Final Report

ENVIRONMENTAL IMPACT ASSESSMENT FOR DEVELOPMENT OF BUS RAPID TRANSIT SYSTEM IN NAYA RAIPUR CHHATTISGARH

Submitted to:

Infrastructure Development Finance Company

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Abbreviations

AAQSRN	: Ambient Air Quality Standards In Respect of Noise
AC	: Alternating Current
AH	: Amp Hour
BDL	: Below Detectable Limit
BOD	: Biological Oxygen Demand
BP	: Bank Procedures
BRT	: Bus Rapid Transit
BS	: Bharat Stage
CDP	: City Development Plan
CEC	: Cation Exchange Capacity
CGWB	: Central Ground Water Board
CNG	: Compressed Natural Gas
CO	: Carbon Monoxide
COD	: Chemical Oxygen Demand
CPCB	: Central Pollution Control Board
CTTS	: Comprehensive Traffic and Transportation Study
dB	: Decibel
DC	: District Collector
DC	: Direct Current
DDP	: Desert Development Program
DG	: Diesel Generator
EA	: Environmental Assessment
EC	: Environmental Clearance
EC	: Electrical Conductivity
EIA	: Environment Impact Assessment
EMP	: Environment Management Plan
EPC	: Engineering Procurement Construction
ESMF	: Environmental and Social Management Framework
EU	: Euro

FY	:	Financial Year
g/cc	:	Gram per cubic centimeter
GEF	:	Global Environment Fund
GHG	:	Green House Gas
GIS	:	Geographical Information System
GoC	:	Government of Chhattisgarh
GoI	:	Government of India
GPRS	:	Global Positioning Response System
GPS	:	Global Positioning System
GW	:	Ground Water
ha	:	Hectare
HMV	:	Heavy Motor Vehicles
IMD	:	Indian Meteorological Department
INR	:	Indian Rupees
IPT	:	Intermediated Public Transport
IRC	:	Indian Roads Congress
IS	:	Indian Standard
ISC3	:	Industrial Source Complex Version 3
ITS	:	Intelligent Transport System
IUCN	:	International Union for Conservation of Nature
IVI	:	Intelligent Vehicle Initiatives
JNNURM	:	Jawaharlal Nehru National Urban Renewal Mission
KW	:	Kilo Watt
mbgl	:	Meters below ground level
mg/l	:	Milligram per liter
MNC	:	Multi National Companies
MoEF	:	Ministry of Environment and Forest
MoRT&H	:	Ministry of Road Transport & Highways
MoUD	:	Ministry of Urban Development
MPN	:	Most Probable Number

NAAQS	:	National Ambient Air Quality Standards
NAMP	:	National Ambient Monitoring Programme
NCR	:	National Capital Region
ND	:	Not Detectable
NH	:	National Highway
Nm	:	Newton Meter
NMT	:	Non Motorized Transport
NOx	:	Oxides of Nitrogen
NR	:	No Relaxation
NRDA	:	Naya Raipur Development Authority
NTU	:	Nephlometric Turbidity Unit
OP	:	Operational Policy
PCB	:	Pollution Control Board
PHPDT	:	Passengers per hour per direction of traffic flow
PM	:	Particulate Matter
PPP	:	Public Private Partnership
PWD	:	Public Works Department
RDA	:	Raipur Development Authority
RMC	:	Raipur Municipal Authority
RoW	:	Right of Way
RSPM	:	Respirable Suspended Particulate Matter
SAR	:	Sodium Absorption Ratio
SC	:	Schedule Caste
SO2	:	Sulphur Dioxide
SPCB	:	State Pollution Control Board
SPL	:	Sound Pressure Level
SPM	:	Suspended Particulate Matter
ST	:	Schedule Tribes
SUTP	:	Sustainable Urban Transport Projects
SW	:	Surface Water

TAZ	:	Traffic Area Zones
TDS	:	Total Dissolved Solids
US EPA	:	United States Environmental Protection Agency
VEC	:	Valued Ecosystem Components

1.0 Introduction

The State of Chhattisgarh was carved out of erstwhile Madhya Pradesh on November 1st, 2000 in deference to its distinctive historical social background and natural resources. The new state is located in the south eastern part of Madhya Pradesh. Raipur city serves as the capital of the state. The city is constrained by availability of land and basic infrastructure. Considering the immense growth potential of the city and with a view to decongest the city, a need was felt for the creation of a new development area in close proximity to the city. The new development area, 'Naya Raipur' is being developed in close proximity to the existing airport of Raipur in a planned manner and with state of the art physical, social and economic infrastructure.

Naya Raipur is located at a distance of 15 km southeast of Raipur city and will be developed in an area of 106.6 square kilometers (including greenbelt). An additional area of about 234.4 square kilometers has been identified as a peripheral area, which would act as a buffer zone between Raipur and Naya Raipur. The target population for the city in 2031 is expected to be 5.6 lakhs.

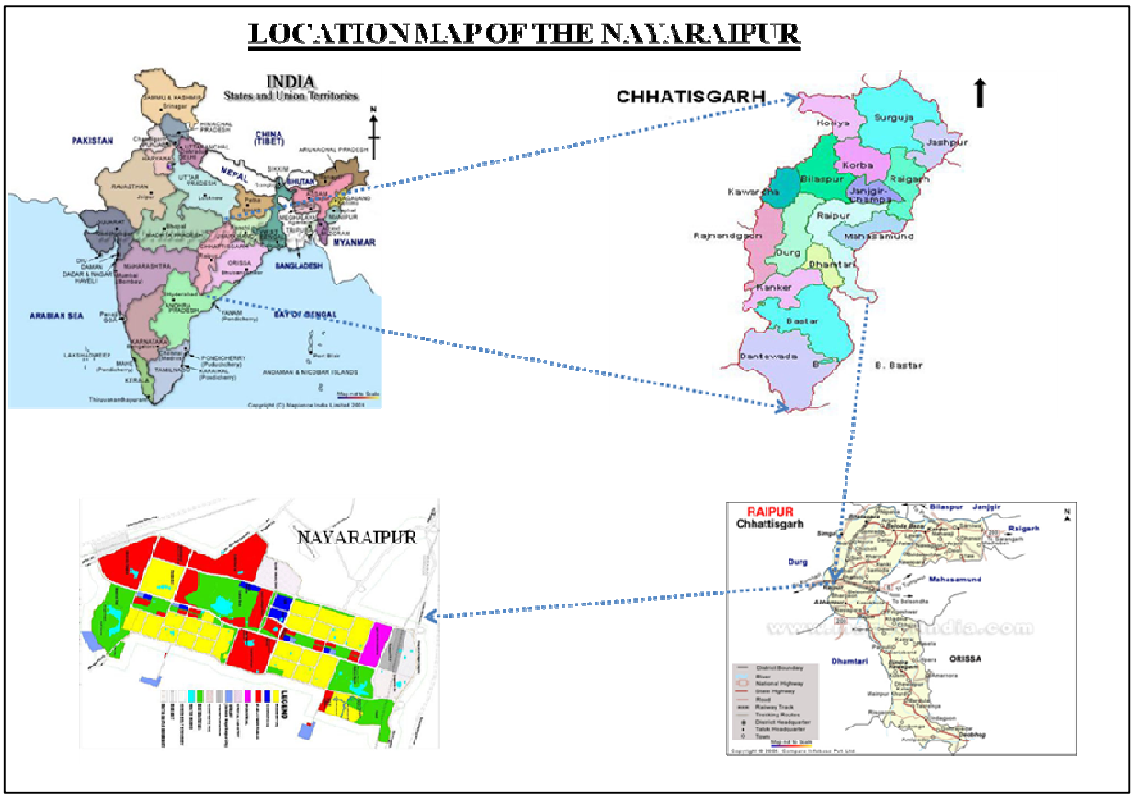
The Government of Chhattisgarh has taken initiatives to develop Naya Raipur with complete sustainable infrastructure in place. In this direction, an appropriate road network system has been planned. The road network has been designed for four to six lanes with provisions of medians, service road and walkways/cycle ways. In order to curtail high vehicle ownership, congestion, pollution and parking problems, Naya Raipur Development Authority (NRDA), the nodal agency for development and administration of Naya Raipur, has proposed a Bus Rapid Transit (BRT) system for the main routes with dedicated bus lanes and feeder bus service on all other arterial and sub arterial roads. It is proposed BRT buses will have night parking in Raipur at three locations, Sonakhana, Amanaka, Secretariat Building. Also proposed four pickup points from Raipur, Kabir nagar, Tatibund, Kasiram nagar, Secretariat building, to starting of BRT corridor at NH-43 (deviated at village Dumartarai) and NH-6 (deviated near agriculture university). As BRT buses cannot run on national highways with dedicated lines these buses run along with normal traffic from Raipur to starting of BRT corridor at Dumartarai and Agriculture University.

The proposed scheme is eligible to get financial assistance under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for eligible components. The components not eligible under JNNURM funding will be funded by Global Environment Fund (GEF), an independent financial organisation that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. GEF promotes the Sustainable Urban Transport Projects (SUTP) as urban transport significantly impacting climate change due to its large share of GHG emissions and oil consumptions. The Ministry

of Urban Development (MoUD) would also provide assistance to NRDA for obtaining debt assistance from the World Bank, if desired by NRDA.

This Environment Impact Assessment (EIA) study for the proposed project is being carried out to cater to the needs of the World Bank Safeguard Policies and Environmental and Social Management Framework (ESMF) prepared for GEF-SUTP.

FIGURE 1-1: LOCATION MAP OF THE NAYA RAIPUR



1.1 PROJECT BACKGROUND

Naya Raipur has been planned as a satellite town and will serve as the capital of Chhattisgarh. The development of the city is proposed to be carried out in a phased manner; spread over a period of 25 years. The details of development have been presented in Table 1-1 .

TABLE 1-1 : PHASES OF DEVELOPMENT – NAYA RAIPUR

Phase	Horizon Year	Cumulative Population	Area (Ha)
Phase I	2011	1,50,000	3252.2
Phase II	2021	3,40,000	3076.1
Phase III	2031	5,40,00	1590.0
Total developed area at the end of Phase III			**7918.4**

Source: DPR

The population projections for Naya Raipur have been based considering the expected growth due to the following reasons

- the administrative capital of the district,
- potential to develop as a trade and commerce center owing to proximity to the airport and,
- Proposed industrial and institutional development in the region.

Since Naya Raipur is designed to be a major economic generator through various industries, planning an effective environment and people friendly mass rapid transit system from the very beginning becomes extremely critical. Thus, NRDA has proposed to develop a territory wise network of socio economically sustainable, efficient and well integrated mass - transit system accompanied by, (i) infrastructure and design that facilitates safe and convenient access to mass transit for all users including those with temporary or long term impairments, (ii) make for most optimal, efficient and conflict free utilization of the passengers capacity of road infrastructure. Therefore, BRT System has been proposed in Naya Raipur.

1.2 SCOPE OF STUDY

The Environment Impact Assessment study will focus on identifying the likely impacts associated with the construction and operation of the proposed BRT corridor in Naya Raipur and pickup points in Raipur and mitigate them through a detailed environment management plan. The study will also design an environmental monitoring plan and an implementation mechanism and a reporting system to assess compliance with the Environment Management Plan. The proposed Naya Raipur development will have a major impact on the entire area as large scale developments are planned in addition to the road network and therefore analysis will draw upon the various other environmental studies undertaken to estimate the cumulative impact in addition to the individual impact of the road development.

The base line studies have been conducted in line with the Government of India / Government of Chhattisgarh and international funding agency guidelines. The purpose of preparing Environment Impact Assessment report is:

- Identify and estimate full range of potential project impacts, both negative and positive.
- Recommend measures for avoiding or mitigating negative impacts, and for enhancing positive effects, wherever feasible.
- Ensure consideration of impacts in the context of project alternatives, and
- Prepare plans that achieve mitigation, monitoring, and management objectives of an environmental impact assessment.

The environmental assessment will be in line with the Environment and Social Management Framework (ESMF) requirements and the World Bank operational policies.

1.3 STRUCTURE OF EIA REPORT

The Environmental Impact Assessment report will discuss the following points.

Chapter 1: Introduction.
Chapter 2: Project Description
Chapter 3: Review of Environmental Regulatory Framework
Chapter 4: Baseline Environmental status
Chapter 5: Assessment of Potential Impact and Mitigation Measures
Chapter 6: Environmental Management Plan
Chapter 7: Summary & Conclusions

2.0 Project Description

This section of the report describes the project and presents the technical details of the project.

2.1 NAYA RAIPUR

The proposed project of constructing Bus Rapid Transit System (BRT) in the city is aimed at providing access to high speed intercity travel between the Raipur and Naya Raipur. Naya Raipur being a new city designed to decongest the existing city, which is congested due to unplanned road network infested with heterogeneous traffic conditions. The project intervention is thus aimed at introducing exclusive bus lanes on all major arterial roads.

For GEF-SUTP project it is proposed to initiate BRT System to cover the central spine of the Naya Raipur city. Proposed sub-components in the project include bus lanes, bus terminals / shelters, procurement of bus fleet and also a technical assistance study on Transit Oriented Development.

Project outlay for the city is estimated at INR 187.66 Crores and is to be implemented in the Phase I of the project.

2.1.1 Landuse

The Region principally consists of agricultural lands of intensive use followed by uplands and barren lands. By and large, agricultural lands are found along the rivers and streams. Project area is of rural set up.

2.1.2 Road Transport System

Two National Highways namely NH-6 and NH-43 flank the capital city region and these are the busiest highways of the state. Most of the goods traffic within the state moves on these highways. With the formation and full functioning of the new capital city, the traffic flow intensity on these corridors is expected to grow further.

With the coming up of administrative functions in the new capital city it is estimated that the new capital city will have high interaction with other district headquarters. Thus, it is important to enhance the connectivity of these areas, through a combined strategy of construction of new links and up gradation of existing roads.

2.1.3 Rail Network

The South-Eastern railway operates on the rail network in Chhattisgarh and the nearest rail head to the new capital city is at Raipur.

2.1.4 Air Transport System

The air transport in the State is quite limited. There is only one major airport in the State, connecting the city of Raipur. The airport connects Raipur with major cities of India.

2.2 NEED OF THE PROJECT

Naya Raipur is being developed to serve as the administrative capital of the state of Chhattisgarh and to fulfil the infrastructural and trade needs of the area. Naya Raipur is flanked by National Highway 6 (NH-6) in North and National Highway 43 (NH 43) in South. Both the highways connect the satellite city with Raipur city. The road network for Naya Raipur city has been planned in the form of city arterial roads and intra sectoral roads. The city arterial roads connect Raipur and Naya Raipur including the main road running transversely through Naya Raipur and few major roads. These roads will have a road width of 100 m or 60 m. The intra sectoral roads will connect the city arterial roads to the interiors at Naya Raipur and will have a road width of 24 m, 18 m or 12 m.

Once all planned development is completed, the estimated traffic demand in peak hours along the major roads in Naya Raipur has been estimated at 12000 PHPDT (passengers per hour per direction of traffic flow). Since Naya Raipur is planned to be a major economic generator through various industries, planning an effective environment and people friendly mass rapid transit system which is safe, sustainable and economic and efficient, from the very beginning becomes extremely critical and is one of the major intentions of NRDA. Accordingly, a BRT System has been proposed in Naya Raipur, which would connect Raipur and Naya Raipur and also serve the main corridors of Naya Raipur. The system capacity is planned to cater to the traffic demand in Phase I (2013) to start with and will be amplified in subsequent phases to meet the development of Naya Raipur.

As Naya Raipur is a new developmental area, the existing transport infrastructure in Raipur has been considered for Naya Raipur. The advent of BRT system expects to bring about new technologies which would focus on “cleaner technologies” wherein the PM emissions will be much lower. The proposed BRT busses will be in compliance with Bharat Stage (BS) II emission norms. According to the study of Metro Bus (BRT) in Mexico City, a 20% to 30% reduction in emission has been indicated. Considering Indian conditions the emission reductions in the range of 10% to 15% are expected. Thus the proposed project will provide an environmentally friendly and effective transportation system.

2.3 PROJECT BENEFITS

The proposed BRT system will offer the following advantages:

- Reduction in time of travel;
- Increase in economic productivity;
- Reduced air and noise emissions;
- Equitable access throughout the city;
- A BRT system compared to other public transit systems has the ideal trade-off between revenue and cost;

2.4 ROAD NETWORK PROPOSED IN NAYA RAIPUR

Commonly, newly formed states lack the infrastructure facility to have a fully operational administration for the government. In this context, Government of Chhattisgarh (GoC) has taken steps to develop Naya Raipur with completely sustainable infrastructure in place. The following road networks have been planned in Stage 1, which are currently under implementation. The details of the road network are set out in the table below.

TABLE 2-1 : DETAILS OF THE ROAD NETWORK NAYA RAIPUR

Road Number	Description	Length (Km)	Number of Lanes
1	100 m wide Expressway joining NH-6 (including interchange) to entry point of Naya Raipur	8.5	4 lanes with median
2	100m wide road joining NH-6 to NH-43 via Capital Complex	17.3	4 lanes with median
3	100m wide road joining 60m wide road to the south of transport hub to Expressway	2.4	4 lanes with median
4	100m wide road joining Expressway and Capital Complex	10.1	4 lanes with median
5	100m wide road near Muktangan connecting NH-43 and North South 100 m wide road	2.9	4 lanes with median
6	60m wide road north of light Service Industries	2.4	4 lanes with median
7	60m wide road additional link from North South road around Sendh Lake	4.1	4 lanes with median
8	60m wide road joining Expressway and Airport	3.3	4 lanes with median
9A	60m wide road starting from Westside 100m wide road, going around Capital Complex and joining to the North of Commercial Complex joining 100m wide N-S road	5.9	4 lanes with median
9B	60m wide road starting from Westside 100m wide road, going around Capital Complex and joining to the North of Commercial Complex joining 100m wide N-S road	2.3	4 lanes with median
10	60m wide road joining south of Capital Complex and N-S 100m wide road	4.2	4 lanes with median
11	60m wide road surrounding educational complex/ Commercial Complex near health complex on South	3.6	4 lanes with median

Road Number	Description	Length (Km)	Number of Lanes
	Total length of roads	**67.0**	

Source: DPR

2.5 TRAVEL DEMAND ANALYSIS

In absence of a Comprehensive Traffic and Transportation Study (CTTS) for Naya Raipur, the information collected from various sources such as Development Plan and Regional Plan have been analysed to delineate the traffic flow using transport models. Passenger trips are expected to be generated from the work/business trips, education trips and other/visitor trips. Trip details have been estimated using trip generation rates assumed based on the population, employment and area developed. The basic travel data obtained by assessing the travel characteristics, in this manner is the basis on which BRT System has been designed.

As per the development Plan, Naya Raipur is being planned for a population size of 5.6 lakh people in 2031 and is estimated to have per-capita trip rate of 1.4. However, for study purpose, the per-capita trips performed by vehicular modes is assumed to be 0.8 (excluding walk and cycle trips). With this assumption, passenger trips have been estimated separately by the trip purpose i.e work, education and other purpose trips.

Based on the current assessment of development, the population anticipated in Naya Raipur in FY13 is 70,000 and employment of 31,000 of which the government offices will account for an employment of 7000. Also, about 75% of the projected population and employment targets for 2021 and 2031 will be realized by those timeframe.

Significant trips are expected from the surrounding area to Naya Raipur. Further, significant number of jobs in Naya Raipur would be served by non-resident population.

The area was divided into 51 Traffic Area Zones (TAZs) in Naya Raipur, 34 TAZs in Raipur and 3 other TAZs. Apart from TAZs, various pick up points in Raipur, which will also form a part of the network corridor, have been identified. The whole of Naya Raipur area has been divided into TAZs as per sectors along with few other major areas of land use such as software Technology Park, integrated freight complex, Capital Complex, universities / institutional areas, industrial areas.

The number of trips generated in each TAZ was assessed using the socio economic parameters of the TAZ. Model share on the basis of past studies and specific recommendations of Naya Raipur have been used.

Modal Share

The key transport service characteristics that influence choice of travel mode have been identified and analysed. In this regard, the modal share on the basis of past studies and specific recommendations of Naya Raipur has been used. Modal share predicted amongst different modes in the Development Plan indicate that the share of trips by personalized vehicles and public/ intermediated public transport (IPT) account for 50% each respectively for inter-city trips. Larger modal share for public transit has been assumed for intra –city trips also in view of proposed well networked facility. In case of intra-city and inter-city trips, the share of public transit could be 40%. The modal distribution assumed in general in case of inter-city and intra city has been shown in the figures below:

FIGURE 2-1 : MODAL SHARE IN INTER-CITY PASSENGER TRIPS

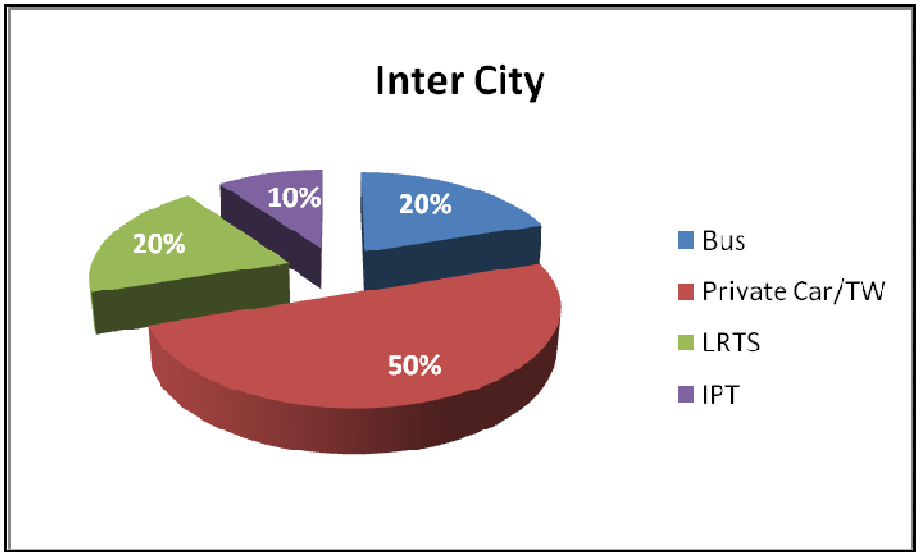
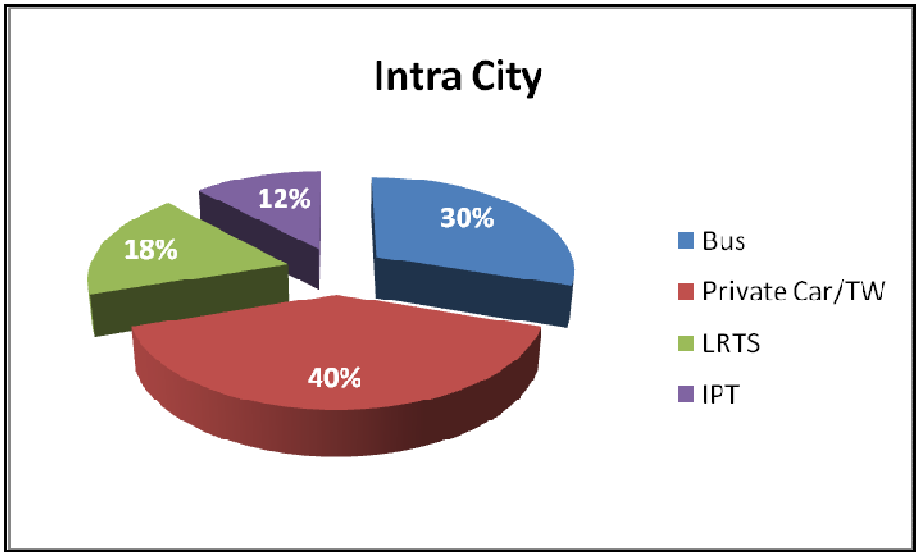


FIGURE 2-2 : MODAL SHARE IN INTRA-CITY PASSENGER TRIPS



In addition, separate share of public transit system has been adopted by purpose and travel pattern. Significant inter-city work trips are expected to be performed by public transit system due to trip lengths involved. Similarly, education trips are expected to be performed by school/college buses.

It is estimated that the mass transit trip generation would be approximately 0.38 lakh trips per day by year FY13 and could grow upto approximately 1.73 lakh trips and 2.5 lakh trips per day by the year 2021 and 2031 respectively.

Moreover, from the studies carried out for the BRT System in Ahmedabad, it has been observed that there is a 32% modal shift from private to public transport vehicles in six months.

Keeping in mind the BRT system proposed for the Naya Raipur with modal share of 40 % in the year 2031 the estimated bus passenger traffic demand along major corridors in the Naya Raipur has been depicted below:

TABLE 2-2 ESTIMATED BUS PASSENGER TRAFFIC DEMAND ALONG MAJOR CORRIDORS

S. No.	Year	Passengers Per Hour Per Direction Traffic Flow (PHPDT)
1.	2013	800 – 1500
2.	2021	1650 – 6000
3.	2031	2400 – 7000

2.5.1 Traffic Assignment

The travel pattern and routes are well defined within routes A1, A2, and A3 catering to Raipur and Naya Raipur trips, it is assumed that about 75% of trips shall use A1 and A3 along NH 6 as NH 6 is being upgraded to 4 lane highway. Road number 2 and expressway via NH 6 are expected to serve majority of trips during the initial development phase. Route details for the corridor and travel demand for Naya Raipur are shown in Table 2-3 and Table 2-4 respectively.

TABLE 2-3: DETAILS OF BUS ROUTES AND NETWORK CORRIDOR

Bus Route	Corridor Length	Locations in Raipur	Linking Roads	Locations in Naya Raipur
A1	18.0	Telibandh chowk	NH 6 – Expressway	Capital Complex
A2	22.0	Santoshi chowk	NH 43 – Khandwa	Capital Complex
A3	24.0	Government Housing Colony – Telibandh chowk	NH 6	Capital Complex

Bus Route	Corridor Length	Locations in Raipur	Linking Roads	Locations in Naya Raipur
A4	17.0	N.A	N.A	Nawagaon chowk – Capital Complex – University Complex (NH 43 Junction)
A5	8.0	N.A	N.A	Different sections of Naya Raipur

TABLE 2-4: TRAVEL DEMAND FOR NAYA RAIPUR (DAILY TRIPS)

Bus route	Corridor Length (Km)	2013		2021		2031	
		Boarding	PHPDT	Boarding	PHPDT	Boarding	PHPDT
A1 & A3	18 & 24	44523	2214	205733	7306	221660	7515
A2	22	14841	738	68578	2435	147773	5010
A4	17	12915	644	42788	1429	78289	1674
A5	8	4305	215	28525	476	52193	1116
Total Boarding's		**76854**		**345624**		**499915**	

PHPDT – Per Hour per Direction Traffic
Source: DPR

To achieve efficient mobility and all round accessibility, primary network of the city would have to have public transit priority. The details of the BRT corridor have been shown in Table 2-5.

TABLE 2-5 DETAILS OF DEVELOPMENT OF BRT LANES

S. No	Corridor Description	Length (km)
1	Additional BRTS lanes along the 4-Lane Road	33.0
2	New Road Construction with Bus Lanes	7.0
	Total length in kilometers	**40.0**

2.6 ALTERNATIVES ANALYSIS - TECHNOLOGY OPTIONS

The estimated bus passenger traffic demand along major corridors in the Naya Raipur ranges between 800 to 1500 Per Hour Per Direction Traffic Flow (PHPDT) in the year 2013 and 1650 and 6000 PHPDT in the year 2021, it is likely to go upto 2400 and 7000 PHPDT in the year 2031. The demand has been estimated favoring the BRT System proposed for the Naya Raipur with modal share of 40% in the year 2031.

The travel demand have been estimated based on the envisaged land-use and likely travel pattern assumptions based on experience and the corridors already identified in the Development Plan but there could however, be some new corridors coming up with the development of new areas in phase II and phase III development of Naya Raipur. The land use pattern might vary vis-à-vis the one envisaged in the Development Plan. The estimated travel demand may also vary due to development of these additional corridors and macro level assumptions of the demand estimates and micro level estimates could only be ascertained once the city is developed.

Ministry of Urban Development (MoUD), Government of India with help of the guidelines provided by the World Bank studies suggested that the selection of transport system should be done with respect to the traffic demand and ground constraints. The guideline as suggested by MoUD is set out in the table below.

TABLE 2-6 : GUIDELINES SUGGESTED BY MOUD

S.N	Typical System Capacity (PHPDT)	
1	Bus System (Mixed RoW)	4000 – 6000
2	Bus System (exclusive right of way)	6000 – 15000
3	Mono Rail	15000 – 25000
4	Light rail transit system	15000 – 30000
5	Heavy rail metro system /Sub Urban system	30000 – 80000
6	Suburban Electrical multiple units	30000 – 60000

The estimated traffic demand along the major roads in Naya Raipur once all planned developments are completed has also been estimated at 12000 PHPDT in peak hours. Accordingly, a BRT System has been proposed in Naya Raipur, which would connect Raipur and Naya Raipur and also serve the main corridors of Naya Raipur. The system capacity is planned to meet the traffic demand in Phase I to start with and will be augmented in subsequent phases to meet the development of Naya Raipur.

2.7 ANALYSIS OF ALTERNATIVES

2.7.1 No Project Scenario

The 'No project scenario' is analysed with respect to the development of the city by the backdrop of requirement of reliable quality infrastructure for sustained growth economy and consequent wellbeing of its citizens. Providing better connectivity between Raipur and Naya Raipur will ensure that goods and people from areas covered by the road can commute quicker and save time. Increase in trade and commerce activity is expected. The savings in the Vehicle Operating Costs makes the project viable.

The commercial activity will be getting a good boost due to proposed BRT roads. The commercial activity will give rise to employment potential for people in and around these

places. However, there would be an increase in the vehicular pollution-air and noise, in the vicinity of the road. Some agricultural lands have been diverted for BRT road. In Rakhi village where the road is passing through village, all villagers people lost their properties close by the road to accommodate the proposed widening. This entire village has been rehabilitated in another place.

If the project is not implemented, there is every likelihood that the existing road network roads will deteriorate further. In the absence of the proposed BRT project, the both cities (Raipur & Naya Raipur) will also find it difficult to have good transportation. Increased air pollution, due to slow moving traffic and congestion, will follow. Noise levels will rise due to traffic congestion with increased honking. Without the project, the traffic would continue to pose a safety risk for the road users.

Therefore, the 'project with' scenario, with its minor impacts is more acceptable than the "without" project scenario which would mean slow down development in these cities. Hence, it is clear that the implementation of the project will be a definite advantage to these cities in order to achieve all-round development of its economy and progress for its people.

2.7.2 Project with Alternatives

In this project, project alternatives in terms of location, option are very limited, as the BRT project is coming on the existing road network, which was already constructed.

2.7.3 Alternatives in construction of Bus Stops in BRT corridor

Bus stops in BRT corridor should be erected with pre fabricated constructing with cement, as this will reduce generation of solid waste.

2.8 PROPOSED BRT SYSTEM

The details on the network corridor and other technical specifications of the proposed BRT corridor have been discussed in this section.

2.8.1 Corridor Assessment

Raipur

The road network within Raipur is identified based on the primary and secondary research carried on the potential locations on the road network, envisaged to generate majority of the passenger traffic commuting to Naya Raipur. The intersecting roads in the city are quite congested and it will take more than an hour to travel roundtrip from Tatibandha to Telibandha which are about 10.5 km apart, including the stops for picking up passengers. It will take more than 2 hrs for the BRT system to cover round trip on main roads of Raipur from Tatibandha and number of buses required will also be high. Therefore, it is proposed that the BRT buses in Naya Raipur, providing linkage between Raipur and Naya Raipur to

start from eastern and southern ends of the city along NH 6 and NH 43. Apart from this, some buses can be extended during peak hour to the government housing colony.

It is proposed BRT buses will have night parking in Raipur at three locations, Sonakhana, Amanaka, Secretariat Building. Also proposed four pickup points from Raipur, Kabir nagar, Tatibund, Kasiram nagar, Secretariat building, to starting of BRT corridor at NH-43 (deviated at village Dumartarai) and NH-6 (deviated near agriculture university). As BRT buses cannot run on national highways with dedicated lines these buses run along with normal traffic from Raipur to starting of BRT corridor at Dumartarai and Agriculture University.

Naya Raipur

The BRT corridor with in Naya Raipur is primarily based on the potential land use pattern envisaged in the development plan.

BRT Routes Planned

The details of the bus routes planned for the BRT system. Existing NH 6, NH 43 is used for connecting Raipur to Naya Raipur. There are four BRT corridors. 1) Actual BRT route starts from Serikheri village on NH 6, which is called road No.1 with length of 8.5 Km from Serikheri village towards Naya Raipur. 2) From here road No. 4 will starts to reach Capital Complex, length is 10.1 Km. 3) Road No.2 in the existing road network will be also cater BRT route, which is connecting NH 6 to NH 43 passing through Capital Complex with a length of 17.3 Km. 4) Road No. 5 will starts from NH 43 near Muktangan connecting to BRT Corridor road No. 2 its length is 2.9 Km. The same provided in Table 2-7 and Figure 2-3.

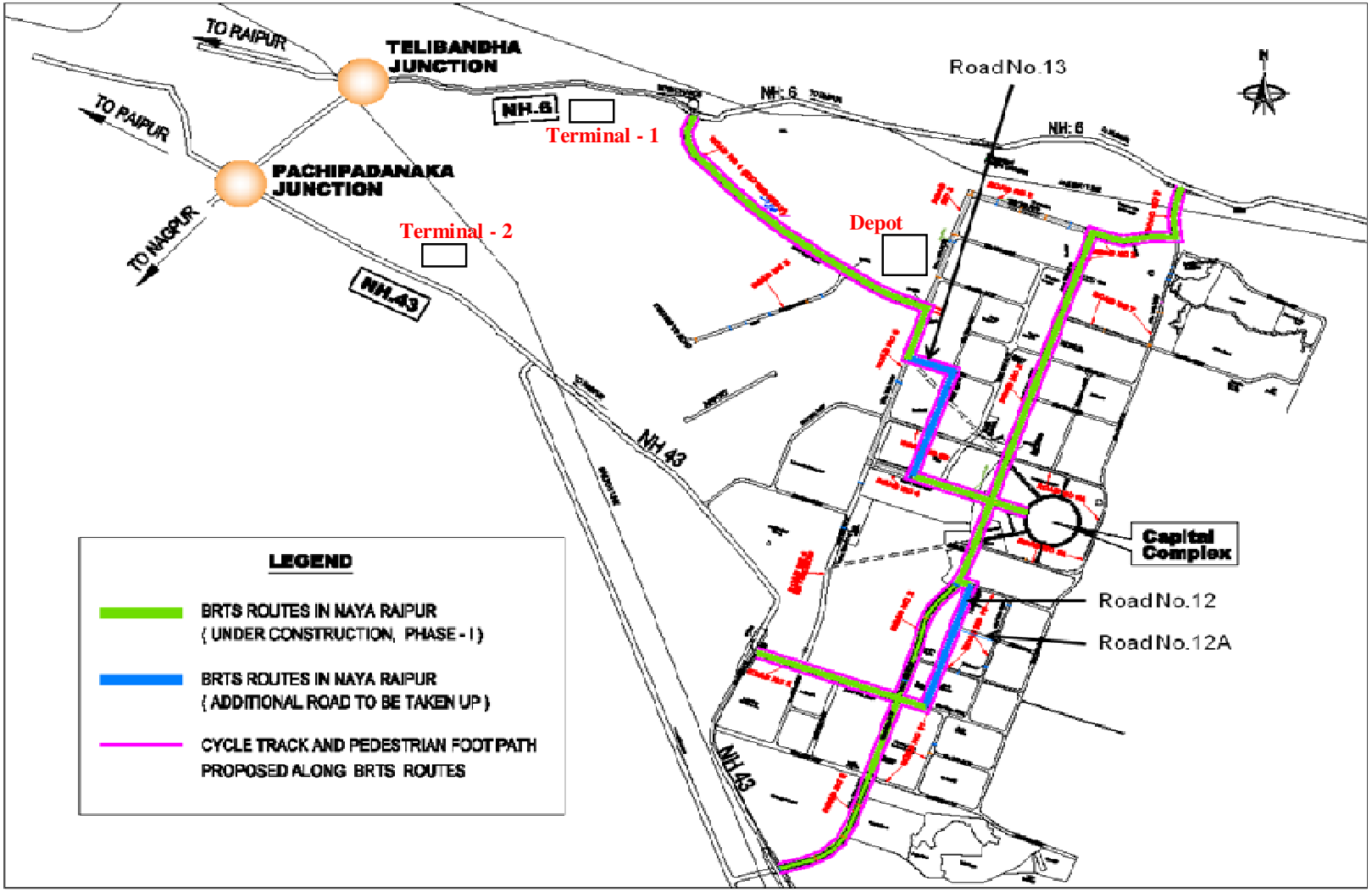
TABLE 2-7 : DETAILS OF BRT CORRIDOR

BRT Road Nos.	Corridor Length (km)	Starting Point	End Point
1	8.5	Serikheri Village on NH 6	Starting point of Road No. 4
2	17.3	NH 6	NH 43
4	10.1	End point of Road No. 1	Capital Complex
5	2.9	NH 43 near Muktangan	Road No. 2
12/12A	7	End point of Road No. 5/perpendicular road from road No. 12 to road No. 10	Joining Road No. 2
13		L shaped road connection road No. 4	--

Source: DPR

Within Naya Raipur city, the BRT corridor will be developed along Road Numbers 1, 2, 4, 5 12, 12A and 13. Majority of the commuters from Raipur to Naya Raipur would be visiting only a few prominent locations within Naya Raipur. So it is proposed to operate BRT buses in these roads. There will be other areas of Naya Raipur which need to be provided transit connection. It is essential that fairly acceptable frequency of buses to be provided in these routes. BRT Corridor with bus routes and terminals and depots is shown in Figure 2-3.

FIGURE 2-3 : BRT CORRIDOR



2.8.2 BRTS Components

Components in Raipur

Terminals:

Two terminals are proposed for BRT system. One is near NH-6 opposite to Agriculture University. Another is near NH-43 in village Dumartarai. Terminals are shown in figures below.

FIGURE 2-4: BUS TERMINAL ON NH 6

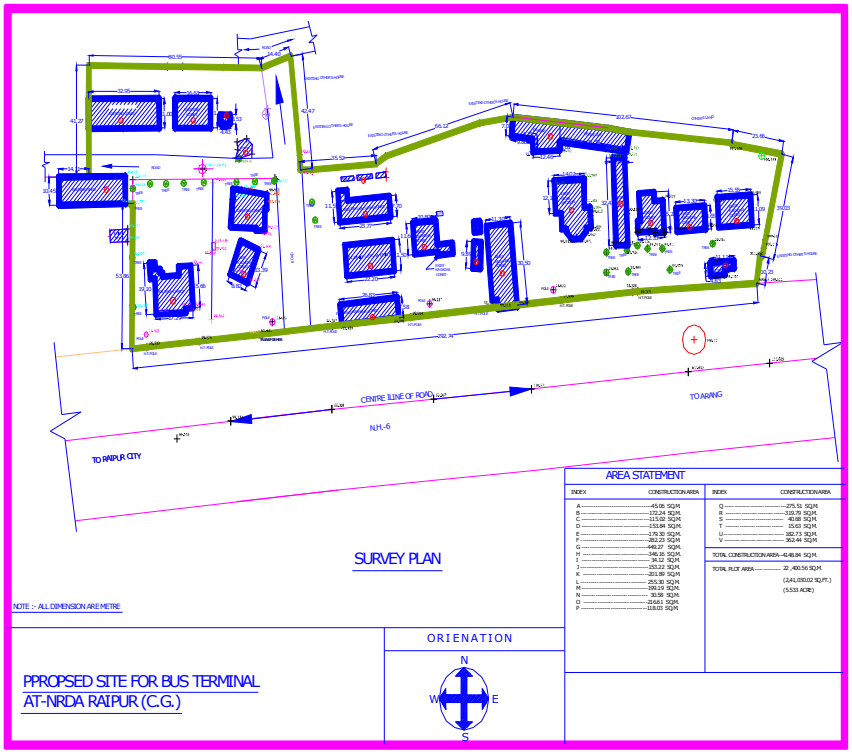
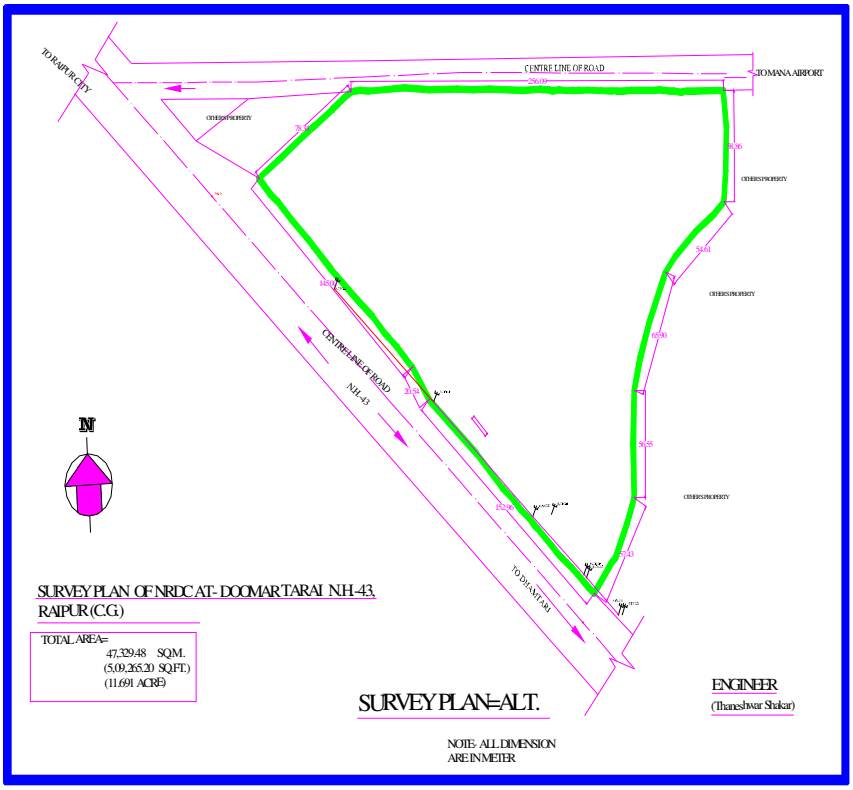


FIGURE 2-5: BUS TERMINAL ON NH 43



Bus-Terminal hold the following:

- Terminal building with adequate bus-bays
- Handicapped friendly passenger facilities
- Drinking water and public amenities with proper maintenance
- Passenger chairs for comfortable sitting
- Pedestrian corridors to access terminal
- Minimum walking for transfer boarding
- Ticketing facilities
- Adequate information system
- Park-and-ride facilities

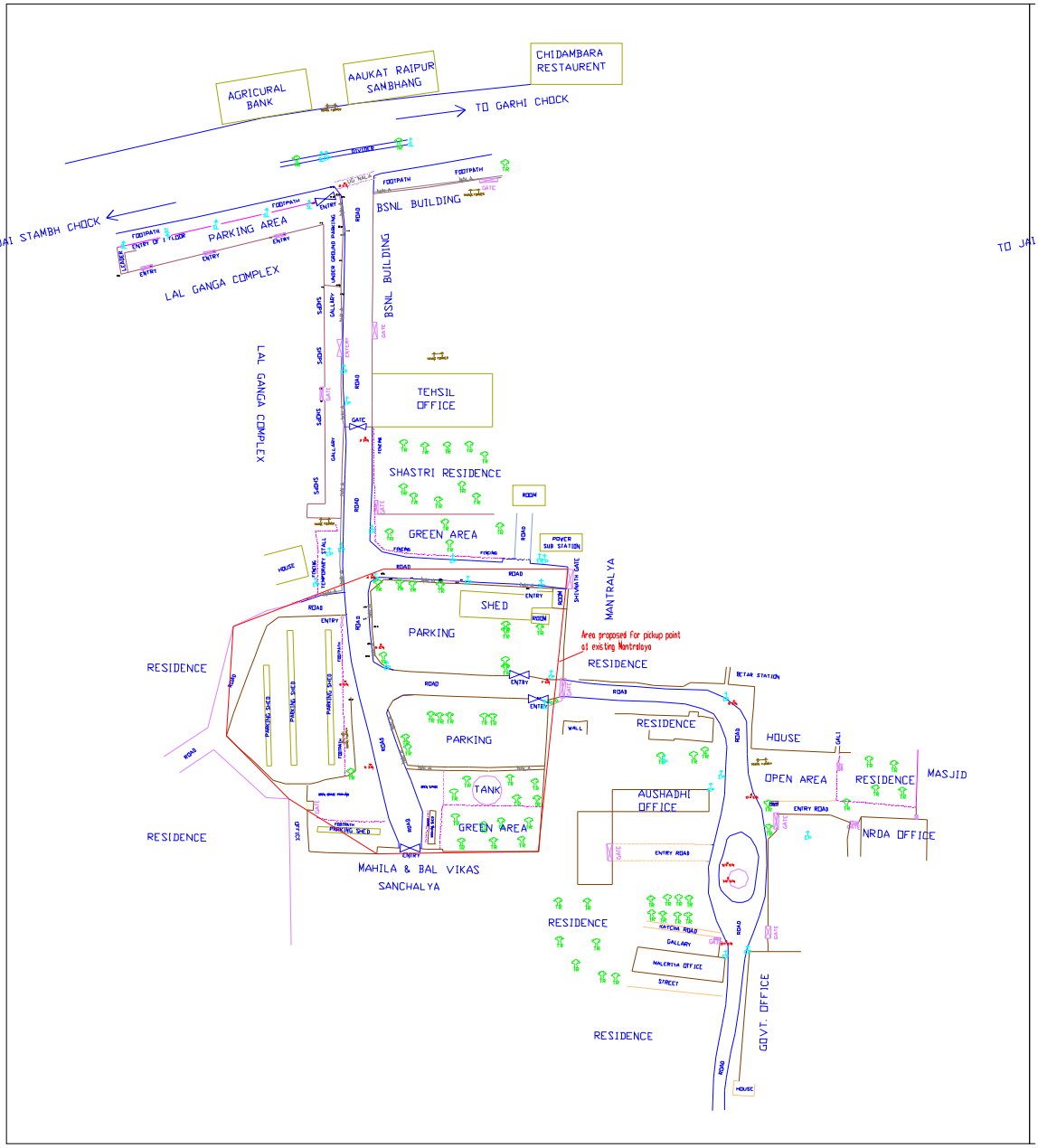
Night Parking:

Night parking is proposed at three locations, Sonakhana, Amanaka, Secretariat Building, in Raipur to cater services to BRTS.

Pickup Points:

There are four pickup points in Raipur, a) Kabir Nagar, b) Tatibund, c) Kasiram Nagar, d) Secretariat Building, to pick employees and local people.

FIGURE 2-6: LOCATION OF PICK UP POINT AT SECRETARIAT BUILDING



Components in Naya Raipur

Bus Depot:

One bus depot is proposed at junction of road No. 1 and road No. 3 in Chichagaon. Bus depot will have maintenance work shop facilities and fuel filling points.

BRTS Bus Stops:

Around 80 bus stops are proposed in Naya Raipur. Additional 12 bus stops will developed in additional roads being developed.

BRTS Routes:

BRTS route numbers 1, 2, 4, 5, 12, 12A and 13 falls in Naya Raipur. (Figure 2-3)

2.8.3 Project Implementation Framework

Some components of the BRT System have already been included under the ongoing developmental activities in Naya Raipur. The project components have been categorized into 3 packages for implementation. The development works under each package and the proposed implementation framework are set out in the table below:

TABLE 2-8 : DETAILS OF THE DEVELOPMENTAL PACKAGES

Sr. No.	Packages	Implementation Framework
1.	**Package I** • Development of additional roads (approximately 7 kilometers) in Naya Raipur. • Development of cycle tracks and pedestrian walkways along the entire BRT network corridor of 40 kilometers.	Engineering-Procurement-Construction (EPC) Framework
2.	**Package II** • Development of two bus terminals in Raipur city. • Development of bus shelters in Raipur, National Highway 6 & 43 and Naya Raipur.	EPC Framework
3.	**Package III** • Procurement of BRT bus and Intelligent Transport System (ITS) equipment, including the ticketing system, GPS/GPRS/GIS system, etc. • Installation of the ITS equipment on to the buses. • Operations of the entire BRT project facilities.	Suitable PPP framework

Development activities to be undertaken in Package II would be further divided into individual activities and a sequential treatment would be given to each of the activities to avoid inconvenience to residents and traffic in the city. For the implementation of Package III, a private operator could be selected for procurement of the rolling stock, ITS and operations and maintenance of the BRT System in Naya Raipur for a specified period of time.

2.8.4 Land Ownership of the Corridor

BRT system is a Greenfield project and the road network ownership in Naya Raipur will be vested with NRDA. Few links in Raipur city would be under the jurisdiction of Raipur Municipal Authority (RMA). The details of land ownership of the network corridor for BRT system are set out in the Table 2-9.

TABLE 2-9 : LAND OWNERSHIP DETAILS OF THE BRT SYSTEM NETWORK CORRIDOR

S. No	Network- corridor	Corridor Length (km)	Ownership details
1	Corridor within Naya Raipur	40.0	NRDA
2	NH- 6	6.5	MORT&H/NHAI
3	NH- 43	14.5	National Highway (NH) division, public works department, Government of Chhattisgarh
4	Corridors within Raipur	6.0	Raipur Development Authority (RDA)

2.8.5 Roadway and Service Design

The implementation of BRT system in Naya Raipur is reasonably easy as it offers a complete new development area. Incorporation of roadways into a BRT system is the major defining factor. Roadways are the most critical element in determining the speed, reliability and cost estimation of the BRT services.

Proposed Alignment of Bus Lanes for BRT system in Naya Raipur

The curb lane operations of BRT buses have been proposed for Naya Raipur for reasons given below:

- The inter-city and intra-city public transport system envisaged for Naya Raipur focuses on the need/requirement of a public mass transportation system that is efficient and cuts down the usage of personalized modes of transport systems and hence would avoid reduction in the speed of the BRT buses at the intersections.
- The average width of the roads in Naya Raipur is 40 meter (single direction). So to provide easier accessibility to passengers from the footpaths, a curb lane system is proposed.

Proposed Open and Closed System for BRT operation

In Naya Raipur, mix of open system and closed system is being proposed as the BRT buses would have to operate on both mixed traffic and on segregated lanes.

BRT will have dedicated lanes with mix of grade separators, demarcating by paint and physical barrier.

Proposed Service System for Naya Raipur

A direct service with identified points in Raipur being directly connected to BRT System corridors has been proposed for Naya Raipur. The public bus transportation system would connect the other areas to the identified points, wherein the BRT buses would pick up passengers from such identified points and transfer them to Naya Raipur.

2.8.6 Geometric Design of Corridors

The concept of the BRT System in India is naive and displays potential to replace other forms of public bus transportation system. The policy matters in terms of design standards and principles exclusively for BRT System are missing in India and do not find its place in the guidelines prepared by the Indian Roads Congress (IRC) or Ministry of Road Transport & Highways (MoRT&H) till date. Since the geometric designs for the BRT System is primarily a part of the road (urban /semi urban sections) cross sectional component either with exclusiveness or mixed condition, the design guidelines adopted for roads or highways (IRC 86:1983 Geometric Design Standards for Urban Roads in Plains) will be applied for the BRT System corridors.

Design Parameters

a) Street Lighting

Street lighting mainly consists of carriageway lighting and street side lighting. Provision is made for street lighting for important corridors, based on the immediate requirements. Road Number 1 has complete provision; Road Number 2 has provision for a length of approximately 4 kilometers near the Capital Complex.

b) Bus Stops

Bus shelters, at the entry point to the system, are the most important passenger interface; so it is essential for these facilities to be convenient, comfortable, safe and easily accessible for all age groups of people. A total of 13 road links are proposed to be developed with the total length of approximately 67 kilometers. Of these, except Road Number 1, other roads have provision of at least one bus bay.

c) Pedestrian and Cycle Tracks

With multiple objectives of equitable opportunity for all modes of traffic, reduce non-renewable energy consumption and vehicle emissions and promote a sustainable urban transportation system, it is proposed to provide comfortable and safe facilities for pedestrians and cyclists along with the implementation of BRT system along the BRT corridors. The road system being implemented in Naya Raipur already incorporates pedestrian footpaths and cycle tracks for about 4.5 km. The remaining 36 km of roadway also will be provided with pedestrian footpaths and exclusive cycle tracks, as part of the implementation of the BRT system.

d) Proposed Buses

As BRT buses will run on the existing/proposed roads in Raipur and Naya Raipur and on National Highways, it is proposed to deploy Semi-Low Floor buses for both high and low capacity buses. The average trip length for Naya Raipur BRTS is estimated to be in the order of 12kms, so it is recommended to have more seating space than standing area. BRTS buses

in Naya Raipur will run with clean CNG fuel. It is proposed to adopt local services along all corridors and express services for buses running to Capitol Complex and other employment centres during the morning and evening peak hours. In the proposed BRT system, though the number of bus stops is more in both Raipur and Naya Raipur, considering the stretch between the two areas, it is proposed to deploy AC buses. Use of AC buses may result in higher average turnaround time per trip.

e) Frequency of Operation

The frequency of trips will be maintained high, with a minimum headway of five minutes between 7 am and 9 pm and before 7 am and after 9 pm headway can be slowly increased. Within Naya Raipur, route A4 is recommended to maintain a minimum headway of five minutes during peak periods and minimum headway of fifteen minutes during off peak hours. The loading factor will increase over the years and this minimum headway can be reduced further over the years.

f) Fleet Size

As per estimates, Naya Raipur will be provided with an operational fleet of 100 buses by 2011, 310 in 2021 and 405 in 2031.

g) Feeder Services

Naya Raipur BRTS will implement mainly a Direct Services System. However, to serve all the main roads in Naya Raipur and the villages in and around Naya Raipur, mini-buses running in mixed traffic conditions with other private traffic are suggested as feeder services. A small fleet of mini buses is suggested for the internal transit and as feeder services from the adjoining villages is the main terminal within Naya Raipur.

2.9 ROLE OF AGENCIES IN BRT SYSTEM OPERATION

The main activities involved in development and operation and maintenance of BRT System and the role of various agencies have been listed out herein:

TABLE 2-10 : ROLE OF AGENCIES IN BRT SYSTEM

Roles	RMC	PWD	Traffic Police	Utility providers in Raipur	NRDA	Remarks
Transport Planning			✓	✓	✓	Joint Action
Road Construction					✓	
Road Maintenance	✓	✓			✓	On stretches owned by the concerned agencies
Traffic Enforcement	✓	✓	✓		✓	Joint Action
Traffic devices-signs, signals etc.	✓		✓		✓	On stretches owned by the concerned agencies
Parking	✓		✓		✓	Joint Action

Roles	RMC	PWD	Traffic Police	Utility providers in Raipur	NRDA	Remarks
Road Safety	✓		✓		✓	Joint Action
Bus operations, including route planning					✓	Joint Action
Utilities	✓			✓	✓	

Source: DPR

2.10 PROJECT COST

The project cost can be classified into two categories based on the nature of expense. The capital cost and the operations and maintenance costs. The details of the proposed system have been discussed here.

Capital cost

The capital cost breakup of proposed project is set out below.

TABLE 2-11 ESTIMATED COST OF PROJECT COMPONENTS

S. No	Project Component	Estimated cost (In Crores)
1	Development of new roads identified in Naya Raipur (approximately 7 km)	34.6
2	Development of Cycle Tracks and Pedestrian walkways (approximately 36 km)	37.7
3	100 streamline BRT buses	30.0
4	20 mini buses operating as feeder service to the main BRT buses within Naya Raipur	2.0
5	Development of Bus Stops / Bus Shelters	2.2
6	Development of two Bus Terminals in Raipur	10.0
7	Development of Bus Depot in Naya Raipur	9.0
8	Traffic Safety System for non-motorized vehicles	1.0
9	GPS/PIS System	4.0
10	Ticketing System	1.0
11	Technical Assistance for Transit Oriented Development	1.0
12	Monitoring and Evaluation	1.6
13	Project preparation and implementation expenses	17.1
14	Contingencies	8.0
	Total project cost	**159.2**

Operational cost

The operational costs in the first year of operations comprising expenses incurred in carrying out day to day operations of the BRT System and its management and the details of the same have been estimated and are set out in the table below.

TABLE 2-12 : BREAKUP OF THE OPERATIONAL COSTS IN THE FIRST YEAR OF OPERATIONS

S. No	Description	Estimated operational cost (Rs. Crores)
1	Fuel Expenses	7.9
2	Repair and Maintenance Expenses	3.2
3	Salary Expenses	3.0
	Total	**14.1**

3.0 Review of Environmental Regulatory Framework

This chapter discusses the policies, legislations and procedures for environmental assessment and land acquisition / resettlement, at the national and state levels. Several environmental standards specified by Ministry of Environment and Forest (MoEF) and other ministries may be applicable to the proposed project of Naya Raipur roads. Project and project area will be under the purview of water (Prevention and Control of Pollution) Act 1974; Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act 1986 via State Pollution Control Boards (SPCB) newly established for Chhattisgarh to implement and enforce the national standards for effluents, water quality, ambient air quality and ambient noise level. Further, the project will be under the purview of the guidelines of CPCB formulated for municipal waste generation as Municipal waste (Management and Handling) Rules 1998. A detailed list of applicable legislations is given in Table 3-1.

The proposed project of Naya Raipur roads may fall under the regulation of several environmental standards specified by Ministry of Environment and Forests (MoEF) and other ministries.

TABLE 3-1 : APPLICABLE LEGISLATIONS

Applicable GOI policies & Regulations	Year	Objectives	Applicability
Environmental (protection) Act	1986	Protection and improvement of overall environment	Environment in general
Air (prevention and control of pollution)Act	1981	Controlling air pollution by controlling emission and air pollutants according to prescribed standards	Air pollution
Water (Prevention and Control of Pollution) Act and Cess Act of 1977	1974	Controlling water pollution by controlling emission & water pollutants as per the prescribed standards	Water pollution
Indian forest Act	1980	Protection of forests	Forest
The Wildlife (protection) Act	1972	Protection of wildlife	Wildlife
The Land acquisition Act	1894 and 1989	Setting out rules for acquisition of land by government	Land Acquisition
Noise pollution (regulation and control) rules 2000	2000	Noise pollution regulation and control	Control of Noise
EIA Notification, 2006	2006	Infrastructure projects impact assessments	Environmental clearance
International environmental regulation in which India is a signatory		International Environmental issues such as emission of Green House Gases (GHG)	Global Environmental issues

The proposed project is located in the rural area near Raipur where no reserved forest or ecologically sensitive water bodies exists. The road alignment selected is not expected to pass through environmentally sensitive locations.

3.1 ENVIRONMENTAL CLEARANCE

For protecting and enhancing the quality of the environment at the national level and for promoting sustainable development throughout India, the Ministry of Environment and Forests of India (MoEF) is responsible. These requirements and the projects to which they apply are set out in a Notification issued by MoEF on September 14, 2006. The different projects have been categorized as A category and B category projects based on the type of industry/development, pollution load and size of the project. The A category projects are appraised at the Central level whereas the category B projects are appraised at the State level.

State level environment impact assessment authority, Chhattisgarh had given environment clearance saying these road development are neither National Highways nor State Highway. This BRT development should be a part of Naya Raipur Satellite City and not treated separately. Hence this project is covered in serial no: '8(b) Townships and Area Development Project' of EIA Notification, 2006. The Environmental Clearance for Naya Raipur has been attached as **Annexure – I**.

3.2 ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK (ESMF)

This Environmental and Social Management Framework (ESMF) lays down the principles and guidelines for addressing environment and social impacts due to the implementation of the demonstration projects in the selected cities. Key objectives of ESMF are:

- Provide a framework for the integration of social and environmental aspects at all stages of project planning, design, execution and operation.
- Ensuring positive social and environmental impacts and avoiding/minimizing any potential adverse impacts

The environmental and social safeguards policies shall be applied to all projects to be taken up under GEF-SUTP. Adoption of this framework shall ensure that the projects meet the national and state level environmental and social safeguards and are also consistent with the applicable safeguards policies and provisions of the World Bank.

3.2.1 Application of the ESMF

Projects triggering significant environmental / social impacts, i.e. projects with potential to trigger impacts on environmental sensitive areas, or large scale resettlement activities are not envisaged under GEF-SUTP. However, in the event of such projects, being critical to the GEF priorities, the projects shall be included after undertaking the necessary environmental and social assessments, as mandated by the GoI / state governments and conforming to the safeguard policies of the World Bank.

3.2.2 Applicable Policies

National Resettlement and Rehabilitation Policy, 2007 and the Land Acquisition Act 1894 (as amended in 1984) are the applicable legislations at the centre and these would be applicable for all components of the project. While at the state level, respective state governments have formulated a resettlement policy for various multilaterally funded projects being undertaken in the states and these would be applicable.

In addition, the World Bank policies such as Environmental Assessment OP 4.01, Cultural Properties OP 4.11, and Involuntary Resettlement OP 4.12 will be applicable in sub-projects involving civil construction activities and removal of squatters / encroachers.

3.2.3 Resettlement policy

The National Resettlement and Rehabilitation Policy, 2007 and the Land Acquisition Act 1894 (as amended in 1989) are the applicable policies at the central level and are described in detail below.

National Policy on Resettlement and Rehabilitation Policy (NRRP, 2007)

The project is likely to physically displace 400 families or more en masse in plain areas and 200 families or more en masse in tribal or hilly areas, DDP blocks, or areas mentioned in Schedule V and Schedule VI of the Constitution of India. The objectives of the Policy are:

- Minimizing displacement and promoting as far as possible, non-displacing or least displacing alternatives;
- Ensuring adequate rehabilitation package and expeditious implementation of the rehabilitation process with the active participation of displaced persons;
- Ensuring that special care is taken for protecting the rights and also ensuring affirmative state action for weaker segments of society, especially members of SCs and STs and to create obligations on the state for their treatment with concern and sensitivity;
- Providing a better standard of living to displaced families;
- Integrating rehabilitation concerns into the development planning and implementation process; and
- Facilitating a harmonious relationship between the requiring body and displaced persons through mutual cooperation, where displacement is on account of land acquisition.

Sub-projects conceived under SUTP though involve relocation of squatters and encroachers do not envisage large scale social and resettlement impacts. However, in the event of such impacts occurring in the project area, special rehabilitation scheme of Naya Raipur Development Authority shall take care of these issues.

Special Rehabilitation Scheme of Naya Raipur Development Authority

Under section 69 of Chhattisgarh Town & Country Planning Act 1973 read together with section 56, for land acquisition with mutual consent and agreement is proposed to ensure a reasonable compensation package to project affected persons in NRDA area. Persons giving

their land under mutual consent and an agreement with Naya Raipur development Authority, alone will be eligible to benefit from this special rehabilitation scheme and those persons who do not agree to sell their land to NRDA under this scheme shall be entitled only to benefits under the normal provisions of Land Acquisition Act, 1894.

Land Acquisition Act, 1894

The Act provides a framework for facilitating land acquisition within India. This Act enables the State to acquire private land for public purposes. The Act also ensures that no person is deprived of land except under this Act and entitles the Affected Person/s to a hearing before acquisition. The main elements of the Act are given in Table 3-2.

TABLE 3-2 : LAND ACQUISITION ACT

Section	Aspect	Provision
Section 4	Notification of land	Notification of land identified for the purpose of public welfare. Objections must be made within 50 days to the DC (highest administrative officer) of the concerned district. No further sales or transfers are allowed.
Section 6	Intention to acquire land	DC is directed to take steps for the acquisition, and the land is placed under Section 9. Interested parties are then invited to state their interest in the land and the price.
Section 11	Enquiry and award by collector	DC shall make an award within one year of the date of publication of the declarations. Otherwise, the acquisition proceedings shall lapse.
Section 12	Award of collector when to be final	Award shall be filed in the Collector's office and shall, except as hereinafter provided, be final and conclusive evidence, as between the Collector and the persons interested, whether they have respectively appeared before the Collector or not, of the true area and value of the land, and the appointment of the compensation among the persons interested
Section 18	Reference to court	In case of disagreement on the price awarded, within 6 weeks of the award the parties (under Section 18) can request the DC to refer the matter to the Courts to make a final ruling on the amount of compensation. Compensation for land and improvements (such as houses, wells, trees, etc.) is paid in cash by the project authorities to the State government, which in turn compensates landowners. The price to be paid for the acquisition of agricultural land is based on sale prices recorded in the District Registrar's office averaged over the three years preceding notification under Section 4. The compensation is paid after the area is acquired, actual payment by the State taking about two or three years. An additional 30 percent is added to the award

Section	Aspect	Provision
		as well as an escalation of 12 percent per year from the date of notification to the final placement under Section 9. For delayed payments, after placement under Section 9, an additional 9 percent per annum is paid for the first year and 15 percent for subsequent years.

Getting of Permits/ NoCs/ clearances are in scope of respective construction contractor whereas NRDA will look into these things getting done. They are NOC from State Pollution Control Board, Consent to Establish, Consent to Operate, Permit to cut the tree.

4.0 Baseline Environmental Status

To identify any potential impact on and potential change to the natural and socioeconomic environments, it is vital to have a thorough understanding of the nature of the existing environment prior to commencement of the proposed activities. This chapter describes the existing environmental settings in the study area.

To characterize existing baseline environmental and socio-economic conditions including establishing prevailing conditions for a range of media through primary monitoring, undertaking focused surveys; collection of secondary information from various published sources was carried out. This included the physical environment, biological environment and socio-economic environment. The major purposes of describing the environmental settings of the study area are:

- Understanding the need of the project and environmental characteristics of the area;
- Assessing existing environmental quality, as well as the environmental impact of future development;
- Identification of environmentally significant factors or geographical areas that could influence decisions about any future development.

The details of the baseline studies are discussed hereby in the following section.

4.1 METHODOLOGY OF CONDUCTING BASELINE STUDY

Components of physical environment like water, ecology, soil, air, socio-economic and noise quality in the surrounding areas were assessed primarily through field studies, and by undertaking monitoring and analysis of samples collected from the field. The potential impacts/mitigation measures for the attributes – Air, Noise, Water (surface & ground), Soil, Trees, Urban Ecosystems and Landscapes, Social Issues and Urban Infrastructure, Religious and Cultural Structures and Solid/Liquid Waste affecting the BRT route shall be discussed in detail in Chapter 5 & 6. Information about geology, hydrology, prevailing natural hazards like earthquakes, etc. have been collected from literature reviews and authenticated information made available by government departments. Extensive surveys were carried out to understand and record the biological environment prevailing in the area and the same was verified against published information and literature. The socioeconomic environment has been studied through extensive consultations with various stakeholders with a strong focus on neighboring villages. Additionally, socioeconomic data has been obtained from the Census and various government departments.

With interdisciplinary team discussions, criteria questions and professional judgment, the scoping and extent of data generation was formulated. The study area for undertaking baseline studies has been taken as 5 km on either side of the road alignment. However, based on the initial survey, understanding of the project and professional judgment, the study area

for primary baseline studies and intensive data collection was taken as 2 km on either side of the alignment.

4.2 LOCATION OF THE STUDY AREA

Naya Raipur is located near the centre of large fertile plains of Chhattisgarh region and is situated between 21°0.5'19.23" N and 81°45'0.99"E to 21°13'2.87" N and 81°46'59.09"E. The proposed Naya Raipur City is situated in Raipur district of Chhattisgarh and occupies the south-eastern part of upper Mahanadi basin. Raipur district is bounded on the north by Bilaspur & Janjgir Champa districts, on the south by Koraput district of Orissa state, on the east by Koraput & Kalahandi districts of the same state and by Durg district on the west. Kharun River in the west forms the western boundary of the district and Seonath & Mahanadi mark the northern boundary with Bilaspur and Janjgir Champa districts.

4.3 AIR ENVIRONMENT

Primary data was collected for the summer season to understand the air quality of the region and to assess the impact on air environment.

4.3.1 Climate and Meteorology

Raipur falls in the sub-tropical climatic region. The climate of the area is moderate and tropical, characterized by a hot summer from March to mid June, a humid monsoon or rainy season stretching from mid June to September, a short pleasant post-monsoon during October and November, and a cool winter spanning between December and February. Therefore, climatologically there are four seasons i.e. summer (pre-monsoon), monsoon, post-monsoon and winter.

A) Meteorological Data

Table 4-1 shows climatological summary for Raipur for the year 2009.

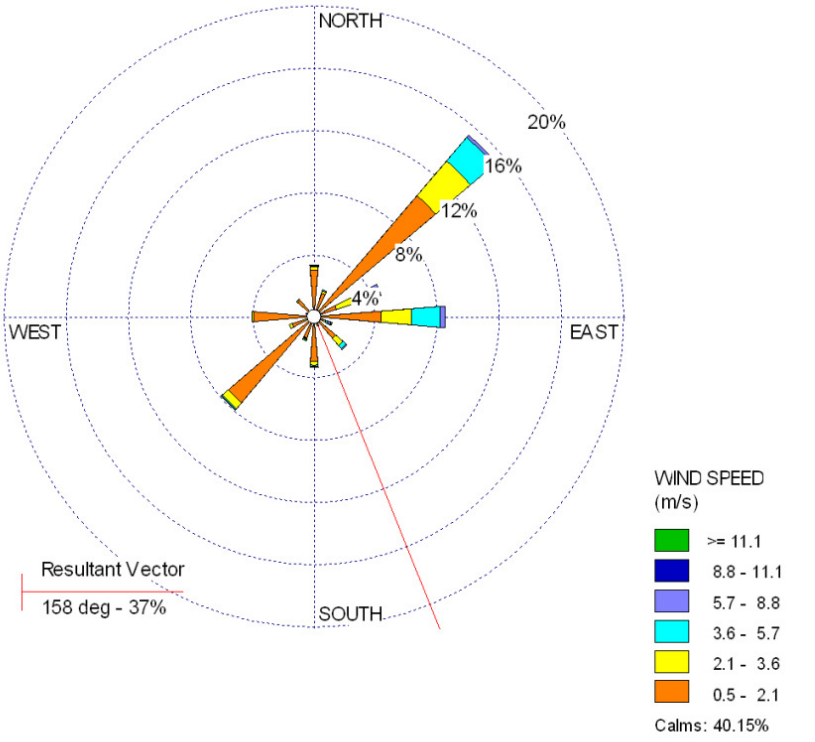
TABLE 4-1 : CLIMATOLOGICAL SUMMARY FOR RAIPUR (2009)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)	Mean Wind Speed (m/s)
January	35.0	14.4	52.4	0.0	0.6
February	37.8	15.4	38.3	0.0	0.8
March	40.0	19.6	32.4	0.0	0.8
April	44.0	21.0	25.1	2.1	1.0
May	45.8	24.6	31.3	4.9	1.7
June	43.8	23.8	45.0	25.8	2.7
July	33.6	24.0	81.6	571.8	3.1
August	34.6	23.4	79.8	246.4	1.9
September	36.2	24.0	75.6	66.4	1.3
October	34.0	16.0	67.7	20.1	0.6
November	33.6	12.8	68.4	10.5	0.8
December	30.4	12.4	62.9	0.3	0.3
Average/ Total	**37.4**	**19.3**	**55.0**	**948.3**	**1.3**

Source: IMD Pune

Wind rose summarizes a considerable amount of wind frequency information into a single graphic and is shown in Figure 4-1 (annual for 2009).

FIGURE 4-1 : WIND ROSE RAIPUR (ANNUAL FOR 2009)



Development of BRT system in Naya Raipur
DATA PERIOD 1st Jan 2009 31st Dec 2009 00.00-24.00
AVG WIND SPEED 1.28 m/s
CALM WINDS FREQUENCY 40.15%
DISPLAY WIND DIRECTION (Blowing From)
SENES CONSULTANTS INDIA PVT. LTD.

The annual wind rose diagram reveals that wind was blowing predominantly from the northeast direction. The onsite average wind speed was observed 1.28 m s^{-1} with frequency of calm winds 40.15% during the monitoring period. The annual predominant wind direction is north easterly.

B) Long Term Climate Trends

Long-term climate trend data was obtained for Raipur station from Indian Meteorological Department (IMD). The region is characterized by dry and warm climate. Summers are very hot which commences from March to mid-June. Winter witnesses cold waves between the months of October and February. Monsoon starts mid June and lasts till the end of September. The mean monthly average maximum and minimum temperature in winter i.e. in the month of January is about 27 and 13 °C respectively. Whereas, mean monthly average maximum and minimum temperatures in summer i.e. in the month of May are about 42 and 28 °C respectively. The relative humidity during south-west monsoon season is over 75 percent but sometimes it goes to 100 percent. During winter season, air is fairly dry. Rain is predominant during July and August. On an average, there are 61 rain days in a year. The Raipur District

receives 87.1 percent of the total rainfall from the south-west monsoon during June to September. The winter–rainfall accounts for 9 percent of the total rainfall. During the monsoon season, the maximum rainfall occurs during the months of July and August. Over the course of a year, wind usually blows in all directions, with varying frequencies. Certain directions occur more frequently than others – these are known as the prevailing wind directions. On an average, over the course of a year, the prevailing winds are from the north and northeast direction.

The long-term climate trend of secondary data collected for the IMD station located in Raipur over a period of 1951-1980; as well as the decadal trend of secondary data collected from IMD Pune (1993-2002) is provided in **Annexure – II**.

4.3.2 Ambient Air Quality in Study Area

National Ambient Monitoring Programme (NAMP) intends to determine compliance to ambient air quality standards. Therefore, source apportionment studies based on "Receptor" is adopted in many countries to get information on causes of elevated PM concentrations. For this purpose, chemical characterization of PM along with the application of source dispersion models is a prerequisite to attribute ambient concentrations to their sources for the development of emissions reduction strategies. The general guidelines for the site selection are provided in the footnote[1] below.

Site–specific Background Air Quality Monitoring

A site specific background air quality monitoring program was conducted for one season (pre monsoon season). Background data was collected for SPM, RSPM, SO_2, NO_x and CO.

Six sampling stations were located in the study area to provide the surrounding baseline air quality. The details of monitoring locations are specified in Table 4-4 and Figure 4-2.

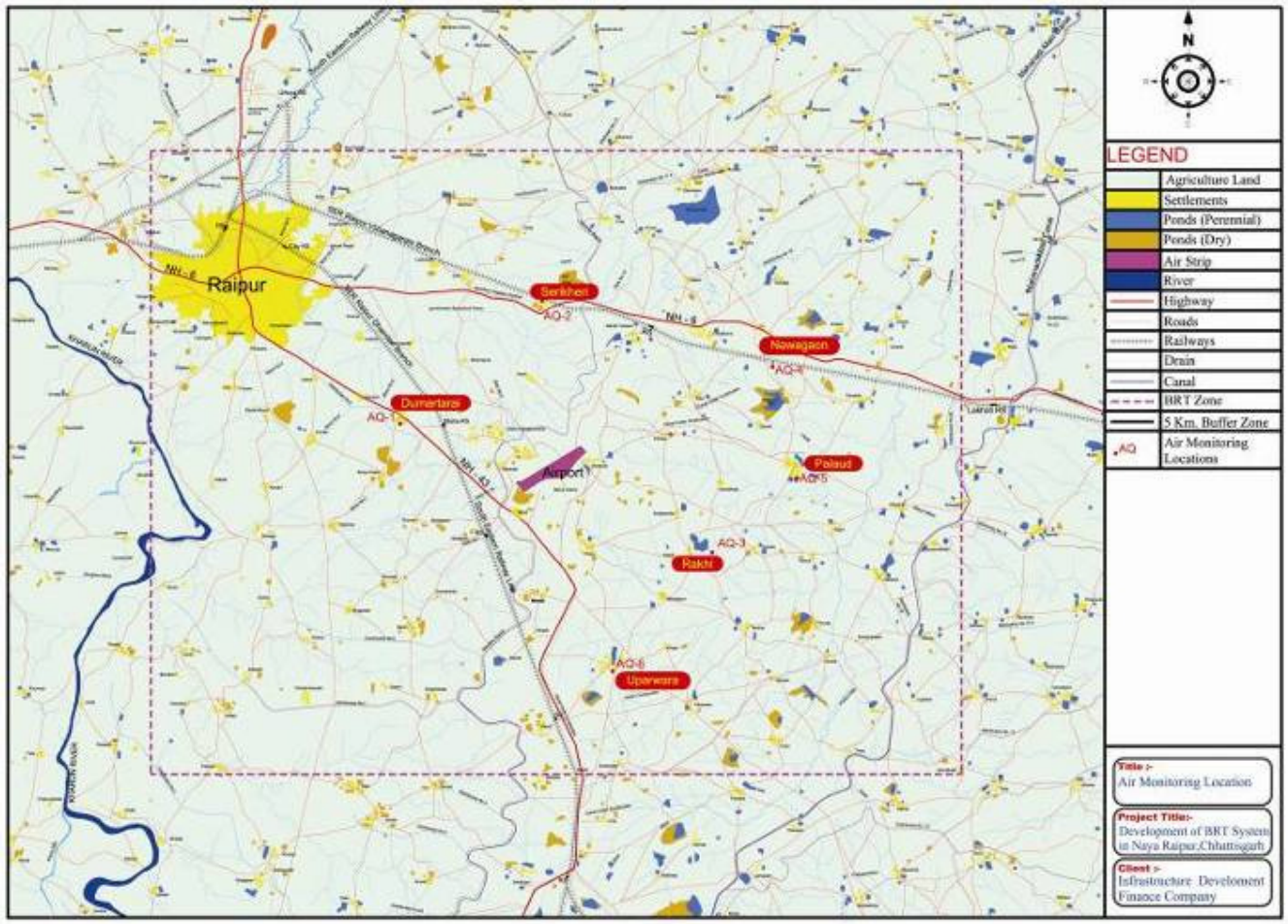
TABLE 4-2 : MONITORING LOCATIONS

Monitor	Description	Land Use
AQ1	Dumar Tarai Village	Residential
AQ2	Serikheri Village	Residential
AQ3	Capital Complex	Institutional
AQ4	Nawagaon Village	Residential
AQ5	Palaud Village	Residential
AQ6	Uparwara Village	Residential

[1] ***General Guidelines for Site Selection***

Siting guidelines refer to the environs surrounding a measurement location, and these differ depending on the zone representation intended for a specific monitoring site. Large nearby buildings and trees extending above the height of the monitor may present barriers or deposition surfaces. Certain trees may also be sources of PM in form of detritus, pollen, or insect parts. These can be avoided by locating samplers by placing them more than 20m from nearby trees, and twice the difference in elevation difference from nearby major buildings or other obstacles. The background monitoring sites should be located at more than 10km from large population centres, and more than 100m from roads and wood burning. The main objective of study is not compliance monitoring but to select "Hot Spots" representing maximum impact zone of different source categories.

FIGURE 4-2 : AIR MONITORING STATIONS



As per standard methodologies and accepted protocols, as detailed by the MoEF the background-monitoring program was carried out.

Air quality was monitored with four high volume samplers, for 24 hours, twice a week. Each sampler maintained a volumetric flow rate between 1-1.2 m^3/min. In this manner, 24 hourly values for all pollutants were collected at each of the four locations, except for CO which is 8-hourly. Analysis of pollutants was done as per standard IS codes.

Monitoring has been conducted in pre-monsoon season of the year 2009. Monitoring results (observed levels and ranges) of SPM, RSPM, SO_2, NO_x and CO are presented in the Table 4-5 to Table 4-10**.**

TABLE 4-3 : MONITORING PROGRAM RESULTS – AQ1

Units: µg/m^3

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	126.4	114.6	102.8	200
RSPM	30.3	26.3	22.4	100
SO_2	13.9	12.9	11.8	80
NO_x	16.4	15.6	14.8	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 4-4 : MONITORING PROGRAM RESULTS – AQ2

Units: µg/m^3

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	96.7	92.5	88.3	200
RSPM	21.4	19.9	18.4	100
SO_2	11.8	10.8	9.8	80
NO_x	16.9	15.2	13.6	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 4-5 : MONITORING PROGRAM RESULTS – AQ3

Units: µg/m^3

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	166.4	151.5	136.6	200
RSPM	36.2	31.3	26.4	100
SO_2	14.8	13.5	12.2	80
NO_x	17.2	16.3	15.4	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 4-6 : MONITORING PROGRAM RESULTS – AQ4

Units: μg/m³

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	88.3	82.5	76.8	200
RSPM	20.3	19.5	18.8	100
SO_2	11.6	11.0	10.4	80
NO_x	14.4	14.0	13.6	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 4-7 : MONITORING PROGRAM RESULTS – AQ5

Units: μg/m³

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	102.4	96.0	89.6	200
RSPM	24.6	22.6	20.6	100
SO_2	13.8	12.7	11.6	80
NO_x	17.4	16.3	15.2	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 4-8 : MONITORING PROGRAM RESULTS – AQ6

Units: μg/m³

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	114.4	102.5	90.6	200
RSPM	25.4	22.9	20.3	100
SO_2	13.2	12.4	11.6	80
NO_x	16.9	16.1	15.3	80
CO	< 1.0	< 1.0	< 1.0	2000

With respect to pollutants, the results of the monitoring program indicate the following:

- The observed SPM and RSPM levels are within the NAAQS at all locations.
- NO_X and SO_2 concentrations are well within the specified standards at all the monitored locations.
- CO concentration is also within the specified standards at all the monitored locations.

4.3.3 Noise Environment

To be able to make an assessment of noise impacts, a noise monitoring study has been carried out to establish existing ambient noise quality in the study area.

A) Ambient Noise Quality

An assessment of baseline noise quality was undertaken to establish the status of exposure of the major sensitive receptors.

This assessment was accomplished by conducting a site–specific background–monitoring program and where appropriate, drawing comparisons to the applicable Ambient Air Quality Standards in Respect of Noise (AAQSRN).

B) Site-Specific Background Noise Quality Monitoring

Noise monitoring was conducted at eight locations within the study area .The background-monitoring program was done in accordance with the requirements of an EIA study. Sound pressure level (SPL) measurements were automatically recorded to give the noise level for every hour continuously for 24 hours in a day.

Accordingly one full day (i.e. 24 hourly values) of data was collected at each of the eight locations. These monitoring locations are set out below**.**

TABLE 4-9 : AMBIENT NOISE MONITORING STATIONS

Monitor	Description	Category
N1	Dumar Tarai	Residential
N2	Serikheri	Residential
N3	Capital Complex	Commercial
N4	Nawagaon Village	Residential
N5	Palaud	Residential
N6	Uparwara	Residential
N7	Mana	Residential
N8	National Highway 43	Commercial

Table 4-10 provides equivalent noise levels viz., L_{eqday} and $L_{eqnight}$, at the noise monitoring locations, alongside noise standards as prescribed by the CPCB. L_{eq} was calculated using the following equation:

$$L_{eq,T} = 10\log\left(1/n\sum_{i=1}^{n}10^{\frac{L_i}{10}}\right)$$

Where L_i = levels observed at n equally spaced times during interval T.

TABLE 4-10 : MONITORING PROGRAM RESULTS – NOISE

Location	Day Time[2]		Night Time[3]	
	Leq (dB (A))	Limit Leq (dB (A))	Leq (dB (A))	Limit Leq (dB (A))
Serikheri	43.3	55	39.0	45
Capital Complex	56.1	65	49.1	55
Navagaon Village	44.0	55	38.6	45
Dumar tarai	46.8	55	41.1	45
Palaud	44.8	55	38.8	45
Uparwara	44.4	55	39.1	45
Mana	46.9	55	40.6	45
NH-43	54.9	65	45.6	55

[2] *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*
[3] *Night time shall mean from 10.00 p.m. to 6.00 a.m*

The results of the monitoring program indicate that both daytime and nighttime levels of noise are within AAQSRN limits at all the 8 locations surveyed.

4.3.4 Traffic Pattern & Density

Traffic counts were carried out on NH-43 and NH-6 to provide background values of traffic density, and correlate such data to the levels of air pollution and noise along the road.

Site-Specific Traffic Monitoring

Site-specific traffic study was conducted on NH-43 connecting Raipur – Jagdalpur, and on NH-6 connecting Raipur – Bilaspur on weekday and weekend. The traffic volumes observed on weekday and weekend on these roads have been presented in **Annexure-III**. Vehicular traffic included heavy vehicle (truck, buses, matadors) and light vehicle (Car, scooters, motorcycle).

As per the graphs, for few vehicles such as cycle rickshaw & cycles their density on the road has been observed to be constant throughout the day. In average not more than 1 vehicle has been observed per hour. Their number goes to maximum of 2-3 vehicles per hour. In few hours of the day no vehicle movement has been observed for the aforementioned vehicles.

For vehicles such as three wheelers, some rise has been observed in its density on road in the period after 1 am, which reaches its threshold of near about 55 - 60 vehicles per hour in the period between 7 am to 11 am. After this a decrease in vehicle density takes place which

Noise Standards:

Area Code	Category of Area/Zone	Limits in dB (A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

reaches its minimum of 4 – 6 vehicles per hour as the day completes its 24th hour. The average density of the vehicle is observed to be in the range of 20 to 30 vehicles per hour.

For vehicles such as HMVs / 2Axle or 3Axle, the pattern is observed to be similar as three wheelers. A rise has been observed in the period after 1 am, which reaches its threshold of 50-60 vehicles per hour in the period between 3 am to 2 pm. After this, decrease in the vehicle density takes place & reaches its minimum of 10-20 vehicles per hour in the period between 10 to 12 pm. The average density of the vehicle is observed to be in the range of 30 to 40 vehicles per hour.

For vehicles such as cars/vans, two wheelers & Busses/Lorries, a sharp rise in the vehicle density has been observed after 1 am. For cars/vans it reaches its threshold of 150 to 200 vehicles per hour in the period of 1 pm to 3 pm. After this, an equally sharp dip takes place in its density & reaches its minimum of 7 to 20 vehicles per hour in the period of 10 to 12 pm. The average density of the vehicle is observed to be in the range of 50 to 100 vehicles per hour.

For two wheelers it reaches its threshold of 100 to 170 vehicles per hour in the period of 10 am to 6 pm in the week days & by 12 pm on weekends. After this, an equally sharp dip takes place in its density & reaches its minimum of 5 to 15 vehicles per hour in the period of 10 to 12 pm. The average density of the vehicle is observed to be in the range of 30 to 100 vehicles per hour.

For Busses and Lorries it reaches its threshold of 130 to 170 vehicles per hour in the period of 9 am to 1 pm. After this, an equally sharp dip takes place in its density & reaches its minimum of 5 to 20 vehicles per hour in the period of 10 to 12 pm. The average density of the vehicle is observed to be in the range of 50 to 90 vehicles per hour.

4.4 WATER ENVIRONMENT

This section documents the baseline scenario of the water environment in the study area. The data has been collected from primary monitoring carried out in the study area.

4.4.1 Baseline Water Quality & Sampling Locations

To establish baseline water quality in the project area water sampling and analysis has been conducted, following standard guidelines for physical, chemical and bacteriological parameters, though they are not getting affected due to project. Analysis has been done as per the methods prescribed in "Standard Methods for the Examination of Water and Wastewater (American Public Health Association)". Five ground water and surface water samples were evaluated in the study area. Table 4-11 & Table 4-12 give details of the ground water and surface water sampling stations. The sampling locations are also depicted in Figure 4-3.

TABLE 4-11 : GROUNDWATER QUALITY MONITORING LOCATIONS

Station No.	Description
GW - 1	Rakhi
GW - 2	Navagaon
GW - 3	DumarTarai
GW - 4	Uparwara
GW - 5	Palaud

TABLE 4-12 : SURFACE WATER QUALITY MONITORING LOCATIONS

Station No.	Description
SW - 1	Rakhi
SW - 2	Navagaon
SW - 3	DumarTarai
SW- 4	Uparwara
SW-5	Palaud

Table 4-13 shows the physicochemical characteristics of composite ground water sampling in the selected areas as compared with the standard (IS 10500: Indian Standards/Specifications for Drinking Water) reference values. Table 4-14 shows the physicochemical characteristics of surface water samples as compared to CPCB Standards for Class "C" water i.e. water to be used for drinking after conventional treatment followed by disinfections.

FIGURE 4-3 : WATER SAMPLING LOCATIONS

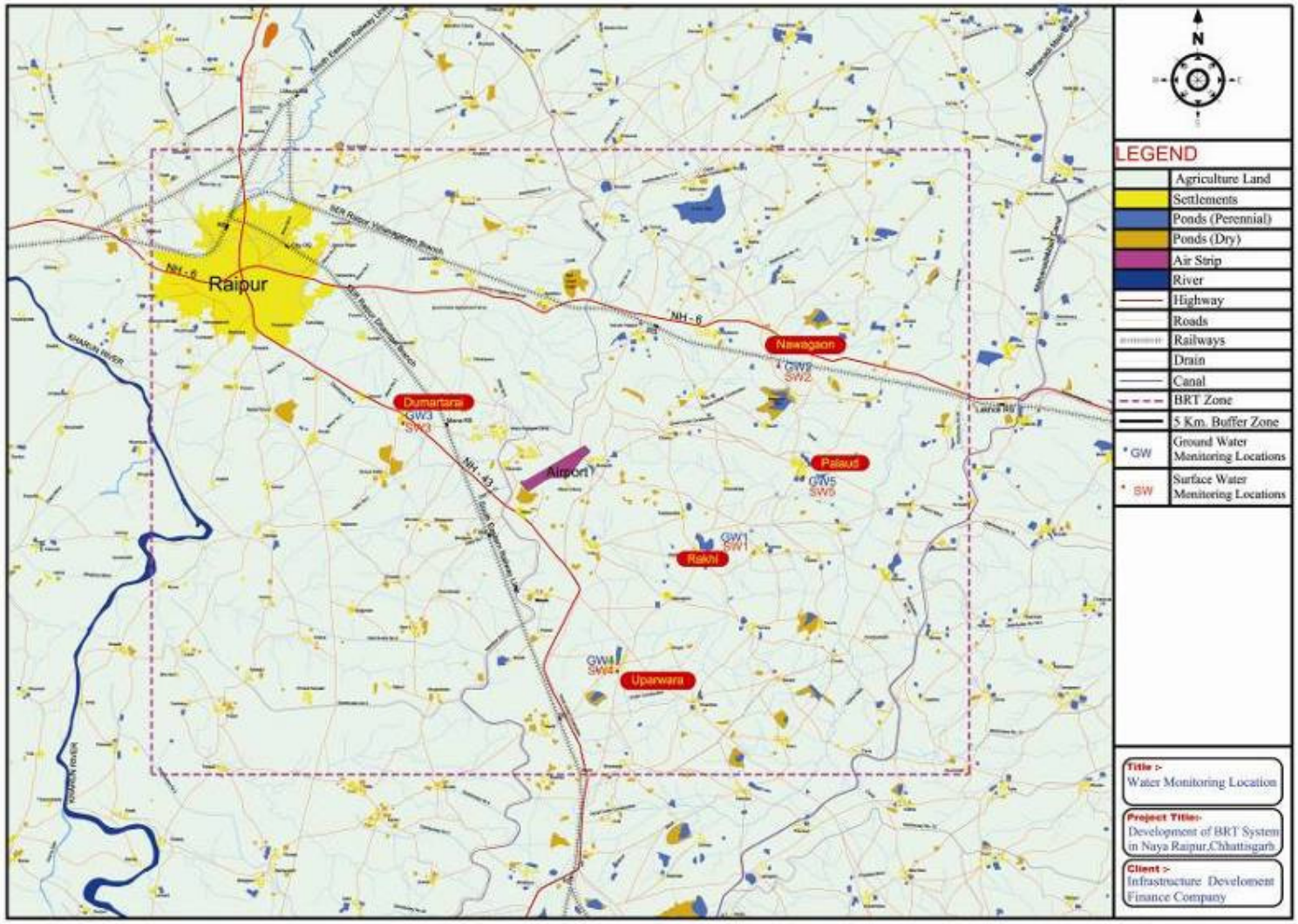


TABLE 4-13 : GROUND WATER TEST RESULTS AS PER IS: 10500

S.N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
1	pH	-	7.34	7.48	7.22	7.52	7.66	6.5 – 8.5	NR
2	Color	Hazen	04	03	04	03	04	<5	<25
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	-
4	Odor	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	-
5	Conductivity	µs/cm	542	566	1160	488	328	--	--
6	Turbidity (NTU)	NTU	1.60	1.30	2.30	1.30	1.20	<5	<10
7	Total Dissolve solids	mg/L	336	358	738	306	206	<500	<2000
8	Total Hardness as $CaCO_3$	mg/L	216	208	320	184	104	<300	<600
9	Total Alkalinity	mg/L	200	220	360	180	120	<200	<600
10	Calcium as Ca	mg/L	64	64	96	57	26	<75	<200
11	Magnesium as Mg	mg/L	13	12	19	10	09	<30	<100
12	Residual Chlorine	mg/L	Nil	Nil	Nil	Nil	Nil	<0.2	-
13	Boron	mg/L	0.20	0.30	0.60	0.50	0.40	<1.0	<5
14	Chloride as Cl	mg/L	21	25	106	18	21	<250	<1000
15	Sulphate as SO_4	mg/L	27	18	47	28	09	<200	<400
16	Fluorides as F^-	mg/L	0.80	0.50	1.70	0.50	0.40	<1.0	<1.5
17	Nitrates as NO_3	mg/L	06	05	14	06	03	<45	<100
18	Sodium as Na	mg/L	23	32	115	24	25	--	--
19	Potassium as K	mg/L	02	03	06	02	02	--	--

S.N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
20	Phenolic Compounds	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
21	Cyanides	mg/L	ND	ND	ND	ND	ND	<0.05	NR
22	Anionic Detergents	mg/L	ND	ND	ND	ND	ND	<0.2	<1.0
23	Mineral Oil	mg/L	ND	ND	ND	ND	ND	<0.01	<0.03
24	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	<0.01	NR
25	Arsenic as As	mg/L	ND	ND	ND	ND	ND	<0.01	NR
26	Copper as Cu	mg/L	0.052	0.048	0.059	0.040	0.050	<0.05	<1.5
27	Lead as Pb	mg/L	0.03	0.02	0.04	0.04	0.04	<0.05	NR
28	Manganese as Mn	mg/L	0.10	0.12	0.22	0.18	0.15	<0.1	<0.3
29	Iron as Fe	mg/L	0.12	0.18	0.24	0.26	0.24	<0.3	<1.0
30	Chromium as Cr^{6+}	mg/L	ND	ND	ND	ND	ND	<0.05	NR
31	Zinc as Zn	mg/L	3	2	4	3	2	<5	<15
32	Aluminum as Al	mg/L	ND	ND	ND	ND	ND	<0.03	<0.2
33	Mercury as Hg	mg/L	ND	ND	ND	ND	ND	<0.001	NR
34	Pesticides	mg/L	Absent	Absent	Absent	Absent	Absent	Absent	<0.001
35	E-coli	MPN/ 100 ml	Absent	Absent	Absent	Absent	Absent	Absent	--

ND = Not Detectable NR= No Relaxation

TABLE 4-14 : SURFACE WATER QUALITY WITHIN STUDY AREA

S.N	Parameter	Units	SW-1	SW-2	SW-3	SW-4	SW-5	IS:2296 standards
1	pH	-	6.88	7.28	6.98	6.99	6.92	6.5 – 8.5
2	Color	Hazen units	07	09	08	10	09	300
3	Conductivity	µs/cm	469	486	1596	836	848	--
4	Dissolved Oxygen	mg/L	5.10	5.30	4.80	5.30	5.10	> 4.0
5	BOD (3 days at 27°C)	mg/L	06	08	12	10	08	< 3.0
6	Total Dissolved Solids	mg/L	296	308	988	524	536	<1500
7	Total Hardness	mg/L	120	128	520	128	124	--
8	Chloride as Cl	mg/L	35	21	255	85	128	<600
9	Fluorides as F^-	mg/L	0.50	0.50	1.90	1.30	1.40	<1.5
10	Sulphate as SO_4^{--}	mg/L	16	36	105	139	72	<400
11	Alkalinity	mg/L	160	160	300	140	160	--
12	Nitrates as NO_3	mg/L	04	06	18	11	05	--
13	Cyanides as CN	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
14	Calcium as Ca	mg/L	29	35	85	32	29	--
15	Magnesium as Mg	mg/L	12	11	18	11	13	--
16	Sodium as Na	mg/L	51	48	167	129	133	--
17	Potassium as K	mg/L	02	03	06	06	06	--
18	Iron as Fe	mg/L	2.1	3.5	4.5	1.8	1.9	<50
19	Chromium as Cr	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	<0.01
21	Lead as Pb	mg/L	0.06	0.09	0.08	0.08	0.06	<0.1
22	Copper as Cu	mg/L	0.60	0.70	0.80	0.50	0.40	<1.5
23	Arsenic as As	mg/L	ND	ND	ND	ND	ND	<0.2
24	Selenium as Se	mg/L	ND	ND	ND	ND	ND	<0.05
25	Phenolics as C_6H_5OH	mg/L	Nil	0.002	0.004	0.004	0.004	<0.005
26	Zinc as Zn	mg/L	06	08	10	06	08	<15
27	Mercury as Hg	mg/L	ND	ND	ND	ND	ND	--
28	Aluminum as Al	mg/L	0.02	0.03	0.04	0.05	0.04	--
29	Anionic detergents as MBAS	mg/L	0.4	0.5	0.5	0.4	0.3	<1.0
30	Oil and grease	mg/L	0.2	0.6	0.8	0.6	0.2	<0.1
32	Insecticides	mg/L	Absent	Absent	Absent	Absent	Absent	Absent

ND = Not Detectable

Various parameters of ground water and surface waters were tested and the results found are discussed hereunder:

Ground water: At Rakhi village all the parameters are under the desirable limits as per IS:10500, at Navagaon village manganese and total Alkalinity are found a bit higher than desirable limits as per IS:10500 but it is less than the permissible limits prescribed by IS:10500. Water sample at Dumar Tari were found a bit higher in Manganese, TDS, total hardness as $CaCO_3$, Total Alkalinity, Calcium and Fluorides but still these are under the permissible limits prescribed by IS:10500. Uparwara and Palaud were found a bit higher in Manganese yet under the permissible limits prescribed.

Surface water: All the parameters tested at all the five sites, namely Rakhi, Navagaon, Dumar Tari, Uparwara and Palaud were found under the permissible standards prescribed by IS: 2296 except for Biochemical Oxygen Demand which was higher at all the five sites, this may be attributed to the Organic substances present in waters though these were also under the standards prescribed by CPCB for disposal of waters into surface water bodies as per the relevant acts.

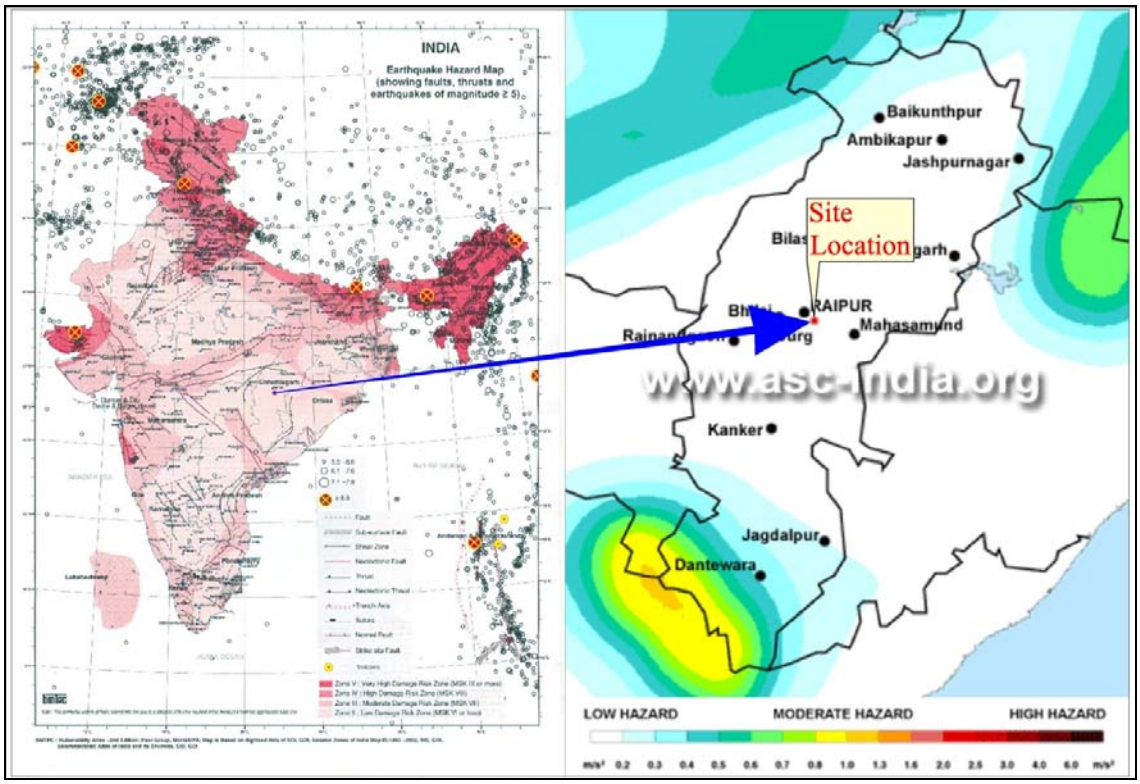
4.5 LAND ENVIRONMENT

4.5.1 Seismo-Tectonic Appraisal of the Area

Chhattisgarh has very low rates of seismic activity. In recent years, tremors from earthquakes in neighboring states have been felt, most notably in 1969. Minor seismic activity has been recorded in the vicinity of Chiraikund and Muirpur along the border with Madhya Pradesh. A few faults which form the eastern section of the Narmada-Son Fault Zone have shown movement during the Holocene epoch. Another active fault is the Tatapani Fault which trends in an east-west direction in the vicinity of Manpura in Sarguja district. In the south, the active Godavari fault forms the northern flank of the Godavari Graben and runs through the southern part of the state.

The project site is located in the central India which is a seismically low region, as depicted in the figure below. Raipur falls under zone II category of seismic zone (i.e. having low seismic intensity) and therefore has a low risk of potential damage due to earthquake.

FIGURE 4-4 : SEISMIC MAP OF AREA



4.5.2 Soil

Soil sampling was done to establish the baseline characteristics and to assess the anticipated impacts due to proposed project. Soil samples have been collected using auger from a depth of 60 cm.

Detail about the types of soil in Chhattisgarh state is given in **Annexure – IV**.

TABLE 4-15 : SOIL SAMPLING LOCATIONS

S.No	Station No.	Description
1	S - 1	Capital Complex
2	S - 2	Navagaon

A quantitative assessment of the particle size distribution in the soil was made by wet sieve analysis and sedimentation analysis using hydrometer, as per procedures laid down in IS: 2720 Part IV. The particle sizes[4] were designated according to the scale given in IS: 1498.

The three major type of soil are – (a) sands, which have at least 70% sand and less than 15 % clay (b) clay, which have more than 40 % clay content (c) loam, which is a mixture of sand silt and clay. The soil test results have been tabulated below in Table 4-16.

TABLE 4-16 : SOIL CHARACTERISTICS OF THE STUDY AREA

S.N	Parameter	S1	S2
1	Texture	Clay	Clay
a	Sand (%)	18	14
b	Silt (%)	34	28
c	Clay (%)	48	58
2	pH	7.50	7.24
3	EC (us/cm)	224	212
4	Bulk Density (g/cc)	1.12	1.08
5	SAR	1.30	1.22
6	Available Nitrogen (kg/ha)	198	166
7	Available P as PO_4 (kg/ha)	36	28
8	Available K (kg/ha)	148	180

[4] Particle size scale (IS: 1498)

Soil Type	Texture	Particle Size
Gravel	Coarse	20 – 80 mm
	Fine	4.75 – 20 mm
Sand	Coarse	2.0 – 4.75 mm
	Medium	0.425 – 2.0 mm
	Fine	0.075 – 0.425 mm
Silt & Clay	-	Less than 0.075 mm

S.N	Parameter	S1	S2
9	Exchangeable Ca (meq/100g)	2.60	2.90
10	Exchangeable Mg (meq/100g)	1.20	1.40
11	Exchangeable Na (meq/100g)	3.40	2.90
12	Organic Carbon (%)	0.80	1.10
13	Manganese (meq/100g)	0.10	0.18
14	Zinc (meq/100g)	5.10	5.50
15	Boron (meq/100g)	0.20	0.28

Clayey soils are found in the area with bulk density of two samples as 1.08 and 1.12 g/cc respectively. Soil of the area is neutral to slightly alkaline with pH ranging from 7.2 to 7.5. Most crops grow best if the soil pH range is 6.0 to 7.5. Soluble salts expressed in terms of electrical conductivity of saturation extract of the different soil (ECe) samples are 224 and 212 µmhos/cm respectively.

The Organic carbon percentages of the two samples are found to be 0.80 and 1.10 respectively. Soil carbon not only improves the physical properties of soil, it also increases the cation exchange capacity (CEC) and water-holding capacity of sandy soil and it contributes to the structural stability of clay soils by helping to bind particles into aggregates. Soil organic matter, of which carbon is a major part, holds a great proportion of nutrients, cations and trace elements that are of importance to plant growth. It prevents nutrient leaching and is integral to the organic acids that make minerals available to plants. It also buffers soil from strong changes in pH. It is widely accepted that the carbon content of soil is a major factor in its overall health.

The Sodium Absorption Ratio (SAR*)* measures the relative proportion of sodium ions in a water sample to those of calcium and magnesium. The SAR is used to predict the sodium hazard of high carbonate waters especially if they contain no residual alkali. High concentration of sodium disperses soil colloidal particles, rendering the soil hard and resistant to water penetration. The potential of sodium hazards increases in soil with higher SAR values. The analysis of the sample shows that SAR of the two soil samples studied is 1.30 and 1.22 milliequivalent /Kg respectively.

4.6 ECOLOGICAL ENVIRONMENT

The ecological survey has been done to establish the baseline ecological conditions within study area to assess the potential ecological impacts of the proposed project on ecology, to develop adequate and feasible mitigation measures (via inputs to project design and layout, working practices, or compensate where appropriate) to keep ecological impacts within acceptable limits, and to prepare comprehensive management plan. This section of report renders ecological baseline of the area.

The study area represents grass and bushes mainly with grass weeds. The proposed capitol complex and BRT construction is located in plain rural areas, where the agricultural ecosystem predominates in the regional ecological structure. The aquatic biodiversity is very less in the region.

4.6.1 Valued Ecosystem Components

Valued Ecosystem Components can be defined as a resource or environmental feature that is important (not only economically) to a local human population, or has a national or international profile, or if altered from its existing status, will be important for the evaluation of environmental impacts of industrial developments, and for the focus of administrative efforts. Attributes which may be selected as Valued Ecosystem Components are given in Table 4-17.

TABLE 4-17 : SUMMARY OF VALUED ECOSYSTEM COMPONENTS

Physical Environment	Biological Environment
Air Quality Noise Surface Water Flow paths and drainage areas	Aquatic Resource Ponds, Canals, Streams, Nallas Terrestrial Ecosystem Agro Ecosystem Farm Forest

Physical Environments

Air Quality: Air quality is considered as VEC because it is an important health and safety of human beings. Air quality also has aesthetic value in terms of visibility and odour. Air emission from the project will consists primarily of burning of fuels during heavy vehicles plying, machines and D.G sets during construction phase. During operation phase there will be continuous emission from stationary and mobile source (BRTs Buses, other vehicles and D.G sets).

Noise: Noise has been selected as a VEC because it has intrinsic value for people. High noise levels will distract people and are concern to health. The construction of the project will produce a variety of noises, including continuous noise from drilling, earth removal, haul trucks, heavy trucks movement, machinery and D.G sets operation. During operation phase, plying of BRTs buses and other vehicles will result in increase in overall noise level. To mitigate noise level thick greenbelt will be created along the proposed BRTs corridor

Surface water: Surface water bodies like ponds have been considered as VECs in the proposed project area. Surface water is a critical component of the biological and physical environment and is protected under the water (*Prevention & Control Of Pollution Act 1974*). Related to the proposed project topography two primary variables of surface water have been selected as VECs: surface water quality and surface runoff.

Surface water Quality & Flow paths and drainage areas: Surface water quality is important VEC components, because surface water is main source of water for various daily activities and even drinking. These are surface water ponds in the proposed project site, whose water quality is important for human and animal health. Surface water quality is linked to other key ecosystem components, including fish and animal life, and is therefore an indicator of environmental health.

Flow paths define the hydrological network in any watershed and describe the linkages between different streams, ponds and river systems. Change to flow paths or drainage area can impact downstream flow rate and the supply of nutrients. Flow path and drainage has been taken as VEC because there are ponds in the proposed project site which are rain fed and mainly depends upon drainage of area.

Though there are ponds/lakes in the project area, only part of the Sendh pond is adjacent to BRT route. Others are isolated ponds. Proper structures for streams have been made to maintain their course.

Biological Environment

Aquatic Resource: It has been considered as Valued Ecosystem Component because there are lots of surface water resource like ponds, streams, nallas and canals. Human, animals and other environmental components are dependent on aquatic resource. Therefore, changes to aquatic resources will have potential impacts to other components of the ecosystem.

Terrestrial Ecosystem:

Agro ecosystem: Agro ecosystem has been considered as VEC because major section of the study area and proposed project site is cultivable land with single cropping patterns. Rice is main primary producer in the proposed project area, on which human and animal are directly or indirectly dependent. It even affect abiotic factor such as soil type.

Village woodlots and Farm forest: Village woodlot and Farm forest are consider as VEC because it has direct affect on biotic and abiotic factors. These village woodlots and farm forest are having direct affect on air, climate, soil and humidity of proposed area. It supports habitats of mammals and birds. It provides fruit and timbers for people and fodder to support domesticated animals.

4.6.2 Forest Area and Resources

Raipur and DumarTarai district has 5469 sq. km under the forest cover, i.e. 33.21 percent of its total geographical area (Source: *Forest Survey of India-2009*). The district has 189 sq. km of ‘very dense forest’, 3,848 sq. km of ‘moderately dense forest’ and 1432 sq. km of ‘open forest’. Forest types occurring in the district are Northern Dry tropical mix deciduous type (Source: *Champion and Seth Classification*). No reserve forest and protected forest exist along the proposed BRTS corridor and in vicinity.

The district has got tropical mix dry deciduous forest with Sal and other species namely Harra, Lindia, Tinsa, Salai, Tendu, Mahua, Haldu, Kana, Chur and Bhira. Sanctuary like Sitanadi and Udanti Sanctuary are about 116 km and 122 km respectively. The South and South eastern part of district is hilly of which Atang Milcowa, Deo Dongar and Makewa Dongar are the peaks. Mahanadi along with its tributaries like Pairi, Jonk and sukha flows through the district. Paddy is the main agricultural product followed by oil seeds, wheat and gram.

4.6.3 Terrestrial Ecology

Floral Profile

Identification of flora was conducted based on sample plot method along the proposed BRTS corridor, villages, and open field (agricultural field and waste land) in the study area. There is uniformity in patterns of distribution and growth. Majority of the species reported are common type, with growth along bunds, waste land and very less in agricultural field. Extensive growths of aquatic weeds are noticed where water logging or moisture are present. The overall biodiversity in study area is low due to similarity in species distribution and poor growth.

Floral Profile along Existing National Highway

The floral profile of the existing highway witness growth of weeds like *Aristida purpurea, Erianthus munja* and *Lantana camara*. These weeds had permanently replaced grasses covering lower strata. Dried twigs of *Paranthenium hysterophorus*, *Heteropogon contortus*, *Datura stramonium, Chenchrus cilitaris* etc. are also noticed in agricultural waste land or uncultivated land adjacent to National Highway. Among trees recorded, higher frequency of *Albizzia Lebback*, *Euclyptus sp., Dalbergia sissoo, Acacia catechu, Azadirachta indica,* Bamboo (*Dendrocalamus strictus*), (Bambuaa aroumdinacea), wild dates (*Phoenix sylvestris*) *etc.* are noticed.

Farm Forest

Trees along the farm bunds and in small patches up to 0.1 hector in area are called farm forest. Majority of species reported in farm forest are planted once and few are having natural growth. The planted species recorded in farm forest are Arjun (*Terminalia arjuna*), Bair (*Aegle marmelose*), Sagwan (*Tectona grandis*), Eucalyptus (*Eucalyptus sp*), Drum stick (*Moringa oleifera*), Neem (*Azadirachta indica*), Mahua (*Madhuca indica*), Ambla (*Emblica officinalis*), Cashew nut (*Anacardium occidentale*), Emli (*Tamarindus indica*), Mango (*Mangifera indica*), Jamun (*Syzygium cumini*), Peepal (*Ficus religiosa*), Bargad(*Ficus bengalensis*), Bail (*Zizypus maurutiana*), etc. The naturally growing species are Babul (Acacia nilotica), Wild dates (*Phoenix sylvestris*), *Prosopis sp.*, Bair (*Aegle marmelose),* Arjun (*Terminalia arjuna*), Jharber (*Zizyphus numularia*), Gamhar (*Gmelina arborea*) etc

Photo 4-1 : Farm Forest along Road No. 2

Weeds recorded in the form forest are Calotropis (*Calotropis procera*), Lantana (*Lantana camara*), Bahia (*Ipomea carnea*), *Cenchrus ciliaris, Saceharim spontaneum, Saccharum munja, Aristida depressa, Heteropogon contortus, Parthenium hysterophorous,* etc

Village Woodlot

Naturally or planted trees on community or private land. Commonly planted trees recorded in village woodlot are Eucalyptus (*Eucalyptus sp.*), Ambla (*Emblica officinalis*), Mango (*Mangifera indica*), Bamboo (*Dendrocalamus strictus*), (Bambuaa aroumdinacea), Peepal (*Ficus religiosa*), Neem (*Azadirachta indica*), Banyan tree (*Ficus bengalensis*), Sissoo (*Dalbergia sissoo*), Teak (*Tectona grandis*), Mahua (*Madhua indica*) bamboo sp, Jamun (*Syzygium cumini*), etc.

Photo 4-2 : Village Woodlot along Road No. 4

Road Side Plantation

Based on sample plot methods trees, shrubs, bushes and weeds are recorded along the proposed BRTS corridor. Among trees Arjun (*Terminalia arjuna*), Nilgri (*Eucalyptus globulus*), Wild dates (*Phoenix sylvestris*), Babul (*Acacia nilotica*), Prospic sp. Bair (*Aegle marmelose*), (*Terminalia Balerica*), Mahua (Madhuca Indica), Neem (*Azadirachta indica),* Kamhar *(Gmelia arborea), Imali* (*Tamarindus indica*)*,* Jharber *(Zizyphus numularia),* Bair *(Ziziphus Mauritiana),* Burgad *(Ficus bengalensis) etc.* are recorded along the proposed site.

Undergrowth plant like shrubs, herbs and grasses are noticed in scattered manner. The undergrowth species recorded along the proposed BRTs corridor are mostly weeds and bushes. Weeds recorded along the road sides are Calotropis (*Calotropis procera*), Lantana (*Lantana camara*), *Cenchrus ciliaris, Saceharim spontaneum, Saccharum munja, Aristida depressa, Heteropogon contortus, Parthenium hysterophorous,* etc. Where soil is moist or along the edge of ponds growth of Bahia (*Ipomea carnea*) was noticed.

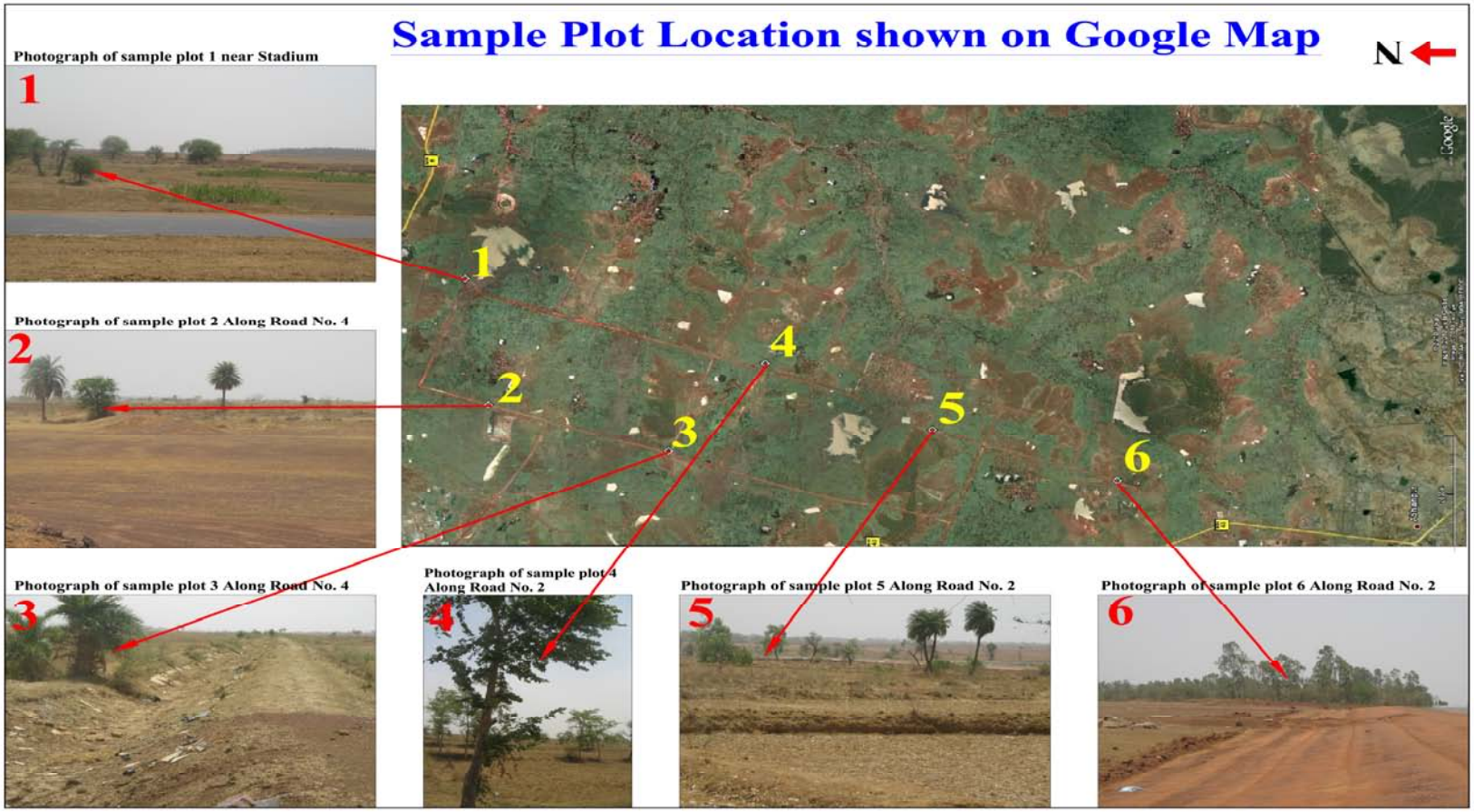
Quadrant sampling method (Plot Sample) was used to calculate floral type and their distribution along the proposed BRTs Corridor. Location of sample plot is shown in Figure 4-9 and Table 4-18 gives the list of species recorded, with their frequency, density and abundance of distribution along the proposed BRTs Corridor.

TABLE 4-18 : LIST OF DIFFERENT SPECIES AND OTHER DATA GENERATED BY QUADRANT METHOD

S.No	Name of species	Quadrants Laid Down						Total no. of Individual of Species	Total no. of quadrants of occurrence	Total no. of quadrant studied	Frequency (%)	Density	Abundance
1	2	3						4	5	6	7	8	9
		1	2	3	4	5	6						
1	Nilgri (*Eucalyptus globules*)						22	22	1	6	17	3.6	22
2	Imli (*Tamarindus indica)*				1			1	1	6	17	0.2	1
3	Kikar (*Acacia Nilotica)*	2	1	3	2	1	6	15	6	6	100	2.5	2.5
4	Neem (*Azadirachta indica)*	1			2			3	2	6	33	0.5	1.5
5	Mahua (*Madhua indica)*	3					2	5	2	6	33	0.8	2.5
6	Bahera (*Terminalia arjuna)*	1		1	2	1	5	10	5	6	83	1.7	2
7	Ber (*Ziziphus Mauritiana)*			4		1		5	2	6	33	0.83	2.5
8	Gamhar (*Ghamlina arborea*)				1		1	2	2	6	33	0.3	1

9	Khajur (*Phoenix sylvestris)*	3	2	5		3	3	16	5	6	83	2.6	3.2
10	Peepal (*Ficus religiosa)*					1		1	1	6	17	0.16	1
11	Jharber (*Zizyphus numularia)*			2	3			5	2	6	33	0.83	2.5
12	Jamun (*Syzygium cumini*)	1		1	1		2	5	4	6	67	0.83	1.3

FIGURE 4-5 : LOCATION OF QUADRANT SAMPLING POINT (SAMPLE PLOT) ALONG PROPOSED BRT CORRIDOR WITH THEIR PHOTOGRAPH



Faunal Profile

Mammals

No wild mammals are directly sited in the proposed project site and study area. Domesticated mammals like buffalo, cow, goat etc are commonly noticed grazing in open field. Small mammals like field mouse (vermin), five stripped squirrels and wild mammals like Hyaena (*Hyaena hyaena*), rabbits (*Lepus nigricollis*), Monkey (Macaca Mulata) Fox (Vulpes bengalensis), mongoose (*Herpestes auropunctatus*) and Jackal (Canis aureus) are reported by the villagers. Table 4-19 gives list of animals reported during site visit.

TABLE 4-19 : LIST OF WILD ANIMALS REPORTED IN STUDY AREA

S.No	Local Name	Scientific Name	RED LIST (IUCN)
1	Hyaena	*Hyaena hyena*	Near Threatened-2009
2	Rabbit	*Lepus nigricollis*	Least Concern - 2010
3	Monkey	*Macaca Mulata*	Least Concern -2009
4	Fox	*Vulpes bengalensis*	Least Concern -2010
5	Mongoose	*Herpestes auropunctatus*	Least Concern - 2009
6	Jackal	*Canis aureus*	Least Concern - 2010

(Source: Villagers & Forest department)

Avifauna

Sampling of avifauna was carried out between the hours 6:30 to 8: 00 A.M. This survey was based on a "Walk/Drive Though" survey. A point count sampling method was adopted to list the bird species seen or heard.

The Area lack rich diversity of avifauna. During the time of survey common birds like Common crow, Pigeon, Pariah kite, Jungle babbler, Ring dove, Spotted dove, Indian parakeet, Indian roller, Drango, White breasted king fisher, Common myna, Pond heron, Sparrow, Coot, etc are recorded.

TABLE 4-20 : LIST OF COMMON AVIFAUNA RECORDED DURING SURVEY

S. No.	Scientific Name	Common Name	Source	Wildlife Schedule
1.	*Acridotheres tristis*	Common Myna	Sited	IV
2.	*Athene brama*	Spotted Owlet	Villagers	IV
3.	*Columba livia*	Blue Rock Pigeon	Sited	IV
4.	*Corvus splendens*	House Crow	Sited	V
5.	*Cuculus canorus*	Cuckoo	Villagers	IV
6.	*Cutornix cutornix*	Quail	Villagers	IV

S. No.	Scientific Name	Common Name	Source	Wildlife Schedule
7.	*Dicrurous adsimilis*	Drango	Sited	IV
8.	*Milvus migrans*	Pariah Kite	Sited	IV
9.	*Passer domesticus*	House Sparrow	Sited	IV
10.	*Psittacula krameri*	Roseringed Parakeet	Sited	IV
11.	*Pycnonotus cafer*	Red vented Bulbul	Villagers	IV
12.	*Turdoides caudata*	Common Babbler	Sited	IV
13.	*Bubulcus ibis*	Cattle Egret	Sited	IV
14.	*Halcyon smyrensis*	white throated kingfisher	Villagers	IV
15.	*Ceryle rudis*	Pied kingfisher	Villagers	IV
16.	*Ardeola grayii*	Pond Heron	Sited	IV
17.	*Fulica atra*	Coot	Sited	IV

(Source: recorded during site visit and interaction with villagers)

Amphibians

Amphibians are recorded in ponds along the proposed project site and nearby settlements. The commonly reported amphibians are Bull frog, Indian skipper frog and Indian cricket frog.

Reptiles

During survey no reptilian species are noticed. The villagers mention the presence Agama (*Agama tuberculata*), lizard (*Calotes sp.*) and skink (*Scincilla sp.*) in field, bushes along the road site and waste land. Among Snakes Dhaman *(Ptyas mucosa)* are commonly encounter by the farmers. Poisons snakes like Cobra (*Naja naja)*, Banded Krait (*Bungarus multicinctus*), Russel viper (*Vipera ruselii*), are rarely encounter by the farmers in the field. Scorpions are commonly noticed by the villagers in the study area.

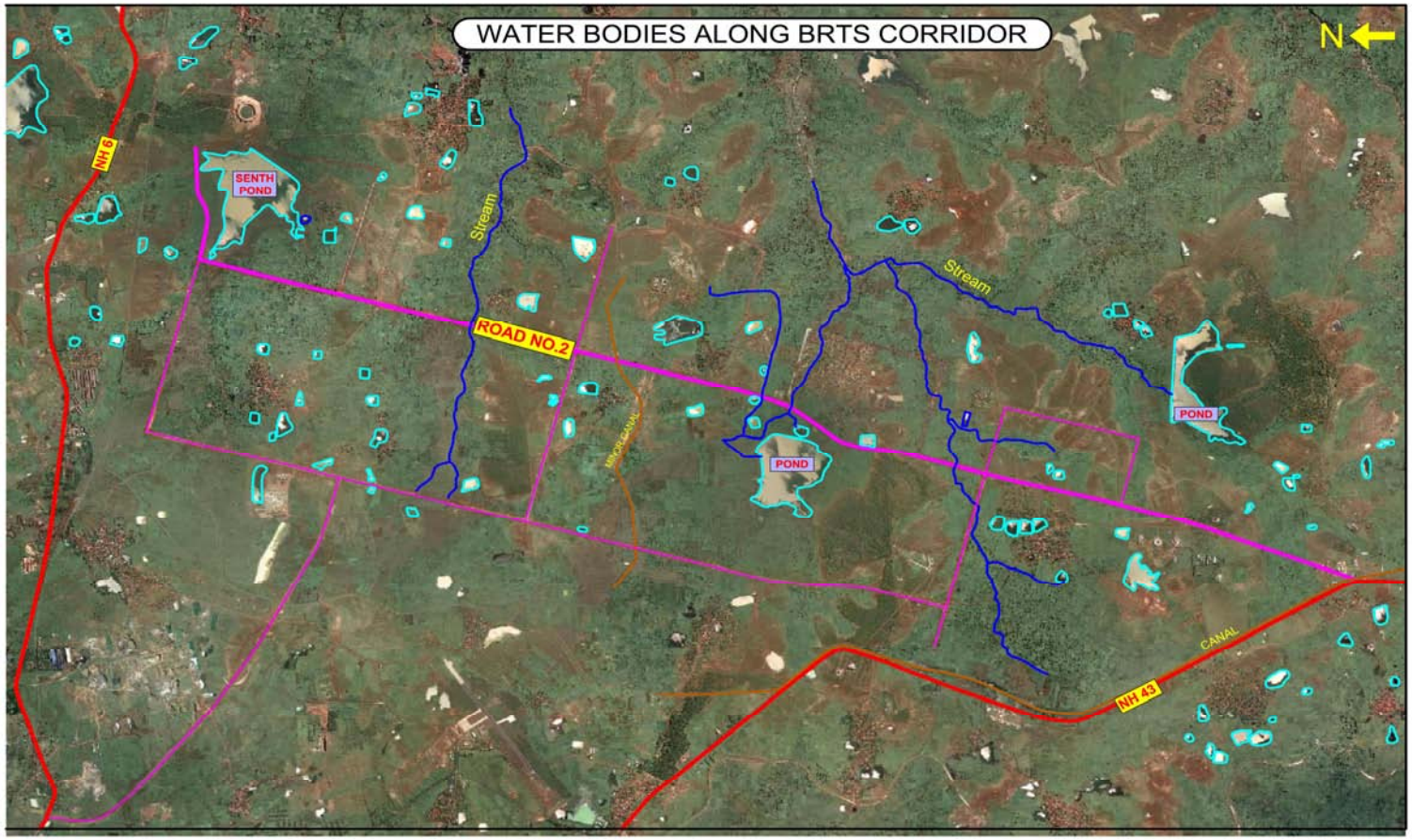
4.6.4 Aquatic Ecology

Along the proposed BRTs corridor a few large and small ponds are reported in adjacent or within 100 m away. Other water bodies are noticed near the proposed corridor. Three small streams are crossing Road no. 2 but they are seasonal and water is available only during rainy season. They are part of natural drainage of the area. No established riparian was noticed during the time of survey. Flora recorded along the flows of stream and nalas are weeds, reeds and bushes of Bahia (*Ipomea carnea*). At some locations, scattered growth of wild dates (Phoenix sylvestris) is noticed.

Photo 4-3 : Sendh Lake from Road No. 7

The nearest river reported is Kharum River, which is about 5 km away. All these streams finally drain into Kharum River. Lentic water bodies reported along the proposed BRTs corridor are man-made ponds. No natural pond has been noticed in the study area. These ponds are mostly perennial and are rain fed. These ponds are main source of water for the villagers, for drinking, bathing, irrigation, feeding animals and other anthropogenic activities. Along the edge of these ponds growth of hydrophytes like *Ipomea carnea, Marsilea villosa,* Cenchrus cilitaris are noticed. Piciculture practices are commonly noticed in these ponds. Figure 4-6 showing distribution of water bodies along the proposed BRTs corridor.

FIGURE 4-6 : SHOWING LOTIC & LENTIC WATER BODIES ALONG THE PROPOSED CORRIDOR



4.7 SOCIO ECONOMIC ENVIRONMENT

This section discusses the baseline scenario of the socio-economic environment in the study area and the anticipated impacts of the proposed project on the socio-economic environment. The areas of discussion in this chapter are demographic structure, economic activity, education, literacy profile, land use and infrastructure resources. The assessment attempts to predict and evaluate the anticipated impacts of project upon people, their physical, psychological health and well being, their economic facilities, cultural heritage, lifestyle and their value system.

4.7.1 Socio Demographic Profile

Population

Raipur is the capital of Chhattisgarh State with a population of 30,16,930 as per census 2001. The Raipur city population is 6,70,042; the projected population at the decadal growth rate of 34.8% would house a population of 10.64 lakh in 2011 and 14.98 lakh in 2021[5].

The demographic details of Raipur urban agglomeration is given in Table 4-21

TABLE 4-21 : POPULATION GROWTH OF RAIPUR URBAN AGGLOMERATION

Year	Population in Lakhs	Growth Rate (%)
1951	0.89	--
1961	1.39	56.18
1971	2.06	48.2
1981	3.38	64.08
1991	4.61	36.39
2001	6.69	45.12

Source :Census of India

The decadal growth rate of Raipur increased from 36.39% in 1981-1991 to 45.12% in 1991-2001. The decadal growth rate of the district at the same time was 30.14% and 18.97%. This means higher urban growth rate in comparison to the overall population growth. The sex ratio, and literacy rate of Raipur is given in Table 4-22.

TABLE 4-22 : SEX RATIO AND LITERACY RATE OF RAIPUR URBAN AGGLOMERATION

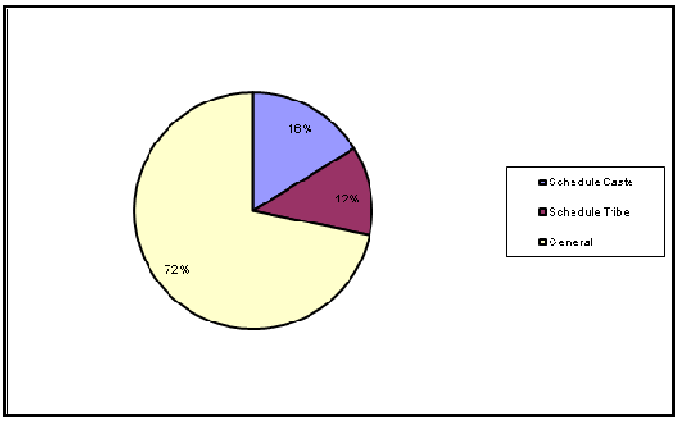
Area	Sex Ratio	Literacy Rate (%)
Raipur District	980	68.5
Raipur City	923	81.1

Source: Census of India 2001

The population composition of Raipur District is depicted in Figure 4-7 which clearly shows the sizable percentage of SC and ST population.

[5] CDP, Raipur

FIGURE 4-7 : POPULATION DISTRIBUTION IN VARIOUS CATEGORIES



Census of India 2001

Work Participation

This section provides a review of the present position and trends in the employment and distribution of workers, based on various parameters. The workforce participation rate of Raipur district is 41.9% and Raipur city is 32.4%, as per census 2001.The involvement in different sectors is given in Table 4-23**.**

TABLE 4-23 WORK PARTICIPATION RATE

Area	Total Workforce (%)	Main Workers (%)	Marginal Workers (%)
Raipur District	41.92	76.03	23.97
Raipur City	32.48	91.57	8.43

Census of India 2001

The employment pattern in the district is given in Figure 4-8 and Figure 4-9.

FIGURE 4-8 : MAIN WORKERS: ENGAGEMENT IN DIFFERENT SECTORS

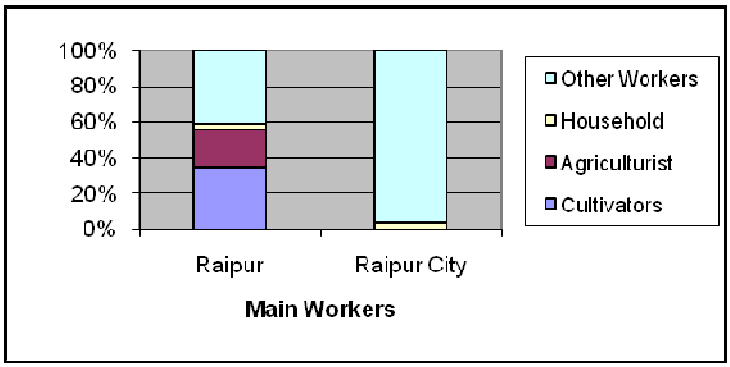
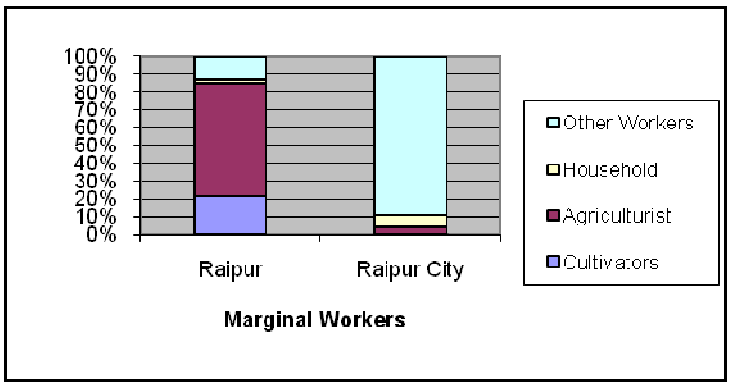


FIGURE 4-9 : MARGINAL WORKERS : ENGAGEMENT IN DIFFERENT SECTORS



The figures above signify the dependency of urban population on other categories of employment. This means that for sustainable growth, investment in the industrial sector and provision of necessary infrastructure is the need of the day.

4.7.2 Social Profile

A project development entails a host of social concerns, which need to be identified for sustainable growth in the area. To identify project related social concerns, a series of consultations were carried out with the villagers who will be affected by the proposed project.

The villages covered in this process were Rakhi, Palaud, Nawagaon, Uparwara, Mana, Dumar Tarai, and Serikheri.

The baseline information of these villages is summarized in the section given below:

Social Amenities

The amenities in the villages include electricity, water supply, telephone and sewerage. Power supply in the villages is available but there are power cuts.

Water is available through hand pumps and a large portion of the population uses this source of water for domestic use. Community ponds are also used by animals and for washing.

Land Holding

Most of the farmers have small land parcels. Two-thirds of land holdings are small (<2ha)[6] with agriculture as the major land use along with a small portion, which is used for residential purposes. Kharif is the dominant crop in the region.

Housing Characteristics

Houses are semi pucca in nature with some exceptions, constructed from locally available material.

[6] Chhattisgarh Livestock Development Policy,2006

Willingness to relocate

The village of Rakhi is to be rehabilitated completely for development of Naya Raipur. Naya Raipur Development Authority (NRDA) has prepared a Rehabilitation Scheme based on the Rehabilitation Policy of the Government of Chhattisgarh, wherein it is emphasized in the Rehabilitation Plan[7] that agricultural land for development is purchased from farmers by mutual consent and that the Land Acquisition Act will not be used as far as possible. The rates worked out for compensation are:

1. Land-
    a. Rs 11 Lakh per hectare for irrigated land
    b. Rs. 10.00 Lakh per hectare for un-irrigated land.
2. Additional Compensation – Rs 1 Lakh per hectare for irrigated and un-irrigated land
3. Compensation in lieu of special rehabilitation benefits- Rs. 2.75 Lakh per hectare.
4. Families, which need to be relocated, would be provided new houses in a residential colony developed by NRDA within 5Kms distance from their existing homes. Special benefits are also provided to the project affected landless labourers.
5. The provision of houses will be done as per the type of house presently owned by the affected families.

Religious and Cultural Sites

There are a number of small religious structures very close to the proposed corridor:

1. Sitalla mata temple located in Nawagaon village
2. Bhasurur temple in Nawagaon Village
3. Hanuman temple near Telebandha Junction.

Among the above three religious structures Sitalla mata temple is affecting, therefore NRDA is constructing new temple on opposite side of the road with acceptance of the Nawagaon village people.

[7] NRDA Rehabilitation Plan for Naya Raipur Project

Culture and Tradition

The local language used is "Chhattisgarhi". Traditional medical practitioners are more acceptable to the rural folk. Festivals celebrated in the area are Gouri-Goura, Surti, Hareli, Pola and Teeja, which are celebrated in the month of 'Shravan'. The villagers follow a traditional life style.

Photo 4-4 : Hanuman Temple Near Telibandha Junction

Roads and Communication

The present road network in the district consists of National Highway-6 and 43. Access roads from villages, which fall near the highway are used by the villagers who commute easily by their own means or public/private transportation. While villages that are far flung depend entirely on personal and private means to commute.

Livestock

Animal husbandry is a major economic activity of villagers, which includes poultry farming and livestock. The goats, sheep, cows, pigs and backyard poultry are the most valuable species of livestock to all groups of farmers as it fulfills their own daily needs as well as is a important source of income.

Photo 4-5 : National Highway near Pachipadanaka Junction

4.7.3 Issues of the Local

Issues of the Local public and mitigation measures are summarized as follows:

TABLE 4-24: ISSUES AND MITIGATION MEASURES

Sr. No.	Issues/Concerns of the local	Mitigation Measures
1.	Livelihood will be disturbed, in case of losing business and agricultural land	Compensation paid by NRDA as per Rehabilitation Policy

2.	Residential areas affected	Construction of new houses for the affected people
3.	Compensation at the market rate should be provided to the affected including those who are earning their livelihood	Compensation paid by NRDA as per Rehabilitation Policy
4.	Jobs may not be provided to local people during construction	Labour will be engaged from local areas to the maximum possible extent. Moreover, NRDA is providing Training Programmes for improving the life of the people nearby. They are providing two to three months training in varied fields and making them semi skilled labours with a training certificate, which will be useful to them in future. Trainings are provided for electricians, plumbers, land surveyors, bar benders, etc. Type of training is decided on the basis of requirement. When sufficient numbers of people gather for a particular skill, they are grouped and trained by NRDA. Candidates are given food, accommodation and some amount monthly (Rs.2000/head/month).
5.	Movement across the road to another village or fro collection of fodder or animal grazing would become very difficult	Underpasses should be provided at strategic locations.

4.8 PUBLIC CONSULTATIONS

To know the opinion of various groups of daily commuters, consultations were held to identify their concerns and issues relating to the BRTS in April 2010. Efforts were made to include vulnerable sections in order to voice their concerns. The groups that were consulted on the services were women, students from university and colleges, residents of proposed transfer station, commuters in Raipur city and conductors, drivers and owners of auto rickshaws and buses both private and public (plying under contract with government on select routes). The public consultations are provided as **Annexure V**.

4.8.1 Women commuters

Women are comfortable with the bus service as some seats are reserved for them, so they do not face major problems and issues. They are of the opinion that BRT system can be improved by means of increasing the frequency of buses. Currently they find the services are limited and during specific times the frequency is very less. For long journey A/C buses should be introduced considering the weather conditions in Raipur as the commuters face

hardship due to the extreme heat making the journey both uncomfortable and difficult. Overall experience of the women with the BRT system can be summarized as largely good.

4.8.2 Consultation with students from university, colleges and schools

Students in the university and colleges are of the view that more BRTS bus services should be provided during the morning and evening hours. Special University specials should be introduced. Students should be issued concessional monthly passes for the BRTS.

Parents of school going children feel that the school administration will operate their own buses if required in the near future for Naya Raipur and so do not have much stake in the BRTS service.

4.8.3 Residents near Terminal at Agriculture Institute on NH-6

Most of the BRT buses on NH-6 will ply from the terminal which is planned to be developed on land owned by Indira Gandhi Agriculture University. Passengers from city buses will de-board at this point and then board buses plying under BRT system to Naya Raipur. The identified land has 17-20 staff quarters. The discussion with residents of the identified location gives an idea that most of the residents are working in university either on daily wages or class IV employees during consultation with them they are of the view that wherever university administration will shift them they are ready for it., while discussion with University authorities reveals that after formal intimation for land requirement from NRDA they will plan for dismantling and resettlement of the occupants.

4.8.4 Residents near Pachpedinaka -Doomar Tarai Terminal on NH-43

The plot to be developed as terminal on NH-43 is vacant land with no immediate settlements or any features observed around it.

4.8.5 Commuters in Raipur city

Discussions were held with commuters travelling on different routes of the BRTS. Fare charges are based on the distance which is more affordable. Contradictory to the flat rate decided arbitrarily by the Auto rickshaw drivers, which is much higher than the BRTS rate. BRTS commuters are of the view that the frequency of city bus service is not enough so these should be increased. Commuters are of the opinion that traffic congestion can be decreased by banning some type of vehicles especially rickshaws on particular roads. Some passengers feel that A/c bus service should be introduced and that bus service should run on time.

4.8.6 Consultation with conductors, drivers and owners of private buses in Raipur and Naya Raipur

At present the bus services are limited only to the identified routes. The government has selected the operators through a process of tendering. It is expected by bus owners and employees that for the new routes, operators will be selected similarly. Existing routes should not be given to new operators as this will result in a loss for the current operators and their employees.

5.0 Assessment of Potential Impacts and Mitigation Measures

BRTS Naya Raipur being a Greenfield project. BRTS is provided with a separate lane in the Development Plan for the selected corridors on the developed road net work, expected to cater high traffic volume generation in future. Potential environmental impacts are impacts on land, water, air, noise and ecology. These impacts can be classified in to construction phase and operation phase.

5.1 IMPACTS

5.1.1 Air

Construction Stage: As road network construction is completed, creating of BRTS on existing road may not affect air environment much. Major impact on air during construction phase, could be due to transportation of construction material to the terminal/depot site and in turn their construction. Mostly bus stops will be erected with pre fabricated material hence causing less air pollution.

Mitigation Measures: Care would be taken during transportation of materials, like covering the material with tarpaulin, spraying water to avoid dust suspension. Provision of temporary dust barriers while construction of terminals/depots, so that dust does not affect other areas. The transportation vehicles will be provided with pollution control systems and regularly checked so as not to exceed the emission levels.

Operation Stage: The project road network will significantly reduce the traffic congestion in the city, as the BRT component will reduce the total transport demand and thereby reduces its air pollutant emission.

Mitigation Measures: Naya Raipur city's human activities, including industrial activities, transport, and households are affecting the city's air quality. Therefore, the project's air quality mitigation measures will be carried out along with other sectors' air quality improvement measures by local authority. Regular maintenance of BRT buses will keep air pollution under control.

5.1.2 Noise

Construction Stage: Noise impacts are anticipated from heavy construction machinery for the construction of terminals/depots and bus stops.

Mitigation Measures: The construction machinery will be attached with silencers and regularly maintained. The DG sets will be provided with acoustic enclosures. Since the project area is coming in a newly developing area with not much human habitations, therefore noise will not have significant impact.

Operation Stage: Noise during operation stage will be due to plying of vehicles.

Mitigation Measures: Developing of green belt will reduce noise levels in future and avoiding planning new sensitive receptors near major roads.

5.1.3 Surface and Groundwater

Construction Stage: Impacts to the water environment are anticipated due to soil erosion process during construction of bus terminals/depots. Contamination of surface and ground water with fuel and chemical spills; and discharge of wastewater from the equipment maintenance shops. Water contamination can occur due to discharge of sewage from construction camps.

Mitigation Measures: All these impacts will be for short time. To avoid contaminating water sources from storm water and spills, designing of storm drains as per site conditions for storm water management. Collection and disposal of spills immediately after occurrence of the event. The oily waste/grease will be collected and skimmed by oil traps and sold to the authorized agents. Whereas the sewage from construction camps will be collected in soak pits and septic tanks.

Soil excavated from ponds is used for strengthening the bunds to avoid erosion. These bunds will be covered with grass and shrubs.

Operation Stage: Significant impacts to surface or groundwater are not anticipated. Surface run off from the BRTS route may affect quality of water.

Mitigation Measures: The implementation of storm water management plan will reduce contamination of water. Liquid waste from terminals will be treated in treatment plants and oily waste coming out from the depots, will pass through the oil traps and sent to the treatment plants for recycling. The recycled water will be used for gardening purpose.

5.1.4 Soil

Construction Stage: Soil erosion due to construction of bus terminals/depots. Not much soil erosion will occur during construction of bus stops. Contamination of soil may comprise of accidental spills of petroleum products and hazardous materials.

Mitigation Measures: Preventive and mitigation construction practices as minimizing areas of soil clearance, selecting less erodible materials, planting vegetative cover around the area. As BRTS is coming on the previously constructed road network, there will not be much impact on soil erosion due to making of BRTS components on/beside existing roads. Development and implementation of a spill management plan will be required.

Operation Stage: No significant environmental impacts to soil are anticipated during operation of the road.

Mitigation Measures: Monitoring of storm water runoff and soil will be carried out along these roads during the operation stage.

5.1.5 Trees

Construction Stage: Around 481 tree affected in BRT route.

Mitigation Measures: Tree plantation programs are being carried out along the BRT corridor.

Operation Stage: The trees will have positive environmental impacts on urban landscapes, contribute to soil erosion control, improve air quality, and create microclimate. To some extent, roadside trees also provide noise protection.

Mitigation Measures: In total, 215 Ha of trees will be planted under the Project area. Assuming 1200 trees per hectare, approximately 2,50,000 trees will be provided on either side of the road and medians.

5.1.6 Urban Ecosystems and Landscapes

Construction Stage: Short-term impacts on urban ecosystem and landscapes are anticipated during the construction stage. Construction waste at the terminals and depots, can impact the hygienic environment and landscapes. As BRTS is coming on existing road network less dust is expected. Moreover BRT corridor is coming up in newly developing area with very less settlements.

Mitigation Measures: Mitigation measures include restricting construction works to construction sites, halting earthworks at depots and terminals during monsoons, timely cleaning of construction sites, and planting trees.

Operation Stage: The Project will have an impact on urban ecology and landscapes. Whereas before the Project the rural ecosystems are mostly represented by agricultural and rural ecological communities, it is expected that after the construction equilibrium will be shifted toward urban communities. Biodiversity of the ecosystem will be reduced even further. Provided that comparatively small areas planted with widespread local trees however, no significant impacts on the urban ecosystem are expected. No rare or endangered flora or fauna occur in the project area, and no impacts to such species are anticipated. No considerable impacts to villages are anticipated, as these are located outside the project area.

Mitigation Measures: Planting trees along the roads will be undertaken to increase biodiversity, enhance urban landscaping and aesthetic value.

5.1.7 Social Issues and Urban Infrastructure

Construction Stage: Urban traffic congestion can occur due to construction activities or increased construction machinery traffic on some roads near the Terminals/Depots/ Bus stop

construction sites. The construction can cause temporary interruptions or increased loads for such urban systems as water supply, natural gas pipelines, sewerage, energy, communication lines, and heating. The impacts on urban traffic will be temporary and manageable, provided close cooperation with the relevant urban infrastructure departments will be established. Temporary electric and water supply schemes should be developed in coordination with the relevant authorities to supply construction works with electricity and water.

Mitigation Measures: The Project Management Office will develop a traffic management plan to prevent congestion and traffic jams by consulting with the Traffic Control Department. Information on the urban construction status will be provided through television, radio, and newspapers. Bulletin boards will be set up to publicize the objectives of the projects, construction timetable, and grievance hotline. Safety measures will be adopted for pedestrians' and residents' safety and convenience. These will include footbridges, fences, and appropriately situated lighting.

Operation Stage: In the operation stage, the Project is anticipated to have positive impacts on the social environment and urban infrastructure. Conflicts between NMT, motor vehicles, and pedestrians will be minimized; traffic bottlenecks will be relieved, and the number of road accidents will be reduced. Adverse health impacts associated with road traffic will be reduced by minimizing vehicular emissions and noise. The Project will have a beneficial impact on Naya Raipur investment competitiveness and attract more investors.

5.1.8 Religious and Cultural Structures affecting in the BRT route

A temple of Shitala Mata near Navagaon which was coming in the BRT corridor has been shifted in the opposite direction, beside the Navagaon pond. Construction of this new temple is almost over. This has been constructed with acceptance of Navagaon people. No other religious structures come in the BRT corridor.

FIGURE 5-1: TEMPLE LOCATED ON THE BRT CORRIDOR

FIGURE 5-2: TEMPLE SHIFTED BESIDE NAVAGAON POND

5.1.9 Solid/Liquid Waste

Construction Stage: Solid/liquid Waste will be generated during construction of Terminals/Depots.

Mitigation Measures: Construction waste will be disposed off in dump sites. Waste oils/Greases from equipments will be collected in drums and disposed to authorized dealers.

Operation Stage: Solid waste will be produced at the Terminals/ Depots and cleaning of roads. No significant impacts are anticipated during operation stage. ETPs will be provided at Bus depots to treat waste water generated from depot activities. STPs will be provided at terminals to treat waste water.

Mitigation Measures: Maintenance of the urban road should be organized, including cleaning roads and drainage systems, collecting solid waste, etc. Solid waste generated at the Bus Terminals and Bus Depots, will be sent to the local municipal authorities. Waste oils/Greases from equipments as well as from ETPs will be collected in drums and disposed to authorized dealers.

6.0 Environmental Management Plan

The scope of present environmental impact study includes delineation of Environmental Management Plan (EMP). The aim of an environmental management plan is to avoid or minimize impacts due to project implementation and where possible, enhance beneficial effects.

6.1 THE ENVIRONMENTAL MANAGEMENT PLAN

The detailed impact identification and management plan during construction and operation stage is delineated in Table 6-1 and Table 6-2.

TABLE 6-1 : IMPACTS AND MANAGEMENT PLAN DURING CONSTRUCTION STAGE

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	Supervision
1.	**Air**			
	Generation of Dust	Dust can be suppressed by sprinkling of water regularly hence reducing dust generation. Temporary barriers will be provided around the construction site of Terminals/Depots so that dust does not spread in the nearby areas.	Contractor	NRDA
	Emission from Vehicles and Equipments	Machinery and transportation vehicles are selected in compliance with emission standards. They will be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in good working condition.	Contractor	NRDA
2.	**Noise**			
	Noise from Vehicles and equipment	All vehicles and equipment used in construction is fitted with exhaust silencers. Servicing of all construction vehicles and machinery are maintained. Noise levels will be maintained within limits.	Contractor	NRDA
3.	**Surface and Ground water**			
		Construction camp sewage will be collected in soak pits and septic tanks. Regular maintenance of these pits and tanks to avoid spill outs. Any kind of discharge into the water bodies is strictly prohibited.	Contractor	NRDA

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	Supervision
4.	**Soil**			
		Temporary embankments will be made to avoid soil erosion outside the terminals and depots.	Contractor	NRDA
5.	**Urban Ecosystems and Landscapes**			
		Protection of planted trees and planting of more trees.	Contractor	NRDA
6.	**Solid/Liquid Waste**			
	Solid waste generated from construction sites(Terminals/Depots), construction camps etc.	Disposal of waste oil and construction debris at regular intervals. Garbage bins provided at the construction camps are regularly emptied and disposed in a hygienic manner.	Contractor	NRDA

TABLE 6-2 : IMPACT IDENTIFICATION AND MANAGEMENT PLAN DURING OPERATION STAGE

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	Supervision
1.	**Air**			
	Emissions	BRT buses will be using compressed natural gas as fuel. This system minimizes vehicle emissions (including greenhouse gas emissions). Moreover, trees will be planted	Contractor for a period of 24 months	NRDA

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	**Supervision**
		on roadsides (curbs and medians) to reduce pollutant concentrations. Inspection and maintenance of vehicles will be done at regular intervals.		
2.	**Noise**			
	Landscaping	Planting of trees will reduce noise levels to a high extent.	Contractor for a period of 24 months	NRDA
	Vehicle Technology and Maintenance	Vehicle technology will enhance noise emission standards and reduce noise levels. Enforcement of vehicular noise standards, implement inspection and maintenance programs, vehicles with excessive noise should be gradually taken out of service. Also, proper and regular maintenance of vehicles will keep the noise levels under control. Enforcement of vehicle speed control, especially at night time.		NRDA
3.	**Surface and Ground Water**			
		NRDA is proposed to develop RWH system along BRT corridor and Bus Terminals/ Bus Depots. Periodical cleaning of rain water harvesting system to avoid clogging. Regular maintenance of tank bunds which are falling near to BRTS corridor.	Contractor for a period of 24 months	NRDA

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	Supervision
4.	**Soil**			
		Regular maintenance of storm water drains along the BRT corridor and in terminals and depots.	Contractor	NRDA
5.	**Trees**			
		Trees and vegetation removed during construction phase would be replanted in other places. After road construction, trees and grasses would be planted on either side of the road network as well as in the medians. Total of 215 Ha trees will be planted under the project area. The plants selected should be pollutant tolerant, able to absorb pollutants, dust-resistant, noise reducing, and beautifying so as to create an unspoiled green land area. Types of plants that can survive easily should be chosen.	Contractor for a period of 24 months	NRDA
6.	**Urban Ecosystems and Landscapes**			
		Regular watering of trees, pruning and removal of dried trees and leaf drops.	Contractor	NRDA
7.	**Solid/Liquid Waste**			
		The solid waste will be collected daily by the local municipal authorities from roads	Contractor for a period of 24 months	NRDA

Sr. No.	Environmental parameter	Management Plan	Responsibility	
			Implementation	Supervision
		and terminals/depots. Periodical maintenance of ETPs at bus depots and STPs at terminals. Regular collection and disposal of waste oils from bus depots. Continuous maintenance of drainage system in terminals/ depots.		

6.2 SAFETY OF PEDESTRIANS DURING PLYING OF BRT BUSES WITHIN THE RESIDENTIAL AREAS

Following safety rules should be adhered to while movement of BRT buses within the residential areas.

- Various signages at the crossings will be provided. Signage would be in the form of identifying entry and exit points to the BRTS corridor, speed limits, pedestrian crossings, blow horn sign, traffic lights, speed breakers, etc. Footpaths and walkways along the road side would add to the safety of the pedestrians.
- Signage should be in easily understandable symbols, maps, pictorial depictions or written (bilingual and will include the local spoken languages).
- BRTS corridors will be demarcated on the ground and clear signals will be marked on the roads.

6.3 PLANTATION ALONG ROAD SIDE

Automobiles may be considered as ground level, mobile sources of pollution of both type – gaseous as well as particulate. Components of green belts on roadside hence, should be both absorbers of gaseous as well as of dust particles, including even lead particulates. Choice of plants for roadside plantations may be for containment of pollution and for formation of a screen between traffic and roadside residences. This choice of plants should include shrubs of height 1 to 1.5 m and trees of 3 to 5 m height. The intermixing of trees and shrubs should be such that the foliage area density in vertical is almost uniform.

An ideal tree for plantation in the green belt should have following characteristics:

- Fast growth rate for quick development
- Strong branches with durable canopy having capacity of withstanding storm
- Large leaf size for more retention of pollutants
- Dense foliage for better trapping of pollutants
- Long life span for extended life of green belt

List of plants suitable for pollution, dust and noise pollution attenuation are mentioned below.

TABLE 6-3 : LIST OF PLANTS TO BE PLANTED ALONG THE ROAD SIDE

S.No	Common Name	Scientific Name	Tolerant
1	Siris	*Albizia lebbeck*	Pollutant, Dust
2	White Siris	*Albizia procera*	Pollutant, Dust
3	Neem	*Azadirachta indica*	Pollutant, Dust
4	Jangli saru	*Casuarina equisetifolia*	Pollutant, Dust
5	Sissoo	*Dalbergia sissoo*	Pollutant, Dust

6	Gamhar	*Gmelia arborea*	Pollutant,
7	Madhua	*Madhua indica*	Pollutant, Dust
8	Bakain	*Melia azaderach*	Pollutant, Dust
9	Pongam	*Pongamia pinnata*	Pollutant
10	Khejri	*Prosopis cineria*	Pollutant
11	Sal	*Shorea Robusta*	Pollutant, Dust
12	Jamun	*Syzygium cumini*	Pollutant, Dust
13	Tamarind	*Tamarindus indica*	Pollutant
14	Arjun	*Terminalia arjuna*	Pollutant, Dust, Noise
15	Myrobalan	*Terminalia bellerica*	Pollutant, Dust
16	Bair	*Zizyphus mauritiana*	Pollutant, Dust
17	Semal	*Bombax ceiba*	Pollutant, Dust
18	Kadamb	*Anthocephalus cadamba*	Pollutant, Dust
19	Devil tree	*Alstonia scholaris*	Pollutant, Dust, Noise
20	Shisam	*Dalbergia latifolia*	Pollutant, Dust
21	Bougainvillia	*Bougainvillea spectabilis*	Pollutant, Dust
22	Kaner	*Nerium indicum*	Pollutant, Dust
23	Kaner	*Indian oleander*	Pollutant, Dust
24	Weeping fig	*Ficus Benjamina*	Pollutant
25	Dhak	*Butea monosperma*	Pollution, Dust, Noise
26	Indian Coral tree	*Erythrina variegata*	Pollution, Dust, Noise
27	Tamarind	*Tamarindus indicus*	Pollution, Noise

6.4 THE ENVIRONMENTAL MONITORING PROGRAMME

For effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. The objectives of the monitoring programme are:

- To ensure that the measures suggested herein are being taken during construction
- To evaluate the efficiency of the proposed mitigation and enhancement measures
- To investigate the adequacy of the EMP as well as suggest improvements to it
- To generate data that could be incorporated in future EMPs
- To evaluate what additional enforcement is required for the effective implementation of the EMP.

6.4.1 Ambient Air Quality Monitoring

Ambient air quality parameters recommended for BRT development are RPM, SPM, CO, NOx, HC, SO_2 and Pb. These are to be monitored at designated locations twice a year for atleast five years from the commencement of construction. Twenty-four hours basis air quality data should be generated over three days at all identified locations.

6.4.2 Water Quality Monitoring

Water quality will be monitored for pH, total solids, total dissolved solids, total suspended solids, oil & grease, COD, chloride, lead, zinc and cadmium by Standard Methods. Monitoring should be carried out once in a year starting at the scheduled time of construction for five years.

6.4.3 Ambient Noise Monitoring

Noise level measurements will be carried out at all designated locations along the project corridors. Twenty-four hours of sound pressure levels on an hourly basis will be monitored with regular intervals during BRT construction and operation phases. Noise should be recorded at a weighted frequency using a slow time response mode of the measuring instrument.

6.5 BUDGET FOR ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Budget for the BRT project as Capital Cost and Recurring Cost is given in Table 6-4 and Table 6-5.

TABLE 6-4: ENVIRONMENTAL BUDGET FOR BRT - CAPITAL COST

COMPONENT	ITEM	Unit	Unit Cost (Rs.)	QUANTITY	Total Cost (INR)
Management Costs					
Water	Sewage Treatment Plant at two Terminals	KLD.	10,00,000	2	20,00,000
	Effluent Treatment Plant with Oil Separator at Depot	KLD.	50,00,000	1	50,00,000
	Construction of Rainwater Harvesting Structure	No.	50,00,000	5	250,00,000
Greenbelt	Greenbelt Development/Plantation of trees	Ha	50,000	215 Ha	107,50,000
Sub-total Management Measures (A)					**427,50,000**
Monitoring Costs					
Air Quality	Monitoring at 2 specified locations – 1) 0.5km from crusher 2) Near New Capital Complex – Road No. 2	No.	3500	2 stations X 4 seasons X for 2 years =16 samples	56,000
Water Quality	One drinking water sample at the construction camp site	No.	2500	1 location X every quarter X 2 years = 8 samples	20,000
Noise Quality	Monitoring at 2 specified locations – 1) 0.5km from crusher 2) Near New Capital Complex – Road No. 2	No.	1000	2 stations X 4 seasons X for 2 years = 16 samples	16,000

COMPONENT	ITEM	Unit	Unit Cost (Rs.)	QUANTITY	Total Cost (INR)
Sub-total Monitoring Costs (B)					**92,000**
Total Costs (A+B)					**428,42,000**

TABLE 6-5: ENVIRONMENTAL BUDGET FOR BRT - RECURRING COST

COMPONENT	ITEM	Unit	Unit Cost (Rs.)	QUANTITY	Total Cost (INR)
Management Costs					
Water	Maintenance of Sewage Treatment Plants at the two Terminals	KLD	1,00,000	2	2,00,000
	Maintenance of Effluent Treatment Plant at Depot	KLD	2,00,000	1	2,00,000
	Maintenance of Storm Water Drains (Total length of BRT corridor – Road Nos. 1,2,4,5,12/2A,13 is 45.8 km)	Lumpsum		45.8 X 2 91.6 km	2,50,000
	Maintenance of Tank Bunds constructed along BRT corridor	Lumpsum			2,50,000
	Periodical Cleaning of Rainwater Harvesting Structures (Considering 40 structures)	No.	5,00,000	5	25,00,000
Green Belt	Watering of trees, pruning of trees, removal of dried leaves	Lumpsum	-	-	12,00,000

COMPONENT	ITEM	Unit	Unit Cost (Rs.)	QUANTITY	Total Cost (INR)
Solid Waste	Cleaning and collection by municipal authorities	Lumpsum	-	-	10,00,000
	Disposal of waste oils from depots	Lumpsum	-	-	5,00,000
Sub-total Management Measures (C)					**61,00,000**
Monitoring Costs					
Air Quality	At specified locations within the site	No.	3500	2 stations X 12 months X for 1 year =24 samples	84,000
Water Quality	One sample will be collected for the surface water quality from the natural stream or ponds or drains in the BRT stretch	No.	2500	1 Sample each in pre-monsoon and post-monsoon season for 1 year = 2 Samples X 1 year = 2 samples	5000
Noise Quality	At 2 specified stations quarterly	No.	1000	2 stations X 4 seasons X 1 year =8 samples	8000
Sub-total Monitoring Costs (D)					**97,000**
Total Costs (C+D)					**61,97,000**

7.0 Summary & Conclusions

The proposed BRT is essential for the future development of Naya Raipur. The project addresses the sustainable urban development through its road network implementation and traffic management system. It will provide a key premise for the district's sustainable development. By sharing the city functions with the existing urban centre, district development will contribute to the sustainable development of the entire Raipur city. The project includes two components for urban traffic sustainability: 1) development of the BRT, 2) utility facilities. The EIA revealed that the BRT System at Naya Raipur will have not much environmental impacts on soil, air, water, urban and rural ecosystems, economic activities, communities and society.

The EMP will reduce environmental impacts to acceptable levels. It includes environmental protection measures for all potential environmental impacts and a monitoring plan. It also designates relevant organization's environmental responsibilities. The EMP ensures implementation of the environmental mitigation measures during construction and operation. Therefore, the BRT project will be implemented in an environmentally sound manner and will effectively contribute to the sustainable urban development of Chhattisgarh and the future development of Naya Raipur.

ANNEXURE – I ENVIRONMENTAL CLEARANCE FOR NAYA RAIPUR

STATE LEVEL ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
CHHATTISGARH
Government of India
Ministry of Environment and Forests

1-Tilak Nagar,
Shiv Mandir Chowk,
Main Road Avanti Vihar,
Raipur (C.G.)
E-mail: seiaaccg@gmail.com
Website: www, seiaacg.org

No. 303 /SEIAA-CG/EC/T&AD/RYP/1/08 Raipur, Dated 8/12/2008

To,

Chief Executive Officer
Naya Raipur Development Authority
Near Mantralaya,
Raipur (Chhattisgarh).

Sub: - Conditions to be complied with for according Environmental clearance for PLANNING & DESIGNING OF NAYA RAIPUR SATELLITE CITY OF CHHATTISGARH, NRDA, RAIPUR– Regarding.

Ref: -
1. Your letter no. 382/EIA & EMP Naya Raipur/NRDA/07 Raipur, dated 11/02/2008
2. Your letter no. 1036/3-92/EIA & EMP Road/NRDA/07 Raipur, dated 25/04/2008
3. Your letter no. 1037/EIA & EMP Naya Raipur/NRDA/07 Raipur, dated 25/04/2008
4. This office letter no. 99/SEIAA-CG/T&AD/RYP/1/08 Raipur, dated 03/07/2008.
5. This office letter no. 138/SEIAA-CG/T&AD/RYP/1/08 Raipur, dated 04/08/2008.
6. Your letter no. 3067/NRDA/08 Raipur, dated 21/08/2008.

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The application submitted by Naya Raipur Development Authority for Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" was considered in second meeting of SEAC, Chhattisgarh held on 5th April 2008. Initially NRDA, Raipur has submitted two separate applications for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" and "Construction of Express Way of 100 meter ROW, Roads with 100 meter ROW and 60 meter ROW at Naya Raipur". These two applications were considered in the second meeting of SEAC, Chhattisgarh held on 5th April 2008. The proposed expressway and roads at Naya Raipur are neither a National Highway nor a State

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Highway. The National Highways and State Highways (new or expansion) only are covered in the schedule of EIA Notification, 2006, therefore the SEAC, Chhattisgarh decided that the construction of Express Way of 100 meter ROW, Roads with 100 meter ROW and 60 meter ROW at Naya Raipur project should be a part of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur and it should not be treated separately. Accordingly, NRDA, Raipur submitted the revised Form-I, Form-I 'A' including the express way and roads in the Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur project. The SEAC, Chhattisgarh considered this application. As per decision taken in second meeting of SEAC, Chhattisgarh, project proponent along-with consultant made the presentation before SEAC, Chhattisgarh on 26th April 2008. This project is covered in serial no. '8(b) Townships and Area Development Project' of EIA Notification, 2006.

The Government of Chhattisgarh has envisaged creation of a new capital city by the name of 'Naya. Government of Chhattisgarh has constituted the 'Naya Raipur Development Authority' as a Special Area Development Authority to plan, implement and administer Naya Raipur.

The Naya Raipur city mainly includes the following:

- Government complexes to include Secretariat, Assembly, Government Offices, and Police Head-quarters area.
- Cultural center to include Museum, Art Gallery, Library, Theatres, Convention center and International Center.
- City Center to include city level shopping malls, commercial offices, restaurants, multiplexes and other areas of recreation.
- University including research and institutional complexes.
- Software technology park, exhibition and business centers.
- Central City Park around an existing vast water body. Park and Sports Center in the North end to include urban forest, theme park and sports complex. City Park South to include Theme Park, Jungle Safari, Golf Course and Film City.
- Transport and integrated freight complex to service the city and its industrial area.
- Living areas with medium density development.
- Express way / roads etc.

As per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated - 05/02/2008, the State Level Expert Appraisal Committee, Chhattisgarh recommended for issue of provisional Environmental Clearance (Conditions to be complied with for according Environment Clearance) as per the provision of Environmental Impact Assessment Notification, 2006 and the subsequent amendments.

II

The application submitted by Naya Raipur Development Authority for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" and recommendation of State Level Expert Appraisal Committee, Chhattisgarh was considered in the third and fourth meeting of SEIAA, Chhattisgarh held on 16th June 2008 and 30th September 2008 respectively. After detailed deliberations SEIAA, Chhattisgarh accepted the recommendation of SEAC, Chhattisgarh and decided to issue the Provisional Environmental Clearance (conditions to be complied with for according Environment Clearance) as per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated 05/02/2008) for Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur.

In pursuant to above Provisional Environmental Clearance (conditions to be complied with for according Environment Clearance) as per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated 05/02/2008) for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" is hereby accorded subject to strict compliance of the terms and conditions mentioned below:-

PART A – SPECIFIC CONDITIONS

I. Construction Phase

Facility of Labourers during Construction: -

i) Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project. Construction camp and temporary labour sheds shall be located away from the construction site. Construction camps shall be provided for construction personnel to avoid indiscriminate settlement of construction workers and labourers.

ii) Provision of drinking water, wastewater disposal, solid wastes management and primary health facilities shall be ensured for labour camps. Proper sanitation facilities shall be provided at the construction site to prevent health related problem. Domestic as well as sanitary wastes from construction camps shall be cleared regularly.

iii) Water usage during construction shall be optimised to avoid any wastage.

iv) Ground water shall not be used for construction works during construction phase.

v) Adequate safely measures shall be adopted to the construction workers.

vi) All the labourers to be engaged for construction works shall be screened for health and adequately treated before issue of work permits. The contractor shall ensure periodic health check-up of construction workers.

vii) Provision shall be made for the supply of kerosene or cooking gas /pressure cooker to the labourers during construction phase.

III

Environmental Management during Construction: -

i) Some of the existing buildings/houses/structures within project site are proposed to be demolished. Re-use of debris at existing site as far as practicable is recommended with a special care for handling and disposal of asbestos waste, if any. Rest of waste is to be disposed at the sanitary landfill disposal site at Naya Raipur City.

ii) The asbestos waste, from demolition debris, if any, shall separated and shall be disposed at proposed Common Hazardous Wastes, Treatment and Disposal Facility of Naya Raipur City.

iii) Appropriate measure like adequate drainage, embankment consolidation and slope stabilization shall be taken along the city road to avoid soil erosion. Top soils (20 cm) of the borrow pit sites shall be conserved and restored after completion of excavation. All the topsoil excavated during construction activities shall be stored for use in horticulture/landscape development within the project site. Proper erosion control and sediment control measures shall be adopted.

iv) Earth material generated from excavation shall be reuse to the maximum possible extent as filling material during site development. The construction debris and surplus excavated material shall be disposed off by mechanical transport in suitable pre-identified dumping areas to avoid land degradation and water logging due to indiscriminate dumping. Dumping areas shall be biologically reclaimed through topsoil cover and plantation.

v) A soil erosion and sedimentation control plan shall be prepared prior to construction. The soil erosion, sediment control and storm water practices mentioned in this document shall be incorporated depending upon the site characteristics to control soil erosion and loss of top soil during construction.

vi) Disposal of muck including excavated material during construction phase shall not create any adverse effects on the neighbouring communities and disposed off taking the necessary precautions for general safety and health aspects.

vii) Low sulphur diesel type diesel generator sets should be used during construction phase. Diesel generator sets during construction phase shall have acoustic enclosures and shall conform to Environment (Protection) Rules, 1986 prescribed for air and noise emission standards.

viii) All Vehicles/equipments deployed during construction phase shall be ensure in good working condition and shall conform to applicable air and noise emission standards. These shall be operated only during non-peaking hours.

ix) Ambient noise levels shall conform to residential standards both during day and night. Fortnightly monitoring of ambient air quality (RPM, SPM, SO_2 and NOx). Equivalent noise levels shall be ensured during construction phase and closely monitored during construction phase.

x) The protective equipments such as earplugs etc. shall be provided to construction personnel exposed to high noise levels. Stationary construction

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equipments generating noise shall be placed at-least 125 m away from inhabited areas and at-least 200 m away from the silence zones. Construction activities carried out near residential area shall be scheduled to daytime only. Only limited necessary construction shall be done during nighttime. No unloading of construction materials shall be done at night. Vehicular noise and use of horns shall be controlled through enforcement of laws and public awareness. Use of pressure horns shall be strictly prohibited. Appropriate noise barriers at silence zones shall be provided. To reduce noise level, the arterial roads shall be designed to have 2 to 3 rows of plantation.

xi) The separation of housing from traffic noise by interposing buffer zones, and the protection of schools and hospitals and other sensitive areas by green belts, public gardens, etc. should be ensured. To overcome the problem caused by aircraft noise, noise exposure forecast (NEF) criterion should be adopted. No residential development shall be allowed beyond NEF 35 level. For very critical buildings such as buildings necessary for maintaining and supplementing the airport services, and for commercial development, such as hotels, provide sealed windows and to centrally air-condition the entire building. Local housing roads shall not provide short cuts for heavy traffic zones through residential areas. Trees with heavy foliage shall be planted on both sides of carriageway. Highway noise barriers shall be also used for reducing traffic noise around residential areas.

xii) Construction spoils, including bituminous material and other hazardous materials including oil from construction equipments must not be allowed to contaminate watercourses and the dumpsites for such material must be secured so that they shall not leach into the ground water. If necessary, oil trap shall be installed where heavy machineries are deployed.

xiii) Proper and prior planning, sequencing and scheduling of all major construction activities shall be done. Construction material shall be stored in covered godowns/sheds. Truck carrying soil, sand and other construction materials shall be duly covered to prevent spilling and dust emission. Adequate dust suppression measures shall be undertaken to control fugitive dust emission. Regular water sprinkling for dust suppression shall be ensured. Mass transit system shall propose for the new city in order to reduce the vehicular emission.

xiv) Use of Ready-Mix concrete is recommended for this project.

xv) Accumulation/stagnation of water shall avoid ensuring vector control.

xvi) Regular supervision of the above and other measures shall be in place all through the construction phase so as to avoid disturbance to the surroundings.

Selection of Materials for Better Energy Efficiency: -

i) Use of energy efficient construction materials shall be ensured to achieve the desired thermal comfort.

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ii) Use of fly ash based bricks/blocks/tiles/products shall be explored to the maximum extent possible. Blended cement with fly ash shall be used (not less than 17%). The provisions of Ministry of Environment and Forests, Government of India Notification No. 763(E) dated 14/09/1999 [amended notification no. SO 979 (E) dated 27/08/2003] regarding use of Fly Ash must be complied with. Appropriate usage of other industrial wastes shall also be explored. Soil borrow area should be filled up with ash with proper compaction and covered with top soil kept separately. Fly ash/pond ash should be used for low- lying areas filling. In embankments / fly over / road construction etc. ash should be utilized as per guidelines of Ministry of Environment and Forests, Government of India/ Central Pollution Control Board/ Indian Road Congress etc. concerning authorities. The use of perforated brick / hollow blocks / fly ash based lightweight aerated concrete etc. should also be explored so as to reduce load on natural resources.

iii) Construction shall conform to the requirements of local seismic regulations. The project proponent shall obtain permission for the plans and designs including structural design, standard and specifications of all construction works from concerned authority.

iv) Reduce the use of glazed surface as per National Building Code 2005. Use of glass in various complexes may be reduced up to 40% to reduce the electricity consumption and load on air-conditioning. If necessary, use of high quality double glass with special reflective coating in windows. Roof of the various complexes should meet prescriptive requirement as per Energy Conservation Building Code by using appropriate thermal insulation material to fulfil requirement. Opaque wall should meet prescriptive requirement as per Energy Conservation Building Code which is proposed to be mandatory for all air conditioned spaces while it is inspirational for non-air-conditioned spaces by use of appropriate thermal insulation material to fulfil requirement.

v) Use of energy efficient construction materials to achieve the desired thermal comfort shall be incorporated. The desired level of roof assembling 'U' factor and insulation 'R' value must be achieved. Roof assembling 'U' factor for the top roof shall not exceed 0.4 Watt/sq.m/degree centigrade with appropriate modifications of specifications and building technologies. The provisions of National Building Code 2005 shall be strictly followed.

vi) Modern electrical power transmission & distribution system shall be installed. Power supply for up to 33 kV shall be supplied through underground distribution system. Power supply at 132 kV or above shall be supplied through overhead system. The main receiving stations (Grid stations) shall have the SCADA (Supervisory Control and Data Acquisition) facility to ensure online monitoring & control of power supply.

vii) Street lighting shall be energy efficient. The High Pressure Sodium Vapour (HPSV) Lamps & Compact Fluorescent Lamps (CFL) along city network system shall be provided. High intensity, high mast lights to be installed at intersections, bus stops, stadium, transport hubs and major pedestrian

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movement areas as per the specifications and guidelines prescribed by the Bureau of Indian Standards. Solar energy may be used for outdoor lighting.

viii) Extensive network of cellular phones and landlines shall be provided. Fibre optic cables shall be used. The telephone and electric cables shall be laid in the same corridor. Adequate vertical and horizontal separation between telephone and electric cable shall be maintained.

ix) Guidelines to the household shall include usage efficiency measures such as energy efficient lighting and rainwater harvesting system.

x) Reduce hard paving-onsite (open area surrounding building premises) and/or provide shade on hard paved surfaces to minimize heat island effect and imperviousness of the site.

xi) Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Expressways, City Arial Roads, Sector Peripheral and Intra-Sectoral Roads etc. are proposed to come up in the earmarked area. All proposed air-conditioned buildings should follow the norms proposed in the ECBC regulations framed by the Bureau of Energy Efficiency. Use of chillers shall be CFC & HCFC free.

Water Body Conservation: -

i) No water body shall be lined or no embankment shall be cemented. The water bodies shall be kept in natural conditions without disturbing the ecological habitat.

ii) Improvement or rehabilitation of existing natural streams, channels / nallas shall be carried out without disturbing the ecological habitat.

iii) No untreated wastewater shall be discharge in the any water bodies under any circumstances.

iv) All the construction and preparatory activities shall be carried out during dry seasons only.

Water Supply: -

i) Proposed Annicut on Mahanadi River shall be source of water supply for first phase, whereas, for second and third phases, new barrage near Rajim shall be the source of water supply.

ii) The water supply norms based on manual of Central Public Health and Environmental Engineering Organization (CPHEEO) and master plan for Delhi 2001 shall be adopted for Naya Raipur City.

iii) The water treatment plant shall be provided for treatment of water. The treatment shall include screening, sedimentation, filtration and disinfections. The Water Treatment Plant shall be constructed in different modules.

iv) Appropriate arrangement shall be made for treatment and reuse of backwash water of filtration plant.

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v) Project proponent shall provide adequate measuring arrangement at the inlet point of water uptake and at the discharge point for the measurement of water utilized in different categories to monitor the daily water consumption. Measuring arrangement for effluent generated shall also be provided.

vi) Water saving practices such as usage of water saving devices / fixtures, low flow flushing systems, sensor based fixtures, auto control walls, pressure reducing devices etc. should be adopted.

Greening Programme: -

i) Lay out of proposed Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Expressways, City Arial Roads, Sector Peripheral and Intra-Sectoral Roads etc. shall be made in such a way that it shall cause minimum disturbance to existing flora and fauna. Appropriate green belt shall be developed to compensate the habitat loss of trees for site clearing. The project proponent must obtain permission for tree cutting from competent authority as per prevailing Act/Rules. The exotic species existing within the planning area, if any, shall be protected. The greening programme shall include plantation of exotic and indigenous species.

ii) A buffer of 20m on either side of canals & streams, 50m around water bodies and 100m along Mahanadi canal shall be reserved as greenbelt without allowing any development. Plantation along the side of the roads and in the open spaces shall be developed to act as sinks of air pollutants.

iii) Adequate plantation programme along the city level road and open spaces shall be planned. The plantation of trees shall be completed in the construction stage. The plantation programme shall be drawn to conform the natural climate conditions. The plantations shall consist of mixture of available indigenous, fast growing and sturdy species of trees, shrubs and herbs. Preferential plantation of flowering trees with less timber and fruit value shall be carried out. To compensate the habitat loss of any fauna, about five hundred wide greenbelt all around the Naya Raipur City shall be developed.

iv) Green belt shall be comprised of specific plant species as per Central Pollution Control Board's guidelines depending up on the type/nature of pollution. The pollutants wise plant species shall be provided.

Sewage Management: -

i) As per the proposal submitted by project proponent, the project area shall be divided into two drainage zones – southern zone & northern zone. Southern zone shall cater about 60% and Northern zone about 40% of the total sewage. Two Sewage Treatment Plants of total 96 MLD (minimum) capacities shall be constructed. STP should be developed in phases. As single modular Sewage Treatment Plant is energy efficient, hence, the possibility of single modular Sewage Treatment Plant of adequate capacity should also be explored for treatment of sewage generated from Naya Raipur city in order to conserve the

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energy. Treatment based on primary settling followed by activated sludge process and dis-infection shall be adopted. Sewerage system of adequate capacity to carry the sewage during peak hours shall be laid to collect and convey the sewage from various complexes. Three sewage-pumping stations of adequate capacity shall be constructed for sewerage system at southern zone, northern zone & intermediate pumping station. The augmentation of Sewerage System, Sewage- Pumping Stations and Sewage Treatment Plants shall be ensured before the operation phase starts.

Rain Water Harvesting Scheme: -

i) Rainwater from open spaces shall be collected and reuse for landscaping and other purposes. Rooftop rainwater harvesting shall be adopted for Naya Raipur City. Every government/private buildings, shopping malls & residential apartments shall have rainwater-harvesting facilities. The storm water flowing in roadside drains shall also be recycled and reused to maintain the vegetation and discharged into natural water bodies. Before recharging the surface runoff, pre treatment must be done to remove suspended matter and oil & grease.

ii) Net imperviousness of the site should not exceed the imperviousness factor as prescribed by the National Building Code of India, Bureau of Indian Standards, 2005.

Transport Management: -

i) Dedicated cycle tracks and pedestrian paths shall be provided along the major roads. Appropriate access shall be provided for physically challenged people in the pedestrian paths.

ii) The design of service roads and the entry and exit from the housing complexes shall conform to the norms & standards prescribed by the National Highways Authority of India/ State Public Works Department.

iii) All the villages shall be connected by an all-weather village road to a higher order road either directly or through another village settlement. Naya Raipur City Transport System shall not cover more than 12.55% (10055.77 Ha) of the gross area of Naya Raipur. Naya Raipur City Transport System shall comprise of City Arial Roads (ROW-100 m), Sector Peripheral (ROW-60 m) and Intra-Sectoral Roads (ROW-24m /18m /12m).

iv) The road system shall have the road cross sections for general traffic, exclusive ways for public mass transport (bus) system, pedestrian paths and ways, cycle tracks, utility corridors and green strip. The major roads shall be free of service lanes to check direct access of abutting property / activity from the main road. An internal road system linked to the main roads at defined locations shall be provided for access to all the activities.

v) In the initial period, flexible pavement (as per IRC guidelines for the design of flexible pavement IRC: 37-2001) shall be constructed to allow the consolidation and settling of base. Cement concrete pavement shall be

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constructed in the later phases. Permeable (porous) paving in the parking areas, and walkways & patio areas should be used to control surface water runoff by allowing storm water to infiltrate the soil and return to ground water.

vi) All intersections shall be designed and developed as roundabouts. The diameter of the central rotary shall be more than the carriageway widths of links meeting at the intersections. Roundabouts shall be landscaped with wide variety of flora and fauna of Chhattisgarh. Geometric designs of Links and Nodes shall be based on manuals and guidelines and in conformity with standards and specifications prescribed by concerned authorities.

vii) All utility lines (electricity, telephone, cable, water supply, sewerage, drainage, etc.) shall be laid below ground level. Ducts shall be provided along and across the roads to lay the utility lines. Major trunk (water/sewerage) lines are to be laid along the utility corridor.

viii) The road drainage shall be designed to enable quick runoff of surface water and prevent water logging. The road level shall be kept at least 0.5 to 1.0 meter above the observed high flood level. The guidelines on Urban Drainage, IRC: SP-50 shall be followed. Fencing along the outer edge of the road right off way shall be carried out to prevent unauthorized ribbon development. The pedestrian shall be given priority attention in the transport system, which includes footpaths, pedestrian ways (along the ROW of the major roads 100 m / 60m) and pedestrian corridor, pedestrian plazas and other facilities. On the both sides of all roads, well –lit and smooth surfaced footpaths, of minimum 2.0 m width shall be provided. Cycle Tracks, of minimum 3m width shall be provided along the green and pedestrian corridors and ways. The hoardings shall be strictly prohibited along the roads.

ix) The public mass transport of Naya Raipur shall include (a) Bus System [Common Carrier] (b) Intermediate Public Transport modes and (c) Rail based Light Rail Transit.

x) Adequate provision shall be made to cater the parking needs. Parking spaces standards as given in 'Manual on Norms and Standards for Environmental Clearance of Large Construction Projects' issued by Ministry of Environment & Forests, Government of India shall be adapted.

Others: -

i) All mandatory approvals and permissions as required from Airport Authority, Director of explosives and Fire Department etc. shall be obtained.

ii) Unskilled construction labourers shall be recruited from the local areas. Construction materials shall be procured locally as far as possible.

iii) Provision shall be made in layout plan for distribution of convenient shops and Nursery Schools as per planning norms and minimum walking distance from the households.

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iv) Provisions shall be made for the integration of solar water heating system. Provision for the use of biomass as a source of energy generation may be explored.

v) Provision of vermi-composting for the biodegradable solid wastes generated from the Government Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Housing Complexes as well as the large amount of biomass that shall be available from the tree plantation shall be made.

vi) Information regarding hydrogeology and ground water regime shall be incorporated. Surface water analysis regarding quality and the availability of sufficient quantity of water supply to the various complexes shall be ensured. Periodical monitoring of ground water table and quality shall also be carried out. Construction of tube wells, bore wells shall be strictly regulated. The ground water shall not be abstracted without prior permission from the competent authority in the project area. Permission to draw ground water shall be obtained from the competent authority prior to construction / operation of the project.

vii) The Strom water management plan shall be designed in such a manner that the storm water is discharged though an existing dedicated Storm water outfall only. The design shall confirm the existing drainage scheme of the surrounding locality. Storm water control and its re-use as per CGWB and BIS standards for various applications should be followed.

viii) Adequate roadside drains shall be provided along the city road to facilitate its better maintenance and increase in the life of the carriageway, which shall avoid soil erosion and land degradation due to water stagnation. The roadside drains shall be provided on both sides of the road. Longitudinal and cross drainage system shall be regularly maintained. Adequate new drainage works and cross drainage structures shall be provided for smooth passage of runoff. Filling of existing natural drainage courses shall be strictly avoided. Suitable drainage at construction site and camp shall be provided to eliminate the formation of stagnant water pools.

II. Operation Phase

Sewage Treatment Plant: -

i) Project proponent shall operate and maintain the sewerage system, sewerage pumping system and sewage treatment system regularly to ensure the treated effluent quality within the standards prescribed by Ministry of Environment and Forests, Government of India or prescribed by Chhattisgarh Environment Conservation Board (which ever stringent). All the effluent treatment system shall be kept in good running conditions all the time and failure (if any), shall be immediately rectified without delay, otherwise, some alternate arrangement shall be made for storage of untreated sewage until the control measures are rectified to achieve the desired efficiency. Project proponent shall install separate electric metering arrangement with time totalizer for the running of

pollution control systems. The record (logbook) of power & chemical consumption for running the pollution control systems shall be maintained.

ii) Properly treated and disinfected (Ultra Violet) sewage shall be utilized in pisciculture, forestry, fire fighting, in Government buildings, shopping malls and private & government apartments for cooling purpose, to develop and maintain the greenbelt along the city road, expressway and in open spaces etc. As far as possible discharge of treated sewage into watercourses / water bodies shall be avoided. Only treated sewage confirming the norms of effluent standards prescribed by Ministry of Environment and Forests, Government of India or prescribed by Chhattisgarh Environment Conservation Board (which ever stringent) shall be allowed to discharge into those watercourses / water bodies, which is not use for source of drinking water supply or use for bathing purpose in downstream, depending upon the assimilative capacity of the watercourse / water body.

iii) Open defecation within the Naya Raipur city shall be strictly controlled.

iv) Non-mixing of fecal matter with the municipal solid wastes shall be strictly ensured.

v) Non-mixing of sewage/sullage with rainwater shall be strictly ensured.

Emission of Diesel Generator Set: -

i) Noise barriers shall be provided at appropriate locations so as to ensure that the noise levels do not exceed the prescribed standards. DG sets shall be provided with necessary acoustic enclosures as per Central Pollution Control Board norms.

Ensure Energy Efficiency: -

i) Back up supply as well as public transportation system proposed for project shall be based on Natural Gas/cleaner fuel subject to their availability.

ii) The project proponent shall resort to solar energy at least for street lighting and water heating for Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, gardens / park areas.

iii) During maintenance, energy efficient electric light fittings & lamps – low power ballasts, low consumption high power luminaries, lux level limiters & timers for street lighting shall be provided.

iv) A report on the energy conservation measures confirming to energy conservation norms finalized by Bureau of Energy Efficiency should be prepared incorporating details about building materials & technology, 'R' value & 'U' factors etc.

Municipal Solid Waste/ Other Wastes: -

i) Municipal solid wastes generated in the Naya Raipur City area shall be managed and handled in accordance with the compliance criteria and

procedure laid down in Schedule – II of the Municipal Wastes (Management and Handling Rules,2000 (As amended).

ii) The specification of the landfill sites shall be in accordance with the compliance criteria and procedure laid down in Schedule – III of the Municipal Wastes (Management and Handling Rules, 2000 (As amended).Similarly, the standard for composting, treated leachates & Incineration (if any) as mentioned in Schedule – IV of the Municipal Wastes (Management and Handling Rules, 2000 (As amended) shall be followed.

iii) Two-chambered container (one for recyclable wastes and other for all organic and compostable wastes) shall be placed at 500 m distance on the roadside. Covered dustbins / garbage collector in convenient places to collect the municipal solid wastes shall be provided. Coordination with government and semi government agencies, railways, industrial establishment and institutions for finalizing a programme for efficient removal and reduction of solid wastes from roadsides and drains shall be ensured. Modern trucks capable of using hydraulic lifting as well as safe covered garbage containers shall be provided for transportation.

iv) The project proponent must specify whether bio composting or vermi composting of municipal solid wastes should be carried out? The technical details of bio composting or vermi composting of municipal solid wastes shall be submitted.

v) Proper composting/vermi composting of municipal solid wastes shall be carried out. The proponent must develop the Solid Wastes Segregation, Collection, Handling, Transportation and Disposal Scheme ensuring safe and scientific segregation, collection, handling, transportation and disposal of organic and inorganic portion. The organic waste is to be composted/vermi composted at the compost plant within the project site. All municipal solid wastes shall be segregated, collected, transported, treated and disposed as per provisions of the Municipal Solid Wastes (Management and Handling) Rules, 2000 (As amended).

vi) Public awareness programmes of benefit of living a clean and healthy life by proper management of solid wastes shall be organized regularly.

vii) Hazardous wastes and bio-medical wastes shall be disposed off separately. Centralized common facility for segregation, collection, transportation, treatment and disposal including incinerator (fitted with adequate air pollution control equipment and stack of adequate height) for management of all bio-medical wastes shall be established. All bio-medical wastes shall be segregated, collected, transported, treated and disposed as per provisions of the Bio-Medical Wastes (Management and Handling) Rules, 1998 (As amended).

viii) Centralized common facility for segregation, collection, transportation, treatment and disposal for management of all hazardous wastes shall be established. All hazardous wastes shall be segregated, collected, transported,

treated and disposed as per provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 (As amended).

ix) The use of hand gloves, shoes and safety dress for all waste collectors and sorters shall be enforced.

x) Recycling of all recyclable wastes such as; newspaper, aluminium cans, glass bottles, iron scrap and plastics etc. shall be encouraged through private participation. Project proponent shall take appropriate action to ensure minimum utilization of plastics carry bags and plastics small containers etc. within the Naya Raipur city. 100% collection and recycling of plastics used within the Naya Raipur city shall be ensured.

xi) Intensive program of tree plantation on the disposal areas shall be carried out after the site is filled up.

PART B – GENERAL CONDITIONS

i) Project proponent should submit the details of animal population & its management and management of wastes (liquid and solid both) generated from animal husbandry within the Naya Raipur city area and rehabilitated population area.

ii) Details of project-affected people (PAPs) being rehabilitated/relocated shall be provided. A special rehabilitation scheme to ensure a reasonable compensation package to project affected persons in NRDA area shall be implemented as per R & R policy of Government of Chhattisgarh. Rehabilitation scheme to ensure most favorable compensation package to project-affected people (PAPs) in Naya Raipur Development Area shall be adopted. New houses shall be provided in a residential area to families, which need to be relocated on account of development works within 5 kms. Relocated families shall be given plots of either 1500 sq.ft. area or 2400 sq.ft. area.

iii) Minimal dislocation of human settlement on account of the project shall be ensured. In addition to payment of compensation also make available land for horticulture / floriculture or utility shops, Gumties or residential plot, free of cost in and around existing Abadi land of the villages to the project affected people. Families of any village, which needs to be relocated on account of development works, shall be provided new houses in a residential colony within 5 kms distance from their existing homes. The rehabilitation colony shall have adequate number of school buildings, Angan Wadis and common facility centres. The residential colony shall also accommodate families who need to be rehabilitating from other villages.

iv) Demarcation of the total area being given compensation to project-affected people (PAPs) on the location map along with resettlement plan shall be provided.

v) Rest room facilities shall be provided for service population.

vi) The environmental safeguards and mitigation measures contained in the EIA Report shall be implemented in letter and spirit.

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vii) All the conditions, liabilities and legal provisions contained in the Environmental Clearance shall be equally applicable to the successor management of the project in the event of the project proponent transferring the ownership, maintenance of management of the project to any other entity.

viii) The project proponent shall make financial provision in the total budget of the project for implementation of the above-mentioned conditions and for suggested environmental safeguard measures. The funds earmarked for the environmental protection measures shall not be diverted for other purposes.

ix) Six monthly monitoring reports shall be submitted to the Chhattisgarh Environment Conservation Board, Raipur, who shall be monitoring the implementation of environmental safeguards shall be given full cooperation, facilities and documents / data by the project proponents during their inspection. A complete set of all the documents shall submit to State Level Environmental Impact Assessment Authority, Chhattisgarh.

x) The responsibility of implementation of environmental safeguards rests fully on the project proponent. Project proponent shall establish an environmental management cell to carryout functions relating to environmental management under the supervision of senior executive, directly reporting to the head of organization.

xi) In the case of any change(s) in the scope of the project, the project shall require a fresh appraisal by the SEIAA. As the details for the Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions etc. have not been submitted with respect to built-up area, excavation, water consumption, sewage generation, solid wastes generation, power requirement, pollution control arrangements, environmental safeguards, construction material etc. for construction and operation phases, therefore, the respective project proponents shall obtain separate Environmental Clearance for those construction projects which falls under the schedule of Environment Impact Assessment Notification, 2006 from State Level Environmental Impact Assessment Authority, Chhattisgarh as per provisions of Environment Impact Assessment Notification, 2006.

xii) The issuance of this letter does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Central, State or Local laws or regulations.

xiii) Risk Assessment study along-with Disaster Management Plan (DMP) shall be prepared. The mitigative measures for disaster prevention and control shall be prepared and get approved from competent authority. All other statutory clearances from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponent. Project proponent shall obtain statutory clearances / licenses/ permissions from concerned Central Government/State Government Departments, Boards, Bodies and Corporations etc. for development of Naya

Raipur City. Project proponent shall follow direction issued by Central Government/ State Government, Central Pollution Control Board/Chhattisgarh Environment Conservation Board from time to time regarding control of water & air pollution and for environmental conservation.

xiv) The State Level Environmental Impact Assessment Authority, Chhattisgarh reserves the right to amend the above conditions and add additional safeguard measures subsequently, if found necessary, and to take action including revoking of the environment clearance under the provisions of the Environmental (Protection) Act. 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

After submission of sanctioned Development Plan of Naya Raipur City – 2031 by competent authority and compliance/ incorporation for fulfilment of above terms and conditions in the "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" project, the final Environmental Clearance shall be accorded by State Level Environmental Impact Assessment Authority, Chhattisgarh after consideration and recommendation of it by State Level Expert Appraisal Committee.

Please acknowledge the receipt of this letter.

For & on behalf of
State Level Environment Impact Assessment
Authority, Chhattisgarh

Member Secretary
State EIA Authority, Chhattisgarh
Raipur (C.G.)

File No. /SEIAA-CG/EC/T&AD/RYP/1/08 Raipur, Dated / /2008

Copy to:-

1. The Secretary, Department of Environment, Mantralaya Chhattisgarh, Raipur-492001
2. The Chairman, Chhattisgarh Environment Conservation Board, 1-Tilak Nagar, Shiv Mandir Chowk, Main Road Avanti Vihar, Raipur (C.G.)
3. The Chief Conservator of Forests (C) Regional Office (WZ), Ministry of Environment & Forests, Kendriya Paryavaran Bhawan, Link Road No.-3, E-5, Arera Colony, Bhopal.

Member Secretary
State EIA Authority, Chhattisgarh
Raipur (C.G.)

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ANNEXURE – II CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR

Table 1 discusses the long-term climate trend of secondary data collected for the IMD station located in Raipur, over the period of 1951-1980.
Table 2 discusses the decadal trend of secondary data collected from IMD Pune, over a period of 1993-2002.

TABLE 1: CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR (1951-1980)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)	Mean Wind Speed (m/s)	Predominant Wind direction
January	27.5	13.3	50	6.7	1.1	N
February	31.1	16.5	41	12.3	1.4	N
March	35.5	20.8	33	24.6	1.7	N
April	39.6	25.3	31	15.7	2.2	W
May	42.0	28.3	31	18.8	2.6	W
June	37.4	26.5	58	189.8	3.0	SW
July	30.8	24.0	81	381.0	3.0	SW
August	30.2	23.9	83	344.7	2.6	W
September	31.3	23.9	77	230.2	2.0	W
October	31.6	21.5	64	53.9	1.4	NE
November	29.6	16.5	54	7.4	1.1	NE
December	27.3	13.2	52	3.7	0.9	NE
Average/ Total	**32.8**	**21.1**	**55**	**1288.8**	**1.9**	

Source: Climatological Table, IMD

TABLE 2: CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR (1993-2002)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)
January	27.6	13.0	59.1	10.2
February	30.6	16.3	54.1	19.1
March	35.4	20.2	39.3	15.6
April	40.0	24.7	36.2	13.5
May	41.9	27.5	39.2	19.6
June	37.1	26.0	64.0	176.9
July	31.7	24.3	82.3	347.5
August	30.0	23.9	86.7	379.9
September	31.0	23.6	83.0	195.1
October	31.7	21.4	73.9	60.5
November	29.9	16.2	63.3	13.1
December	28.0	12.7	57.5	1.8
Average/ Total	**32.9**	**20.8**	**61.5**	**1252.7**

Source: IMD Pune

ANNEXURE – III TRAFFIC MONITORING DATA

TABLE 3: TRAFFIC MOVEMENT AT NH-43 – WEEKDAY

Average Number of Vehicles							
Time	**Two Wheelers**	**Three Wheelers**	**Cars and vans**	**Busses & Lorries**	**HMV**	**Cycles**	**Cycle Rikshaw**
0100	17	5	21	17	17	1	0
0200	14	6	19	28	28	2	1
0300	22	14	28	28	33	1	0
0400	25	24	35	59	47	2	0
0500	39	35	61	68	40	3	0
0600	59	34	78	105	60	1	1
0700	108	60	110	120	44	0	0
0800	109	48	127	147	41	0	1
0900	134	34	166	151	48	4	0
1000	152	43	159	164	52	0	0
1100	164	37	181	170	41	0	0
1200	170	28	187	173	54	2	1
1300	167	22	197	145	43	4	2
1400	153	21	168	128	52	0	2
1500	130	26	165	114	37	0	0
1600	143	34	157	94	34	2	0
1700	156	42	131	107	35	0	0
1800	153	53	116	98	33	0	1
1900	125	35	105	69	41	0	0
2000	115	43	96	56	45	0	0
2100	98	29	78	43	47	0	0
2200	73	22	52	35	31	0	0
2300	42	17	34	26	23	1	1
2400	21	6	13	12	16	1	1

FIGURE 1: TRAFFIC DENSITY – NH 43- WEEKDAY

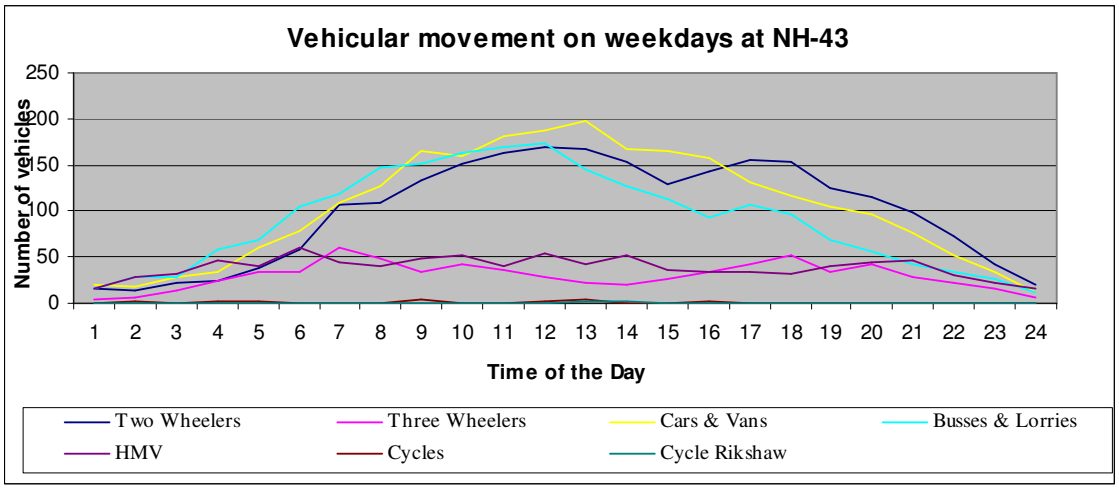


TABLE 4: TRAFFIC MOVEMENT AT NH-43 – WEEKEND

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
0100	9.0	7.0	15.0	11.0	14.0	0.0	0.0
0200	5.0	9.0	13.0	15.0	29.0	2.0	1.0
0300	15.0	10.0	23.0	16.0	36.0	1.0	1.0
0400	13.0	24.0	23.0	26.0	39.0	1.0	0.0
0500	28.0	28.0	36.0	50.0	35.0	0.0	0.0
0600	38.0	26.0	40.0	65.0	39.0	0.0	0.0
0700	26.0	37.0	48.0	71.0	41.0	0.0	0.0
0800	61.0	50.0	76.0	84.0	36.0	0.0	0.0
0900	64.0	42.0	104.0	97.0	36.0	1.0	0.0
1000	76.0	34.0	80.0	135.0	38.0	2.0	0.0
1100	67.0	40.0	132.0	123.0	34.0	0.0	1.0
1200	100.0	30.0	124.0	154.0	30.0	1.0	0.0
1300	78.0	23.0	131.0	128.0	36.0	2.0	0.0
1400	59.0	19.0	126.0	91.0	35.0	0.0	2.0
1500	68.0	16.0	134.0	85.0	30.0	1.0	0.0
1600	42.0	17.0	112.0	66.0	26.0	0.0	0.0
1700	37.0	28.0	94.0	69.0	26.0	0.0	0.0
1800	28.0	15.0	88.0	56.0	23.0	0.0	0.0
1900	33.0	21.0	86.0	44.0	34.0	0.0	0.0
2000	24.0	9.0	73.0	38.0	27.0	0.0	0.0
2100	20.0	13.0	61.0	30.0	27.0	0.0	1.0
2200	26.0	10.0	41.0	24.0	16.0	0.0	0.0

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
2300	15.0	5.0	31.0	19.0	14.0	0.0	1.0
2400	8.0	5.0	7.0	5.0	11.0	0.0	3.0

FIGURE 2: TRAFFIC DENSITY – NH 43- WEEKEND

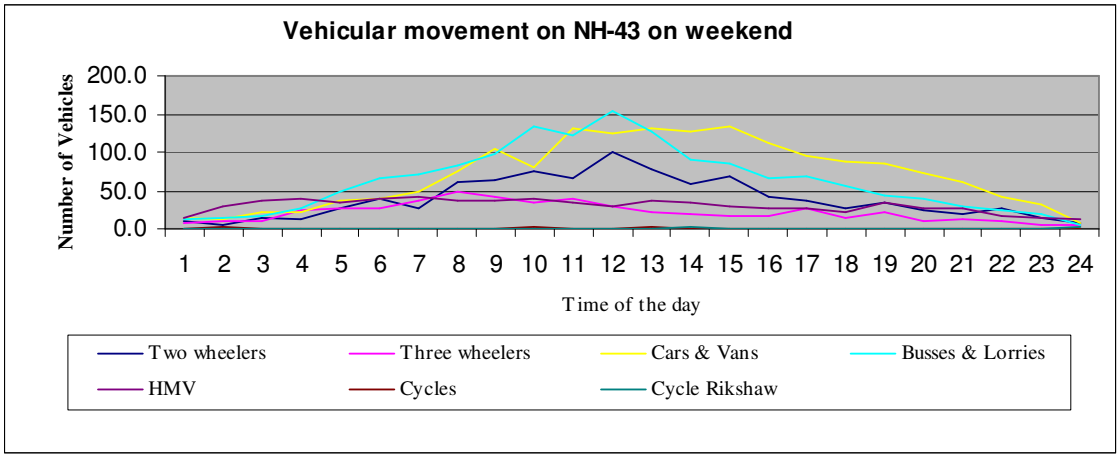


TABLE 5: TRAFFIC MOVEMENT AT NH-6 – WEEKDAY

Average Number of Vehicles							
Time	**Two Wheelers**	**Three Wheelers**	**Cars and vans**	**Busses & Lorries**	**HMV**	**Cycles**	**Cycle Rikshaw**
0100	14	10	24	17	25	2	1
0200	22	12	23	26	25	1	1
0300	23	17	30	35	22	0	0
0400	25	23	38	53	32	1	1
0500	33	33	51	52	34	3	0
0600	36	37	69	81	45	1	2
0700	61	42	90	98	51	0	0
0800	75	56	98	127	46	1	1
0900	86	46	132	133	50	0	1
1000	107	47	146	147	41	0	0
1100	132	40	157	147	50	1	0
1200	131	37	161	159	57	0	0
1300	138	46	176	142	50	1	1
1400	135	31	157	132	42	0	2
1500	121	31	140	106	32	0	0
1600	127	26	123	95	25	1	0
1700	147	31	115	88	39	0	0

Average Number of Vehicles							
Time	**Two Wheelers**	**Three Wheelers**	**Cars and vans**	**Busses & Lorries**	**HMV**	**Cycles**	**Cycle Rikshaw**
1800	125	36	109	80	39	1	1
1900	69	31	100	69	35	0	0
2000	46	25	85	58	38	2	1
2100	31	24	72	46	58	0	1
2200	21	21	50	41	42	0	0
2300	18	15	34	26	32	2	0
2400	10	6	23	16	27	2	0

FIGURE 3: TRAFFIC DENSITY – NH 6- WEEKDAY

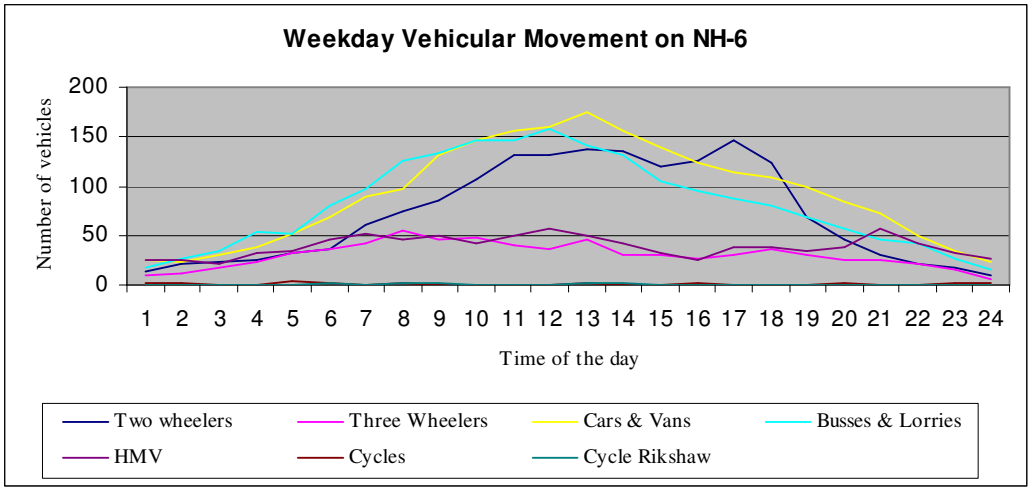
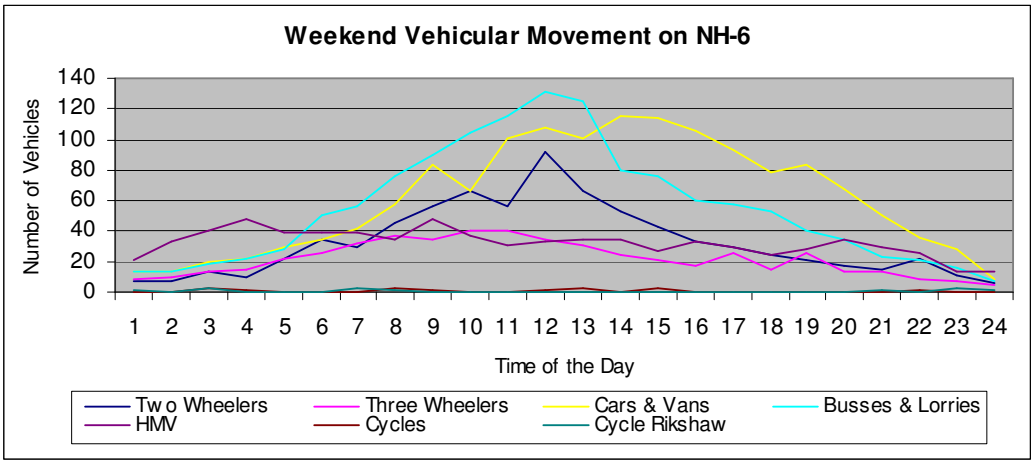


TABLE 6: TRAFFIC MOVEMENT AT NH-6 – WEEKEND

Time	**Two Wheelers**	**Three Wheelers**	**Cars and vans**	**Busses & Lorries**	**HMV**	**Cycles**	**Cycle Rikshaw**
0100	7	8	13	13	21	0	1
0200	7	10	13	13	33	0	0
0300	13	13	20	19	40	2	2
0400	10	15	22	22	48	1	0
0500	22	22	30	28	39	0	0
0600	34	26	34	50	39	0	0
0700	30	32	42	56	39	0	2
0800	46	37	58	76	35	2	1
0900	56	34	83	90	48	1	0
1000	66	40	66	104	37	0	0
1100	56	40	101	116	31	0	0

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
1200	92	34	108	131	33	1	0
1300	66	31	101	125	34	3	0
1400	53	24	115	80	34	0	0
1500	43	21	114	76	27	3	0
1600	33	17	106	60	33	0	0
1700	29	26	93	58	29	0	0
1800	24	15	78	53	25	0	0
1900	21	26	83	41	28	0	0
2000	17	14	68	34	34	0	0
2100	15	13	50	23	30	0	1
2200	22	8	36	21	26	1	0
2300	11	7	28	16	14	0	3
2400	6	5	9	7	14	0	1

FIGURE 4: TRAFFIC DENSITY – NH 6- WEEKEND



ANNEXURE – IV TYPES OF SOIL IN CHHATTISGARH

A wide variety of soil types are found in Chhattisgarh.

The soil of the study area is very shallow, yellowish brown to reddish brown, sandy clay loam to clay loam. The agricultural properties and fertility status of the soil of this region are generally poor and not suitable for the growth of the various kinds of crops.

In the study area, there water bodies in the form of lakes, ponds, nallahs and irrigation canals. Land is irrigated using surface water. Rain water is the main source for irrigation.

A variety of factors control soil formation - climate, biotic factors, relief, drainage, parent rock materials and time. The soils in the region are as follows:

Vertisol

A soil in which there is a high content of expansive clay known as montmorillonite that forms deep cracks in drier seasons or years. Typically form from highly basic rocks such as basalt in climates that are seasonally humid or subject to erratic droughts and floods. Depending on the parent material and the climate, they can range from grey or red to the more familiar deep black.

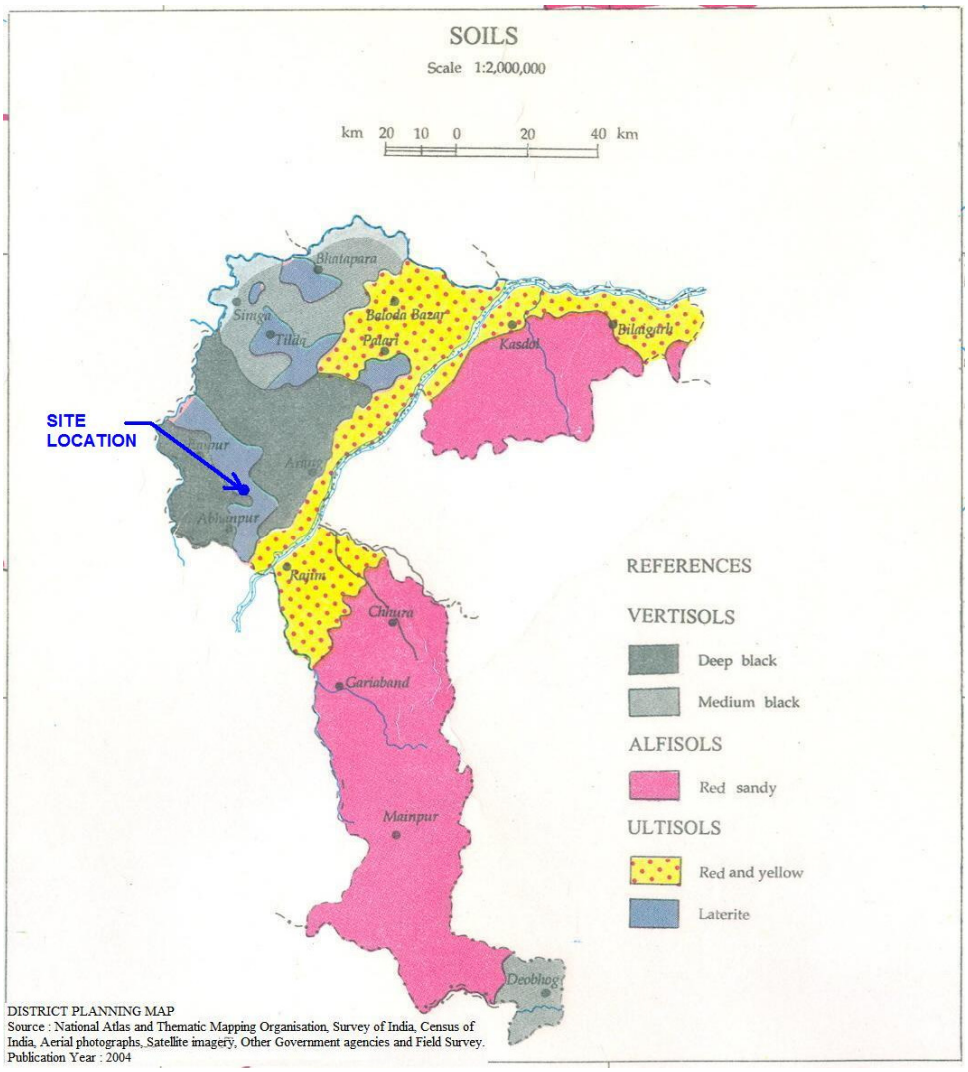
Alfisols

Having clay-enriched subsoil with a relatively high native fertility "Alf" refers to Aluminium (Al) and Iron (Fe). Alfisols have undergone only moderate leaching. By definition, they have at least 35% base saturation, meaning that Calcium, Magnesium, and Potassium are relatively abundant

Ultisols

“Red clay soil", defined as mineral soils containing no calcareous material anywhere within the soil, with less than 10% weatherable minerals in the extreme top layer of soil, and less the 35% base saturation throughout the soil. These are found in Pilari, Baloda Bajar,Bilaigarh and Rajim area and various other parts of the district too.

FIGURE 5: SOIL TYPES IN RAIPUR (CHHATTISGARH)



ANNEXURE – V PROCEEDINGS OF THE PUBLIC CONSULTATION

Different sections of people were explained about the BRT project and were asked to voice their concerns, suggestions and views for the same. The public consultation was carried out from 14th to 16th April 2010 by Mr. Ahsan Najeeb and Ms. Rajani Iyer (SENES Representatives) at varied locations in Raipur city and their consultations have been provided below.

1) WOMEN COMMUTERS

Location: Bus stops, Residential Colonies
Date: 14th April, 2010.
Time: 11:00am to 1:30pm

1. Asha Verma --- told that sufficient seats should be reserved for women.
2. Dhanlakshni Jain is of the Opinion that frequency of buses should be increased.
3. Sudha Sahu --- said some ladies special buses should be run in peak hours.
4. Maahi Chaubey --- told that AC buses must run for long distances, as extreme weather makes journey uncomfortable and difficult.
5. Seema Nigam --- feels bus routes are limited and frequency is less BRT buses should reach till major masses and more number of buses provided.
6. Ruchi Srivastav --- told that ladies seats should be reserved in all buses and should be marked properly and maintained strictly.
7. Usharani Dubey --- wants the buses to run on correct time, hence can be relied upon.
8. Bharati Sahay --- told travelling in normal buses makes the journey painful. AC buses with low fares should be started, so that the travel becomes relaxing.
9. Sanjana Goyal --- has odd working hours and so wants frequency of buses to increase.
10. Mahavi Singh --- said that some bus seats be booked for ladies and elderly persons and that ladies entry be from front door and men enter from rear door.

2) CONSULTATION WITH STUDENTS FROM UNIVERSITY, COLLEGES AND SCHOOLS

Location: Bus stops, Near University and college
Date: 15th April, 2010.
Time: 9:00am to 11:30am

1.) Manish Diwan --- Student of Bodhi Satva High school feels number of buses plying during morning and evening hours should be increased.
2.) Dinesh Naidu --- Student of Nac Mit Pt college feels students should be issued monthly passes as it will encourage them travel by bus which in turn will decrease congestion and traffic on road.
3.) Nitin Rai --- Student of Gurukul Institute says special university buses should be introduced for the students of different universities.
4.) Vikas Pali --- Student of RIT has an opinion that concessional seasonal or monthly bus passes should be introduced for students.
5.) Rajan Dahariya --- Student of Agrasen Mahavidhyalaya feels that more number of buses should run during the morning and evening hours, which will make traveling easier for students without congestion in buses.

6.) Aditya Dixit --- Student of RIT feels special university buses should be introduced for the students along with other people.
7.) Seema Lalwani --- Student of Disha Institute of Management & Technology feels more number of buses should ply during morning and evening hours.
8.) Lalit Yadav --- Student of Government Medical college feels more number of buses should be introduced so that traveling will be more comfortable.
9.) Krishna Soni --- Student of Government Medical college feels existing number of buses is not at all sufficient and more number of buses should be introduced.
10.) Kunal Dhawan --- Student of RIT syas bus passes should be issued to the students which will decrease the traffic as more students will be using public transport rather than their own transport.

3) CONSULTATIONS WITH PERMANENT AND TEMPORARY EMPLOYEES OF THE IGAU

Location: Indira Gandhi Agricultural University
Date: 15th April, 2010.
Time: 6.00 pm to 7:30 pm

1. Upadhyaya ---As the family is staying in staff quarters they are willing to move where the university accommodates them.
2. N.L. Shrivastava---both the husband and wife are not keeping good health and therefore he and his family want to be accommodated within the campus to reduce problems they will face if shifted from out of the university campus.
3. Dinesh Bhosale---Working as a peon in one of the departments feels that the university will make the necessary arrangements as the staff quarters they are living in are old and the families of the staff members have made partitions inside to accommodate their enlarging families.
4. S. Yadav ---Felt that as they were working and staying in the houses provided by the university, then even if the land is given for any project the university will shift them to other houses within the campus.
5. R. S.Tiwari---Referred to a road near their houses which is connecting their houses and a residential complex to the highway and mentioned that another road will have to be provided to enable people to go about their activity.

4) COMMUTERS IN RAIPUR CITY

Location: Bus stops, Near Offices
Date: 14th April, 2010.
Time: 3:00pm to 5:30pm

1.) Ratan Sahu --- Government employee, feels number of buses should increase as he finds difficult to reach office once he misses bus.
2.) Ashok Gupta --- Feels A/c buses should be introduced as it will make the journey comfortable.

3.) Rahul Verma --- Says frequency of the buses should be more from one destination to other as it would decrease the load in the bus.
4.) Anil Jain --- A local businessman feels autorickshaws should be banned in some routes as they charge more rates and create kiosk in traffic.
5.) Ved Prakash Banchor --- Private job employee finds it difficult to travel during summer season and recommends A/c buses in different routes.
6.) Ashish Thakur --- Informed about the congestion in the present road and feels autorickshaws and heavy vehicles should be banned on some routes.
7.) Umesh Rawat --- Employee, says frequency of the buses should increase and buses should be more spacious.
8.) Uttam Devangan --- Feels buses should maintain proper timing and also number of buses plying should increase.
9.) Riya Agarwal --- Thinks charges of the bus service is very much affordable and will be good if the buses run on time.
10.) Kripa Soni --- Feels number of buses plying in the city should increase and also proper timing should be maintained.

5) CONSULTATIONS WITH CONDUCTORS, DRIVERS AND OWNERS OF PRIVATE BUSES

Location: Bus stands, Bus Depots
Date: 15th April, 2010.
Time: 3:00pm to 5:30pm

1. Deendayal Sharma --- feels that introducing BRT would be good for city's progress but the existing buses should also be allowed to continue.
2. Babubhai Bhagel --- is of the opinion that existing bus drivers and conductors should be appointed for the new bus services, hence improving their lives.
3. Amit Sahay --- told that BRT buses must run in different routes, so as not to affect their daily income.
4. Mahendra Chandrakar --- (Owner of private bus firm) told that bus operators must be selected by a procedure of tendering, as near the case for appointing existing operators.
5. Raja Kumar --- told that bus lanes and other vehicle lanes should not be mixed anywhere, as it will disturb traffic and affect punctuality/efficiency of buses.
6. Daneshwar Sahu --- told that buses should be stopped only at bus stops and no other places.
7. Rajesh Chandrakar --- feels that the existing routes should not be given to new operators as it will result in loss of current operators and their employees.

ANNEXURE – VI COMMENTS OF WORLD BANK

TABLE 7: COMPLIANCE OF THE WORLD BANK COMMENTS (13TH SEPT 2010)

Sr. No.	Comments of World Bank	Clarifications/Arguments
1.	There is no mention of consultations carried out. In that regard, of particular importance are consultations within Raipur city where the new facilities are coming up. Concerns from relevant stakeholders, including local residents, should be documented and the way they are (to be) handled in the project design and implementation should also be clarified.	Public Consultation with the relevant stakeholders like local residents, people residing near the terminals, commuters from Raipur city, women commuters, students, etc. have been conducted and presented in the EIA report.
2.	No analysis of alternatives is presented. For instance, I remember we had a location initially considered for the bus stop close to the CM residence where tree cutting would have been an issue which is now changed to a plot outside the city. Such analysis would give the readers who may not be familiar with the site enough confidence that these issues were indeed considered.	According to NRDA, no alternatives other than the current ones were proposed for Bus Terminals, Bus Depots, Bus Stops and Bus Routes.
3.	Some mitigation and enhancement measures that can actually show value that the EIA can bring - provision of oil and grease traps where bus maintenance is to be carried out, public utilities like drinking water spouts, and toilets, provision of water harvesting, etc. seem to have been missed out.	ETP with Oil separation facility will be provided at the bus depot, where the oily waste will be sold to local authorized agents and recycled water will be reused for gardening purpose. Bus Terminals will be provided with drinking water spouts and other public amenities. NRDA proposes to develop RWH system along the BRT corridor and Bus Terminals and Depots.
4.	There is no discussion of Safety due to the movement of buses within the colony areas. If it is already clear that this will be handled properly, it would be useful to give the steps proposed to be taken for such an influx of buses at fixed hours.	Proper signages like entry and exit points of BRT, traffic lights, speed breakers, pedestrian crossings, blow horn sign, speed limit indication, marking BRT corridor on the roads, providing footpaths and cycle paths will be provided to improve the safety within the colony area.

TABLE 8: COMPLIANCE OF THE PMCS COMMENTS (15TH SEPT 2010)

Sr. No.	Comments of PMC	Clarifications/Arguments
1.	There is a need to revisit the observations/comments provided earlier and if any doubt prevails then to seek clarification before submitting the report.	The earlier comments have been answered appropriately and a compliance report for the same has been prepared and attached as appendix in the final EIA report.
2.	The second chapter needs prudent editing.	Done
3.	Analysis of Alternative needs to be worked out as, also, pointed out by W.B's observation and presented in a separate chapter.	According to NRDA, no alternatives other than the current ones were proposed for Bus Terminals, Bus Depots, Bus Stops and Bus Routes.
4.	Public Consultation needs to be presented.	Public Consultation with the relevant stakeholders like local residents, people residing near the terminals, commuters from Raipur city, women commuters, students, etc. have been conducted and presented in the EIA report.
5.	Chapter 4 should prudently give rational project specific data rather than starting with definitions of the attributes.	Done
6.	Chapter 5 'Assessment of Potential Impact & Mitigation measures' & Chapter 6 'Environment Management Plan' is weak and needs to be strengthened corresponding to data in chapter 4.	Done
7.	Chapter 7, Summary & Conclusions needs to be updated in light of the above changes.	Done

TABLE 9: COMPLIANCE OF PMC COMMENTS (16TH NOVEMBER 2010)

Sr. No.	Comments of PMC	Clarifications/Arguments
1.	Analysis of alternative has to be developed as discussed i.e., without/with project, trade-off between optional locations of any facility etc., leading to final selection.	Sec 2.7 Analysis of Alternatives
2.	Public Consultation needs to be supported by necessary documentation.	**Annexure – V** Proceedings of the Public Consultation
3.	The Budget as discussed is erroneous and needs to be brought in line with the desired Envionmental management.	Table 6-4 and Table 6-5
4.	Chapter 1.2, Pg no. 3 Cover facilities within BRT scope at Raipur, also.	Done
5.	Chapter 2.7.1, Pg no. 12 Could we have a map in which various BRT components are clearly shown.	Done
6.	2.7.2 Could you provide the figure in the main text	Done
7.	Chapter 3.0 Could we have short discussion of applicable Environmental legislations	
8.	Chapter 3.1 Do put the Environmental Clearance for Naya Raipur in the Annex.	**Annexure – I** EC for Naya Raipur
9.	Chapter 4.2 Could you provide the Latitude/Longitude of the project area.	Provided
10.	Chapter 4.3 Avoid giving definition.	Done
11.	4.3.1 A Avoid giving definition and keep historical data in Annex.	Done
12.	4.3.2 Avoid giving definition.	Done
13.	4.3.3 Avoid giving definition.	Done
14.	4.3.4 Keep explanations pertaining to the table (bullets etc.) at the bottom of the table.	Done
15.	4.6.4 Are no. of streams crossing BRT corridor. If so, give name of significant ones and chainages (where crossed by BRT corridor) of others.	Done
16.	Chapter 5 Could we have the analysis of potential impact/mitigation measures of the attributes covered in the baseline and in the same sequence.	Provided the attributes in the same order as in baseline chapter.

17.	Are you referring to area to be planted in the mitigation? Could you give the identified locations and the numbers too.	Provided