National Highway Authority of India

(MINISTRY OF ROAD TRANSPORT & HIGHWAYS)

GOVERNMENT OF INDIA

WIDENING TO FOUR-LANES INDORE–KHALGHAT SECTION OF NH–3 IN MADHYA PRADESH ON BOT BASIS

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

March 2006

ENVIRONMENTAL IMPACT ASSESSMENT

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ABBREVIATIONS

ADB	Asian Development Bank
ADT	Average Daily Traffic
APHA	American Public Health Association
BGL	Below Ground Level
BIS	Bureau of Indian Standards
BOD	Bio Chemical Oxygen Demand
BOT	Build, Operate & Transfer
CGWB	Central Ground Water Board, Government of India
CUM	Cubic Meter
DB	Decibel
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMAP	Environmental Management Action Plan
EMP	Environmental Management Plan
EMU	Environment Management Unit
EQ	Environment Officer
EW	East West .
FIRR	Financial Investment Rate of Return
G0I	Government of India
I/LCB	International/Local Competitive Bidding
ICRCL	Interdepartmental Committee on the Redevelopment of Contaminated Land Classification
IMD	India Meteorological Department
IRC	Indian Road Congress
KM	Kilometre
LGP	Length of Growing Period
LPG	Liquefied Petroleum Gas
MOE&F	Ministry of Environment & Forest
MORTH	Ministry of Road Transport & Highways
MOST	Ministry of Surface Transport
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing & Calibration Laboratories
NGO	Non Governmental Organisation

NH	National Highway
NHAI	National Highway Authority of India
NOx	Nitrogen Oxide
NS	North South
PCU	Passenger Car Units
PEA	Preliminary Environmental Appraisal
PEIU	Project Environmental Implementation Unit
PIU	Project Implementation Unit
R&R	Resettlement & Rehabilitation
ROW	Right of Way
RPM	Respirable Particulate Matter
SO2	Sulphur Dioxide
SPM	Suspended Particulate Matter
SREE	Senior Environmental Engineer/Expert
TMA	Tree Management Agency
TOR	Terms of Reference
USDA	United States Department of Agriculture
WB	West Bengal
WHO	World Health Organization

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1.0 INTRODUCTION

1.1 Background

The Ministry of Road Transport and Highways (formerly Ministry of Surface Transport – MOST), Government of India has taken up the improvements of the National Highways on certain prioritized sections spread all over India. The improvement works to National Highways comprises widening rehabilitation up - gradation from its existing two lane to four lane with divided carriageway configuration. The NH-3 section between Indore and Khalghat is one such prioritized section selected for improvement in Madhya Pradesh.

The Ministry of Road Transport and Highways (MORTH) entrusted the consultancy services for the preparation of a Detailed Project Report (DPR) for Widening to Four Lanes of Indore-Khalghat Section of NH3 in Madhya Pradesh to the Joint Venture of L.R. Kadiyali and Associates (LRKA) and Consulting Engineers Group (CEG) in April, 2000. The DPR was submitted in September, 2002. In view of the budgetary constraints, the MORTH were desirous of developing 10,000 Kms of Non-NHDP projects under a BOT format. The work has since been transferred to **National Highway Authority of India (NHAI).**

Since considerable time had elapsed between the preparations of the DPR and now, the NHAI were desirous of updating the DPR. LRKA were commissioned this assignment on 6th May, 2004 and DPR was updated was submitted by the Consultant to National Highway Authority of India in May 2005

1.2 Project Location

The Project Highway section starts from the outer end of Indore bypass at Km 12.60 (Ch 0.00) and terminates before the existing bridge across River Narmada at Km 84.60 (Ch77.61) near Khalghat.

The Project Highway section is a part of the Agra to Mumbai section of NH-3 within the State of Madhya Pradesh and traverses through dense settlements of Mhow, Tigaria, Rau, Manpur, Gujri, Dhamnod and others. The section traverses between 300-600 m above mean sea level (MSL) with the exception of Bheru Ghat and Bakaner Ghats (between Chainage 42.65 and 51.50). In these Ghat Sections, the Project Highway ascends to a maximum of 880 m above Mean Sea Level (MSL) and has Reserve Forests of the Manpur division. Excepting this, the either side of the Project Highway corridor mostly exhibits agricultural land use with rural environment, interrupted by dense settlements at Manpur, Gujri and Dhamnod among others.

The location of the Project Highway section of NH-3 is illustrated in Figure 1.1.

1.3 Present Condition of Project Highway

The geometry of the project road is generally fair, but there is an urgent need for geometric adjustments at many sections, particularly in Bheru Ghat and Bakaner Ghat sections (between Chainage 42.65 and 51.50). The project highway sections also traverse through highly dense settlements at Mhow, Manpur, Gujri and Dhamnod. The traffic along the Project Highway section is reported to get chocked / jammed frequently, which some times extends up to few days in case of accidents/vehicular breakdowns particularly in Ghat sections.

The pavement on the present road is of flexible type with most stretches being re-surfaced with bituminous layer under periodic maintenance. The existing pavement runs on embankment of height varying from 1 m to 1.5m The average height of embankment is about 1.0 m, and few cut sections are present. The present pavement width is generally about 7m. increasing to 9 m through some horizontal curve portions and 11 m through built - up areas. The road has paved shoulders for about 5 km length with varying width between 1 - 2 m. The remaining shoulders are of earthen (moorum, granular soil) type with width varying between 0.5 and 3 m.

The Project Highway section has 4 major and 12 mionr bridges. There are about 133 cross drainage structures comprising 46 pipe culverts. 66 RCC slab culverts, 18 arch culverts and 3 are covered with stone slabs.

1.4 Project Objectives

The principal objectives of the consultancy contract for “Preparation of Feasibility Study and Detailed Project Report for Rehabilitation and Upgrading of existing two lane road to four lane divided carriageway configuration of NH-3 between Indore and Khalghat (Project Highway) are :-

- To determine the technical, economical, financial and environmental viability of four laning and strengthening of Project Highway section consistent with the requirements. of safe and high speed travel
- Strengthening the existing two lane pavement
- Develop the stretch as a partially access controlled road with possibility of tolling and developing on a Build, Operate & Transfer (BOT) basis.
- To prepare the Detailed Project Report for the technically feasible alternative.
- To prepare tender documents for International/Local Competitive Bidding

(I/LCB)

Recognizing the impacts of project development, the **Terms of Reference** (TOR) for consultancy services also included **Environmental Impact Assessment** (EIA) and preparation of **Environmental Management Plan** for an environmentally sustainable up-gradation of the Project Highway section of NH-3. The Social Impact Assessment, preparation of resettlement and rehabilitation plans for the population likely to be affected by up-gradation/widening also formed the scope of services under the consultancy contract.

1.5 Project influence Area

Direct Area of Influence: The up-gradation proposal generally to follow central or one side widening along the existing alignment unless and otherwise warranted by any specific factor(s). Therefore, the direct area of influence (corridor of impact)for up gradation is confined to existing ROW and extending on either side by 15 m in case of central widening or 30 m in case of one side widening, requiring the use of a variable area of influence. In case of Bypasses and realignments the direct area of influence is proposed ROW i.e. 30 mts on either side of proposed centre line

The field investigations for environmental and social screening and detailed impact assessment studies extended to 30 m on either side of existing alignment for built -up or large urban areas. In rural expanse, areas stretching to 100m on either side of the existing NH-3 section were considered.

Indirect Area o influence:- A distance of 10 km on either side of the project highway (as per guidelines of Ministry of Environment & Forests) was considered to define indirect area of influence. Within this area, features like natonal parks, wild life sanctuaries, protected forest, archaeological and cultural/heritage sites if any are to be recorded.

1.6 Study Methodology

Preliminary Environmental Appraisal: The environmental team led by the Senior Environmental Engineer/Expert (SREE) visited the Project Region for a preliminary Environmental Appraisal (PEA). This was followed by another visit for the detailed baseline environmental investigations and data collection. Junior professionals and other feild staff assisted the SREE for the investigations and data collection activities.

Secondary Data Collection: Upon the completion of the PEA. Secondary environmental data were collected from various government and quasi-government bodies, research institutions and non-governmental organization. The secondary data was broadly subjected to field checking during the subsequent field investigations.

Primary Data Collection: Primary data for the selected environmental attributes were generated along the Project Corridor. The attributes monitored were ambient air quality, ambient noise, water quality and soil quality. The test procedure for generating primary data were in conformance to the guidelines of the Central / State Pollution Control Boards, the Ministry of Environment & Forests (MOE &F), Government of India, relevant Bureau of Indian Standards (BIS) and the procedures recommended by the American Public Health Association (APHA).

The environmental field investigations were carried out by the SGS India Limited. The Institute is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) Government of India.

1.7 Regulatory Procedures & Clearances:-

Environmental Clearance from GOI: The Ministry of Environmental and Forests (MOE&F), Government of India (GOI) is responsible for according Environmental Clearances for any of the developmental projects. MOE&F's EIA notification on development Projects stipulate that any new project or the expansion and/or modernization of any industry or project (If the pollution load is to exceed the existing one), shall not be undertaken in any part of India unless it has been accorded Environmental Clearance by Central Government.

Schedule I of the EIA notification list various types of projects requiring the Environmental Clearance, which include **Highway Projects** (Item No.21). An amendment has made been to Highway Projects through an extraordinary gazette notification dated 10 April 1997. The Amendment relating to Highways states as follows:

In Schedule I Item No.21 (Highways) shall be substituted by Highway Projects except projects relating to improvement work including widening and strengthening of roads with marginal land acquisition along the existing alignments provided it does not pass through ecologically sensitive areas such as National Parks, Sanctuaries, Tiger reserves, Reserve forests. In its latest notification dated l5th October 1999, MOE&F has clarified that marginal land

acquisition means land acquisition not exceeding a total width of 20 meters on either side of existing alignment put together.

It is important to note here that the present widening and up gradation of Project Highway requires land acquisition of more than 20 m width (average) on either side of existing ROW put together and also involve land acquisition of Reserved Forests along Bheru Ghat and Bakaner Ghat sections between Chainange 42 + 65 and 51 + 500. There fore as per the current provisions, environmental clearance from Ministry of Environment and Forests, Government o India is necessary for the Project Highway section improvement.

1.8 Present Submission :-

The present report presents the Environmental Impact Assessment (EIA) along with an Environmental Management Plan (EMP) for the proposed improvements to NH3 section between Indore and Khalghat.

The EIA report has been documented in accordance with stipulations of MOE&F's EIA notification/Environmental guidelines for Rail/Road & Highways. The Environmental Assessment Requirements of the international funding institutions like Asian Development Bank (ADB), The World Bank (WB) have been duly considered for EIA documentation.

The remainder of the report is organized as follows.

Section 2.0- Description of Project

This section provides a brief description of.proppsal for Project development including all of its component. The chapters also includes existing scenario, need for development, and envisaged growth pattern, Economic Assessment along with EIRR and all other parameters of project development and its justification.

Section 3.0 - Description of Environment

This section provides a detailed assessment of baseline environmental conditions of the entire project influence area. The environmental attributes covered are geology, soil, land use, drainage, water resources, flora & fauna, archeological/historical monuments, air quality, noise, water quality and others.

Section 4.0 - Environmental Impacts and Mitigation Measures

Potential impacts on various environmental attributes due to project development and respective mitigation measures are presented in this section.

Section 5.0 - Environmental Management & Monitoring

This section summarizes all actions/measures over and above good design and 'engineering practice that are warranted for focussed Environmental Management during project implementation.

An Environmental Management Action Plan (EMAP) has been prepared in this section, highlighting all concerned environmental issues, mitigation actions to be taken and agencies responsible for implementation and monitoring of implementation.

Section 6.0 – Institutional Requirements

This section presents the institutional requirements for environmental management and monitoring during construction and operation stages of the project highway development.

Section 7.0 - Conclusions

This Section presents the conclusions of the EIA studies carried out for the proposed improvements to NH-3 section between Indore and Khalghat.

2.0 DESCRIPTION OF PROJECT

2.1 Present Condition

The Project highway at present has a 7 m wide paved single carriageway was 2-laned in the nineteen seventies: prior to that, the original 3.50 m wide road was widened to a 5.00 5.50 m paved road in the nineteen fifties. Even though the alignment and profile were upgraded during its 2-laning. They do not meet the geometric characteristics for the design speed of 80/100 km/h: humps / saddles and sharp horizontal curves impede adequate visibility and stopping distance. A part of the pavement will be thirty years old in the year 2005 and would have served its full design life. Many of the pipe culverts along the Project Highway section are of small diameters. Most of the culverts and minor bridges are in distressed state and the expansion joints and bearings of many of the major/minor bridges require replacement.

2.2 Analysis of Alternative Alignments

The Project Highway up-gradation proposal considered two widening options. Option I was to widen symmetrically along the existing alignment irrespective of the dense townships like Mhow (Km 14/9), Manpur (Km 41), Gujri (Km 63) and Dhamnod (Km 72). Option 2 was to consider widening along the existing alignment in rural areas and realignment for dense settlements to reduce the expropriation of houses and minimization of social impacts Prior to finalization of the alignment a loss assessment survey as a part of social screening was carried out to estimate the losses broadly. The loss assessment (category wise) carried out for Option 1 (without bypasses/realignment for any of the settlements) and Option 2 (with bypasses/realignment of project highway for major settlements) is presented in Table 2.1 and Table 2.2 respectively.

Table 2.1 Loss Assessment of The Residential/Commercial Structures

Type of Structure	Option – 1 (With out Bypasses)				Option – 2 (With Bypasses)			
	Permanent	Semi Permanent	Temp orary	Total	Permanent	Semi Permanent	Temp orary	Total
Residential	425	522	436	1383	60	269	107	436
Commercial	197	582	232	1011	46	186	57	289
Residential cum commercial	346	27	59	432	28	2	1	31

Table 2.2 Loss of Public Buildings / Amenities

Option – 1 (With Out Bypasses)						Option – 2 (With Bypasses)					
Educational Institutes	Public Buildings	Gardens	Hospitals/ Health Centers	Boundary Walls	Religious Structures	Educational Institutes	Public Buildings	Gardens	Hospitals/ Health Centers	Boundary Walls	Religious Structure
12	**16**	**1**	**7**	**16**	**74**	**6**	**4**	0	4	5	29

It may be seen from Table 2.1, Option 1 will affect 1383 residential structures, 432 residential cum Commercial Structures and 1011 commercial structures whereas under Option 2, the losses will be 486 residential structures, 31 residential cum commercial structures and 289 commercial structures, Similarly the Option 2 will affect less number of public buildings/amenities as compared to Option 1.

The loss assessments indicate that realignment of the Project Highway along dense settlements like Mhow, Gujri and Dhamnod will reduce social impacts significantly and also the project implementation cost. To minimize the social impacts, Option 2 was considered with three bypasses/realignments as given in Table 2.3. The Social Impact Assessment Report may be referred for more details on loss assessments

Table 2.3 Bypasses for Project Highway

Project Highway Section	Alignment Proposal
Ch 1 +800 to 29+250	Bypass For Mhow
Ch 56 + 500 to 61 + 350	Bypass for Gujri
Ch 65 + 45 to 73 + 950	Bypass for Dhamnod

In addition to the above, the following three alternatives were considered for the improvement of the critical Bheru Ghat and Bakaner Ghat section.

- Improvements along the existing alignment in the Ghat section with improvement of bends.
- Construction of a entirely a new highway for the Ghat section.
- Combination of the above two with the Mumbai bound traffic using the realigned road and the Agra bound traffic using the existing carriageway

Among these alternatives, improvement of the Bheru Ghat section was considered with construction of a entirely new highway and improvement of Bakaner Ghat is considered for the last two options.

2.3 Upgrading / Rehabilitation Proposal

The upgrading and rehabilitation works comprise the building of a 2x 2-lane dual carriageway, widening and reconstruction of the drainage structures (culverts and bridges), road safety and appurtenances and new wayside amenities. First, the additional carriageway and the median will be built parallel to the existing one. Traffic will circulate on the existing carriageway and will be switched over to the newly built carriageway for the reconstruction and widening of the existing carriageway.

2.4 Alignment and Profile

The visibility and stopping distances are inadequate at many of the present vertical and horizontal curves. All these deficiencies are to be up-graded in the improvement proposal. The longitudinal profile is determined by the proposed grade separators, raising of profile at low areas and riding quality for the design speed respecting the minimum requirements as per IRC guidelines. For all the major bridges (length >30 m) and the minor bridges to be rehabilitated, the proposed profile maintains the existing deck levels.

2.5 Present and Forecast of Traffic

The average daily traffic (ADT) varies between 20,000 and 23,000 PCUs per day. Trucks constitute nearly half the volume. The peak hourly traffic varies between 6 and 6.5% of the daily traffic and the Project Highway section has a volume/capacity ratio of 0.68 indicating the necessity of up-gradation. The average traffic projections for the years to 2030 are in the range of 170000 and 270000 PCUs/day.

2.6 Carriageways

The typical cross section considered for the Project highway section along the existing alignment and bypasses is presented in Figures 2.4 & 2.5 respectively. The cross section will have 4.5m wide median in rural areas and 1.5m wide median in settlement areas to minimize the land acquisition and expropriation of structures and social and environmental concerns. All the proposed new bridges along the Project Highway section will be designed to cater to 2x 3 lane traffic.

2.7 Pedestrian and Slow Moving Vehicles

The Up-gradation proposal has considered the following criteria

- The through traffic of NH - 3 shall have uninterrupted movement
- Provision of service roads for local users. The service roads will be connected to NH – 3 either at the grade separated interchanges or closer if needed.
- The central median must not be punctured except under unavoidable requirements.
- Pedestrian crossing points, as required without interference to through highway traffic.

2.8 Drainage Structures and Bridges.

The Project Highway has 16 (4 major and 12 minor) bridges. Apart from this the Project Highway has 46 pipe culverts. 66 RCC slab culverts, 18 culverts and 3 stone slab cross drainage structures. The project profile is raised at low culverts and drainage structures of higher discharge capacity are provided. The Major/inor bridges will be rehabilitated to carry the present traffic and new separate bridges will carry the additional carriageway.

2.10 Project Cost Estimate

The costs of the upgrading and rehabilitation works for 4/6 laning of the Project Highway are estimated at Rs. 462 crores excluding other costs, namely, land acquisition resettlement! rehabilitation, environment mitigation and enhancement, and relocation of utilities.

2.1 1 Economic Assessment

The Project Highway has a robust EIRR of ranging between 17.56% and 22.44% indicating relatively high rate of return for economic investments. The estimated FIRR is 7.58% for the economic investments. Therefore, the development of the Project Highway is a sound economic option. The Project will benefit the local communities in enhancing economic growth potential. Therefore, all necessary mitigation measures are to be incorporated so that development of the Project Highway is rendered as an environmentally sustainable development option.

2.12 Project Implementation Schedule

The project highway is to be developed under BOT scheme. The work shall start in year 2006 and is expected to be completed in year 2009. The work will be

executed in two main phases. Phase 1, works comprises the construction of the additional carriageway, new structures and services/side roads and the traffic will circulate on the existing NH-3 carriageway. The phase2 works comprise the re-construction and widening of the existing carriageway and corresponding structures and side roads will be done and the traffic will circulate on the new carriageway and the service roads.

3.0 BASELINE ENVIRONMENT

3.1 General

This section presents the existing baseline environmental conditions of the project region. In the context of this report, the project region represents the project influence (direct & indirect) area and the surrounding region comprising at least 10 km on either side of the project highway section. The baseline condition have been assessed from the secondary data sources followed by ground truth verification. In addition, primary investigations were carried out within the Project Region for certain environmental parameters. The assessment of all the environmental attributes/parameters based on the secondary data, ground truth verification and the primary investigations are summarized here under.

3.2 Geology

The Project Highway traverses through the districts of Indore, Dhar and large parts of Khargone. The Deccan basalt locally known as the Malwa Traps' occupies the entire Project region covering these districts. The occurrence of alluvium is isolated and is generally restricted to the river and 'Nallah' beds draining the region. The Geological map of the region is presented in Figure 3.1. and succession is given hereunder

Formation	Age	Thickness(m)
Alluvium – clays, silt, sand and gravel	Recent	10m
Deccan Traps – Lava flows	Cretaceous to Eocene	> 240m

Deccan Traps

In Upper Cretaceous times, series of lava flows emanated through fissures and flooded the entire Vindhyan topography. The eruption of lava flows came to an end in Eocene times and area was again subjected to large scale erosion. These traps in the project region are locally known as Malwa Traps. Geological mapping by earlier researchers has revealed that there is a succession of five basaltic flows in an approximate vertical column of 120m.

Table 3.1 presents the general disposition of flows in project region. The flows presented in Table 3.1 have been divided into older (flow Nos. I to III) and young groups (flow Nos. IV and V).

Table 3.1 Geological Flow Disposition of Project Region

Flow No.	Thickness (m)	Height above M.S.L. (m)	Vesicular horizons in the thickness of individual flow in %	Approximate aerial extent in Sq. Km.
V	30	570-600	33	350
IV	27	543-570	22	650
III	18	525 – 543	30	950
II	15	510 – 525	30	1250
I	30	480-510	40	600

Lithologically, different types of trappean flows are grouped into massive and vesicular categories. Massive basalts are generally fine to medium grained dark grey to greenish in colour. Massive basalts weather along joints and spheroidal weathering is common with exceptions of columnar jointing at places. The depth of weathering observed is generally 3 to 5 meters.

The vesicular unit of each flow forms the upper horizon and the thickness in general ranges from few meters to as much as 10 m. It is medium to coarse grained, softer than massive basalt and vesicles are generally filled with secondary minerals like calcite, zeolites and quartz. This unit is jointed to some extent and weathers easily due to vesicularity. The vesicles arc rounded to angular and sub angular.

The Red bole beds, which are predominantly ferruginous clays and are characterized by their lithological and textural uniqueness, generally act as a marker horizon between two flows. The top of individual flow is occasionally marked by reddish brown clay and therefore termed as ‘Red Bole’. The thickness of Red Bole varies from a few centimeters to a few meters. The Red Bole in its genetic relationship is an insitu product of weathering of Basalts, representing a time gap between the two successive flows. They indicate the local topographic highs during the time gap in successive flows.

Structurally, the trappean units are mostly horizontally disposed and do not exhibit any evidence of deformation. Vesicular unit, however, in individual flows within a group of flows do not appear to occur uniformly, which indicates wide variation in thickness within a short distance. The most prominent joints in the area are those trending EW and NS with vertical dips.

Alluvium: The alluvial deposits belonging in age to Recent to Sub-Recent are mainly confined to the banks of the Chambal, the Gambhir and their tributaries, the Khan and the Sipra and occur in narrow patches. They comprise mostly sand, gravel, clay and silt. While the sand and gravel are restricted to the river beds, the clay and silt are confined to the banks. These deposits attain a maximum thickness of about l5m, but are very irregular in nature.

Black cotton soil with a thickness of 0.5 to 1.00 meter is the chief soil cover in the area. This is followed by a yellow colored soil, known locally as 'pili mitti', with an average thickness of 8 to 10 m.

3.3 Geo - Hydrology

The Deccan traps, which are the predominant rocks in the project region/districts have wide variation in the water bearing properties. The massive basalts with their weathered zones and secondary porosity and the vesicular basalts with their minutely connected and partly filled vesicles play an important role in determining the occurrence movement and storage of ground water. These invariably form potential aquifers. The red boles are generally non - productive formations. In the alluvial areas, the occurrence of ground water is governed by sand/clay ratio. The sand beds generally form good aquifers, but due to the limited thickness and erratic occurrence in them are poor to moderately productive.

The Geo - Hydrologic map of the project district is given Figure 3.1. Rainfall is the main source of recharge to the basaltic aquifer in the region. Recharge also occurs by seepage from streams and their tributaries to a small extent. Due to low permeability of basalts and undulating topography, the run off is very 'high and this is the apparent cause for the large-scale seasonal fluctuation in the water table of the wells tapping trappean formations. The depth to water level in the Project Region varies between 5-10 m BGL (below ground level) in the pre-monsoon (May) month and it is 2-5 m BGL in post monsoon (November) month. The seasonal and long-term fluctuation in depth to water level of the Project

region is presented in Figures 3.2 & 3.3 respectively. The ground water potential of the Project Region as of l998 is given in Figure 3.4.

The ground water resource assessment of the project region carried out by CGWB indicate the level of ground water development for Indore district as a whole is 72% and categorised under Grey category. Similar assessment for Khargone district through which also Project Highway passes is less than 50% and has been categorised under white -category indicting adequate potential for ground water extraction.

The block wise ground water potential of the project region (both for Indore & Khargone districts) are presented in Tables 3.2 and details are presented in Appendix 1.

Table 3.2 Ground Water Resources of Project region

District	Name of Block	% of Ground water Development (1998)	Category of Blocks
Indore	Indore	78.97	Grey
Indore	Mhow	44.89	White
Indore District Total		72.17	White
Khargone	Kasarabad	26.15	White
Khargone	Maheshwar	48.18	White
Khargone District Total		36.67	

3.4 Physiography & Relief:

The entire Madhya Pradesh State has been divided into three physiographic divisions namely North Deccan Plateau, Central Highlands and Eastern Plateau Transects depending upon elevation, slope and ruggedness of the terrain.

The project highway traverses mostly traverses the Malwa plateau and Narmada valley of the central highland physiographic region of the State (Ref. Figure 3.5. The general slope of the Project Region can be categorised as very gentle (1-3%) to gentle (3 - 8%) The Project Highway (Ch 0.00 to 77.61) traverses between 300-600 m above mean sea level (MSL) with the exception of Bheru Ghat and Bakaner Ghat (between Ch. 42.650 to 51.500). In these Ghat Sections the Project Highway ascends to a maximum of 880 m above Mean Sea Level (MSL).

3.5 Soils:

The Project region falls within the central highland (Malwa Plateau) semi-arid (moist) agro-ecological sub region. The soil families and its sub groups along with soil landform relationship identified within the project corridor/region as per USDA soil taxonomy are presented in Table 3.3. The current landuse, soil constraints along with the required conservation and/or management measures are also presented in Table 3.3. The soil resource map of the project region is presented in Figure 3.6.

In brief, the region generally has medium black soils (30-100 cm deep), formed of montmorillonitic clays developed from trapped rocks. These soils are capable of conserving significant moisture and are of self-mulching type. The suspended black clay particles often induce black tinge to the surface run-off and therefore the water streams in the region will have a slight black color especially during monsoon season. The depth of the soil in the project region generally varies between deep to shallow to very shallow and the drainage range between well to moderately well. The slope of the region is very gentle (1-3%) to gentle (3-8%) and the erosion varies between severe to moderate class.

Most of the medium black soils are fertile, sub-humid climate with a Length of Growing Period (LGP) of 150-180 days. The available water capacity is between very low to medium. The soil reaction (P^H) of the entire project region falls within the neutral range governing the availability of nutrients sufficiently. Therefore, these soils make excellent fields for crops like cotton, soybean, wheat, gram, pulses, millets etc. These soils can also be used for horticultural crops under unproved crop variety and soil management practices contributing to overall development of the region. The major crops of the project region are wheat, Jowar, cotton, soybean, and small millets.

In addition to assessment of soil quality from the secondary data, samples from the project corridor were collected and analysed for heavy metal (Lead) contamination. The details of soil test results are presented in Appendix 2. The Lead concentration varied between 5 and 10.2 mg/kg as compared to the threshold value of 2000 mg/kg specified by the Department of the Environment's Interdepartmental Committee on the "Redevelopment of Contaminated Land Classification (ICRCL) system, U.K.

3.6 Land Use - Project Influence Area/Corridor of Impact

The Project Highway section is a part of the Agra to Mumbai section of NH-3 between Indore and Khalghat and traversing through dense settlements of Mhow, Tigaria Rau, Manpur, Gujri, Dhamnod and others. The section traverses between 300-600 m above mean sea level (MSL) with the exception of Bheru Ghat and Bakaner Ghat between chainage 42+65 to 51+50. In these Ghat section , the Project Highway ascends to a maximum of 880 m above Mean Sea Level (MSL) and has Reserve Forests of the Manpur division on either side of the Project Highway. Excepting this, the Project Highway corridor mostly exhibits agricultural land use with rural environment, interrupted by dense settlements at Manpur, Gujri, and Dhamnod among others. The land use pattern of the direct influence area/corridor of impact is given in Table 3.4.

Table 3.4 Land Use Pattern – Project Corridor

S.No.	Land Use Pattern	Total Area. Ha.
1	Irrigated Land	312
2.	Non – irrigated Land	36
3.	Govt. Open Land	61
4.	Govt Building/ Land	8
5.	Govt. Road / Nallah	71
6.	Forest Land	54.3
7	Private Bldg/land	35

It may be seen form the Table 3.4, the corridor of impact has some 54.3 of reserve forestland diverted for the improvement of project highway despite several measures to minimize the diversion of forestland. The diversion of forestland is essential to improve the geometric of the Project highway particularly in the Ghat sections.

3.6a Flora:

The direct influence area of the Project Highway is devoid of natural vegetation except for Reserved Forest stretches between Bheru Ghat and Bakaner Ghat sections between Chainage 42.65 and 51.50. The Reserved forests abutting on

either side of the project highway largely have sagwan trees (*Tectona grandis*) having commercial timber value.

The project highway improvement development will require diversion of about 54.3 ha of reserve forestland having largely sagwan trees. The tree enumeration survey in these stretches indicated some 1650 trees/km . Excepting this, most of the direct project influence area exhibits largely agricultural land use with rural expanse, interspersed by villages. Occasional coconut /guava /banana/ eucalyptus plantations and mango orchards are seen along side of Project Corridor.

Trees have been planted all along the Project Corridor over the last few decades under various programs of the State Government. The tree enumeration survey all along the direct influence area/corridor of impact show that some 285 trees per km of the project highway including forestland stretches along ghat sections. The summary of tree enumeration along with the type of trees observed within the corridor of impact is presented in Table 3.5 and Table3.6 respectively. The sample sheet showing details of trees, species & girth wise are presented separately in Appendix 3. The trees provide shade for motorists, slow moving traffic, and wayside outlets/kiosks apart from being a nesting place for a variety of avian fauna and other tree dwelling fauna like monkeys among others.

Table 3.5 Summary of Tree Enumeration – Project Corridor

Chainage	Total (left)	Total (Right)	Total	Trees/Km.
0+00 to 77+761	10645	11510	22155	285

Among trees, some-stand out which are substantially older and large than most others. These are referred as giant trees and can often be found close to village settlements and and/or in rural expanse. The trees are generally Tamarind, Neem, Banyan and/or Peepal. Giant trees which are within village limits are focal points for social interaction or for community / religious congregations or even a place for weekly shandies. The giant trees often also serve as bus stops, agro equipment repairing yards, resting places for the slow moving traffic and shelter petty business activities.

In general, these trees are 30 to 50 years old and have a girth of more than 30 cm.

Table 3.6 List of Common Trees – Project Corridor

S.No.	Type of Tree	S.No.	Type of Tree	S.No.	Type of Tree
1.	Acacia Arabica	26	Dhawra	51	Picrothiza kurrooa
2	Aegle marmelos	27	Diospyrus Melanoxylon	52	Plumeria acutitolia
3	Anar	28	Diospyrus melanoxylon	53	Polyalthia longfoha
4	Anwala	29	Diospyrus melanoxylon	54	Prosopis spicigera
5	Areca Catechu	30	Eugphorbia jambolana	55	Ramphal
6	Ayiconnia offcinallis	31	Euphorbia hirta	56	Ricinus communis
7	Azadirachta Indica	32	Fanshi	57	Rimora
8	Badam	33	Ficus benghalensis	58	Santalum album
9	Bauhinia Variegata	34	Ficus religiose	59	Schelicheru oleosa
10	Besia latifolia	35	Gendi	60	Shimda
11	Beswalia serrata	36	Gular	61	Sitaphal
12	Billi	37	Kaner	62	Sonpatta
13	Biya	38	Kastar	63	Sterculia urens
14	Bombax malabaricum	39	Kaveet	64	Surjana Fali
15	Buchaninia latifolia	40	Kawali	65	Syzygium cumini
16	Butea frondosa	41	Kirkiria	66	Tamarindus indica
17	Butea monsperma	42	Lawsonina inermia	67	Tectona grandis
18	Callistemon lanceolatus	43	Mangifera indica	68	Tendu
19	Cassia fistula	44	Melia azaderach	69	Terminalia belovica
20	Chloroylen swietonin	45	Moringa oleifera	70	Terminalia chebua
21	Cocus nucifera	46	Muni	71	Tuar
22	Delbergia latifolia	47	Neebu	72	Eucalyptus glossus
23	Detura stramonium	48	Papita	73	Zizyphus jujuba
24	Delonix regia	49	Phephar		
25	Dendirocalamus strictus	50	Phoenix aylvestris		

The corridor also has social forestry plantations, most of them are young and less than 30cm girth, shrubs. During strong wind and/or storms, some tree(s) get uprooted and pose a serious hazard to the traffic movement and cause traffic block and delays. Uprooting of the trees can be attributed among others to factors like soil erosion, exposure of root zone and lack of an appropriate tree management system.

The clearance of the vegetation and felling of trees (both large and giant) within the direct influence area for the Project Highway Project is a significant environmental concern. Although, most of the plantations does not have ecological and/or commercial value but provide a serene landscape to the road users. The trees do provide a nesting place for innumerable tree dwelling avian fauna. Generally, local populace attaches cultural and religious sentiment to the giant/large trees.

3.6b Water Resources:

The Project highway between Km12.60 to 46.00 falls within the Chambal Sub basin of the Ganga Basin and thereafter between Km 46.00 to 84.70 Km falls within the Narmada basin.

Rivulets such as Chambal, Gambhir, Khan and shipra rivers having a south to north course form the main drainage channels of Chambal Sub basin.

Small rivulets and storm channels cut across at several places most of which are non- perennial and drain only for few days/weeks during/after the monsoons. The basin map of the project region is presented in Figure 3.7.

3.7 Meteorology:

The climate of the Project Region ranges from semi-arid (dry moist, dry and moist) sub-humid to humid tropical. In the Project Region, Indore has a meteorological observatory installed and maintained by the India Meteorological Department (IMD) since 1877. The past data of this observatory for period 1951-80 is presented in Appendix 4. The weather data later than 1980 was not yet published by IMD. The summary of the weather conditions based on 1951 - 80 data is presented here below.

Rainfall: The region gets maximum rainfall during south-west monsoon and the 30 year mean average annual rainfall is 1008mm.The mean rainy clays in a year is 48 with maximum rainfall spread over July (13.4 days), August (12.8 days) and

September (8.6 days). The mean rainfalls in July, August and September months are 284, 287 and 211 mm respectively.

Temperature : The annual mean daily maximum temperature is 31.7°C and daily minimum temperature is 17.9°C. The annual highest and lowest temperatures arc 39.9°C and 13.1°C in May and January months respectively. Generally, March, April and May are the hottest whereas as December and January are the coldest months in a typical year.

Relative Humidity : The annual mean relative humidity during morning hours is 59% and 40% during the evening hours. Generally, August is the most humid month with a relative humidity of 90% during morning and 77% in the evening hours. The driest month of the year is April with a relative humidity of 30% in the morning hours and 16% in the evening hours.

Wind: The predominant wind direction is west for 28% of days in a year followed by Southwest for 14-17% during both morning & evening hours. The calm period is for some .16% of the time and mostly in the morning hours. The mean annual mean wind speed is 13.9 km/hour and varies between 6.1 km/h (November) to 23.3 Km/h (June). The region has clear visibility all through the year with visibility over 20 km for over 140 days in a year. The number of days with thunder is about 34 days in a year, spread over all months and for maximum number of days in June (8) and July (6) months. The number of dust storm days is almost insignificant i.e. 0.8 days in a year, which may occur in between March and June.

3.8 Water quality:

The physico-chemical quality of water bodies flowing across Project influence area/Corridor was assessed during baseline surveys. Water samples were collected from six locations along Project Corridor and analysed for relevant water quality parameters. The sampling stations represented the common water sources of the corridor like river.

Dug wells, tube wells, and canal. The test results along with the tolerance limits for Inland surface Waters: IS 2296-1982 is presented in Appendix5. The summary of the water quality test results of the Project Corridor along with the Tolerance Limits stipulated for the Inland Surface Water are presented in Table 3.7 and investigation details are presented in Appendix 6.

Table 3.7 Summary of Water Quality Test results and Standards

Parameters	Surface Water	Ground Water	Tolerance limits for inland surface waters				
	Range	Range	Class A	Class B	Class C	Class D	Class E
pH	8.08-8.45	8.01 – 8.45	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	60.-8.5
Dissolved Oxygen	4.5 – 5.5	6 - 7	6	5	4	4	-
BOD 5	40 - 60	-	2	3	3	-	-
Total Hardness	110 - 150	120 - 370	300	-	-	-	-
TDS	140 - 236	704 - 1136	500	-	1500	-	2100
Chlorides	17	150 - 250	250	-	600	-	600
Sulfates	10	68.84	400	-	400	-	1000

Class A - Drinking water source without conventional treatment but after dis- infection

Class B – Outdoor bathing.

Class C - Drinking water source with conventional treatment followed by dis-infection.

Class D – Fish culture and wildlife propagation.

Class E - Irrigation, industrial cooling or controlled waster disposal

All units are in mg/ l except pH

It may be seen from the Table 3.7 that the water quality generally conforms to the Tolerance limits except Bio Chemical Oxygen Demand (BOD)). It should be noted here that the referred tolerance limits have since been withdrawn and revised standards are yet to he notified. Consequently, tolerance limits specified for inland surface water in IS 2296-1982 is only considered as a general reference for qualitative assessment.

3.9 Ambient Air Quality

The baseline ambient air quality of the Project Corridor was assessed at six locations. The Stations were in proximity to human settlements subjected to high vehicular traffic. The air quality parameters monitored were Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM) (<1() um), Oxides of Sulphur, Oxides of Nitrogen, Carbon Monoxide, Lead and Hydrocarbons. All the test procedures were in conformance with the procedures recommended by

the Central Pollution Control Board, Ministry of Environment & Forests, Government of India.

The ambient air quality test results along with the National Ambient Air Quality Standards (NAAQS) and standards stipulated by agencies such as World Health Organization (WHO) and United States Environmental Protection Agency are presented in Appendix 7 and investigation details are presented in Appendix 6.

The Minimum, Maximum and Mean concentrations of air quality parameters along with National Ambient Air Quality Standards are presented in Table 3.8.

Table 3.8 Ambient Air Quality of Project Corridor

Air Quality Parameter	Unit	Concentration			NAAQS*
		Minimum	Maximum	Mean	
Suspended Particulate Matter	µg/m3	114.4	831.9	473.2	200
Respirable Particulate Matter	µg/m3	84.88	256.3	341.2	100
Oxide of Sulphur	µg/m3	12	23	17.5	80
Oxide of Nitrogen	µg/m3	98	135	116.5	80
Carbon Monoxide	ppm	1	2	1.5	2
Hydrocarbon	ppm	1.7	2.2	2	-
Lead	µg/m3	0.139	0.29	0.21	1

* Indicates National Ambient Air Quality Standards (24 hrs average for rural & residential areas)

It may be seen from the Table 3.8 that the tested ambient air quality parameters of the Project Corridor arc generally within the National Ambient Air Quality Standards notified by Central Pollution Control Board, Ministry of Environment & Forests, Government of India.

3.10 Ambient Noise Quality:

The baseline ambient noise levels along the corridor were monitored oot at twelve stations. The monitoring stations represented human settlement, industrial, sensitive areas (hospitals/schools/temples), urban and/or built-up areas along the corridor.

The monitoring was carried out both during day time and night time as notified by Central Pollution Control Board. The measured background ambient noise levels along with the computed noise level indicators are presented in Appendix 8 along

with the Ambient Noise Standards notified by the Central Pollution Control Board. The field investigation details are presented in Appendix 6.

A brief summary of the background noise level-indicators is presented in Table 3.9.

Table 3.9 Ambient Noise level of Project Corridor *(to be updated)*

Max. Value Recorded	Min. Value Recorded	Max. Hourly Leq.	Min-hourly Leq	Leq value 15 Hr (day time)	Leq value 9 hr (night time)	L10	L50	L90
84.6	53.6	79.7	55.3	69-79.6	58.2-78.5	77.6-81.2	66-71.8	55.4-60.5

*all values are in dB(A)

In general, the background ambient noise levels recorded along the Project corridor exceed stipulated limits in residential and sensitive areas during day hours. During night hours, the levels exceed only between 9PM to 1PM. The difference between the day and night time noise levels is very marginal, attributable to high night time traffic.

3.11 Archaeological / Historical Monuments:

Reconnaissance of the Project Corridor has revealed that there are no protected/ declared Archaeological/Historical monuments along Project Corridor. The Department of Archaeology, Govt. of Madhya Pradesh and Archaeological Survey of India has also informally confirmed the consultants' findings in this regard.

3.12 Cultural Heritage / Sensitive and / or Natural habitats :

An appraisal has indicated that there are no cultural heritage sites, sensitive and / or natural habitats, sacred groves, protected nature reserves, and wetlands along the Project Corridor.

7.0 CONCLUSIONS

The following conclusions are drawn from the EIA studies for the improvement of the 77.61 km of the Indore- Khalghat section of NH-3

- The 77.610 km of the Indore- Khalghat section of NH-3 has a robust EIRR between 17.56% and 22.44% indicating relatively high rate of return for economic investments and is beneficial for the local communities in enhancing the economic growth potential. The FIRR is 7.58%;
- The Project Corridor does not traverse wetlands, sensitive natural habitats. However the project development will require approximately 54.3 hectares of reserve Forest abutting the highway despite considering various measures to constrict the land acquisition. The reserve forest area proposed to be acquired has largely teak plantations. The acquisition of the forest area is essential - improve the highway geometric and engineering considerations in the Bheru Ghat and Bakaner Ghat sections conforming to project objectives. Compensatory afforestation to the extent of Twice the area to be diverted will be taken up in degraded forests of the region as per the provisions of Central and Government of Madhya Pradesh. Provision has been made in the cost estimate for deforestation;
- The Project Corridor does not impact any archeological-monuments and heritage sites.
- The Project will require the clearing of vegetation within the ROW. Although the loss of vegetation will be apparent on short term, impacts will not he significant on long term. The impacts can be seen as a contributor to the safety of the road users, since the present old and unsound trees-are hazardous to the road users. The cleared vegetation will be replaced by a better managed and project specific landscape/arboricultural plan under a separate contract;
- The water requirements for construction will be meet through the construction of project specific bore wells. These bore wells will be left in working condition after the project completion for the use of the local community and operation and maintenance of the project.
- The estimated water requirements, represents less than 10% of the natural recharge capacity of the ground water in the region. Nevertheless, the project proponents NHAI will fund artificial recharging measures in the Project region in coordination with the State Ground Water Authority to contribute to the State's on going program to replenish the ground water resources in short and long terms. Provision has been made in the cost estimate for ground water replenishment/recharging;
- Project specific haulage roads (as required).will be built and replenished with wearing coat after the completion of hauling. During the hauling operations, measures will he enforced to ensure the environment protection, namely, sprinkling of water to contain dust, spillage-proof vehicles for hauling, regular maintenance of vehicles and monthly revalidation of vehicle emission test certificate;
- Work force camps for the Project will be provided with adequate water supply septic tank with soak away pits, health care facilities and rationing of kerosene/LPG to negate dependence on fuel wood;
- The EIA has identified likely impacts and has defined mitigation measures. These mitigation measures will be implemented and monitored during the Project construction and monitored during the operation period. A control matrix showing

responsibilities and monitoring frequency of mitigation measures is defined. The EIA and EMAP will be included in the construction contract provisions so that the contractors are aware of the environmental requirements of the Project;

- The NHAI will create an Environmental Management Unit (EMU) under the supervision consultancy Contract for the implementation of the EMAP. The Environmental Officer of EMU will oversee the implementation of the EMAP by the contractors. The environmental monitoring will be executed by a competent agency on the approved test of the MOE&F, Government of India, or the Department of Environment, Government of Madhya Pradesh. Furthermore, the EMAP implementation will be audited by an independent agency to identify the non -conformance of the EMAP, if any, along with additional measures to be taken;
- Provision has been: made in the Project cost estimate for 'the implementation of the environmental mitigation /enhancement measures for both construction and initial 5 year operation period;

In light of the above, it can be concluded that the rehabilitation and up-gradation of the 77.610 km of the Indore - Khalghat section of NH-3 under the National Highways Development Program will be an environmentally beneficial option.

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4.0 ENVIRONMENTAL IMPACTS & MITIGATION

This section presents an assessment of' potential impacts and mitigation measures to contain impacts. Unlike industrial projects, highway projects particularly up-gradation / widening projects generally induce relatively insignificant potential for adverse impacts. Most of these can be avoided o mitigated through proper engineering designs and by adopting good construction practices with concern for environment protection.

The project development activities in present case will be restricted almost entirely to the existing ROW and consist of improvement of road geometrics. widening of pavement, shoulders & berms, improvement of bridges, culverts and drainage ways. and pavement conditions. These activities will result in enhancement in transport capacity, speed, highway safety among other factors, contributing to economic growth of the region as well as the nation.

The assessment of potential impacts and their mitigation measures presented herein are based on detailed field investigation of the environmental assessment team of project preparation consultants. During the assessment, most potential impacts were found to be relatively of short term nature, provided attention is given to restoration and rehabilitation. Issues regarding land acquisition and displacement of human settlements, and related social issues have also been assessed and presented in a separate report titled Social Impact Assessment and Resettlement & Rehabilitation (R & R).

Potential impacts, actions for negating adverse impacts along with those, which can possibly enhance environmental benefits, are presented in this section. Formal responsibilities for implementation of mitigation actions are indicated in Environmental Management Action Plan (EMAP) under Section 5.0 EMAP identifies potential impacts, proposed mitigation, implementing and responsible agencies to ensure proposed mitigation actions are implemented.

4.1 Geology:

The Project Highway traverses through the districts of Indore, Dhar and large parts of Khargone. The Deccan basalt locally known as the 'Malwa Traps' occupies the entire Project region covering these districts. Geological mapping of

the region has revealed that there is a succession of five basaltic flows in an approximate vertical column of 120 m. The occurrence of alluvium is isolated and is generally restricted to the river and 'NaIlah' beds draining the region. Therefore, geologically, entire project corridor/region is stable. The Department of Mines & Geology, Government of Madhya Pradesh has leased out areas at a number of locations in the project region for quarrying operations. Many of these have been identified under the Project investigations for sourcing of aggregate. In general, aggregates meeting predetermined quality standard/specifications will be sourced from these quarries and hauled to work sites by road. The estimated requirement of the aggregates is approximately 1.5 million cum for the project.

The project will impact these resources by increasing the rate at which these are presently being consumed. Despite this, quarrying operations are unlikely to cause or contribute significantly to their depletion as the region has large natural reserves of aggregate material.

Quarry operations are independently regulated activities and outside the purview of project Highway. Nonetheless, environmental considerations prior to approving specific quarry can limit environmental implications. This is important since significant- quantities of aggregates will have to be quarried in a relatively short period of- time, thereby accelerating present level of quarrying operations. This can often lead to increased dust & noise levels, ignoring safety & health of workers, unhygienic conditions in workers camp due to over crowding or cause loss of natural resources etc. Nonetheless, imposing conditions for upkeep of work environment on quarry owner(s) through contractor and /or material supplier and monitoring from time to time can largely mitigate such implications. To ensure adequate mitigation of potential adverse impacts, only licensed quarrying operations are to be used for sourcing materials. The impacts arising due to hauling of aggregates can be largely mitigated through mitigation measures presented under sub section 5.2 here below.

4.2 Hydrogeology:

The project development particularly clearing ROW operations will require relocation of a few dug wells, tube wells (both drinking water and irrigation

wells) which are falling within the right of way. The wells will be shifted to adjoining areas in consultation with the local communities/owners and not therefore likely to pose any significant impact on groundwater resources of the region.

Most significant impact will be due to requirement of water for construction works, water supplies to work sites and labour camps and also for activities like spraying of water for dust suppression, watering of re - plantation within the right of way among others. As the project- region is devoid of perennial surface water bodies, which can cater to bulk requirements particularly in dry seasons & when demand for Construction water will- be -maximum. The only & easily accessible source is ground water.

The Deccan traps, which are the predominant rocks in the project region/districts, have wide variation in the water bearing properties. The massive basalts with their weathered zones and secondary porosity and the vesicular basalts with their minutely connected and partly filled vesicles play an important role in determining the occurrence, movement and storage of ground water. These invariably also form the potential aquifers. The depth to water level in the Project Region varies between 5-10 m BGL (below ground level) in the pre-monsoon (May) month and it is 2-5 in BGL in post monsoon (November) month.

The ground water resource assessment of the project region carried out by CGWB indicate the level of ground water development for Indore district as a whole is 72% and categorized under Grey category. Similar assessment for Khargone district through which also Project Highway passes is less than 50% and has been categorized tinder white category indicating adequate potential for ground water extraction. Since the percentage of ground water utilization is considerable in lndore district, there is a need for measures to replenish ground water resources and conserve surface water resources in the Indore district.

The estimated construction water requirement for Project Highway improvement works is some 2.2 million cum, most of which is likely to be used in the first two years of the project implementation period. This water requirement represents some 10% of the natural recharge capacity of the region. Therefore extraction of

ground water for Project development although limited to project implementation stage, is likely to contribute to only a marginal depletion of ground water resources in the project region. However keeping in view of the present ground water utilization rate in the project region particularly Indore district, it is essential to consider relevant ground water recharging measures, so that the Project development contributes to the replenishment of ground water resources in the region.

Project development concurrently provides scope fro replenishment of ground water resources to a certain extent through creation of artificial recharging facilities within the borrow areas or any other area within the project region identified by the State Ground Water Authorities. The relevant recharging facilities for the project region could include construction of percolation pits, recharging shafts within the borrowed areas so that these can contribute to the ground water recharging both in short and long term. The extent of ground water recharging is to be determined and executed in consultation with the state ground water authorities. A sum has been earmarked for the purpose in the environmental budget. The artificial recharging activity can be expected to offset impacts of ground water extraction on short term and contribute to replenishing of ground water resources on a long term.

Construction/conversion of borrow areas into surface water bodies and for artificial recharging of aquifers will become an environmentally beneficial option on a long term for following reasons.

- Replenishment of ground water resources in the region. The ground water extraction specifically in Indore District as a whole is significantly high (utilization is some 72% as estimated by CGWB) and these are already under Grey category as notified by Central Ground Water Board. Assessment of ground water resources of project region has revealed an urgent need for replenishing ground water resources.
- Water tanks/ponds will render to aesthetics and contribute to microclimate of the region.

- Aquatic avian fauna of the project region will benefit due to availability of water spread for prolonged duration. So also grazing live stock of the region since the water holes will be available for a longer period as compared to present case.
- Development of borrow areas particularly government lands into water bodies will discourage misuse of burrow areas for instance dumping of mine /municipal solid waste and other undesirable activities.

Despite the measures mentioned above, prior approvals, wherever required, for the construction of new bore well(s) will be taken from the Ground Water Authorities / Department of Mines & Geology, Government of Madhya Pradesh. Extreme precaution is to be exercised to finalize the locations of new bore well; these are to be away from the human settlements and without affecting the existing ground water users of the neighbourhood. The bore wells constructed for the works are to be left in good-working condition for the use of the local community and watering of the vegetation within the Project Corridor during the operation & maintenance period of the project highway.

4.3 Soil :

Soil is an important component of natural environment and is a primary medium for many biological and human activities including agriculture. Therefore soil conservation in relation to road development deserves significant attention. A number of alternatives were considered to minimize diversion of productive land/top soil prior to finalization of present corridor.

The project development will involve raising and widening existing embankment all along the alignment. The estimated requirement for earthwork is approximately 75 lacs cubic meters for embankment, sub-grade and shoulder construction. This would imply that approximately some 500 hectares of land will have to be excavated for at least 1.5m depth. The soil and materials investigation under the project has identified borrow areas in the project region. The potential borrow areas identified are largely governments and private lands. Borrowed materials will be transported to work sites through dedicated haulage roads.

Borrowing such huge quantities and haulage require mitigation measures to contain impacts.

The potential impacts are construction of dedicated haulage roads through rural are erosion problems triggered by borrowing and air pollution particularly dust levels due to borrowing and hauling operations.

The impacts due to borrowing soil can be significantly mitigated by the following measures.

- Prior approvals are to be sought from the concerned Departments of Government of Madhya Pradesh and all local environmental regulations to be complied.
- Within all identified borrow areas, the actual extent of area/zones to be excavated will be demarcated with signboards and operational areas will be access controlled.
- Incase of borrowing dry highlands, all borrowed area are to be provided with gentle slope for side walls, re-vegetated and connected to nearest drainage channel to avoid formation of cess-pools during/after monsoon
- Occupational safety procedures/practices for work force to be adhered as per applicable laws.
- The borrow areas shall have adequate dust suppression measures like sprinklers in work areas and along approach roads.
- Regular monitoring of borrow areas and haulage roads by Project Environmental Implementation Unit (PIU) to ensure compliance
- Use of existing roads for hauling is to be avoided. If unavoidable, roads are to be first strengthened and /or widened so that present users can continue to use along side in dedicated tracks.
- Dedicated gravel roads with 150 mm water bound macadam wearing course conforming to Indian Roads Congress specifications are to be constructed for hauling of materials.

- The alignment of haulage roads will be finalized to avoid agricultural lands to the extent possible. In unavoidable circumstances, suitable compensation will be paid for people whose land will be temporarily acquired for the duration of operations. The compensation will cover for loss of income for the duration of acquisition and land restoration.
- Prior to construction of roads, topsoil will be preserved and used for turfing of project road embankment etc.
- Water tankers with suitable sprinkling system are to be deployed along the haulage roads. Water will be sprinkled to suppress the airborne dust due to the dumper/truck movement. Required frequency is to be determined by site conditions.
- The vehicles deployed for material transportations will be spillage proof. In any case, the haul roads will be inspected at least once daily to clear accidental spillages, if any
- The material dumping sites will be access controlled to keep away-unauthorized entry of people, grazing cattle and other stray animals.
- All haul roads will be restored with a wearing coat conforming to specifications after completion of hauling for the use of local community.
- Private land owners of borrow areas are to be encouraged through incentives like provision of free saplings and enrichment of soil within borrowed areas to grow timber and other commercial plantations in borrowed areas of dry highlands so that it contribute to green cover of the region and also financial return to land owner(s). A sum has been provided in cost estimate for this purpose.

4.4 Land Use

The project highway is likely to trigger substantial changes in existing land use pattern of the region. Due to project highway development, area under agriculture and vegetation will be diverted both due to project highway and also by adjacent private landowners for commercial gain.

Prior to finalization of ROW, analysis of various alternatives were carried out to minimize acquisition of agriculture land keeping in view of engineering design requirements of project highway.

The project highway proposal will require about 572 hectares of land acquisition and diverted to road construction which include the forestland. The significant impact of project highway is loss of agricultural land. The loss can not be replaced but may get offset only to a certain extent through benefits that local community may accrue through project highway development.

The loss of forest area is some 54.3 hectares despite engineering measures like width constriction of median, exclusion of service roads locally etc are considered to keep the diversion of forest land to bare minimum as compared to the other stretches of the Highway Section. As a compensatory measure, afforestation in degraded forest areas of the project region will be carried out to TWICE the extent of forest area to be acquired / diverted as per the norms of Government of India. The compensatory afforestation will be undertaken by Madhya Pradesh Forest Department and funded by project proponents namely the NHAI. A provision in the environmental budget has been made for afforestation of the degraded forests, which are to be determined by the Department o Forests, Government of Madhya Pradesh. The Department of Forests will be responsible for species selection, upkeep and maintenance so that the forest cover lost due to project highway is retrieved in degraded areas of the project region.

It may be pertinent to mention here that the direct influence area of Project Highway is generally devoid of natural vegetation except for reserved forest areas along the Bheru Ghat and Bakaner Ghat sections along side of the Project Highway between Ch 42+650 and 51+500. The diversion of the reserve forestland will require clearance form the Ministry of Environment & Forests.

Tree felling and clearing of plantations within the right of way is another significant issue. This aspect has been addressed under section Terrestrial Flora & Fauna in subsequent paragraphs. Other than the changes mentioned above, camp sites for construction personnel and labor, work sites, construction of haulage roads, road diversions during construction phase etc also will lead to change in

land use, limited to construction phase and can be restored. Generally, impacts arising out of construction camp/work sites can be largely controlled / mitigated by incorporating suitable mitigation clauses in contract and effectively implementing them at site. The campsites can be restored to its previous state after the completion of project Development, In addition, adherence to good engineering and construction practices and strict enforcement of EMAP will ensure no significant degradation of land use during construction stage.

4.5 Water bodies:

Small rivulets and storm channels cut across at several places most of which are non-perennial and drain only for few days / weeks during / after the monsoons.

Impacts arising out of construction of cross drainage structures are not likely to impact drainage pattern since, under project highway design, discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems. Moreover as a mitigative measure, channel beds are to be cleaned up and restored to its previous state after completion of construction. The sections of all upstream and down stream drainage channels will be improved up to a distance of at least 300m to ease the water passage across drainage structures.

4.6 Water quality:

As discussed earlier, most of the water bodies across Project highway are non-perennial and drain storm water only for few weeks during monsoon season.

Impacts arising Out of up-gradation of cross drainage structures due to project development are not likely to significantly impact water quality, as all construction activities will be generally scheduled for non-monsoon months. Moreover as a mitigation measure, rivulets/channel beds will be cleaned up and restored t its previous state after completion of construction. The measures are detailed under. Environmental Management Action Plan of section 5.0.

4.7 Terrestrial Flora & Fauna

The vegetative cover within Project Corridor will be impacted upon during clearing operations of right of way. The most significant category of vegetative cover impacted upon is Trees. Social forestry plantations form next category.

Trees falling within the right of way are on an average generally 30-40 years old, and have a girth of more than 30 cm. Although, most trees/plantations does not have ecological and/or commercial value but provide a serene landscape to the road users. The trees however do provide a nesting place for innumerable tree dwelling avian fauna. Tree enumeration survey indicated that altogether there are 285 trees per KM within the ROW, apart from social forestry plantations, which are less than 30cm in girth. Almost all of these are to be cleared for project construction. Although an attempt will be made to retain trees, which are young, straight, sound and fall on proposed median with 0.75cm clear distance on both sides of median edge. The exact number of such trees can only be determined at the time of marking of ROW at site.

As a compensatory measure, plantation of new saplings within the right of way (ROW) will be undertaken by Madhya Pradesh Forest Department, under funding by NHAI. As per the current provisions at least TWICE the numbers of trees/saplings/plantations lost during clearing operations are to be replanted.

The species for replanting can be selected form the list of common trees as per Table 3.6 attached as these are found to be generally suitable for the region. Madhya Pradesh Forest Department on behalf of project proponents will also undertake regular upkeep and maintenance of plantations in accordance with micro- ecological considerations. To increase survival rate of new saplings, a core Tree Management Agency (TMA) will be created during project implementation period to ensure complete retrieval of vegetative cover and timely replacement of perished plantations. The TMA is to be represented by Project implementation Unit (PIU) of NHAI, Construction Supervision Consultant appointed by NHAI and regional officers of Madhya Pradesh Forest Department, Contractor and local NGOs. Replanting operations are to be commenced just after disturbance due to construction has stopped and NOT after completion of construction.

Considering the above, impacts arising out of clearing vegetative cover including trees within ROW will not be significant in long term although loss will be apparent and significant on short term. The impacts should be seen as a contributor to safety of road users, since many trees which are old and hazardous will be removed away from main carriageway through this project development

and cleared vegetation is being intended to be replaced within ROW in a better managed and accelerated phase.

The clearing of trees will impact upon tree dwelling avian fauna and monkeys on a short term. Impacts on wild life species, threatened or endangered spices etc are not likely to occur as these are not known to occur along Project Corridor.

4.8 Aquatic Flora & Fauna:

As mentioned earlier, the project highway traverses across numerous drainage channels/rivulets of Chambal sub basin of the Ganga Basin and Narmada basin systems. Most of these are non-perennial and drain storm water only for few weeks during monsoon season.

Impacts arising out of up-gradation of drainage structures due to project development are not likely to impact upon aquatic flora and fauna, since these are dry for most parts of year and it does not apparently support any significant aquatic flora and fauna. In any case, construction of bridges/cross drainage structures will be limited to non-monsoon months. The channel beds will be cleaned up and restored to its previous state prior to onset of monsoon.

4.9 Air quality:

Vehicular emissions are one of the most significant air pollution sources both in urban and rural environment. The vehicle emission is determined by various factors like fuel composition, level of engine maintenance, vehicle age, speed and congestion, traffic & road condition etc. The most significant impact of vehicle emission is on human health. The health impacts of vehicular air pollution are difficult to quantify and therefore to evaluate in economic terms. In most cases, establishment of direct cause-and-effect linkage between localized vehicular air pollution, and specific illness is difficult except for attribution.

Vehicular pollution also affects terrestrial flora both physically and chemically. Dust settling on leaves is known to interfere with pollination and photosynthetic function if accumulation is significant. Acidification of surface water through surface runoff can interfere with nutrient uptake by roots, thus affecting growth. Ethylene, a hydrocarbon has a detrimental hormone influence on plant growth

while NOx, SO2 and ozone can all cause localized death of tissue (leaf necrosis). Certain plants can absorb toxic pollutants such as lead from air, making consumption of these plants hazardous.

Although most research efforts concerning effects on animals have focused on human health, some faunal health problems have been connected to air pollution. As in humans, such problems are mostly related to respiratory system.

Objects in human use are also vulnerable to air pollution on two fronts: staining and corrosion. Particulate does settle on all types of structures, modern buildings, monuments and cultural heritage sites and increases cost of maintenance. Acid deposition associated with NOx and SO2 is can be a cause for destruction of limestone, marble or lime mortar structures. Acidity originated from vehicular emissions can deteriorate paints and accelerate corrosion of metals.

The present project highway development is not likely to have significant impacts on air quality and human settlements along roadside. The reasons can be largely attributed to the following factors:

- The operation stage of project is expected to facilitate movement of traffic at design speed of 100 Km/hr. and some 70% of traffic will cruise between 80 - 100 km/hr, which is optimal for minimum emissions.
- Secondly, widened ROW of Project highway development will increase distance between passing vehicles and human settlements along roadside as compared to present situation. The increased distance will reduce human exposure concentrations of vehicular emissions.
- The existing ambient air quality parameters along project corridor particularly those representing vehicular pollution are not at an alarming level and well within National Ambient Air Quality Standards.
- The project development, not limited to the present stretch but the National Highways Development initiated by NHAI in the region is certain to induce vehicle owners to switch over to newer vehicles primarily to derive benefits of low travel time costs. Even if this switchover happens gradually, still it would be contributing to lower

emissions because of technological improvements in newer vehicles, stricter emission norms, better fuel combustion systems etc

- Air quality impacts during construction stage are transitory and could largely be mitigated by strict adherence to specific control measures. These are presented in Environmental Management Action Plan (EMAP) under section 5.0

4.10 Noise :-

Noise impacts are inevitable in most road development projects regardless of scale or character. Among communities living along highway(s), even when noise is not perceived consciously, chronic exposure to road noise can affect human welfare in varying degrees, both physiologically and psychologically. Chronic noise exposure can be a source of annoyance, create communicating problems and lead to elevated stress levels as well as behavioral and other health effects. Noise can cause auditory fatigue, temporary and permanent loss of hearing ability, induce sleeping disorders and can even cause learning problems in children. In areas, which have low ambient levels like rural expanse, noise from road construction will be more noticeable than similar noise level in higher ambient noise levels. New roads in quiet areas or noisy trucks at night are perceived as worse than higher levels of noise in busy area(s) during day hours.

The factors contributing to noise impacts are highly variable. Consequently sources/types of noise associated with highway development are briefly mentioned hereunder.

i. Vehicular noise :

Poor vehicle conditions and maintenance is a major factor, which contribute to increased noise levels in highways. Vehicular noise emanates from engine transmission, exhaust, suspension and acceleration & deceleration, braking poor riding quality, stop and go traffic conditions. Generally heavy vehicles such as transportation trucks induce more noise than light vehicles.

ii. Driver behavior:

Vehicle drivers contribute to road noise by indiscriminate use of horns playing loud music, bad driving habits such as sudden braking/accelerating causing squealing of tyres etc.

iii. Road noise:

The physical characteristics of road surface and its surroundings play significant role in contributing to noise levels. Frictional noise from contact between tyres and pavement surface contributes significantly to overall traffic noise. The noise level depends largely on tyre and pavement conditions and type. Well maintained, smooth surfaced roads are less noisy than those with cracked damaged and patched surfaces. Improper expansion joints in bridge decks are also noisy. Roadside surfaces such as vegetated soil tend to absorb and moderate noise while reflective surfaces like concrete and / or asphalt does not have any beneficial function.

iv. Road geometry:

The vertical alignment of road can influence the extent of noise that can he transmitted to roadside receptors. Vehicles tend to produce most noise while ascending and descending steep slopes and negotiating sharp curves. Audible nuisance is higher when settlements are located at pavement level and decrease when settlements are lower and/or higher than pavement levels. Also presence of barriers along road side whether specially installed for noise attenuation, or naturally occurring can lower impact of road noise.

v. Environmental Factors

Weather conditions such as temperature, humidity, wind speed and prevailing wind direction can determine extent of noise propagation. Temperature and humidity determine air density, which in turn affect propagation of sound waves.

vi. Terrain

Topography also determines noise impact. Roads in mountain valleys or canyons tend to be more noticeable than that from a similar road development on a flat terrain. Above grade roads tend to propagate noise over greater distance.

vii. Spatial Relationships:

The most important factor, which determines impact of noise, is spatial relationship of road to potential noise receptors. The closer the road to receptors, greater the impacts. Higher the population density along side highway greater the number of receptors and consequently greater the impacts. Doubling the distance between the road and receptor results in a decrease of 3dB(A) in noise level.

(viii) Traffic pattern:

The noise production of a particular traffic stream is determined by a number of factors like type of vehicles in the stream, level of condition & maintenance number of vehicles passing per unit time, constancy of flow and speed of traffic.

(ix) Road construction & Maintenance:

Road Construction and maintenance activities require use of heavy machinery. Although, these activities may not be continuous, they do contribute to increased noise levels, on a short-term basis. Temporary impacts in the immediate vicinity of project development may occur due to construction. The magnitude of noise depends upon specific types of equipment, construction methods, and scheduling of works.

Noise induced by construction equipment is generally intermittent and depends on type of specific operation, location, function, equipment usage cycle and attenuates quickly with distance. Noise attenuation studies for similar projects indicate that construction related noise levels of 85-90 dB (A) at 15m from source would be reduced to less than 6OdB(A) at a distance of 700m. Review of Noise modelling results for highway projects

along with reported field observations also indicate an attenuation rate of 3 to 4dB(A) for every doubling of distance for source point.

The noise impacts due to construction and operation of project highway is not likely to be significant for the following factors:

- The project development provides for a widened ROW at most stretches with provision of service roads. This will increase distance between vehicles on highway to human receptors along side as compared to present situation and therefore the exposure levels. The increased distance is in range of 20 - 30m depending on specific stretch and noise attenuates by 3 to 4dB (A) for every doubling of distance from source point.
- Improved traffic, pavement type and conditions of project highway will decrease noise levels. Pavement types like drainage asphalt pavements are recognized to contribute lower noise levels as compared to densely graded asphalt pavement.
- The project highway traverses generally on a flat terrain and does not have sleep ascending and descending slopes are minimized in the project proposal. Therefore frequency of increased noise levels due to sudden acceleration/deceleration of vehicles will be reduced during operation stage.
- Better road conditions and improved speed limits after project development will induce vehicle owners to switch over for newer vehicles to derive benefits of better road conditions, which will contribute to reduced noise and emission levels.
- The project development is proposed to be at a higher elevation as compared to present situation from engineering considerations. This will reduce exposure levels of noise receptors due to spatial relationship discussed in previous paragraphs.
- The ROW has reserved space on each side of the project road for development of plantations, trees & vegetative cover. Although this will contribute little to noise control, but confer a psychological benefit in

reducing perceived nuisance of traffic noise on along side human receptors.

- Construction of barriers like earthen mounds or brick or concrete walls are known to reduce noise levels. Noise mounds require considerable areas and thus additional land acquisition is essential. Due to this and other related impacts. mounds are not considered. Barriers also tend to form a obstacle between road and roadside communities, many not preferred by local communities. However this will be taken up in consultation with the likely affected parties on a case to case basis especially for sensitive buildings along the corridor.

4.11 Vibration:

The vibration induced by resonance of traffic noise can have a detrimental effect on structures in close proximity to highway. This will be of more concern in case of cultural heritage/historical sites, which may have been standing for many centuries but were not designed to withstand vibration induced by high traffic movement. Makeshift or lightly constructed buildings, common along highway may also succumb to vibration damage.

4.12 Archeological / Historical Monuments

As there are no protected/declared Archeological/Historical monuments along/Project Corridor, there will not be any impacts.

All excavation activities along ROW shall be carried out with utmost care. In case, slabs with epigraphically evidence or edicts, sculptural or any other materials pertaining to archeological importance are encountered during excavation, Department of Archeology, Government of Madhya Pradesh shall be informed for their intervention.

4.13 Cultural Heritage Sensitive and/or critical natural habitats

As there are no cultural heritage sites, sensitive and/or critical natural habitats, National parks, Wild life sanctuaries, sacred groves, protected nature reserves, and wetlands along the Project Corridor, there will not be any impacts.

4.14 Shrines/Idols/Statues

The project corridor has a number of small temples/and idols under trees and two status of political/ National leaders are also recorded within ROW. All such structures falling within ROW are to be transplanted/ relocated to suitable places in consultation with the local community leaders. Interaction with the local community leader to be initiated, well in advance, for relocation of structures to complete satisfaction of local community.

Any other archaeological remains if found during excavation work within ROW or in the vicinity, Department of Archaeology should be informed for detailed investigations as determined by them.

4.15 Human Health and Safety

The project development will have both adverse and beneficial impacts on human health and safety. While adverse impacts are generally limited to project implementation, beneficial impacts can be accrued during operation stage. Some of the most obvious benefits are:

- Improved road safety since all inadequacies or road will get corrected and overall safety of corridor will be significantly increased
- Improved access to health care facilities
- Quicker response time in emergency situations
- Provision of service roads for local and for slow moving and non-motorized traffic

The human health and safety issues and its mitigation measures are more fully addressed in Environmental Management Action Plan (EMAP) under section 5.0.

4.16 Construction Debris

The Project Highway improvement will generate significant quantities of debris from dismantling of existing pavement, bridges and drainage structures, excavation and embankment construction, removal of buildings and site clearing of the ROW. The volume of excess earth excavated and debris from the dismantling of structures are estimated at 0.9 million cum and 1000 cum

respectively; Under the contract, provision has been made for recycling of substantial part of these into the new construction. The dismantled materials from the present carriageway will be mostly recycled to the extent possible. The contract provisions will include a clause for recycling subject to meeting the technical specifications. In case, it will not be possible to recycle the entire volume of the dismantled materials, the potential locations for solid waste disposal are the natural depressions and borrow areas. The areas used for dumping of uncontaminated debris shall be covered with 300mm soil for re-vegetation. The contaminated debris (truck parking and service stations) shall be dumped in depressions whose bed must be impervious e.g.. stone quarry sites or depressions-made impermeable with 450mm thick impervious floor apron as per MOST Technical Specifications. Each successive 1.0 m layers shall be covered with 500 mm thick soil layer, and the area -will be covered with 300 mm thick layer for re-vegetation.

5.0 ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

5.1. General

An environmental management action plan (EMAP) along with an environmental monitoring program (EMP) for implementation and operation periods of project development is presented in Tables 5.1 & 5.2. A control matrix for environmental monitoring for construction and operation periods is presented in Table 5.3. The EIA report along with EMAP will be included in the Construction Contracts so that the prospective contractor(s) are clearly, aware of the environmental requirements of the Project Highway development.

5.2 Environmental Mitigation Action Plan

The EMAP comprise the following

- Identification of the issues and Project Action(s) and the Environmental Attributes that is likely to be impacted upon due to the project development;
- Suitable Mitigation and/or environmental enhancement measures;
- Responsible Agency for the implementation of the defined mitigation measures; and
- Environmental management and monitoring plan.

Issues/ Project Actions/Environmental Attributes: The project actions, which are likely to have environmental impacts are clearing operation of ROW, traffic diversions, construction of campsites, haulage roads, quarry and borrowing operations, hauling construction materials, construction of cross drainage structures, air and noise pollution at all operational areas from the construction equipment, plant and machinery, sanitation in work force camps and plant sites among others.

Mitigation Measures: Appropriate mitigation and /or environmental enhancement measures have been defined for the different project actions and the environmental attributes likely to be impacted upon.

Responsibility for Implementation: The EMAP will be included in the construction contracts and the contractors will be responsible for its implementation. In addition, environmental management unit (EMU) under the Supervision Consultancy Contract on behalf of NHAI will monitor the implementation of the EMAP by the contractor. Environmental Officer under EMU will oversee and monitor the implementation of EMAP on a day to day basis; the organizational arrangements for monitoring are described under Section 5.

Environmental Management Monitoring Frequency: A monitoring mechanism has been framed for effectively controlling and overseeing the implementation of the Environmental Management during the project implementation. Table 5.3 gives the control matrix for the environmental monitoring.

5.3 Technical Specifications and Conditions of Contract

Apart for the environmental measures, project highway development will adhere to the Technical Specifications based on the Ministry of Surface transport (MOST) specifications for Road and Bridge Works (1995) and the Conditions of Contract.

Provisions for protection of environment are included in these documents. The MOST specification has, for instance, a number of clauses relevant to environmental concerns. Clause 111 (Precautions for Strengthening the Environment) has general requirements for borrow-pit location, quarry operations, control of erosion and pollution, as well as hazardous substances. The Scope of Works (Clause 105) specifics attention to First aid. Adequate sanitary arrangements, and regular clearance of rubbish and clearing-tip and restoration of site. Clause 201 on Site Clearance has requirements to preserve the roadside trees, for monuments not to be disturbed and for control of erosion and water pollution. It also provides for removal of roots, overhanging trees and wastes. Clause 306 (Soil Erosion and Sedimentation Control) provides for provision of berms. sediment basins, fiber mats, mulches, grasses, slope drains and other devices to be specified or directed. It also provides for minimization of areas opened and

corrective action at Contractor's expense. Clause 307 provides for Tuning with sod and Clause 308 for seeding and mulching.

5.4 Environmental Mitigation Cost

A broad cost estimate for implementation of the EMAP is given in Table 5.4. The environmental mitigation and enhancement cost is estimated at Rs. 5.69 crores

6.0 INSTITUTIONAL REQUIREMENTS

The Institutional requirements for the environmental management and monitoring during the project development are presented in this section.

6.1 Institutional Requirements – Construction Stage

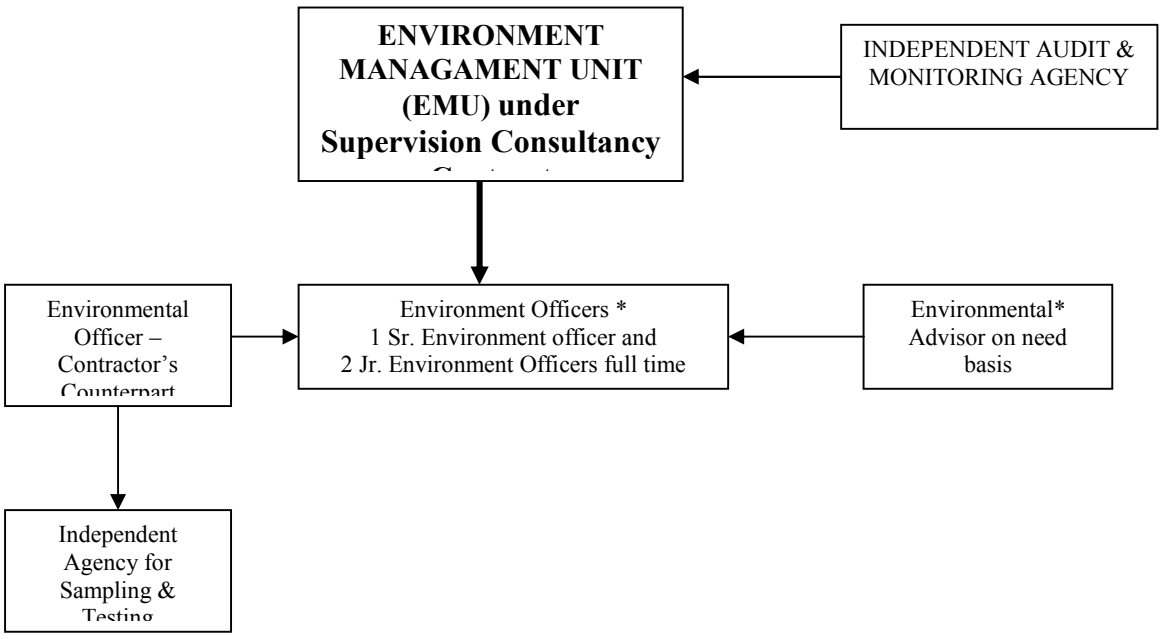
The project implementation will have one supervision consultancy contract. The supervision consultancy contract shall have a provision for creation for an Environmental Management Unit (EMU) for the environmental management and monitoring for the entire project. The supervision consultant, called " The Engineer", will provide the following personnel for the EMU.

a. Environment officers (1 Sr. Officer and 2 Jr officers)

b. Environmental Advisor (on need basis)

c. Independent Audit Monitoring Agency

The Organization for the implementation of the EMAP is presented here below.



Note : Activities within are accounted in EMAP implementation Costs.

* Personnel / agencies to be provided by the " The Engineer (Supervision Consultant)"

The roles and responsibilities for the EMAP implementation during the construction period are described herein.

EMU : The EMU will manage the implementation of the EMAP for the entire project. It will be headed by the Team Leader under the supervision consultancy contract and assisted by Environmental officer. The Team Leader will requisition the services of an Environmental Expert for advisory service on need basis to address any major issue which may arise at any stage of the Project construction and operation. In addition, Team Leader will requisition services of an independent environmental audit and monitoring agency for the Project.

Environmental Officer: The EMU will have one Sr. Environmental officer (SEO) responsible for project. The SEO will be responsible to ensure adherence of the environmental mitigation measures and the EMAP 'at all stages of project implementation and will be assisted by two Junior Environmental Officers (JEO). The SEO assisted by the JEOs will independently monitor the implementation of environmental measures, frequency of measures and the laboratory and field tests detailed under the EMAP.

The broad duties/ responsibilities of the **Environmental Officers** will include.

a) Review of project design and specifications to ensure their adequacy and suitability with respect to the recommendation of the EMAP;

b) Co1lection and dissemination of relevant environmental documents including amendments to environmental protection acts issued by the various agencies namely Government of India, State and local bodies;

c) Interact with the counterpart of the Contractor(s), review work progress/plans and ensure implementation of the EMAP;

d) Coordination with the NGOs, community groups and Government departments on environmental issues, provide clarifications/ and obtain clearance during project implementation, as required from the regulatory authorities and/or submitting periodic compliance reports as required by the State Authorities;

e) Monitoring sensitive environmental attributes during construction to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMAP are implemented;

f) Documentation of the environmental management/monitoring activities for the regular project implementation progress report; and

g) Development of environmental training/awareness programmes for the contractors. the project implementation personnel and the communities.

Environmental Monitoring Agency : The Contractor will engage the service of an independent and qualified agency to execute and test environmental field investigations under the EMAP. The agency shall be approved and certified by the Ministry of Environment and Forests, Government of India, and or the

Department of Environment; Government of Madhya Pradesh. The costs of these services are included in the contracts for works.

Independent Auditing Agency: The EMU will requisition the services of a competent, Independent auditing agency approved by the ministry of Environment and Forests, Government of India. The responsibilities of the auditing agency will include auditing of the implementation of the EMAP and submission of quarterly reports to the EMU. In addition to the audit reports, the agency will also identify slippage and any other required measures.

6.2 Institutional Requirements – Operation Stage

NHAI/Concessionaire will appoint an agency, responsible for the operation & maintenance and collection of the toll from the road users. The Terms Reference (TOR) for the agency will be finalized by NHAI/Concessionaire. Among others, the TOR will include the environmental monitoring and management of the project Highway during the operation period. The agency will submit periodical environmental status reports to the EMU/ NHAI/Concessionaire.

Father more; NHAI/Concessionaire will appoint an Environmental officer for the operation period that will monitor the implementation of the EMAP by the agency for first years of the project operation.

The Environmental Officer will assess the accrual of environmental benefits at the end of each year due to the Project Highway development and will prepare an annual post project environmental assessment and benefit evaluation report.

Institutional arrangement for the environmental management and monitoring of project development has been accounted in EMAP cost estimate.

APPENDIX - 1

GROUND WATER RESOURCES AND IRRIGATION POTENTIAL OF PROJECT REGION

S.No.	Name of Block	Total Replenishable Ground warer Resource	Provision for Domestic, Industrial & othr uses	Available Ground water Resources for Irrigation in net terms	Utilisable Ground water Resources for Irrigation in net tersm	Gross Draft estimated on pro-rata basis (1998)	Net Draft (998)	Balance Ground water Resouces for future use	Level of Ground Water Development (1998)	Weighted agerage delta	Utilisable Irrigation Potential for Developmnet	Category of Black
		(ham/yr)	(ham/yr)	(ham/yr)	(ham/yr)	(ham)	(ham)	(ham)	(%)	(m)	(ha)	
DISTRICT :- INDORE												
1	Indore	12810	1920	10890	9800	12280	8600	2290	78.97	0.4	24500	Grey
2	Mhow	17270	2590	14680	13210	9420	6590	8090	44.89	0.4	33030	White
Total		**30080**	**4510**	**25570**	**23010**	**21700**	**15190**	**10380**	**123.86**	**0.8**	**57530**	
DISTRICT :- KHARGONE												
1	Kasrabad	19500	16575	N.A.	N.A.	4369	3058	13517	26.15	1.1	41439	White
2	Mahehwar	12220	19387	N.A.	N.A.	5592	3914	6473	48.18	1.5	25968	White
Total		**31720**	**35962**	N.A.	N.A.	**9961**	**6972**	**19990**	**74.33**	**2.6**	**67407**	

TEST RESULTS OF SOIL QUALITY-PROJECT REGION

S.No.	Sampling Locations	Lead -ppm
1	S - 1	10.24
2	S - 2	6.452
3	S - 3	5
4	S - 4	5.13

Soll Sampling Statlons :-
S - 1 = Near Marhat hotel (13-14 Km.stone)
S - 2 = Near Ghat area (57-58 Km. stone)
S - 3 = Near Madhav hotel, Dhamnod Residential area (76-77 Km. Stone)
S - 4 = Near River Bridge, khalghat (84-85 Km. Stone)

Appendix - 3

Sample sheet of Tree Enumeration Survey Data between Indore to Khalghat Section of NH - 3

Kms.	S. No.	Name of the Species	Diameter of the Tree in cms.												Total (Left)	Total (Right)	Total (Left & Right)
			10 to 20		20 to 30		30 to 40		40 to 50		50 to 60		60 & above				
			L	R	L	R	L	R	L	R	L	R	L	R			
Ch 0.o - Ch. 1.000	1	Zizyphus Jujuba	17	17	28	24	7	8	2		1		1		56	49	105
	2	Kaveet		1		9		2							0	12	12
	3	Eucalyptus Glossus	74	5	42	6	10	4	6		3				135	15	150
	4	Delonix regia	1	3	1	3	2	2				1		1	4	10	14
	5	Acacia Arabica	5	2	4	3	1	3							10	8	18
	6	Tamarindus Indica						2		1		4		10	0	17	17
	7	Polyalthia Longifolia		1											0	1	1
	8	Cassia Fistula					1	3							1	3	4
	9	Butea Frondosa				2									0	2	2
	10	Zizyphus Jujuba	1	1											1	1	2
	11	Azadirachta Indica.	3	3	1	3		1		1		1			4	9	13
	12	Tectona grandis		1											0	1	1
	13	Mangifera Indica		2			1					4		2	1	8	9
	14	Kastar		1		1									0	2	2
	15	Prosopis spicigera				1									0	1	1
	16	Ficus religiose				1									0	1	1
	17	Moringa oleifera		2		1									0	3	3
	18	Datura Stramonium	8	1	1	1									9	2	11
	19	Lawsonia Inermis		2											0	2	2
	20	Melia azaderach	4		1				1						6	0	6
		Total	**113**	**42**	**78**	**55**	**22**	**25**	**9**	**2**	**4**	**10**	**1**	**13**	**227**	**147**	**374**
	1	Mangifera Indica	3	2	3	3	1	2		1		3	1		8	11	19
	2	Acacia Arabica	19	8	22	14	2	10		2		1		1	43	36	79
	3	Zizyphus Jujuba	40	18	20	18	5	5							65	41	106
	4	Kaveet		2		1									0	3	3
	5	Phoenix aylvestris	4		30	3				1		1			34	5	39
	6	Cassia Fistula	1	1	3	1	1	1		1					5	4	9
	7	Azadirachta Indica.	2	4	2	6		2		2					4	14	18
	8	Diospyrus melanoxylon						1							0	1	1
	9	Eucalyptus glossus	22	6	7	13	2	9		4					31	32	63
	10	Delonix regia		8		14		7		2					0	31	31
	11	Areca catechu				1									0	1	1

Ch 1.000 - Ch. 2.000	12	Prosopis spicigera		1				1							0	2	2
	13	Gendi			1			1							1	1	2
	14	Tamarindus indica			1		2			1			2		5	1	6
	15	Cocos nucifera				1	1	3		3					1	7	8
	16	Ficus religiose		5	2		2	1						1	4	7	11
	17	Zizyphus Jujuba		1	1	1									1	2	3
	18	Moringa oleifera				1		1							0	2	2
	19	Ficus benghalensis		1											0	1	1
	20	Ramphal		1											0	1	1
	21	Kastar		1											0	1	1
	22	Kaner	3	4	1										4	4	8
	23	syzygium cumini	1		2	1	1			1		1			4	3	7
	24	Polyalthia longifolia	3	1											3	1	4
	25	Bille						1							0	1	1
	26	Butea Frondosa	1		1		1								3	0	3
	27	Euginia jambolana	3		2										5	0	5
	28	Plumeria acutifolia			1										1	0	1
	29	Datura stramonium	1												1	0	1
	30	Surjana Fali			2										2	0	2
	31	Ricinus communis	1												1	0	1
		Total	**104**	**64**	**101**	**78**	**18**	**45**	**0**	**18**	**0**	**6**	**3**	**2**	**226**	**213**	**439**
Ch. 2.0 - Ch. 3.0	1	Azadirachta Indica.	12	9			8	2		1					20	12	32
	2	Mangifera indica	1	1					3	4	2		1		7	5	12
	3	Butea frondosa	5	7											5	7	12
	4	Dalbergia latifolia	3	7	4	5									7	12	19
	5	Eucalyptus glossus	12	5			1	3							13	8	21
	6	Gendi	5		4	2				3					9	5	14
		Total	**38**	**29**	**8**	**7**	**9**	**5**	**3**	**8**	**2**	**0**	**1**	**0**	**61**	**49**	**110**
Ch. 3.0 - Ch. 4.0	1	Acacia Arabica	11	1											11	1	12
	2	Phoenix aylvestris	1												1	0	1
	3	Zizyphus Jujuba		1											0	1	1
	4	Eucalyptus glossus	1												1	0	1
		Total	**13**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**2**	**15**
Ch. 4.0 - Ch. 5.0	1	Phoenix aylvestris				2									0	2	2
	2	Acacia Arabica		1											0	1	1
															0	0	0
		Total	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**

WEATHER PHENOMENA OF PROJECT REGION

APPENDIX - 4, Table 1

Month	Weather Phenomena (With no.of days) - 1931 to 1960						Weather Phenomena (With no.of days) - 1931 to 1960					
	Precipitation (0.3mm or above)	Hail	Thunder	Fog	Dust Storm	Squall	Precipitation (0.3mm or above)	Hail	Thunder	Fog	Dust Storm	Squall
January	1.9	0.1	1.1	0.5	0.3	0.0	1.6	0.1	1.1	0.6	0.0	0.0
February	0.6	0.0	0.3	0.2	0.1	0.0	0.6	0.0	0.6	0.3	0.0	0.1
March	0.9	0.0	1.1	0.0	0.0	0.2	0.9	0.0	1.2	0.0	0.5	0.1
April	1.1	0.0	1.4	0.0	0.0	0.0	0.4	0.0	1.5	0.0	0.0	0.3
May	2.0	0.0	3.0	0.0	0.1	0.3	1.9	0.1	3.2	0.0	0.1	0.5
June	11.0	0.0	8.0	0.3	0.1	0.2	10.3	0.0	8.4	0.3	0.1	1.2
July	20.0	0.0	5.0	0.0	0.0	0.0	19	0.0	6.2	0.0	0.0	0.2
August	20.0	0.0	4.0	0.2	0.0	0.1	19.7	0.0	4.5	0.2	0.0	0.0
September	15.0	0.0	5.0	0.7	0.0	0.1	12.8	0.0	5.1	0.7	0.0	0.3
October	3.0	0.0	1.9	0.3	0.0	0.0	2.9	0.0	2.1	0.4	0.0	0.1
November	1.9	0.0	0.5	0.6	0.0	0.0	1.6	0.0	0.5	0.6	0.0	0.0
December	6.9	0.0	0.5	0.5	0.0	0.0	0.9	0.0	0.4	0.8	0.1	0.0
Annual Total or Mean	78.0	0.1	31.8	3.3	0.6	0.9	72.6	0.2	34.8	3.9	0.8	2.8

CLOUD COVER DATA OF PROJECT REGION (1951-1980)

Month	Cloud amount				No. of days with all cloud amount (OKTAS)										No. of days with all cloud amount (OKTAS)										FOG
	All	Clouds	Low	Clouds	0*		1.- 2		3. - 5		6. - 7		8*		0*		1.-2		3.-5		6.-7		8*		
	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	
January	1.7	1.8	0.5	0.7	14	12.0	8.0	9.0	5.0	6.0	3.0	3.0	1.0	1.0	26.0	23.0	2.0	5.0	2.0	3.0	1.0	0.0	0.0	0.0	0.0
February	1.2	1.5	0.2	0.6	17.0	15.0	6.0	7.0	4.0	4.0	1.0	2.0	0.0	0.0	25.0	21.0	2.0	4.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0
March	1.4	1.9	0.3	0.9	17.0	13.0	7.0	9.0	5.0	6.0	2.0	3.0	0.0	0.0	28.0	20.0	2.0	7.0	1.0	4.0	0.0	0.0	0.0	0.0	0.0
April	1.4	2.3	0.3	1.3	15.0	8.0	8.0	9.0	5.0	8.0	2.0	4.0	0.0	1.0	26.0	13.0	3.0	10.0	1.0	6.0	0.0	1.0	0.0	0.0	0.0
May	1.3	2.3	0.5	1.6	17.0	9.0	8.0	10.0	4.0	8.0	2.0	4.0	0.0	0.0	26.0	11.0	3.0	11.0	2.0	8.0	0.0	1.0	0.0	0.0	0.0
June	4.6	4.8	2.7	3.2	2.0	1.0	5.0	5.0	9.0	10.0	10.0	10.0	4.0	4.0	8.0	3.0	6.0	9.0	10.0	14.0	5.0	4.0	1.0	0.0	0.0
July	6.9	6.6	4.9	4.2	0.0	0.0	1.0	0.0	3.0	5.0	13.0	15.0	14.0	11.0	1.0	0.0	3.0	4.0	13.0	18.0	12.0	8.0	2.0	1.0	0.0
August	7.2	6.8	5.2	4.4	1.0	1.0	0.0	0.0	2.0	3.0	11.0	16.0	17.0	11.0	0.0	1.0	2.0	4.0	11.0	17.0	14.0	9.0	4.0	0.0	0.0
September	5.1	5.5	3.3	3.7	2.0	0.0	5.0	3.0	7.0	9.0	8.0	12.0	8.0	9.0	8.0	0.0	5.0	8.0	7.0	16.0	8.0	6.0	2.0	0.0	0.0
October	1.9	2.6	0.7	1.5	12.0	6.0	10.0	11.0	5.0	8.0	3.0	5.0	1.0	1.0	24.0	12.0	4.0	11.0	2.0	7.0	1.0	1.0	0.0	0.0	0.0
November	1.8	2	0.5	0.9	14.0	11.0	7.0	10.0	5.0	5.0	3.0	3.0	1.0	1.0	24.0	21.0	3.0	5.0	2.0	3.0	1.0	1.0	0.0	0.0	0.0
December	1.7	1.9	0.4	0.6	14.0	12.0	8.0	10.0	5.0	6.0	3.0	3.0	1.0	0.0	28.0	22.0	2.0	6.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0
Annual Total or Mean	3.0	3.3	19.5	23.6	125	88.0	73.0	83.0	59.0	78.0	61.0	80.0	47.0	39.0	224.0	147.0	37.0	84.0	53.0	102.0	42.0	31.0	9.0	1.0	0.0

CLOUD COVER DATA OF PROJECT REGION (1931-1960)

Month	Cloud amount				No. of days with all cloud amount (OKTAS)										No. of days with all cloud amount (OKTAS)										FOG
	All	Clouds	Low	Clouds	0*		1. - 2		3. - 5		6. - 7		8*		0*		2. -3		3 - .5		6. - 7		8*		
	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	**8:30**	**17:30**	**8:30**	**17:30**	**8:30**	**17:30**	**8:30**	**17:30**	**8:30**	**17:30**	
January	1.9	2.2	0.8	1.0	15.0	12.0	7.0	8.0	4.0	6.0	4.0	4.0	1.0	1.0	23.0	18.0	4.0	7.0	3.0	5.0	1.0	1.0	0.0	0.0	0.0
February	1.2	1.7	0.3	0.7	18.0	15.0	5.0	6.0	3.0	4.0	2.0	2.0	0.0	1.0	25.0	21.0	2.0	4.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0
March	1.2	1.9	0.3	0.9	19.0	14.0	6.0	7.0	4.0	6.0	2.0	4.0	0.0	0.0	27.0	20.0	3.0	6.0	1.0	4.0	0.0	1.0	0.0	0.0	0.0
April	1.3	2.2	0.4	1.3	18.0	14.0	7.0	9.0	3.0	6.0	2.0	4.0	0.0	1.0	25.0	14.0	3.0	9.0	2.0	6.0	0.0	1.0	0.0	0.0	0.0
May	1.3	2.3	0.5	1.7	18.0	9.0	7.0	9.0	2.0	7.0	3.0	5.0	1.0	1.0	25.0	11.0	3.0	10.0	2.0	8.0	1.0	2.0	0.0	0.0	0.0
June	4.5	4.9	2.5	3.3	3.0	1.0	5.0	4.0	7.0	9.0	8.0	10.0	7.0	6.0	11.0	3.0	7.0	9.0	7.0	13.0	4.0	5.0	1.0	0.0	0.0
July	7.3	7.0	4.9	4.2	0.0	0.0	1.0	0.0	2.0	4.0	7.0	11.0	21.0	16.0	1.0	1.0	4.0	6.0	12.0	15.0	10.0	7.0	4.0	2.0	0.0
August	7.1	6.8	5.2	4.2	0.0	0.0	1.0	1.0	3.0	4.0	7.0	12.0	20.0	14.0	1.0	0.0	3.0	7.0	11.0	14.0	9.0	8.0	7.0	2.0	0.0
September	5.6	5.8	3.7	3.8	2.0	0.0	5.0	3.0	4.0	8.0	8.0	11.0	11.0	8.0	8.0	1.0	5.0	8.0	6.0	15.0	7.0	5.0	4.0	1.0	0.0
October	1.7	3.1	0.7	1.7	15.0	7.0	7.0	10.0	3.0	7.0	4.0	6.0	2.0	1.0	24.0	13.0	4.0	10.0	2.0	7.0	1.0	1.0	0.0	0.0	0.0
November	1.5	1.9	0.4	0.6	16.0	14.0	7.0	9.0	3.0	4.0	2.0	2.0	2.0	1.0	26.0	24.0	2.0	4.0	1.0	2.0	1.0	0.0	0.0	0.0	0.0
December	1.5	1.8	0.3	0.6	16.0	13.0	8.0	9.0	3.0	6.0	3.0	3.0	1.0	0.0	27.0	23.0	2.0	5.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0
Annual Total or Mean	3.0	3.3	1.7	2	140	95.0	66.0	75.0	24.0	71.0	52.0	74.0	66.0	50.0	223.0	149.0	42.0	85.0	50.0	95.0	34.0	31.0	16.0	5.0	0.0

RELATIVE HUMIDITY AND RAIN FALL OF PROJECT REGION (1931-1980)

Month	Relative Humidity (%)				Rain Fall			
	1931-1960		1950-1980		1931-1960		1951-1980	
	8:30	17:30	8:30	17:30	Monthly Total	Heaviest fall in 24 hrs	Monthly Total	Heaviest fall in 24
January	63	31.0	57.0	31	8.40	80.5(1920)	9.0	80.5 (1920)
February	74	19	45.0	22	1.10	32.0 (1888)	1.7	32.0 (1888)
March	31	17	33.0	17	3.50	19.3 (1944)	2.8	19.8 (1968)
April	30.0	15.0	30.0	16.0	3.50	51.1 (1895)	2.0	51.1 (1895)
May	44.0	18.0	44.0	19.0	13.20	99.1 (1886)	9.3	99.1 (1886)
June	73.0	47.0	72.0	46.0	147.10	127.0 (1885)	134.3	127.0 (1885)
July	88.0	72.0	87.0	72.0	316.00	293.4 (1913)	284.6	293.4 (1913)
August	88.0	77.0	90.0	77.0	266.50	2098.8 (1928)	217.3	209.8 (1913)
September	85.0	67.0	84.0	65	220.90	136.7 (1933)	211.6	169.8 (1962)
October	60	42	59.0	39	48.40	88.4 (1949)	36.5	91.8 (1975)
November	54	32	52.0	35	22.10	69.0 (1958)	20.0	82.6 (1969)
December	57	32	57	36	2.70	45.0 (1928)	9.2	51.5 (1978)
Annual Total or Mean	**60**	**39**	**59**	**40**	**1053.40**	**293.40**	**1008.3**	**293.40**

WIND DATA OF PROJECT REGION (1931 - 1960) APPENDIX - 4, Table 5

Month	Percentage No. of Days Wind From																		Mean Wind Speed (Kmph)
	N		NE		E		SE		S		SW		W		NW		CALM		
	8:30	17:30	8:30	17:30	8..30	17:30	8:30	17..30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	
January	4	15	23	19	12	5	13	7	7	5	5	17	3	13	1	11	32	8	9.9
February	6	13	17	14	11	3	11	3	5	4	9	18	7	19	3	19	31	7	10.8
March	6	12	17	9	9	2	9	2	5	3	8	15	15	29	9	23	22	5	13.0
April	7	10	15	3	5	2	5	1	3	2	8	14	31	38	20	25	8	3	15.0
May	3	5	2	3	1	1	1	1	1	2	8	12	58	50	25	26	1	0	24.4
June	1	4	1	3	0	2	0	1	1	5	22	25	63	44	11	14	1	2	27.0
July	1	1	0	1	0	1	0	1	1	2	29	34	59	50	9	9	1	1	26.3
August	1	1	0	1	0	1	1	1	1	1	25	28	59	33	11	13	2	1	21.7
September	5	9	5	7	2	3	2	4	1	2	12	16	41	34	25	21	7	4	18.5
October	5	17	13	34	9	11	9	9	4	3	6	4	9	4	9	8	36	10	9.8
November	2	16	18	40	14	12	14	7	5	3	3	3	1	1	0	3	43	15	7.5
December	2	14	17	30	15	8	15	7	6	4	3	11	1	7	0	9	41	10	7.1
Annual Total or Mean	4.0	10	11.0	14	6	4.0	7.0	4.0	3.0	3.0	11.0	16.0	29.0	28.0	18.0	15.0	19.0	6.0	15.9

WIND DATA OF PROJECT REGION (1951 - 1980)

Month	Percentage No. of Days Wind From																		Mean Wind Speed (Kmph)
	N		NE		E		SE		S		SW		W		NW		CALM		
	8:30	17:30	8:30	17:30	8..30	17:30	8:30	17..30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	8:30	17:30	
January	5	18	22	26	17	6	10	3	9	6	7	15	3	11	1	9	26	9	8.4
February	7	15	20	20	14	4	7	2	7	4	11	17	7	20	2	14	25	4	9.8
March	7	16	17	11	13	3	5	1	7	3	9	16	18	30	7	18	17	2	11.7
April	11	14	13	6	8	2	3	1	4	2	9	14	33	38	14	21	5	2	14.5
May	5	8	4	4	2	2	1	1	1	2	12	12	53	47	20	24	2	0	20.4
June	2	6	1	4	0	2	1	1	2	3	26	24	57	41	11	14	0	2	23.3
July	1	3	0	1	0	1	0	1	3	4	35	39	51	41	7	8	3	2	22.1
August	1	3	1	1	0	1	0	0	1	2	31	24	54	53	10	11	2	2	20.4
September	6	11	4	9	3	5	2	2	2	2	14	16	43	34	19	18	7	3	15.4
October	7	18	12	32	10	13	5	5	7	4	5	4	11	6	9	8	34	10	8.0
November	3	17	15	34	18	15	11	16	9	5	3	4	1	2	1	4	39	13	6.1
December	3	17	14	31	18	11	9	4	10	5	4	9	2	7	0	8	40	11	6.6
Annual Total or Mean	5.0	12	10.0	15	9	5.0	5.0	2.0	5.0	4.0	14.0	17.0	28.0	28.0	8.0	13.0	16.0	4.0	13.9

Appendix - 5

WATER QUALITY OF THE PROJECT CORRIDOR

S.No.	Parameters (Unit are in mg/l except pH	Sampling Stations					
		River Water - Narmada Conduct	Bore Well - Near Khalghat	Pond Water - Near Mhow	River water - Narmada	Bore Well - Near Manpur	Dug Well - Gujri
1	pH	8.08	8.45	8.4	8.45	8.01	8.14
2	Colour	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen
3	Turbidity	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU
4	Ordour	Unobjectionalbe	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
5	Sodium (Na)	26	96	39	26	80	72.0
6	Potasium (K)	2	2	11	2	4	4.0
7	Iron (Fe)	0.1	0.16	0.2	0.1	0.1	0.1
8	Flouride (F)	Nil	Nil	Nil	Nil	Nil	Nil
9	Chromium (Cr)	Nil	Nil	Nil	Nil	Nil	Nil
10	Copper (Cu)	Nil	Nil	Nil	Nil	Nil	Nil
11	Total Dissolved Solides	140	1136	220	236.0	704.0	748.0
12	Total Solids	304	1440	560	308.0	1108.0	1036.0
13	Suspended Solids (SS)	164	304.0	340	72.0	404.0	288.0
14	Total Hardness ($CaCo_3$)	110	370	150	120.0	120.0	170.0
15	Magnesium (Mg)	2	68	15	2.0	5.0	15.0
16	Calcium (Ca)	40	36	36	44.0	40.0	44.0
17	Total Alkalinity (CaCo3)	144	743	165	144.0	196.0	227.0
18	Phenolphjthalein Alkalinity	15	165	15	21.0	26.0	26.0
19	Chlorides	17	150	17	17.0	233.0	250.0
20	Nitrites (No_2)	0.012	0.4	0.032	0.0	0.0	0.0
21	Nitrites (No_3)	1.35	32.7	1.45	1.63	1.38	12.12
22	Sulphates (SO_4)	Nil	Nil	10.0	Nil	61.42	68.8
23	Maganese (Mg)	Nil	Nil	Nil	Nil	Nil	Nil
24	Oil & Grease	Nil	Nil	Nil	Nil	Nil	Nil

Notes :-

All samples are collected from surface (0.3 m deep)

TABLE 1 - AMBIENT AIR QUALITY OF THE PROJECT CORRIDOR

S.No.	Air Quality Monitorign Station	Cycle	Parameters						
			SPM - µg/nm^3	RPM - µg/nm^3	SO_2 µg/nm^3	NOX µg/nm^3	CO - ppm	HC - ppm	Pb - µg/nm3
1	Near Marhat Hotel (13-14 Km. Stone)	I	188	84.88	16	98	1.0	2.2	0.18
		II	206	88.6	18	103		1.8	0.2
2	Near Ghat area (57-58 km. Stone)	I	114.4	91.8	13	132	2.0	1.9	0.15
		II	118.3	103.6	16	126		1.7	0.19
3	Near Madhav Hotel, Dhamnod Residential area (76-77 Km. Stone)	1	459.0	104.9	15.0	111.0	2.0	2.1	0.152
		II	398.0	110.1	12.0	114.0		1.8	0.139
4	Near New Bridge, Khalghat (84-85 Km. Stone)	I	831.9	244.8	20.0	135.0	2.0	2.2	0.22
		II	738.1	256.3	23.0	128		1.7	0.29

Notes:-

SPM - Suspended Particulate Matter

RPM - Respirable Particulate Matter

CO - Carbon Monoxide

HC - Hydro Carbons

Pb - Lead

TABLE 2 - SUMMARY OF AMBIENT AIR QUALITY RESULTS & STANDARDS

S.No.	Air Quality Parameter	Unit	Concentraton			NAAQS (residential Rural & Other areas)	WHO	USEPA NAAQS	
			Minimum	Maximum	Mean			Primary)Health related) µg/m^3	Secondary Welfare relation
1	Suspended Particulate Matter	µg/m3	114.4	831.9	473.2	200	-	-	-
2	Respirable Particulate Matter	µg/m3	84.8	256.3	341.2	100	125	150	150
3	Oxide of Sulphur	µg/m3	12	23	17.5	80	125	-	-
4	Oxide of Nitrogen	µg/m3	98	135	116.5	80	150	-	-
5	Carbon Monoxide	ppm	1	2	1.5	2	11.1 (8Hr.)	10 (8 Hr)	-
6	Hydrocarbon	ppm	1.7	2.2	2		-	-	-
7	Lead	µg/m3	0.139	0.29	0.21	1	-	-	-

Notes :-

All the standards relate to the time weighted avrerage over 24 Hrs.

NAAQS - National Ambient Air Quality Standard notified by the Central Pollution Control board.

WHO - World Health Organisation.

USEPA - United States Environmental Protection Agency

TABLE 3 : AMBIENT NOISE LEVELS OF THE PROJECT CORRIDOR

S.No.	Sampling Locations	Max. value Recorded (dB)	Min. Value Recorded (dB)	Max. hourly Leq value (dB)	Min. hourly Leq value	Leq value 15 hourly (dB)	Leq value 9 hourly (dB)	L10 (dB)	L50 (dB)	L90 (dB)
1	Near Marhat hotel, Small Commercial area (13-14 Km.	82.4	58.3	78.2	69.7	75.1	71.3	79.3	71.8	60.0
2	Rasulpura Village, Rural area (18-19 Km. Stone)	80.1	52.6	76.4	62.3	74.2	70.8	77.6	68.6	58.9
3	Near Petrol Pump, Rural area (24-25 Km. Stone)	81.1	56.7	78.4	61.6	74.4	67.5	78.2	69.3	57.4
4	Near STD Shop, Rural area (37-38 Km. Stone)	81.9	52.5	76.8	55.3	75.7	57.3	79.6	67.8	59.4
5	Near Ghat area (49-50 Km. Stone)	82.6	54.7	73.5	58.5	71.2	61.4	77.8	68.7	55.4
6	Near Ghat area (57-58 Km. Stone)	80.3	53.6	77	56.9	75.4	58.2	78.9	66	56.4
7	Dudhi Village, Commercial area (73-74 Km. Stone)	84.5	58.1	79.7	60.4	79.6	62.8	81.2	69.8	60.5
8	Near Madhav hotel, Urban area (76-77 Km. Stone)	80.3	52.4	70.1	66.2	69	67.8	78.2	66.4	56.2
9	Near Petrol Pump, Rural area (79-80 Km. Stone)	81.7	54.0	72.9	66.8	70.3	69.3	78.9	68.7	57.2
10	Near New BridgeKhalghat, Small Commercial area (84-85 Km.	84.6	54.2	77.6	69.4	74.6	78.5	81.2	69.6	55.9

Notes :-

(i) Day time - 6:00 AM to 9:00 PM (ii) Night time - 9:00 PM to 6:00 AM (As per CPCB)

TABLE 4 : WATER QUALITY OF THE PROJECT CORRIDOR

S.No.	Parameters (Unit are in mg/l except pH	Sampling Stations					
		River Water - Narmada Conduct	Bore Well - Near Khalghat	Pond Water - Near Mhow	River water - Narmada	Bore Well - Near Manpur	Dug Well - Gujri
1	pH	8.08	8.45	8.4	8.45	8.01	8.14
2	Colour	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen	< 5 Hazen
3	Turbidity	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU	< 5 NTU
4	Ordour	Unobjectionalbe	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
5	Sodium (Na)	26	96	39	26	80	72.0
6	Potasium (K)	2	2	11	2	4	4.0
7	Iron (Fe)	0.1	0.16	0.2	0.1	0.1	0.1
8	Flouride (F)	Nil	Nil	Nil	Nil	Nil	Nil
9	Chromium (Cr)	Nil	Nil	Nil	Nil	Nil	Nil
10	Copper (Cu)	Nil	Nil	Nil	Nil	Nil	Nil
11	Total Dissolved Solides (TDS)	140	1136	220	236.0	704.0	748.0
12	Total Solids	304	1440	560	308.0	1108.0	1036.0
13	Suspended Solids (SS)	164	304.0	340	72.0	404.0	288.0
14	Total Hardness ($CaCo_3$)	110	370	150	120.0	120.0	170.0
15	Magnesium (Mg)	2	68	15	2.0	5.0	15.0
16	Calcium (Ca)	40	36	36	44.0	40.0	44.0
17	Total Alkalinity (CaCo3)	144	743	165	144.0	196.0	227.0
18	Phenolphjthalein Alkalinity	15	165	15	21.0	26.0	26.0
19	Chlorides	17	150	17	17.0	233.0	250.0
20	Nitrites (No_2)	0.012	0.4	0.032	0.0	0.0	0.0
21	Nitrites (No_3)	1.35	32.7	1.45	1.63	1.38	12.12
22	Sulphates (SO_4)	Nil	Nil	10.0	Nil	61.42	68.8
23	Maganese (Mg)	Nil	Nil	Nil	Nil	Nil	Nil
24	Oil & Grease	Nil	Nil	Nil	Nil	Nil	Nil

Notes :-

All samples are collected from surface (0.3 m deep)

TABLE 5: TEST RESULTS OF SOIL QUALITY- PROJECT CORRIDOR

S.No.	Sampling Locations	Lead -ppm
1	S - 1	10.24
2	S - 2	6.452
3	S - 3	5.00
4	S - 4	5.13

Soil Sampling Stations :-

S - 1 = Near Marhat hotel (13-14 Km.stone)

S - 2 = Near Ghat area (57-58 Km. stone)

S - 3 = Near Madhav hotel, Dhamnod Residential area (76-77 Km. Stone)

S - 4 = Near River Bridge, khalghat (84-85 Km. Stone)

APPENDIX - 7

AMBIENT AIR QUALITY OF THE PROJECT CORRIDOR

S.No.	Air Quality Monitorign Station	Cycle	Parameters						
			SPM - µg/nm^3	RPM - µg/nm^3	SO_2 µg/nm^3	NOX µg/nm^3	CO - ppm	HC - ppm	Pb - µg/nm3
1	Near Marhat Hotel (13-14 Km. Stone)	I	188	84.88	16	98	1.0	2.2	0.18
		II	206	88.6	18	103		1.8	0.2
2	Near Hanuman Temple, Ghat area (57-58 km. Stone)	I	114.4	91.8	13	132	2.0	1.9	0.15
		II	118.3	103.6	16	126		1.7	0.19
3	Near Madhav Hotel, Dhamnod Residential area (76-77 Km. Stone)	1	459.0	104.9	15.0	111.0	2.0	2.1	0.152
		II	398.0	110.1	12.0	114.0		1.8	0.139
4	Near New Bridge, Khalghat (84-85 Km. Stone)	I	831.9	244.8	20.0	135.0	2.0	2.2	0.22
		II	738.1	256.3	23.0	128		1.7	0.29

Notes:-

SPM - Suspended Particulate Matter

RPM - Respirable Particulate Matter

CO - Carbon Monoxide

HC - Hydro Carbons

Pb - Lead

APPENDIX - 8

AMBIENT AIR QUALITY OF THE PROJECT CORRIDOR

S.No.	Sampling Locations	Max. value Recorded (dB)	Min. Value Recorded (dB)	Max. hourly Leq value (dB)	Min. hourly Leq value (dB)	Leq value 15 hourly (dB)	Leq value 9 hourly (dB)	L10 (dB)	L50 (dB)	L90 (dB)
1	Near Marhat hotel, Small Commercial area (13-14 Km.	82.4	58.3	78.2	69.7	75.1	71.3	79.3	71.8	60.0
2	Rasulpura Village, Rural area (18-19 Km. Stone)	80.1	52.6	76.4	62.3	74.2	70.8	77.6	68.6	58.9
3	Near Petrol Pump, Rural area (24-25 Km. Stone)	81.1	56.7	78.4	61.6	74.4	67.5	78.2	69.3	57.4
4	Near STD Shop, Rural area (37-38 Km. Stone)	81.9	52.5	76.8	55.3	75.7	57.3	79.6	67.8	59.4
5	Near Hanuman Temple, Ghat area (49-50 Km. Stone)	82.6	54.7	73.5	58.5	71.2	61.4	77.8	68.7	55.4
6	Near Hanuman Temple, Ghat area (57-58 Km. Stone)	80.3	53.6	77	56.9	75.4	58.2	78.9	66	56.4
7	Dudhi Village, Commercial area (73-74 Km. Stone)	84.5	58.1	79.7	60.4	79.6	62.8	81.2	69.8	60.5
8	Near Madhav hotel, Urban area (76-77 Km. Stone)	80.3	52.4	70.1	66.2	69	67.8	78.2	66.4	56.2
9	Near Petrol Pump, Rural area (79-80 Km. Stone)	81.7	54.0	72.9	66.8	70.3	69.3	78.9	68.7	57.2
10	Near New BridgeKhalghat, Small Commercial area (84-85 Km. Stone)	84.6	54.2	77.6	69.4	74.6	78.5	81.2	69.6	55.9

Notes :-

(i) Day time - 6:00 AM to 9:00 PM (II) Night tiem - 9.00pm to 6.00 am (As per CPCB)

TABLE 5.1 ENVIRONMENTAL MANAGEMENT ACTION PLAN

Project actions/Environmental attributes	Mitigation Measures	Implementing / Responsible Organization
Finalization of alignment	* The ROW has been finalized to minimize social impacts, minimum acquisition of agricultural lands,forest areas, avoidance of temples, burial grounds, for ruins etc to the extent possible.	Project Design Consultant
Land acquisition	* Land acquisition, compensation packages, resettlement and rehabilitation, poverty alleviation programs for affected people and all other related issues are addressed in social impacts and Resettlement & Rehabilitation report.	NHAI/ PIU, Govt. of Madhya Pradesh, NGOs and other agencies recommended in RAP report Environmental officer under the supervision consultancy package will coordinate and ensure implementation.
Setting out and clearing ROW	* Tree's falling within ROW and other vegetative cover are to be removed except those which are sound straight and have 0.75m clearance on both sides of proposed median edge. * Compensatory plantation within proposed vegetation strip of Row to be undertaken by Madhya Pradesh Forest Department on behalf of NHAI. * Re - plantation at rate of 2 for every tree removed is to be commenced just after disturbance due to construction is stopped and NOT after completion of project. The species shall be endemic and very similar to the trees, which have been removed unless they are inappropriate for valid reasons. * List of species for both roadside and median is presented in Table 3.6. The list is only suggestive and may be modified in consultation with Madhya Pradesh forest department necessary. * Small temples, shrines particularly those which are beneath trees & often are worship places are to e transplanted to be transplanted to adjacent areas outside ROW in close consultation with local community leaders. The Department o Archaeology, Gov. of Madhya Pradesh has expressed willingness to transplant such structures on cost basis . Such services could be utilized if required.	NHAI/ PIU, Department of Archaeology, Govt. of Madhya Pradesh, Forest department (social and territorial divisions), NGOs and other agencies recommended in RAP report. Shifting of utilities shall be carried out by respective governmental bodies at cost to be reimbursed from project. Environmental officer under the Supervision consultancy package will coordinate and ensure implementation. To increase survival rate of new saplings a core Tree Management Agency (TMA) is to be created for project implementation period to ensure complete retrieval of vegetative cover and timely replacement of perished plantation. The TMA is to be represented by Project Implementation Unit (PIU) of NHAI, Regional Officers of Madhya Pradesh Forest Department, Contractor and local NGOs and coordinated by Environmental Officer of Construction Supervision Consultant for specific package.

Setting out and clearing ROW (conti...)	* During ROW clearing operation any treasure trove, slabs with epigraphically evidence or edicts, sculptural or any material are found and appear to have historical importance, it should be brought to the notice of department o Archaeology. * All public utilities like power transmissions cables, telephone cables water/ sewerage lines. Drains, tube well et falling within ROW to be relocated to services corridor within ROW or outside as the case may. Public utilities will be generally shifted by respective agencies like Electricity boards, telecom dept. public health dep etc and all such costs are to e reimbursed from project cost.	
Forest Area	* The project development will necessitate reserve forest land to be diverted for non forest uses i.e. project development * The forest area falling within ROW have rocky outcrops interspersed with social forestry plantations. As a compensatory plantation will be undertaken in degraded forests to the extent of TWICE the area to be diverted as per the norms stipulated by Governmental agencies. * The compensatory afforestation shall be undertaken by Madhya Pradesh Forest Department in accordance with the provisions of State forest act and the guidelines from Ministry of Environment & Forests, Government of India. * The extent of forest area to be diverted and other documentation as per the guidelines is to be submitted to forest department for seeking forest clearances and costs for afforestation is to be deposited with Forest department. The costs to over for maintenance and upkeep of plants for at least THREE years include replanting of perished ones. * Afforestation will be carried out in degraded forests as close as to forest area, which has been diverted. The selection of species, timing and extent and implementation schedule will be decided by Forest department and informed to project proponent i.e... NHAI ***** Through this, twice the extent of forestland diverted will be compensated by aforestation. More often compensatory afforestation is carried for diversion of forest areas, which is practically have no vegetative cover and thus development projects also contribute to increase green cover, in contrary to common perception. This is applicable to even present project development.	Project Design Consultant, NHAI/ PIU, Forest Department (social and territorial forestry division), NGOs and other agencies recommended in RAP report. Environmental officer under the Supervision consultancy package will coordinate and ensure implementation.

Haulage Roads	• The alignment of haulage roads (in case of new ones) transportation link shall be finalities to avoid agricultural lands to the extent possible, In unavoidable circumstances, suitable compensating may be paid to people whose land will be temporarily acquired for the duration of operations. The compensation shall cover for loss of income for the duration of acquisition and land restoration.	The planning. design and constrcution/upgradation of existing roads to be used as haulage roads are responsibilities of contractor under approval by Construction - supervision consultant/PIU of NHAI
	• Prior to construction of roads topsoil shall be preserved or atleast shall be used for any other useful purposes rather than allowing its loss by construction activities.	
	• Water tankers with suitable sprinkling system are to he deployed along the transportation links. Water shall be sprinkled along the route to suppress the airborne dust due to the truck movement particularly on unpaved roads. Roads, which are subjected for huge material movement, provision for sprinklers can he made which may become economical as compared to water sprinkling by tankers	Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
	• The vehicles deployed for material transportation shall he spillage proof to avoid or minimize the spillage of the material during transpiration. In any case, the transportation links are to he inspected at least twice daily to clear accidental spillage, if any.	Environmental officer will coordinate with the villagers to ensure that their interests are protected and no social resentment sets in.
	• The borrow and material dumping sites must be access controlled to keep away-unauthorized entry of people, grazing cattle and any other stray animals.	
	• Use of existing roads should he avoided for hauling of materials, If unavoidable, roads are to, first properly strengthened and /or widened so that existing users can also continue to same road along side in dedicated tracks	
Construction Camp Sites	• The construction campsites shall he away from any local human settlements kind preferably located on lands, which are not productive presently. The camps shall have adequate water supply sanitation and all requisite infrastructure facilities This would minimize dependence of personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof.	All facilities are to be planned and implemented by contractor under approval by construction supervision consultant/ PIU of NHAI
	• The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use.	Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
	•All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible.	

Construction Camp Sites (conti...)	• The construction camps shall have health care facilities for adults, pregnant women and children. • All construction personnel shall be subjected to Vaccinations and other Preventive/healthcare measures. • The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should he discouraged/prohibited to the extent possible.	
Diversion of Traffic	• Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to 'project operations to present road users, particularly during night time. • Proper diversion schemes will ensure smooth traffic flow, minimizes accidents, traffic snirl ups, and commotion. • The diversion signs should be bold and clearly visible particularly at night. • Diversion schemes particularly near water bodies should consider grazing cattle crossing points • All project operations shall be cladded.	Diversion schemes shall be prepared by Contractor and approved by Construction supervision consultant/PIU of NHAI Environmental officer and other team members of supervision Consultants will monitor and ensure appropriate implementation
Work Sites	• All personnel in work sites hall have protective gears like helmets, boots etc - so that injuries to personnel are minimized. • Children and pregnant women shall not be allowed to work under any circumstances. No personnel shall be allowed to work at site more than 10 hours per day. Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gear like hear plug etc. and regularly rotated. Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum.	All facilities are to be planned and implemented by contractor under approval by construction supervision consultant/ PIU of NHAI Environmental officer and other team members of supervision Consultants will monitor and ensure appropriate implementation
Quarries	* Material, particularly aggregates shall be sourced only from licensed quarries. * A list of such quarries is available from Department of Mines & Geology. Govt. of Madhya Pradesh. Some of them have been recommended in Pavement &materials report	The selection of quarries and material selection will be the responsibility of contractor under approval of' Construction supervision eunsultan / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation of mitigation actions.
Quarries (conti..)	* All such quarries have occupational safety procedures/practices in place and regular inspection shall be carried to ensure compliance. * Large material drawls should not be a cause for neglect of safety procedures, which is otherwise common.	

	* I case, unlicensed quarries are to be chosen for viable reasons, ensure compliance of all measures mentioned above.	
Water Resources & Drainage Channels	* The project highway necessitate up gradation of numerous cross drainage structures, minor and major bridges to facilitate development of project highway in accordance with design requirements and standards. * Most water bodies across project highway are non - perennial and drain storm water only for few weeks during monsoon season. * Impacts arising out to construction of drainage structures is not likely to impact drainage pattern since, under project highway design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed for 50 year frequency to negate any heading up or flooding problems. * Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. • Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination channel beds. Spillage if any, shall be immediately cleared with utmost caution to leave no traces. • Channel beds are to be clean and restored to its previous state after completion of construction but prior to onset at monsoon. • The sections of all upstream and down stream drainage channels are to he improved up to a distance of at least 300m to ease the water passage across the drainage structures.	The planning, and construction /up gradation of existing/new cross drainage structures roads are responsibilities of contractor under approval by Construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Water Resources & Drainage Channels (conti..)	• Adopting mitigative measures like construction of coffer dams, cessation of operations intermittently for limiting turbidity, limiting hours of operation to day time hence recuperation of turbidity, strict prohibition of disposal of solid and liquid waste disposal into waters etc, good sanitary and hygene practices on river beds etc can largely minimize impacts on water quality during construction of bridges / cross drainage structures, In any case impacts will be short term and transitory in nature.	
	* All equipment / vehicles deployed for construction activities shall be regularly maintained and not older than 2 years. Vehicles/equipment deployed for construction activities shall he regularly maintained for smooth operation, a measure contributing to air quality and noise	Contractor is responsible for ensuring provision of facilities under approval by Construction supervision consultant/PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation

Construction Equipment/Vehicles	* Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. * All vehicles deployed for material movement shall be spill proof to the extent possible. * In any case all material movement routes shall he inspected daily twice to clear off any accidental spills.	Environmental officer will regularly interact with the local people who are likely to be affected to ensure that their interests are protected and no social resentment sets in.
Borrow areas	* Borrow areas identified/ suggested during project preparation have been investigated for presence of ecologically sensitive areas if any and cleared thereof. * Within these location, the actual extent of area/zones to be excavated areas is to e demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for gazing cattle. * Through this project, construction/ conversion of surface water bodies/ ponds are to be taken up in burrow areas where possible be undertaken as a derivative of development and some of the tanks could be developed as picnic spots with water from development works. * The top soil recovered from newly acquired land areas for project development to be preserved and used for turfing of embankment (s) of project highway	Sourcing of burrowing materials and all related activities like planning & deployment of the most optimum number of vehicles without disregarding the existing users in case of existing linkages and construction /up gradation of existing/new haulage roads under approval by constructions supervision consultant/PI U of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Borrow areas (conti..)	* Despite positive points mentiond above, certain mitigative measures are reuird to maximize acrual of benefits due to acquisition of tank bed for porject development. In some cases, for, a detailed Action plan may requird for even improvement of intel channels and their subsidiaries at upstream so that the water is properly channeled and reaches the tank's. This is very important, since project region is erosion prone and threfore need soil conservation and appropriate land use management measures. At time some of such actions may not directly fall under the purview of present project Highway developemnt but implementation of this project could prompt initiation of such conservaton and improvemnet measures by State / Local Government bodies would help in restoring the dwindling water bodies and their extent. Adherence to these measures will negate any adverse impacts and ensure positive benefits due to project development. * Scrapping and tamping of the borrowed areas shall be carried out to minimize localized depressions and render a smooth profile borrow areas.. · Limit operations to day hours only.	

	· Provide protective gear like ear plugs if necessary to operating personnel who are likely to be exposed to noise levels beyond threshold limits. · Rotate personnel to minimize exposure of noise levels beyond limits · All equipments deployed shall be well-maintained and meet emission norms of diesel vehicles. · Demarcate areas identified for operations and install signboards in regional language prohibiting unauthorized movement of locals. Similarly personnel/ labour operating on tank bed shall be restrained to move in areas which are not under operation. Movement if warranted can be only with authorization. · No labour camps shall be allowed either in desilting areas or any other location within lakebed. · No fuel loading / unloading shall allowed anywhere on tank river bed. Under unavoidable circumstances, extreme precaution shall be taken to prevent leakage/spillage of diesel/oil and/or any other lubes	
Air Quality	***** All operational areas under project development be regularly monitored (at least ONCE in a month) for air quality parameters such as SPM, RPM, S02, NOx, HC, CO etc. ***** This will ensure identification of operations/areas of concern with regard to air pollution. Operational areas include work sites, haulage roads, hot mix plants, quarries, borrow sites etc. Mitigation measures such as water sprinkling for dust suppression, permitting construction equipments/vehicles having POLLUTION UNDER CONTROL certificates will reduce work area concentration of air pollutants like RPM. S02. NOx, HC, CO etc. does not exceed permissible limits and therefore does not contribute to build up of pollutants.	Contractor is responsible for ensuring a occupationally healthy environment for all personnel irrespective of category under approval of Construction supervision consultant/Pl U of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation. Environmental officer shall requisition services of private / Governmental agencies for undertaking periodic monitoring if necessary to ensure compliance of contractor in this regard.
	* The region through which Project highway traverses largely moderate to severe erosion problems. In certain stretches, soils also have drainage and salinity problems. The stretches of project highway having erosion, drainage and salinity problems are indicated in relevant section.	Erosion control/embankment protection measures in accordance with the DPR and/or as governed by local site conditions shall be prepared by Contractor under approval of Construction supervision consultant/PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation

Soil erosion and conservation	* Soil erosion, salinity and drainage problems of the region on a macro scale is already being addressed by the State and local Government agencies through integrated dry land development schemes. * Along project highway, the rehabilitation and widening activities will raise, extend and enlarge existing embankments all along the alignment. Therefore, mitigation measures to contain erosion, salinity and drainage problems are essential along ROW. * Measures to ensure embankment stabilization including selection of less erodable material, good compaction, re-vegetation, placement of gabbions/riprap or any suitable measures around bridges and culverts etc are included in technical specifications and contract documents. The Engineering measures for countering soil erosion, slope protection, drainage wherever required considered for project highway and detailed project report.	appropriate implementation Environmental officer may consult with Regional Forest officer of Madhya Pradesh Forest Department in selecting endemic species which also can serve engineering functions..
Soil erosion and conservation (conti..)	* Many of impacts on soil due to project highway can be significantly mitigated by some of the following measures; a) Minimizing area of ground clearances only to the extent required b) Balancing the filling and cutting of earth to the extent possible . c) Avoiding creation of cut slopes and embankments which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area (s) immediately after disturbance due to construction has stopped and Not after construction has been completed. * Re - vegetation of disturbed area to serve specific engineering function. Some of the functions are hereunder. a) Catch and retain material moving over surface (stems) b) Armour the surface against erosion and abrasion by intercepting rain drops (leaves) c) Support slope by propping from base (tree and shrub bases & roots) d) Drain soil profile by drawing water out through roots and releasing it to air by transpiration	

	e) Facilitate infiltration of water through soil profile, thereby reducing proportion of water flowing over soil surface (roots) f) store and reuse topsoil separated during initial clearing and excavation g) shape the slope for maximum seeding survivability h) Selection of species suitable for local soil type, micro climate, seasons, case of maintenance and desired engineering function. * Engineering measures are to be provided in case a) Slopes are unstable because they are too high and sleep. b) Adverse climatic conditions for specific vegetation cover. c) Risk of internal erosion or localized rupture because of drainage difficulties	
Soil erosion and conservation (conti..)	d) Constraints to limit earth work because of limited ROW e) Cut off drains to catch water before it reaches critical areas and avoiding excessive concentration of flow. f) Concrete flow dissipation structures for reducing downstream erosive potential g) Introduction of settlement basins along drains to catch silt and road rubbish etc before runoff flows into down stream watercourses.	Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Noise	* Like for air quality all operational areas under project development shall be monitored for noise levels representing all hours of a typical work shift . * This will ensure identification of operations / areas of concern with regard to noise pollution. Operational areas include work sites, haulage road, hot mix plants, quarries, burrow sites etc. Mitigation measures such provision of ear plugs, rotation of personnel, ensuring regular maintenance / Lubrication, limiting operation to day time etc will contain noise levels to permissible / threshold limits.	Contractor is responsible for ensuring a occupationally healthy environment for all personnel irrespective of category under approval of Construction supervision consultant/PIU of NHAI. Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation. Environmental officer shall requisition services of private/governmental periodic environmental monitoring if necessary to ensure compliance of contractor in this regard

Archaeological monuments/ruins/religious structures/temples	* All construction activities under the project development are to be carried out with utmost care. In case any slabs with epigraphical evidence or edicts, sculptural, historical remains or any other materials pertaining to archaeological / historical importance, Department of Archeology, Madhya Pradesh Should be immediately informed and all activities in and around such stretches site is cleared for activity by Department of Archaeology.	Contractor is responsible for ensuring a noise/ vibration free environment especially in this stretch. Appropriate vibration dampening measures as stipulated in DPR and / Or governed by local site condition are to be implemented by contractor under approval of construction supervision consultant / PIU of NHAI. Any visible signs of damage to fort ruins shall be immediately brought to the notice of PIU / department of Archaeology, Government of Madhya Pradesh. Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Archaeological monuments/ruins/religious structures/temples (conti..)	* Number of small temples, and idols under trees are falling within ROW. All such structures falling within ROW are to be transplanted / relocated to suitable places acceptable to local community. Interactions with local community leaders are to be initiated well in advance and necessary measures required for relocation of structures to complete satisfaction of local community. Through Governmental agencies such as Department of Archaeology, Government of Madhya Pradesh or local bodies or though community participation, relocation works can be carried out. * Excepting small temple structures, no other religious structures/ temples are within ROW and therefore will not be impacted upon due to project development	
Hot Mix Plants	* Hot mix plants shall be at least 500 m away from any human settlements and preferably located on leeward side. * As mentioned else where under this section all such plant/ sites shall be located on barren / uncultivable lands. Diversion of cultivable / agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions	Contractor is responsible for ensuring a occupationally healthy and hazard free environment for all personnel irrespective of category and also for communities in and around operational areas under approval of construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation Environmental officer shall requisition services of private / Governmental agencies for undertaking periodic monitoring if necessary to ensure compliance of contractor in this regard.
Loss of access	* Project development operations, at may times and stretches may lead to temporary loss of access from one side of project highway to other side. * Efforts shall be directed for minimizing such situation even if it amount to small deviation for project operation.	Contractor is responsible for ensuring minimum disturbance to local populace due to operations and provide alternatives wherever access is lost due to operations and restore it as soon as possible under approval of construction supervision consultant / PIU of NHAI

	* The local people shall be taken into confidence through opening up of communication with local population and their leaders.	Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Loss of Fertile soil	* Clearing operation within ROW and at all places of operational area like borrow areas, work sites, labour camps, construction of new/ up gradation of exiting to new haulage roads, hot mix plants, storage areas etc shall consider preservation of fertile soil. * As a first option, topsoil should be restored to its initial place after the specific activity is completed for which the area was vacated or for enriching some other place like embankment slopes for turfing / erosion protective measure., The topsoil can also be used for supporting re - plantation activities within ROW.	Contractor is responsible for ensuring a proper utilization of fertile soil under approval of construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation Environmental officer shall requisition services of private / Governmental agencies for undertaking periodic monitoring if necessary to ensure compliance of contractor in this regard.
Storage of hazardous materials	* All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. * The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. * The areas shall be access controlled and entry shall be allowed only under authorization	Contractor is responsible for ensuring a occupationally healthy and hazard free environment for all personnel irrespective of category and also for communities in and around all operational areas under approval of construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation
Location of camp sites, storage depots,	* The location campsites, storage depots shall preferably on unproductive / barren lands. * Use of agricultural / cultivable lands shall not be allowed under any circumstances. * All fuel loading, unloading, storage areas shall be spill proof. Leakage proof and carried out on paved areas. * The sites shall have suitable system to drain storm water, sanitary facilities and shall not contaminate any near by water courses / drains. * The site shall also have a system for handling any emergency situation like fire, explosion etc.	Contractor is responsible for ensuring suggested actions under approval of construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation

Accidental risks from blasting along road way and in quarries	* All hazardous operation like blasting, deep excavations shall be access controlled for nearby local people/onlookers. * Adequate caution regarding blasting shall be notified for people living by, if any, well in advance. * At some stretches along ROW, blasting will be necessary to clear rocky out crops. The blasting operation shall be carried out in lean traffic hours with adequate precautionary signs for existing traffic particularly for slow moving traffic to prevent any accidents / injuries due to operations.	Contractor is responsible for ensuring suggested actions under approval of construction supervision consultant / PIU of NHAI Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation.

Way side amenities and service stations	All way side amenities, restaurants service stations planned under project development shall have appropriate water, sanitation facilities and measures to eliminate oil & grease and other expected contaminants.	The contractor is responsible for implementation of appropriate designs framed in DPR so as to ensure healthy and hazard free environment along ROW under approval of construction supervision consultant / PIU of NHAI
	* In case of existing highway, these have been observed to the most visible and polluting operations, particularly service stations. Similarly empty oil cans, cotton waste soaked with oil are seen littered all over near parking bays along the Project Highway. Both visible and testing of soil samples from such parking bays indicate saturation with hydrocarbon.	Environmental officer and other team members of supervision consultants will monitor and ensure appropriate implementation ensure appropriate implementation
	* All such parking bays, service stations and rest places planned under project development shall have paved surface with facilities for removal of hydrocarbon and oil & grease content confirming to the effluent guidelines stipulated by Madhya Pradesh State Pollution Control Board.	
	* Effluents from such places are not to be directly discharged into water channels/ streams.	

TABLE 5.2 ENVIRONMENTAL MONITORING PROGRAM - OPERATION STAGE

Project actions/environmental attributes	Management Measures	Responsibilities
Air Quality	* Major human settlements along project highway which are adjacent to project highway are to be regularly monitored for air quality parameters such as SPM, RPM, SO2, Nox, HC, Co etc. . * The monitoring will determine the extent of improvement/deterioration due to project operation and also ensure identification of operations/areas of concern with regard to air pollution	The Terms of reference of operation and Maintenance (concessional agency) to be appointed by NHAI for operation and maintenance of project highway, will also include environmental management and monitoring and submit quarterly environmental status reports to NHAI. In addition, an independent Environmental officer will also be appointed by NHAI to monitor air quality parameters atleast once in three month. Environmental officer will requistion services of private/ governmental agencies for undertaking periodic environmental monitoring, if necessary.
Noise	* Like for air quality, selected sensitive areas along project corridor like hospitals, schools, human settlemment which were considered under baseline monitoring during EA studies may be monitored for noise level both during day time and night level. * The monitoring may be carried out atleast ONCE in THREE month. Each monitoring lasting for full 24 hours covering both day and night time * The monitoring will enable to determien either improvement / deterioration of noise level due to operation of project highway and also identify areas which are experiencing high noise levels as compared to present situation and necessity of any noise mitigation measures.	The concessional agency will be responsible for regular monitoring and submit quarterly environmental status reports to NHAI. An independent Environemnatl officer appointed by NHAI for operation stage will also monitor noise levels atleast once in three month. The noise monitoring frequency will be as per Table 8
Ground Water	* Continue the gound water level monitoring initiated during project implementation period to determine the extent recovery and improvement of ground water after project completion and implementation of artificial recharging measures. * Wells along the project corridor are to be monitored for depth of water below the goround level atleast ONCE in a month.	The concessional agncy will be responsible for monitoring and submit quartelry environmental status reports to NHAI. An independent Environmental officer appointed by NHAI for operation stage will also monitor water levels atleast once in three month and also coordinate with the concerned government agency as necessary.

Groun Water (conti..)	* Regular maintenance of artificial recharging units be undertaken particularly before onset of monsoon.	
Landscape / Arobricultural plan	* The green cover of project highway shall be manitained and regularly watered as per the schedule recommended in the landscaping / arboricultural plan.	The Department of Forests, Government of Madhya pradesh, will execute the landscaping / arboricultural plan under funding by NHAI. The details of the implementation plan will be finalized in consultation with the concerned division of the Department of forests. Environmental officer appointed by NHAI for operation stage will monitor maintenance and upkeep of vegetation.

Table 5.3 Environmental Monitoring Control Matrix

S.No.	Environmental Attributes/ Project Actions	Mitigation Measures (for detail description refer to EMAP table 5.1 & 5.2)	Monitoring Frequency			
			daily	weekly	Bi - monthly	Monthly
CONSTRUCTION PERIOD						
1	Setting out and clearing Row	Archaeological evidences/ idols/tombs if noticed/found - inform Archaeological Department	√			
2	Relocation of Utilities	Ensure complete restoration without impacting existing users	√			
3	Traffic Diversions & Sign Boards	Diversions to be smooth, sign boards in place, clear & bold particularly in night & cause least inconvenience to road users	√			
4	Borrow Areas	Seek prior approval from local environmental regulatory agencies and compliance at all stages of operations. After borrowing ensure re- vegetation, drainage, erosion protection as per EMAP	√		√	
5	Quarries	Compliance of local environmental regulations in project specific quarries and at all stages of operations.		√		
6	Haulage roads	Avoid of agricultural lands, finalization of compensation for land owners, regular inspection to check inconvenience to locals spillage, dust levels/watering frequency, noise level, Restoration after operations with wearing course and handing over road to local community	√			
7	work sites	Comply local Environmental regulations for air quality, Noise, occupational hazard & safety procedures at all stages work.	√			
8	Ground water level in and around construction tube wells	Bore wells shall be away from human settlements, determine sustainable yield, restrict withdrawal of water within yield recommended for region, Monitor depth of water below ground level in wells in and around construction tube wells bore start and after completion of water withdrawal for the day				
9	Construction Equipment/Vehicles	Ensure vehicles are regularly maintained, have Pollution under certificates revalidated every month			√	√

S.No.	Environmental Attributes/ Project Actions	Mitigation Measures (for detail description refer to EMAP table 5.1 & 5.2)	Monitoring Frequency			
			daily	weekly	Bi - monthly	Monthly
10	Air Quality at all operational areas under project	Record SPM, RPM, CO, HC, Nox, SO2 levels for 24 hourly in 8 hr. shifts as per methods/procedures recommended by Central/State pollution Control Board		√		√
11	Noise at all operational areas	Record noise levels at every 5 minutes for 24 hours (both day time & night time)		√		
12	Vibration near Bheru, Hanuman temples, Mosque & any other similar religious structure	Restricted movement of work force. Equipment and activities. Also record vibration levels during a typical working shift from a specialized agency before the start, during and after completion of operations.	√			
13	Top Soil from land clearing operations	Preserve and restore the topsoil. If can not be used for restoration, divert for other applications like re-vegetation, embankment turfing and alike	√			
14	Hot Mix Plants	Located at least 500m from settlements, barren land and not agricultural lands. Monitor air quality, waste discharge and noise levels regularly as mentioned under Sl. No. 10, 11 above. Ensure all operations comply with local environmental regulations	√	√		
15	POL (liquid and Solid waste) /Hazardous Storage Areas	POL storage areas have impervious lining, containment ditches, oil & grease traps, as per EMAP. Regular inspection & maintenance. Comply all local environmental regulations	√	√		
16	Soil erosion and conservation	Borrow areas shall have gentle slopes, connected to near by natural water bodies, re-vegetated		√		
17	Water Quality of Major Water courses	Monitor water quality for Physico chemical parameters as per IS 2296-1982 before start, during and after completion of operations.	√	√		
18	Channel/River beds	Ensure most activities are scheduled for dry months, reshaping of channel bed after completion of construction.				

S.No.	Environmental Attributes/ Project Actions	Mitigation Measures (for detail description refer to EMAP table 5.1 & 5.2)	Monitoring Frequency			
			daily	weekly	Bi - monthly	Monthly
19	Archaeological monuments/ruins/religious us structures/temples	Archaeological evidences/ idols/tombs if noticed/found-inform Archaeological Department. Temples within ROW are relocated in consultation with community leaders. Coordinate with Social team.	As required			
20	Water Supply Sanitation & Health at camp sites	Adequate water supply as per norms, septic tanks and soak away pits, kerosene and LPG supply, health care facilities, vaccination for work force camps		√		
21	Construction of Noise Barriers	Consult affected parties like hospitals, educational Institutions for eliciting opinion during constructing barriers.		√		
22	Construction Debris	Seek prior approval of suitable disposal sites. In cases of borrow areas approved, re-vegetate the fill sites.		√		
OPERATION PERIOD						
23	Way side amenities and service stations (Sanitary, solid and other waste collection and disposal	Regular inspecting for adequacy of facilities, functioning and compliance of local Environmental regulations.		√		
24	Storm water outlets to water courses	Regular inspection for adequacy of facilities, functioning and compliance of local Environmental regulations.	√			
25	Hazardous spills into water courses due to accidents	Regular inspection for adequacy of facilities, functioning and compliance of local Environmental regulations.	√			
26	Air quality at selected human settlements and sensitive receptors	Record SPM, RPM, CO, HC, Nox, SO2 levels for 24 hourly in 8 hr. shifts as per methods/procedures recommended by Central/State pollution Control Board		√		√
27	Noise quality at selected human settlements and sensitive receptors	Record noise levels at every 5 minutes for 24 hours (both day time & night time)			√	

S.No.	Environmental Attributes/ Project Actions	Mitigation Measures (for detail description refer to EMAP table 5.1 & 5.2)	Monitoring Frequency			
			daily	weekly	Bi - monthly	Monthly
28	Vibration near Bheru, Hanuman temples, Mosque & any other similar religious structure	Record vibration levels during a typical traffic days from a specialized agency for all 24 hours to determine the level		√		
29	Maintenance of Way side and median plantations	Regular inspection to ensure upkeep, renewal and watering schedule as per landscape plan	√			√
30	Water Quality of Major Water courses	Monitor water quality for Physico chemical parameters as per IS 2296-1982 before start, during and after completion of operations.		√		
31	Un-desirable activities within ROW	Regular surveillance to ensure no undesirable activities are present within ROW		√		
32	Maintenance and Inspection of artificial aquifer re-charging	Regular inspection for upkeep and maintenance of measures executed in coordination with State Government Department.		√		
33	Monitoring for leachate from Construction debris disposal sites	Monitor ground water quality in near by wells for Physico chemical parameters as per IS 2296-1982 especially before and after monsoons.			√	

Table 5.4 - Cost Estimate for Environmental Mitigation and Enhancement Measures

S. No.	Description of Work	Unit	Rate (Rs.)	Qty.	Amount (Rs.)
1	Construction of Bore wells for meeting water requirements (covered under engineering Cost,	-	-		
2	Replenishment of Ground Water through Artificial Recharging in coordination with State Ground Water Authorities (Provision) *	L.S.	-		5000000
3	Construction of Haulage Roads for Quarries and Burrow areas (covered under engineering Cost)	-	-		
4	Compensatory Afforestation in degraded areas. Twice in lieu of Forest Land Acquisition	Ha	50000	54.3	2715000
5	Plantations within the Project Corridor- 70% of Road length	Km.	100000	54	5400000
5.1	Cutting of Trees				
	(a) above 300mm upto 600mm	Nos.	90	10581	952290
	(b) above 600mm upto 900mm		165	8039	1326435
	(c) above 900mm upto 1800mm		400	3181	1272400
	(d) above1800mm		425	354	150450
	Total				
5.2	Planting tress along borders and shrubs in median including maintenance for First three Years (75% of the road length)	Km.	100000	58	5800000
6	Re-vegetation and development of Borrowed areas including drainage aspects-25% of total Borrow area	Ha	10000	125	1250000
7	Water sprinkling as per EMAP for the entire duration of the Project Construction	L.S.	-		7330000
8	Environmental Monitoring during Project implementation as per EMAP	L.S.	-		3600000
9	Man time cost for Environmental Officer for implementation of EMAP	L.S.	-		7670000
10	Disposal of Soils	L.S.	-		2800000
11	Sub Total	-	-		45266575
12	Contingency @5% of Item 11	-	-		226333
13	Total Cost	-	-		45492908
14	Provision for Inflation @25% of Item 13	-	-		11373227
15	**Total Cost for EMAP**				**56866135**