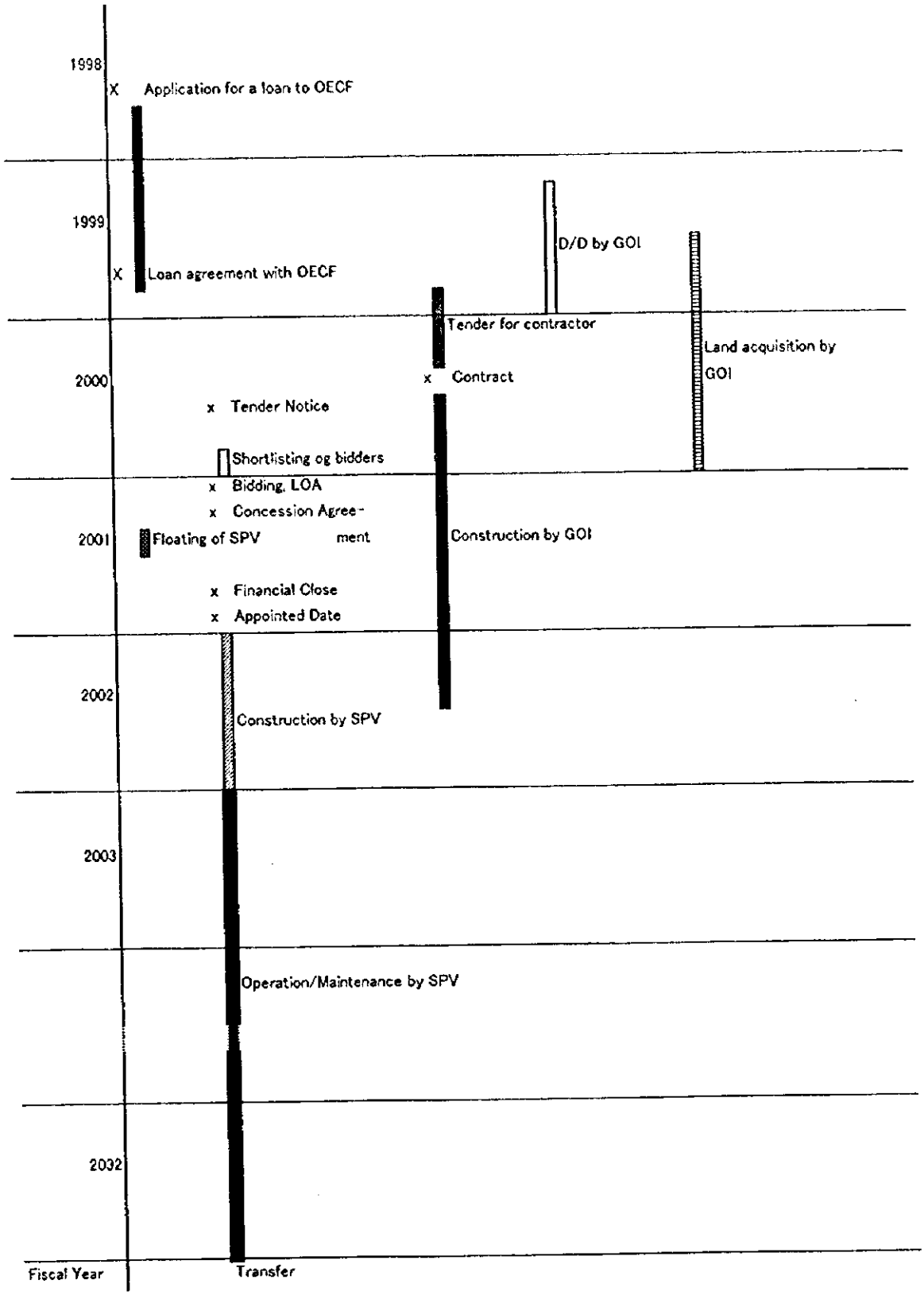


Figure 18-3 An Example of Implementation Schedule for Gwalior Bypass with Preceding Partial GOI Implementation

19 Recommendations

The following Table 19-1 shows the outline of the proposed 10 bypasses obtained through Pre-Feasibility Study.

Table 19-1 Summary of Pre-Feasibility Study Output

Bypass Name	Length (km)	Estimated Project Cost (Rs.)	EIRR (%)		FIRR (%)	Congestion Rate in 2002
			VOC saving only	with Travel Time saving		
1. Bareilly	31.1	1,879,362,000	46.8%	112.1%	25.9%	2.02
2. Patna	49.9	4,923,724,000	27.9%	49.7%	14.2%	1.07
3. Keonjhar	8.5	453,253,000	2.9%	11.6%	Negative	0.81
4. Balugaon	15.4	552,559,000	11.7%	23.0%	13.0%	1.04
5. Vijayawada	28.1	2,054,426,000	23.7%	43.2%	18.6%	0.97
6. Kannur	11.1	1,464,531,000	18.8%	57.4%	7.4%	1.40
7. Nandura	6.4	359,483,000	28.6%	50.2%	19.0%	1.06
8. Khamgaon	10.9	711,891,000	20.0%	36.8%	20.1%	1.45
9. Bhopal	40.3	2,175,863,000	21.6%	56.9%	20.9%	2.03
10. Gwalior	26.0	2,121,407,000	19.7%	34.5%	16.9%	2.06

The above table tells that the construction of all bypasses, except Keonjhar Bypass, is strongly recommended from the viewpoint of contribution to the national economy, as the estimated EIRR (considering VOC saving and Travel Time saving) exceeds 20%. However judging from the assessment results of Bareilly Bypass and Gwalior Bypass in the Phase 2 : Feasibility Study, the balance bypass projects seem not so attractive to the private investors, in case to intend the implementation by BOT basis. Therefore it is expected for GOI to seek out an appropriate financial source like OECF, ADB or WB, and realise these bypasses step by step.

Bareilly Bypass and Gwalior Bypass were selected in the Pre-Feasibility Study as the subject bypass in the next phase, Feasibility Study. Utilising the obtained data by the further field surveys, the design for the feasibility study was conducted. The reviewed and re-established design for the Bareilly Bypass gave the increased work quantities, and reduced the EIRR value, obtained in the previous phase. On the contrary, the reviewed design of the Gwalior Bypass reduced the work quantities, and increased the EIRR value. Table 19-2 below gives the outline of both bypasses.

Table 19-2 Outline of the Project Bypass Profile in Feasibility Study

Bypass Name	Length (km)	Estimated		EIRR (%)		FIRR (%)
		Construction Cost (Rs.)	Project Cost (Rs.)	VOC saving only	with Travel Time saving	
Bareilly	29.98	1,060,628,900	1,583,000,000	45.3%	100.3%	22.0%
Gwalior	26.50	799,305,600	1,140,198,000	45.9%	85.4%	21.2%

The value of FIRR in the above table represents the financial internal rate of return on total investment (FIRR-ROI). This Study assumed the project implementation by private investors. Then the financial viability of SPV was assessed with the condition

of 30 years concession for operation. Table 19-3 shows the estimated value of FIRR-ROE (Financial Internal Rate of Return on Equity), one of the financial viability indicators.

Table 19-3 Summary of estimated FIRR-ROE

Bypass Name	Base Case	Sensitivity Analysis			
		GOI/NHAI Grant	Interest of Long-term Loan		Toll Rate
		40%	15%	10%	+20%
Bareilly Bypass	20.0%	26.1%	22.3%	25.1%	23.2%
Gwalior Bypass	18.0%	23.6%	20.5%	23.1%	21.5%

Note : Concession period was assumed as 30 years bypass operation.

Table below shows the minimum requirement to attain 20% of FIRR-ROE.

Table 19-4 Minimum Requirement to attain 20% of FIRR-ROE

Bypass Name	Required Capital Grant 1) Ratio (Amount)	With 40% Capital Grant Required Concession Period
Bareilly Bypass	13.5% (Rs. 246.4×10^6)	12 years
Gwalior Bypass	29.0% (Rs. 399.7×10^6)	15 years

1) Concession period was assumed as 20 years.

As a conclusion, it was recommended to realise the proposed Bareilly Bypass and Gwalior Bypass by BOT basis, with kind grant of offering the governmental concession as much as possible, and start its operation to the public in the target year (short term) of 2002, which was specified in the Scope of Works of the Study.

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