DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

ENVIRONMENTAL ASSESSMENT (EA)

&

ENVIRONMENTAL MANAGEMENT FRAMEWORK

FOR

BHAUPUR - KHURJA SECTION

OF

PROPOSED EASTERN DEDICATED FREIGHT CORRIDOR

SECTION – I

ENVIRONMENTAL ASSESSMENT (FINAL)

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ABBREVIATIONS

AAQ	Ambient Air Quality
ADB	Asian Development Bank
AFs	Affected Families
AIDS	Acquired Immunodeficiency Syndrome
ASI	Archaeological Survey of India
BIS	Bureau of Indian Standard
BOD	Biological Oxygen Demand
CC	Cubic Centimeter
CF	Conservator of Forest
Cl	Chlorine
CO	Carbon Monoxide
CPCB	Central Pollution Control Board
CPRs	Common Property Resources
CS	Construction Supervision
dB	Decibel
DDP	Desert Development Programme
DFC	Dedicated Freight Corridor
DFCCIL	Dedicated Freight Corridor Corporation of India Limited
DFO	Divisional Forest Offices
DO	Dissolved Oxygen
DR	Detailed Railway
EA	Environmental Assessment
EAC	Expert Appraisal Committee
EIA	Environment Impact Assessment
EMAP	Environment Management Action Plan
EMP	Environmental Monitoring Plan
EMU	Environment Management Unit
ESIMMS	Environmental and Social Impact Mitigation Measures Study
EWG	Environmental Working Group
Fe	Iron
GoI	Government of India
Hg	Mercury
HIV	Human Immunodeficiency Virus
ICCP	Information and Community Consultation Programme
ICDs	Inland Container Depot
IS	Indian Standards
LAA	Land Acquisition Act
LA_E	Exposure Noise Level
LAeq	Equivalent Noise Level
LPG	Liquefied Petroleum Gas
MLA	Member of Legislative Assembly
MoEF	Ministry of Environment & Forests
MP	Member of Parliament
N	Nitrogen
Na	Sodium
NEP	National Environmental Policy

NGO	Non Government Organization
NO	Nitrogen Oxide
NPRR	National Policy on Resettlement and Rehabilitation
NRCP	National River Conservation Plan
OM	Organic Matter
OP	Operational Policy
PAFs	Project Affected Families
PAPs	Project Affected Person
Pb	Lead
PCCF	Principal Conservator of Forest
PDA	Passenger Diesel A (Plain Route) Train
PUC	Pollution Under Control Certificate
RAP	Resettlement Action Plan
ROB	Railway Over Bridge
ROW	Right of Way
RPM	Respiratory Particulate Matter
RRP	Resettlement and Rehabilitation Plan
RUB	Railway under Bridge
SC	Scheduled Caste
SDOE	State Department of Environment
SEIA	State Environment Impact Assessment
SIA	Social Impact Assessment
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SR	Sensitive Receptors
ST	Scheduled Tribe
TOR	Terms of Reference
VRC	Village Rehabilitation Committee
WB	World Bank
WLS	Wildlife Sanctuaries
Zn	Zinc

EXECUTIVE SUMMARY

1.0 BACKGROUND

Ministry of Railways initiated action to establish a Special Purpose Vehicle for construction, operation and maintenance of the dedicated freight corridors. This led to the establishment of "Dedicated Freight Corridor Corporation of India Limited (DFCCIL)", to undertake planning & development, mobilization of financial resources and construction, maintenance and operation of the dedicated freight corridors. DFCCIL was incorporated as a company under the Companies Act 1956 on 30th October 2006. Mumbai-Delhi and Mumbai-Howrah route have a current capacity utilization of more than 140%. This has led to the saturation of the Railways system in terms of line capacity utilizations on these corridors, which are specifically called the Western and Eastern corridor respectively. Dankuni -Sonnagar-Ludhiana section has been identified as part of the eastern corridor and from JNPT to Dadri via Vadodara – Ahmedabad - Palanpur-Phulera - Rewari is called western corridor. These corridors encompass a double line electrified traction corridors. The total length of EDFC works out to 1843 Kms. The present study confines to 272 km in Bhaupur (km 1040) to Khurja (km. 1370) section of EDFC.

2.0 OBJECTIVES OF THE ASSIGNMENT

As per the current regulations of Government of India, railway projects do not require conducting Environmental Impact Assessment (EIA) studies and obtaining Environmental Clearance (EC) from the Ministry of Environment and Forests (MOEF). However, considering the magnitude of activities envisaged as part of EDFC, the DFCCILIL has to conduct an EA and prepare an Environmental Management Plan (EMP) to mitigate potential negative impacts for the first phase of the project and develop an Environmental Management Framework (EMF) to be followed for the subsequent phases of EDFC.

3.0 SCOPE OF ENVIRONMENTAL ASSESSMENT (EA)

The environmental assessment scope includes environmental assessment and environmental management plans for Bhaupur-Khurja section of EDFC corridor. The EA process also envisages to develop a comprehensive environmental management frame work for the entire project which will adopted as part of the corporate environmental policy for DFCCIL.

4.0 DESSCRIPTION OF PROJECT

The present project confines to 272km (135km under package-1, 30km under package-2 & 107km under package-3) from Bhaupur (km 1040) to Khurja (km. 1370) section of of EDFC. Total length under this present project is 272 km. Bhaupur to Khurja is an important section of Delhi - Howrah double line electrified main trunk route of Northern Central Railway connecting the Northern, Central and Eastern regions of the country.. The entire stretch is in the State of Uttar Pradesh and passes through 8 districts of Kanpur Dehat, Auraiya, Etawah, Ferozabad, Hathras, (Mahamaya Nagar), Agra, Aligarh & Bulandsehar. Detours are planned at five locations due to heavy settlement along the existing track. These locations are Achalda, Bhartana, Etawah, Hathras and Aligarh. Details of the section are given in Table -1 below.

Table-1: Project Area: Salient Features

Project Stretch (From-To)	Package No	Chainage km (From-To)	Distribution of length(km)		Total length	No. of Distr-icts	No. of Vill-ages	LA (Ha)
			Parallel	Bypass				
Bhaupur-Bhatuara	**I**	**1040-1170**	95	40	135	3	104	570
Kaist-Biruni	**II**	**1170-1266**	30	0*	30	2	27	93
Jamal Nagar - Khurja	**III**	**1266-1370**	69	38	107	3	98	519
Total (Bhaupur-Khrja Phase-I)		**1040-1370**	**194**	78	272	8	229	1182

* Entire data of Existing Tundla detour has been deleted.

5.0 KEY ENVIRONMENTAL LAWS AND REGULATIONS

Following table presents the environmental regulations and legislations relevant to project.

Table 2: Environmental Regulations and Legislations

Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
1	The Environmental (Protection) Act. 1986, and Rules	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	MoEF, State Department of Environment, CPCB and UPPCB
2	The EIA Notification, 2006	Railway projects are exempted from this notification	No	Railway projects are exempted	N/A
3	The Water (Prevention and Control of Pollution) Act, 1974	Central and State Pollution Control Board to establish/enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction/operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	UP Pollution Control Board
4	The Air (Prevention and Control of Pollution) Act. 1981	Empowers SPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of plants and crushers	UP Pollution Control Board
5	Noise Pollution (Regulation And Control) Act, 2000	Standards for noise emission for various land uses	Yes	construction machineries and vehicles to conform to the standards for construction	UP Pollution Control Board
6	Forest (Conservation) Act, 1980	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the act	Yes	Involvement of forest land diversion for the project	State Forest Department, MoEF
7	Wild Life Protection Act, 1972	Protection of wild life in sanctuaries and National Park	No	No sanctuaries / national park in the project area	N/A
8	Ancient Monuments and Archaeological sites and Remains (Amendment and Validation) Act, 2010	To protect and conserve cultural and historical remains found.	Yes	Normally not applicable, but applies to chance find	Archaeological Survey of India, Dept. of Archaeology

Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
9	The Motor Vehicle Act. 1988	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions.	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
10	The Explosives Act (& Rules) 1884 (1983)	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying.	Yes	If new quarrying operation is started by the concessionaire / contractor	Chief Controller of Explosives
11	Public Liability And Insurance Act,1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials shall be used for road construction	
12	Hazardous Wastes (Management, Handling and Transboundary) Rules, 2008	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	UP Pollution Control Board
13	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during road construction	District & Local Crisis Group headed by the DM and SDM
14	The Petroleum Rules,2002	Storage of diesel, petroleum products for operation of construction equipment etc.	Yes	Storage of Petroleum products is restricted as per The PESO	CCoE or DM
15	National Green Tribunal (Prevention and Protection) Rules, 2011	For settling dispute if any in connection with forest, wenvironmental issues	Yes	Project requires forest land diversion and observation of environmental laws during construction	MoEF
16	Railway(Amendment) Act,2008	Compensation for land	Yes	Some land will be acquired for the project	DFCCIL

For projects with potential to have significant adverse environmental impacts (Category A) an environmental impact assessment (EIA) is required. Category B projects are judged to have some adverse environmental impacts, but of lesser degree or significance than those for category A projects and require an Environmental Assessment (EA) to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the EA is regarded as the final environmental assessment report as is the case for this project. The project railway line passes through very small patches of degraded forests area. No presence of endangered fauna and flora along the project railway line is envisaged. It may also be mentioned that there is only marginal acquisition for forest land due to the proposed project. The Government of India has issued Environmental Impact Assessment Notification in 1994 as a part of Environmental (Protection) Act, 1986 and amendments in September 2006. Railway projects do not fall under any category requiring an environmental clearance from MoEF. Only No Objection Certificate (NOC) is required from SPCB under the Air and Water Acts.

It has been established that there is a need for improving the infrastructure capacity of the transport sector to cater the projected demand for freight and goods

movement. By building up the rail infrastructure which uses 1/6th the fossil fuel consumption as compared to road, overall improvement in environmental condition is envisaged. Over and above since traction in this case would be electricity based, there is a possibility that this electricity can come from the budding nuclear capacity of the nation. Thus there can not be more eco-friendly and efficient transport system to meet with the demand of India's growing economy.

Since this is a large scale project and likely to have some reversible impacts on environment during construction phases & some impact, not of much significance, during operation, this project is being considered as **'A' category project** as per the World Bank safeguard policy. This will help not only in tweaking the construction stage to be more eco-compliant but setting systems to have better and more environment friendly construction in forthcoming railway projects. DFCCIL is committed to establish most efficient and eco-friendly system.

6.0 BASE LINE ENVIRONMENT

Data was collected from secondary sources for the macro-environmental setting like climate, physiography (Geology and slope), biological and socio-economic environment within Project Influence Area, CPM Office/ Project District. First hand information has been collected to record the micro-environmental features within Corridor of Impact, CoI. Collection of first hand (Primary) information includes preparation of base maps, extrapolating environmental features on proposed alignment, environmental monitoring covering ambient air, water, soil, noise and vibration, tree enumeration, location and measurement of socio cultural features abutting project alignment. The environmental profile and strip plan have been prepared.

7.0 ENVIRONMENTAL SENSITIVITY OF THE PROJECT & SUMMARY OF THE ENVIRONMENTAL FEATURES ALONG THE PROPOSED ALIGNMENT

The entire environmental profile covering five km on both side of the proposed alignment has been studied, and strip plans have been prepared to cover the RoW of the proposed alignment in parallel as well as detour sections. Based on this analysis, the following conclusions can be drawn:-

1. There is no wild life sanctuary located along the parallel as well as in detour section of the proposed corridor.
2. There is no wetland identified along the proposed corridor.
3. Reserve / Protected forest are located along the proposed alignment fromBhaupur to Khurja. However, these areas are forest land and have scattered plantations of babool. The total forest land that needs to be acquired is 7.36 ha.
4. There are five congested sections with residential / commercial structures located along the existing railway alignment. For each of these locations, five detours are proposed. These locations are Achalda, Bharthana, Etawah, Hathras and Aligarh.
5. There are no perennial river / water bodies crossing the proposed alignment.
6. There are a number of religious structures, schools, and colleges located along the proposed alignment.
7. The proposed alignment may result in the cutting of approximately 1966 trees in a stretch of 272 km i.e. 7.2 trees per km. The major species present along the alignment are babool, neem, shisam, papal, mango, bargad, kanji, labhera, ashok, sirsa, guler, jamun, ber, eucalyptus, mahua and bel.

8.0 SOCIAL IMPACT

Social impact affecting number of PAFs/ PAPs are 8595 & 46646 respectively. Affected structures will be 212 combining all districts. have been identified. Details are indicated in the relevant sections of the report.

9.0 PUBLIC CONSULTATION AND DISCLOSURE

The Public Consultation meetings for the proposed Eastern Dedicated Freight Corridor were conducted during May 2009 & January 2010. For these meetings,

environmentally sensitive villages that could potentially be affected by the proposed project were selected. The overall objective of the public consultation was to provide information to the stakeholders and collect feedback from them on related environmental issues.

10.0 ANALYSIS OF ALTERNATIVES

This section between Bhaupur station (km 1040) & Khurja (km 1370). is having 41 IR stations on the existing lines. Out of these 41 stations, 15 are surrounded by heavy structures where the DFC line is not feasible. To avoid such heavily built up area, detours have been proposed at these locations. Since the proposed DFC track generally runs on the left side (south) of the IR tracks, proposed detours are not considered for the right side (north) of the IR network because of technical constrains and high cost of construction for underpass / flyover to the IR tracks. However, various alternatives have been analyzed keeping in view environmental, social and technical parameters. The details of the parallel and detour locations are given below. All the detours are on the left side (south) of the railway track except Etawah, which is proposed on right hand side (north side) of the existing railway track. All the parallel alignments are on the left hand side (south) of the existing railway track.

Table 3: Locations of the Parallel Alignment

Sl. No.	From	To	P/D	Start	End	Length (km)
1	Bhaupur start	Achalda Detour Start	parallel	1040.00	1115.00	75.61
2	Achalda Detour End	Bharthana Detour Start	parallel	1119.00	1131.00	12.00
3	Bharthana Detour End	Etawa Detour Start	parallel	1140.00	1147.00	7.00
4	Etawa Detour End	Earlier proposed Tundla Detour Start	parallel	1170.00	1200.00	30.00
5	Earlier proposed Tundla Detour End	Hathras Detour Start	parallel	1266.00	1290.00	24.00
6	Hathras Detour End	Aligarh Detour start	parallel	1299.00	1319.00	20.00
7	Aligarh Detour End	khurja	parallel	1345.00	1370	24.90
					Total length in (Km)	**193.51**
					Say (km)	**194**

Table 4: Locations of the Detour Alignment

Sl. No.	From	To	P/D	Start	End	Length (km)
1	Achalda Detour Start	Achalda Detour End	detour	1115.00	1119.00	4.73
2	Bharthana Detour Start	Bharthana Detour End	detour	1131.00	1140.00	10.48
3	Etawa Detour Start	Etawa Detour End	detour	1147.00	1170.00	25.24
4	Hathras Detour Start	Hathras Detour End	detour	1290.00	1299.00	10.24
5	Aligarh Detour Start	aligarh detour	detour	1319.00	1345.00	28.03
					Total length in (Km)	**78.73**
					Say	**78**

11.0 POTENTIAL IMPACT

Environmental impact assessment involves prediction of potential impacts by the development of the project on the surrounding area. Based on the baseline environmental status described and the proposed project activities, potential impacts have been assessed and predicted, and appropriate mitigation measures are suggested to avoid / reduce / compensate for the potential adverse impacts of the project and enhance its positive impacts. The impacts due to the development of the proposed Dedicated Freight Corridor have been assessed for the planning phase, construction phase and implementation phase.

12.0 MEASURES FOR THE MITIGATION OF ENVIRONMENTAL IMPACTS

Prevention or avoidance of impact is better than mitigation of impact. Hence avoidance and reduction of adverse impacts approaches were adopted during the design stage through continued interaction between the design and environmental teams. This is reflected in the designs of the horizontal & vertical alignment, cross sections adopted, construction methods and construction materials. In-depth site investigations have been carried out so that sensitive environmental resources are effectively avoided, leading to the environmentally best-fit alignment option. The appropriate mitigation measures have been suggested during various phases of the project including specific measures for noise and vibration.

13.0 ENVIRONMENTAL MANAGEMENT PLAN

Environmental Management Plan is an implementation plan to mitigate and offset the potential adverse environmental impacts of the project and enhance its positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted in order to minimize adverse impacts. Social impact mitigation plan and land acquisition plan are included in this section. The process of implementing mitigation and compensatory measures, execution of these measures, agencies responsible for the implementation of these measures and indicative costs are discussed.

14.0 ENVIRONMENT MANAGEMENT FRAMEWORK

The environment management has been prepared covering the objectives to avoid and to minimize adverse environmental impacts/risks due to project, to ensure that adverse environmental impacts/risks are well-mitigated/minimized to achieve applicable environmental standards, to comply with applicable GOI state laws and regulations, and environmental safeguards requirements of development partners, to provide guidance to its own staff in conducting subsequent monitoring & reporting, and in undertaking corrective actions, to develop and exercise mechanisms for effective supervision by DFCCIL during implementation and guidelines for the DFCCIL in terms of for environmental regulations and its implementation for future projects.

CHAPTER – 1: INTRODUCTION

1.1 BACKGROUND

Indian Railway (IR) is one of the largest railway systems in the world. It serves a landmass of over 3.3 million sqm. and a population of over one billion. The last 50 years have seen a tremendous growth in the Indian transportation sector. In the past few years, the volume of rails freight has increased by over five times and the number of passenger kilometers has increased over seven times. The tonnage handled by Indian ports has increased 16 times while the airfreight has increased 30 times. Railway freight, which was 73 MT in 1950-51, had increased to 474 MT in 2000-01, at an average annual increase of 10.98 percent. However, post 2001, the freight traffic has grown at an annual average of 8.50 percent and about 794 MT of freight was transported in 2008-09. This rapid increase in freight traffic is attributed to India's economic growth, which resulted in traffic congestion.

1.2 DEDICATED FREIGHT CORRIDOR

To cater to the rapid growth and demand for additional capacity of rail freight transportation, Government of India has initiated development of 'Dedicated Freight Corridors' along eastern and western Routes, connecting the metro cities of Delhi-Kolkota and Delhi-Mumbai. Dedicated Freight Corridor Corporation of India Limited (DFCCIL) was established to undertake planning & development, mobilization of financial resources and construction, maintenance and operation of the dedicated freight corridors.

- The western corridor will be double line track from Mumbai (JNPT) to Delhi near Dadri and connects the cities of Vadodara, Ahmedabad,Palanpur, Phulera and Rewari.
- The eastern corridor is a 1843 km track from Dankuni, near Kolkata to Ludhiana. This encompasses a double line electrified traction corridor from Sone Nagar to Khurja (820 Km), Khurja to Dadri on NCR double line electrified corridor (46 Km) and single electrified line from Khurja to Ludhiana (412 Km).

The eastern and western corridors are proposed to meet at Dadri, near Delhi.

1.3 OBJECTIVES OF EA & EMF

As per the current regulations of Government of India, railway projects do not require conducting Environmental Impact Assessment (EIA) studies and obtaining Environmental Clearance (EC) from the Ministry of Environment and Forests (MoEF). However, considering the magnitude of activities envisaged as part of EDFC, DFCCIL engaged the services of Advantage India, New Delhi as an independent consultant to conduct an EA and prepare an Environmental Management Plan (EMP) to mitigate potential negative impacts for the first phase of the project and develop an Environmental Management Framework (EMF) to be followed for the subsequent phases of Eastern DFC.

The objectives of the EA and EMF study are to:-

- Identify potential environmental impacts to be considered in the design of Bhaupur-Khurja section of EDFC and recommend specific measures to avoid / mitigate the impacts.
- Formulate an implementable Environmental Management Plan (EMP) integrating the measures to avoid the identified impacts and an appropriate monitoring and supervision mechanism to ensure EMP implementation.
- Review the proposed alignment and other components of entire EDFC and identify possible environmental issues to be addressed during the planning, design, construction and operation of the project.

- Develop and Environmental Management Frame work that provides guidance to DFCCILIL, design / supervision consultants and the contractors in integrating environmental issues at all stages of EDFC development and operation.
- Recommend suitable institutional mechanisms to monitor and supervise effective implementation of EMF and respective EMPs.

1.4 SCOPE OF WORK

The scope of work of Environmental Assessment and Environmental Management Framework consists of the following:-

- Brief Description of the proposed project comprising various proposed activities, their phased implementation and their inter-linkages with regard to environmental impacts.
- Detailed Environmental Profile of the Project Influence Area (within 5 km on either side of the proposed alignment) with details of all the environmental features such as Reserve Forests, Sanctuaries / National Parks, Rivers, Lakes / Ponds, Religious Structures, Archaeological monuments, Natural Habitats, School, Irrigation Canals, Utility Lines, other sensitive receptors, etc. have been covered.
- Detailed Field Reconnaissance of the Proposed Alignment, with strip maps presenting all the environmental features and sensitive receptors (trees and structures in the ROW, Structures Reserve Forests, Sanctuaries / National Parks, Rivers, Lakes / Ponds, Religious Structures, Archaeological monuments, Natural Habitats, Schools, Irrigation Canals, Utility Lines, other sensitive structures) along the project corridor. The environmental features recorded on the strip maps indicating their distance from the centre line of the proposed alignment.
- Detailed Base Line Environmental Monitoring of various Environmental Attributes such as ambient air quality, noise levels, vibration levels, water quality (surface & groundwater), ecological profile, etc.
- Assessment of Environmental Impacts of the project, including analysis of alternatives has been carried out for both 'with the project' and 'without the project' scenarios. In case of detour / by pass locations the alternatives should consider alignment parallel to the existing rail line and the proposed detour / bypass alignment (s).
- Measures for the Mitigation of Environmental Impacts and opportunities for enhancement for all the impacts identified. The measures for the mitigation of impacts should consider options such as minor modifications in alignment, reduction of RoW and engineering measures such as noise barriers / attenuation measures, RUBs/ ROBs, protection of water bodies, conservation of archaeological / heritage structures, etc. Opportunities for enhancement of environmental resources, cultural properties or common property resources explored and recommendations for appropriate measures for implementation.
- Public Consultation and Disclosure of the project and its impacts have been carried out as per the WB operational policies.
- Environmental Management and Monitoring Plan, comprising a set of remedial (prevention, mitigation and compensation) measures have been developed by the consultant and ensure that these are commensurate with nature, scale and potential of the anticipated environmental impacts with necessary Institutional Mechanism for the implementation and monitoring of EMP.
- The Environmental Management Framework comprising the following:-
    i. Screening and Scoping Criteria for assessing the Environmental Significance for various projects / sub-projects of EDFC.
    ii. Categorization of Projects / sub-projects / components of EDFC, such as construction of track, detour lines, bridges, RUBs / ROBs, signalling systems, freight stations, electric substations, ancillary facilities, etc.
    iii. Methodology to carry out the EIA study, guidance on securing various clearances for the project and during construction / operation. Systems,

Policies and Procedures for environmental management during EDFC operation and maintenance, including health and safety aspects.

iv. Institutional Mechanism for the implementation and monitoring of environmental management for EDFC.

v. Training and Capacity Building requirements for the implementation and operationalisation of the EMF.

1.5 METHODOLOGY

In order to assess the environmental impacts due to the proposed project, observations were made through repeated field visits. Relevant secondary data was also collected from various government agencies such as District Collector/Gazetteer Office, Indian Meteorological Department, District Statistical Office, Central Ground Water Board, Survey of India, Geological Survey of India, District Industries Centre, District Forest Office, and Archaeological Survey of India

The **environmental profile** of the project influence area and strip maps are prepared based on the following.

- **Toposheets (scale 1:50000) of Survey of India: -** Toposheets have been collected from Survey of India, Dehradun and proposed alignment has been marked on the topo sheets.
- **Field reconnaissance of the proposed alignment: -** The entire area has been surveyed to gather the information on environmental features.
- **Collecting the data of sensitive receptors during field visit: -** The details on sensitive receptors such as schools, religious structures, hospitals etc. are collected and marked on the strip map.
- **Public consultation at village level: -** During public consultation, the information on sensitive receptors are also collected and marked on strip maps.

Based on the data collected, the strip maps and environmental profile was developed to present all the environmental features and sensitive receptors.

Preparation of Base line environmental profile comprised, collection of meteorological data from nearest IMD stations (Aligarh, Agra and Kanpur) and field monitoring of ambient air quality, water quality, noise, vibration, soil quality and ecological components as per relevant IS methods / Central Pollution Control Board Standards.

An **analysis of alternative** alignments was carried out and finalized based on reconnaissance survey of project impact zone, analysis of data and screening to minimize impact on environment covering settlements, sensitive receptors, ecological components.

Series of **Public consultations** were conducted at villages through the project office of DFCCIL at Aligarh, Agra and Kanpur.

Based on the baseline environmental status and project activities, potential impact has been identified, assessed and predicted and appropriate mitigative measures have been suggested in planning phase, construction phase and post-construction phase.

Environmental management and monitoring plan have been formulated based on the outcome of the environmental impact assessment.

1.6 ORGANIZATION OF THE REPORT

The outputs of the study are presented in nine chapters, as presented below.

Chapter 1 provides brief background of the project, scope of the EIA study, methodology and organization of the report.

Chapter 2 describes type of the project, salient features of the project with details on various components of the project.

Chapter 3 describes legal and administrative framework / policy relevant to the present project.

Chapter 4 covers the environmental profile of the study area within 5 km on either side of the proposed alignment and strip maps presenting all the environmental features and sensitive receptors covering trees and structures within RoW.

Chapter 5 assesses the nature, type and dimensions of the study area and describes the relevant physical and biological environmental components along the proposed railway line. The database on the environmental components relevant to decisions about project location; design and operation have been assembled from various secondary sources and primary monitoring of ambient air quality, noise and vibration levels, water and soil quality, aquatic and terrestrial ecology.

Chapter 6 assesses the various alternatives covering parallel alignment / detours options and details on selection of final alignment to minimize the negative social and environmental impacts.

Chapter 7 covers the prediction of potential environmental impacts by the development of the project on the surrounding area. The impacts due to development of the proposed Dedicated Freight Corridor are assessed for planning phase, construction phase and implementation phase.

Chapter 8 covers the mitigation measures to mitigate the negative impacts due to the development of proposed EDFC on various parameters of the environment during various phases of the project are discussed in this chapter.

Chapter 9 covers the details on public consultation meeting, disclosure of the project and its impacts are covered in this chapter.

Chapter 10 covers the environmental management plans for various environmental parameters, implementation details, monitoring plan and environmental budget.

CHAPTER – 2: PROJECT DESCRIPTION

2.1 INTRODUCTION

This chapter presents the details of various project components and their salient features, based on the detailed project report prepared by DFCCIL.

2.2 SIZE & LOCATION OF EASTERN DFC

A major portion of eastern corridor is located on the Allahabad Division of Northern Central Railway and is being designed for a maximum speed of 100 km/h for train operation.

The present project confines to 272km (135km under package-1, 30km under package-2 & 107km under package-3) in stretches from Bhaupur (km 1040) to Khurja (km. 1369) section of of EDFC. Total length under this present project is 272 km. Details given below (Table-2.1)

Table 2.1: Project Salient Features

Project Stretch (From-To)	Package No	Chainage km (From-To)	Distribution of length(km)		Total length	No. of Distr-icts	No. of Vill-ages	LA (Ha)
			Parallel	Bypass				
Bhaupur-Bhatuara	**I**	**1040-1170**	95	40	135	3	104	570
Kaist-Biruni	**II**	**1170-1266**	30	0*	30	2	27	93
Jamal Nagar - Khurja	**III**	**1266-1370**	69	38	107	3	98	519
Total (Bhaupur-Khrja Phase-I)		**1040-1370**	**194**	78	272	8	229	1182

* Entire data of Existing Tundla detour has been deleted.

The section is an important section of Delhi - Howrah double line electrified main trunk route of Northern Central Railway connecting the Northern, Central and Eastern regions of the country... The entire stretch is located in the State of Uttar Pradesh and passes through 8 districts of Kanpur Dehat, Auraiya, Etawah, Ferozabad, Hathras, (Mahamaya Nagar), Agra, Aligarh & Bulandsehar.

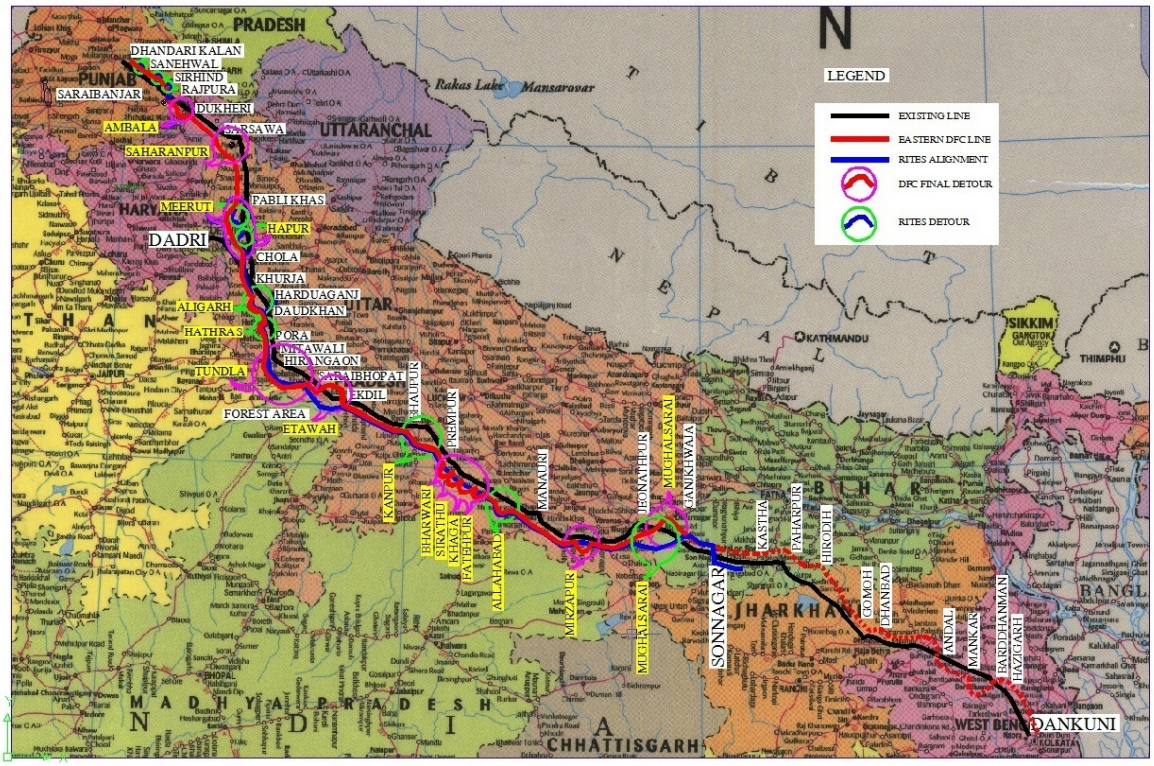
The terrain of the project area is generally flat and no important river crossing the alignment and the entire length lies in the Indo-Gangetic planes.

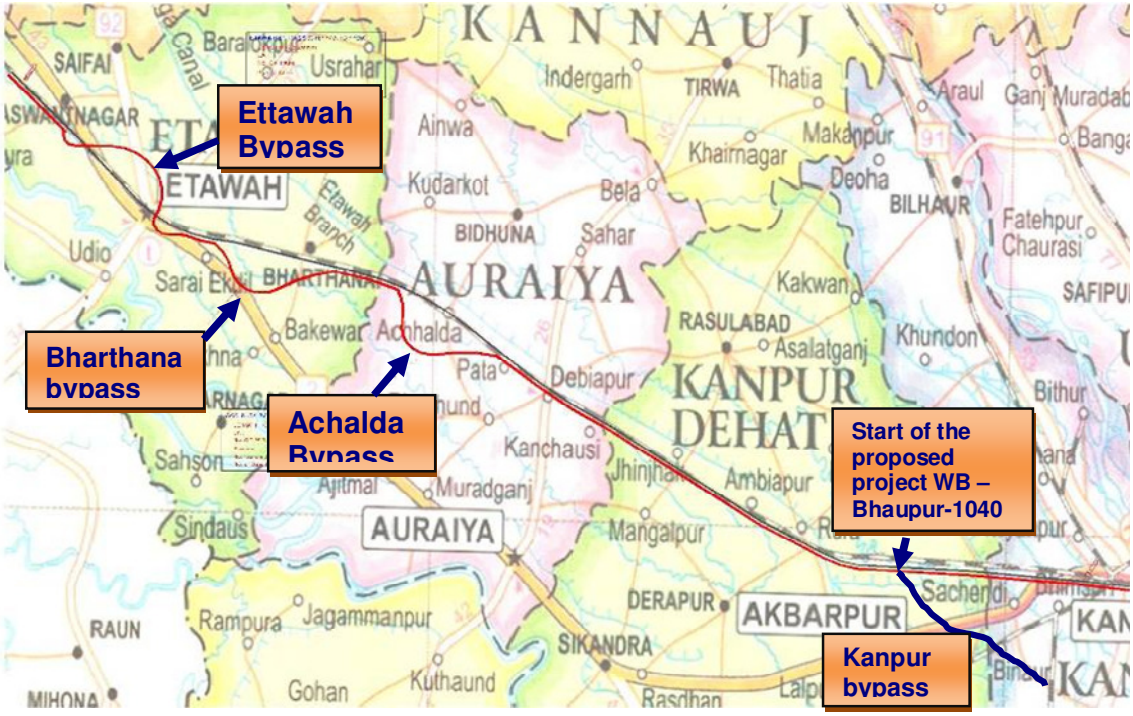
The proposed corridor is generally, parallel to the existing railway track and utilizes available railway land. A spacing of 13-15m is provided between the existing track and the DFC track and in yards a spacing of 6 m is provided. Wherever land is not available, the project proposes detours based on the following criteria.

1. Busiest railway stations, where there is no space to pass the DFC track even after yard modifications,
2. Which involves involuntary displacement of large number of people and families and dismantling of large number of structures etc. so as to reduce social impact and public unrest there of.
3. Which involves forest area, so as to avoid impacts on ecological resources

Schematic maps (Figures 2.1) of the project area of eastern corridor are given below.

DEDICATED FREIGHT CORRIDOR (EASTERN)





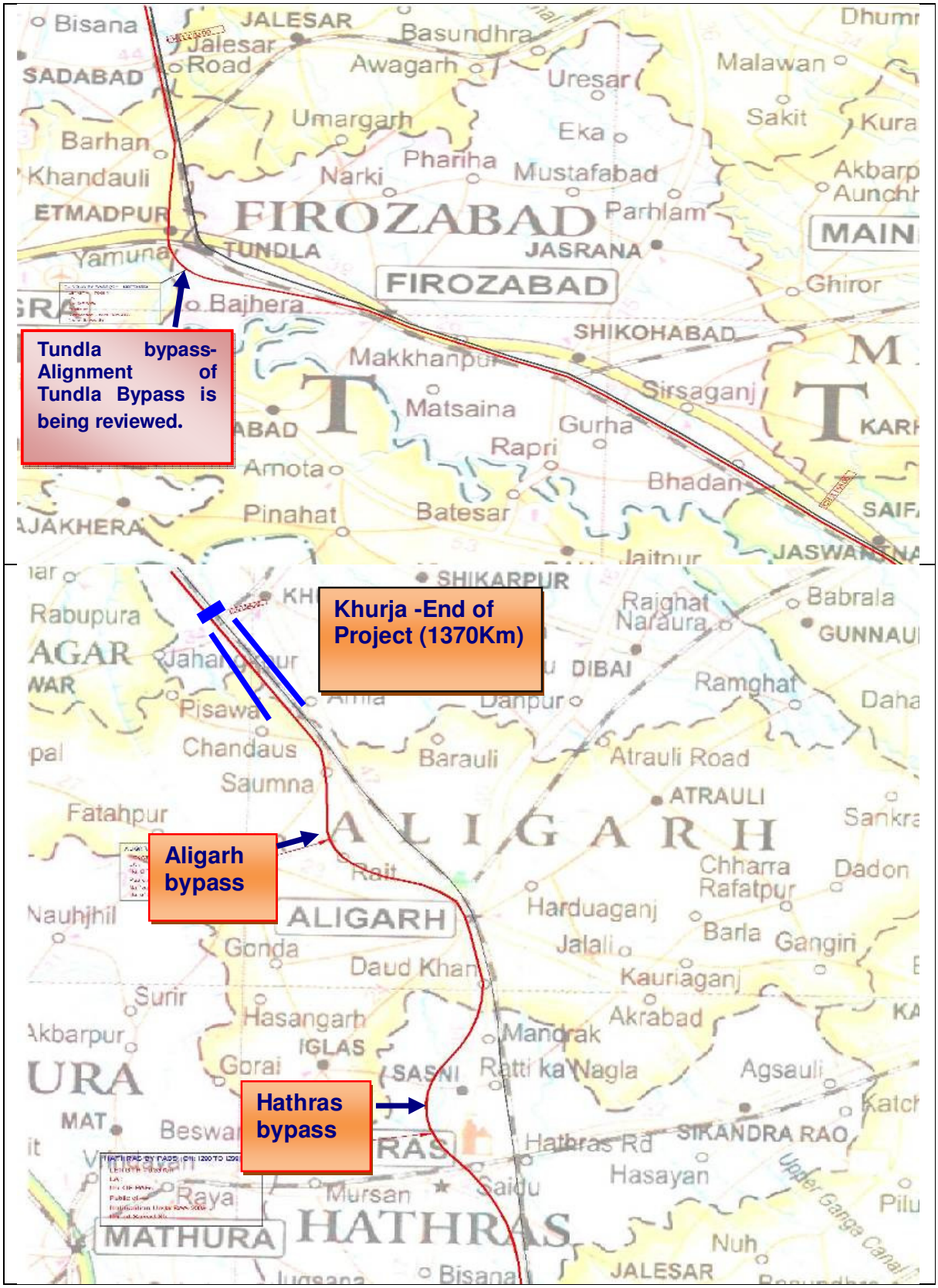


Fig. 2.1: Project Location Map

2.3 SALIENT FEATURES OF THE PROJECT

The salient features of the project are summarized in Table No. 2.2 below.

Table No 2.2: Summarized Description of the Project

S. No.	Description	Details
1.	Route Length (km)	272 km
2.	Parallel	194 km
3.	Detour	78 km
4.	No. of Detours	5 - Achalda, Bharthana, Etawah, Hathras & Aligarh.
5.	Gradient	
6.	Ruling Gradient	1 in 200 (compensated)
7.	Steepest Gradient in Yards	Normally 1 in 1200, 1 in 400 in exceptional cases
	Standards of Construction	
8.	Gauge	1676mm
9.	Rails	60kg 90 UTS rails
10.	Sleeper	PSC, 1660 No./km for main line & 1540 Nos./km for loop line & sidings
11.	Points & Crossing	60 kg rail, 1 in 12 with CMS crossing on PSC Sleepers Layouts.
12.	Ballast	300 mm cushion
13.	Design Speed	100 kmph
14.	Design Axle Load	Freight Traffic with 32.5 tone axle load
	Formation	
15.	Bank width for double line	13.5 m
16.	Slope on Embankment	2H: 1V
17.	Cutting width for double line	19.25m
18.	Blanketing Thickness	0.60 m
	Curves	
19.	Maximum Degree of curvature	2.5^0
20.	Grade Compensation on Curves	@ of 0.04 % per degree of curvature
	Track Centers (Minimum)	
21.	Between to track of DFC	6m
22.	Between Existing Track and DFC	13 to 15mnormally 13-15m but places including yard it is less than 6m due to space constraints
	Bridges	
23.	Standard of Loading	32.5 tonnes axle load,15 tonnes/m trailing load(DFC loading)
24.	Number of Important bridges	Nil
25.	Number of Major Bridges	5 (combined linear waterway 190m)
26.	Number of RUB (Major)	4
27.	Number of RUB (Minor)	82
28.	Number of Minor Bridges	197
29.	Number of Rail Flyovers	6
	Road Crossing	
30.	Number of level Crossing	74
31.	Stationcrossings	4
32.	Junction Stations	3
33.	Additional Land Required	1182 hectares

2.4 DESIGN FEATURES

Salient design features are given below for information. However, it may be noted that execution of the project will be on 'design, build' contract basis.

2.4.1 Gauge

The proposed alignment DFC line almost is parallel to the existing line and the Gauge for the DFC line has necessarily to be Broad Gauge. (BG) (1676mm).

2.4.2 Category of Line

The proposed DFC line is having a potential of maximum permissible speed of 100 kmph for goods trains to meet the anticipated traffic requirements. All bridges will be constructed to DFC loading standard with 32.5 t axle load.

2.4.3 Ruling Gradients

The ruling gradient for the proposed line has been kept as 1 in 200(compensated). Grade compensation has been provided at the rate of 0.04% per degree of curvature as per Para 418 of Indian Railway's Permanent Way Manual. The maximum length of loop and tonnage of goods trains catered for in the design are 715m and 3600T respectively.

2.4.4 Curves

For permitting maximum permissible speed of 100 kmph, a radius of 638 m (2.74º) is adequate with Cant as 140 mm and Cant deficiency as 75mm. However, maximum degree of curve is restricted to 2.5 degrees in the proposed corridor.

2.4.5 Section

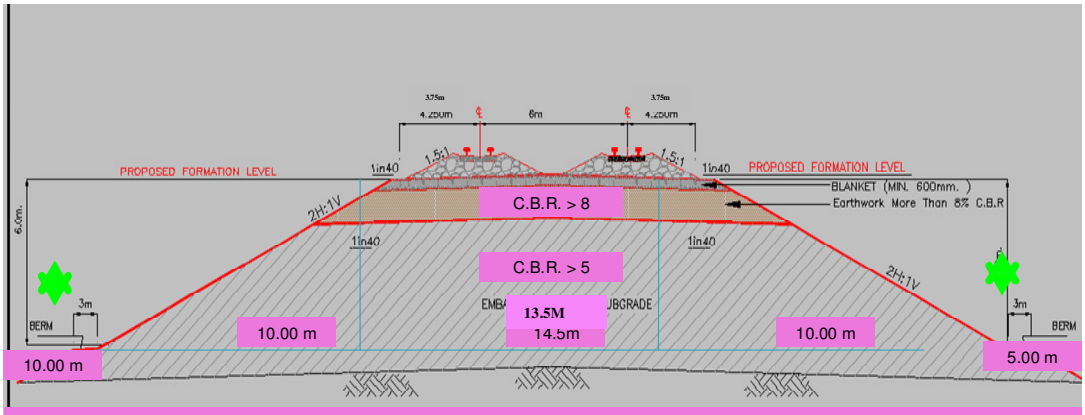
Vertical curves as specified in para 221 of Engineering Code (Para 419 of Indian Railways Permanent Way Manual) have been provided. As per Engineering Code, vertical curves have been provided only at those locations where the algebraic difference in change of grade is equal to or more than 4mm/m i.e.0.4%. A minimum radius of the vertical curves of 4000m as applicable for 'A' category lines for BG has been adopted.

2.4.6 Spacing between Tracks

Spacing between track Centre to centre spacing of DFC tracks has been specified as 6 m and centre to centre spacing of DFC tracks from existing track has been specified as at 13m to 15m to avoid the infringement of existing IR infrastructure. However, spacing of DFC track has been reduced to 7m at thickly populated locations to reduce/avoid the displacement of inhabitants.

2.4.7 Formation

Being a double line construction, a top width of 13.5 m has been considered for embankment with side slopes of 2:1. Formation width in the cutting has been kept as 19.5 m. with side drains. Typical cross section of the proposed freight corridor is presented in figure 2.2.



Cross Section various Embankment Layers

2.4.8 Bank

Formation width of 13.5m.on straight alignment has been considered. The slopes on banks are proposed as 2H: 1V. Provisions of RDSO guidelines will be followed.

2.4.9 Cutting

A bottom width 19.90 m with 1:1 slopes including side drains on both sides have been kept. Where the cutting height is more than 6m, berm of 3m width has been proposed at every 6 m cutting height.

2.4.10 Blanketing

Blanketing layer is provided with 0.6m depth.

2.4.11 Fixed Structure Clearance

Minimum vertical clearance as per SOD for ROB and FOB would be 8.705m to accommodate OHE suitable for the designed speed of 100 kmph.

2.4.12 Permanent Way

The track structure shall consist of 60 kg/m, 90 UTS, FF first class new rails on PSC sleepers having 1660 nos. per km density for main line. First class rails with PSC sleepers having 1540 nos/km density have been adopted for Loop lines and sidings. It is proposed to provide CWR/LWR as per the rovision of the P-Way manual.

2.4.13 Points and Crossings

Points and Crossing with 60 kg rail on MBC sleepers with fan shaped Layouts, 1 in 12 on running lines and for non-running lines and sidings with curved switches and CMS crossings have been proposed.

2.4.14 Ballast

The depth of hard stone ballast (65mm size) cushion below MBC sleepers has been kept as 300mm for main lines. Therefore, a quantity of 4.316 cum/m for straight portion is provided. Provision for wastage, curvature and Points & crossing has been considered as per the provision of para 263 of P-Way Manual.

2.4.15 Road Crossings/Level Crossing

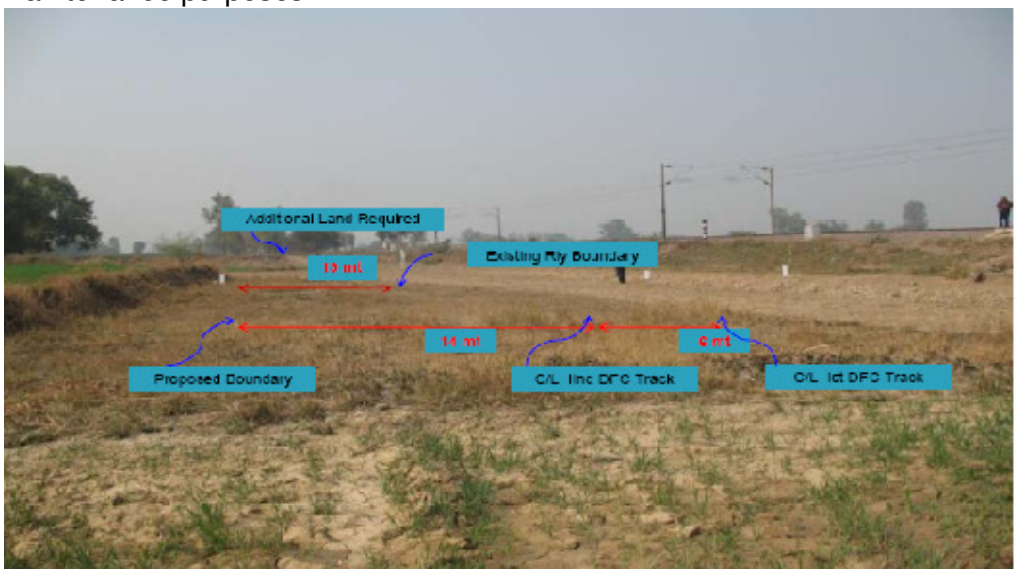
There are about 74 level crossings on the alignment between Bhaupur to Khurja section.

2.4.16 Stations

The Freight Corridor will have two types of stations. Stations required for normal operating requirements are called crossing stations and stations where the loads have to be transferred to/ from existing railway network have been called as Junction Stations. There are 4 Junction Stations at Bhaupur, Tundla, Daudkhan & Khurja. Crossing Stations have been proposed in a manner that there is at least either crossing station or junction station approximately at 40 km. There are total 6 crossing stations on Bhaupur Khurja Line. They are at New Jhinjhak, New Achalda, New Ekdil, Makhanpur, New Mithawali and New Pora. At each station, minimum two numbers of loops, with 750 m CSR have been provided. Sanded Dead Hump has been proposed. At station necessary rooms for S & T have been proposed. Each station will comprise of a small 2-room office with basic amenities for DFC staff.

2.5 Land

Proposed DFC track is planned at about 13-15m c/c from existing UP line of Delhi Howrah route of North Central Railway. Formation width of proposed DFC track (double line) has been planned for 13.5m and side slopes of 2:1 in embankment and 1:1 in cutting. In addition to the above, a minimum 10m & 5m extra land from the toe of the bank is planned for the service road and maintenance purposes.



Since the detour is proposed in embankment, the land requirements are higher compared to the parallel section (about 50m to 60m depending up on height of embankment).

The proposed project stretch will involve acquisition of about 1182 ha of land in which about 85% is under private acquisition, rest 15% is Govt. land. However, the project will require very less about 0.12 ha of built-up area which includes residential, commercial or resi-cum commercial land use. At many built-up locations land width (CoI) has been reduced to as less as 18 m., which resulted in reducing impact on the residential as well as commercial structures.

2.5.1 Utilities

The project involves shifting of number of utility services such as electrical lines (HTL/LTL), transformers, tube wells, bore wells, hand pumps etc. A detailed shifting plan for each of the utilities has been prepared in the project and a summary of utilities that need to be shifted is presented in Table 2.3 and details are given at Annexure 2.1.

Table No. 2.3: Summary of Utilities

Name of utilities	Approx. No.
440 V electric line	35
11 KV electric line	57
33 KV electric line	16
132 KV electric line	61
220 KV electric line	5
400 KV electric line	8
500 KV DC	1
Bore well, Tube well & Hand pumps	58

In general a high tension line runs parallel on south side of the existing alignment. Care has been take to maintain the same pattern in detours sections also (excluding Etawah detour). Hence at every detour high tension line is crossing at two locations. The major utilities to be shifted are towers at Ch. 1088.19, 1176.25 and 1285.25, pole with transformer at Ch. 108.00, underground cable at Ch. 1147.00.

The utilities will be shifted in consultation with the stakeholder agencies including local panchayats and owners of private utilities. Appropriate funds will be allocated in the project for utility shifting.

2.5.2 Turfing

Considering high embankments in detours sections (more than 4 m), turfing has been proposed in detour sections and in major bridge approaches.

2.5.3 Tree Plantation

The project proposes plantation of about 5500 trees average @ 10 trees for per km length of the alignment on either side of the track.

2.5.4 Side Drains

The proposed alignment runs parallel at 13m-15m distance from the existing alignment. In between two embankments, a gully formation is expected. To avoid water logging in the gully areas, concreted side drains (0.75m width with 1:1 side slope) have been proposed. .

2.5.5 Retaining Walls

The project proposes retaining walls to manage site-specific issues such as lack of space or impacts on densely populated areas, etc. The location will be identified in consultation with local population considering the engineering requirements.

2.6 STRUCTURE WORK

2.6.1 Major Bridges

The linear waterway for all the major bridges has been proposed on the basis of span on existing railway line. All the major/important bridges are proposed as PSC girder bridges with substructures on pile foundations. All bridges are to be constructed to DFC Loading Standard with a maximum axle load of 32.5 MT, for the Locomotive and a trailing load of 12 t/m. There are 5 major bridges proposed along the alignment having a total 250m linear waterway.

As presented in Table 2.4, 5 major bridges are proposed at various locations.

Table No. 2.4: Details of the Major bridges

Sl No.	Bridge No.	Proposed Location	Span Arrangement	Name of Location
1	Culvert NO. 304	1054/17-19	3x18.3m	Raipalpur
2	Bharthana MJ1	1976.218	1x12.2m	Bharthana
3	Culvert No. 42	1144/3-5	2x18.3m	Near Etawah
4	162A	1350/546.720	5x12.2m	Bhujpura
5	171	1364/301.435	2x12.2m	Kamarpur

2.6.2 Minor Bridges

RCC boxes are provided at minor bridge locations. As per Railway Board's Circular; the minimum clear span for new bridges has been kept as 1m for proper inspection and maintenance of bridges. All existing minor bridges with a span of less than 1m have been proposed to be extended with to a minimum span of 1.2m opening for crossing the proposed alignment. There are 197 nos. minor bridges along the proposed alignment have a total linear waterway of 829 m.

2.6.3 Railway Flyover

Rail Flyovers have been provided wherever the Freight Corridor line is to cross any existing branch or main line. Rail flyovers are proposed with earthen embankment & main structure with composite Girder.

Rail Flyovers have been provided wherever the Freight Corridor line is to cross any existing branch or main line. Rail flyovers are proposed with earthen embankment & main structure with composite Girder. There are 6 nos. Rail flyovers are provided along the proposed alignment.

The details of the flyovers are given in the Table No. 2.5 below:

Table No. 2.5: Details of Railway flyover

SR NO	BRIDGE NO	CHAINAGE	FORMATION LEVEL	SPAN		REMARKS
				NO	W	
1	BHAUPUR RFO	2195	107.885	1	30.5	Single Line Flyover on Howarah - Delhi Line
2	ET MJ1	2426	153.977	2	30.5	Double Line Flyover on Howrah- Delhi Line
3	ET MJ 2	15793	158.652	3	30.5	Double Line Flyover on Single Etawah-Mainpuri Line
4	ET MJ8	21042.01	160.37	3	30.5	Doubleline flyover Howrah-Delhi line
5	HT MJ1	26/248.396	190.317	3	24.4	Doubleline flyover single Hathras-Killa line
6	HT MJ2	27/319.309	188.339	3	30.5	Double line flyover Mathuira-Hathras line

2.6.4 RUBs (Major)

These types of RUB are those, which cross National Highways or busy state Highways, where spanning arrangement is proposed with 24.4 m to 30.5 m PSC girders. There are 4 nos RUBs which are proposed in the Bhaupur-Khurja section. While deciding the spanning arrangement, future widening of respective road has been duly considered. The details of major RUBs are provided in the Table No. 2.6 below.

Table No. 2.6: Details of Major RUB

SL NO.	BRIDGE NO.	PROPOSED LOCATION	Span Arrangement
1.	ET MJ3	20842	2X24.4m
2	HT MJ3	27/449	1X24.4m
3.	ALG MJ1	5157	1X30.5m
4.	ALG MJ2	6010	2X24.4m

2.6.5 RUBs (Minor)

This type of RUB is proposed on detour portion only. As per the DFC policy, surface crossing on detours are to be avoided. So to facilitate the local public RUBs have been proposed on detour alignment. RUBs have been proposed at each road crossing. Effort has been made to minimize the number of RUBs by diverting the existing roads to the nearest road crossing where RUB has been proposed. Spanning arrangement has been decided as per the requirements of road traffic. A minimum of 5.5 X 3.5 sizes has been proposed for crossing village roads. To cross the district roads & state highways 5.5m x 4.5m and 5.5m x 5.5m sizes have been proposed. Total 82 minor RUBs are proposed. List is given at Annexure-2.2.

2.6.6 Sleepers

60 Kg/90UTS rails on PSC sleepers with a density of 1660 sleepers per km with 300 mm ballast cushion have been provided for the main line. In station yards, for the loop lines, 60Kg rails on PSC sleepers with a density of 1540 sleepers/Km with 300 mm ballast cushion has been proposed. The main line is proposed to be provided with LWR / CWR. Loop line is provided with SWR/ LWR. Entire project length is proposed for track circuiting. Glued joints are provided wherever required. 60 Kg points and crossings on PSC fan shaped layouts are proposed.

Flash butt welding is proposed to convert the single rails into LWR/CWR as per plan approved by DFCCIL by contractor's portable road trailer mounted flash butt welding machine.

The required quantity of ballast to the maximum extent (not less than 4.314 cum per meter length) is to be brought by contractor's dumpers on the formation and laid on the proposed alignment by contractor's pavers. Extensive testing on the completed new tracks is proposed to be done using the track recording and oscillate graph cars for assessing track geometry and ride quality. PSC sleepers are transported from the factory by road and stacked near level crossings. Transportation charges for sleepers have been considered for a distance of 300km. Hard Stone ballast of 65 mm size with 300 mm cushion on the main line, turnouts, on loops and sidings is proposed. Nearly 4.3 cum / running meter of ballast is required for the track.

2.6.7 Electric Sub-stations

The electric sub-stations are having the facilities of signals / relay rooms and have a requirement of area around 140 x 100 m. The sub-stations are having booster transformers and return conductors with a maximum voltage capacity of 27.5 KV.

2.6.7.1 Traction Service Stations (TSS)

The basic consideration in locating the traction substations is to ensure the satisfactory voltage condition on the OHE, while the maximum voltage at sub-station should not exceed 27.5 kV, the voltage of the farthest and based on the traction load conditions taking into account the traffic density, the loads and the speed of the train and terrain shall not fall below 19 kV. These shall be located along the railway track.

2.6.7.2 Sectioning and Paralleling Post (SP)

The conventional neutral section in the OHE at the sectioning and paralleling post is 41 m long and overlap type. The electric locomotive coasts through this dead section in case it comes to a halt under this portion of OHE, there being no power in the OHE, the electric locomotive becomes immobile. In such a situation it needs to be pushed or pulled by another locomotive to bring it under a live OHE. The site for location of the neutral section, therefore, needs to be selected with case, so that the terrain assists the train in negotiating it. Accordingly the natural section for the sectioning post should be located on a straight track at sufficient distance from a stop signal either behind or ahead of it. In undulating terrain the neural section should be located in a valley.

2.6.7.3 Sub-Sectioning and Paralleling Post (SSP)

Between the feeding post and the sectioning post a number of intermediate sub-sectioning and paralleling posts are inserted in the OHE, to provide remote controlled switches for facilitating isolation of faulty sections of OHE.

2.6.7.4 Tower Wagon Sheds

These are proposed at crossing stations and junction stations and at few additional locations.

2.6.7.5 Signal and Signal Rooms

Signals are proposed at every 2 km length with a provision of one signal rooms for ten numbers of signals.

2.7 FENCING

CC Jali fencing shall be provided on all station platforms.

2.8 SERVICE ROAD

As per the policy decided by DFC, service road has been proposed adjoining the embankment. Service road has been planned for 5.5 m width with W.B.M surface. Hume Pipe culverts have been proposed along the service road where there is a minor bridge location on proposed alignment. Service road is discontinued at Major bridges, rail flyovers and densely populated area.

2.9 LABOUR FOR CONSTRUCTION

Adequate number of skilled and unskilled will be employed for a given stretch during the construction phases. Locally labours are available and will be utilized during the construction phase.

2.10 WATER REQUIREMENT

The total water requirement during construction period will be tentatively 3600 cubic meter per kilometre spread over the construction period of about 4 years. The daily requirement for per kilometre length during construction period will be about 5000 litre and will be met through local water resources.

2.11 CONSTRUCTION MATERIAL

Construction material will be required in sufficiently large quantities. While sand will be obtained from River Yamuna (within 100 km from the Project alignment), rail, sleepers, cement and steel will be obtained through respective by manufacturers.

The project involves estimated 95,000 cubic meter of earthwork in cutting and 17,000,000 cubic meter of earth work in embankment. Borrow earth for these activities will be obtained by the contractor from the borrow areas, as per the guidelines detailed out in the subsequent sections of this EA report.

It is estimated that about 1,350,000 cubic meter of ballast would required for laying the track. The ballast would be obtained by the contractor from authorized quarries, as approved by the engineer in charge and in compliance to the guidelines detailed out in the subsequent sections of this report.

2.12 CONSTRUCTION PERIOD

The construction period for the completion of the freight corridor from Bhaupur to Khurja will be four years.

ANNEXURE-2.1

DETAILS OF UTILITY (ELECTRICAL) TO BE AFFECTED (BHAUPUR-KHURJA)

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
1	1040/33-1041/01	BPU	400 Kv	37 Mt	141 Mt	37.0 Mt	74.0 Mt	37 Mt	77.0 Mt	14.0 Mt	-	PGCIL	Existing Track Crossing.
2	1054/23-25	MTO-RRH	132 KV	26 Mt.	37.20 Mt.	-	-	26 Mt.	16.20 Mt.	15 + 6 Mt.	-	NCR	132 KV Tower Line of Rly Runs parallel.
3	1055/3-5	MTO-RRH	132 KV	26 Mt.	50.00 Mt.	-	.	26 Mt.	29 Mt.	15 + 6 m	-	NCR	-do-
4	1060/21-23	MTO-RRH	33 KV	30 Mt.	35.70 Mt.	30 Mt.	58.60 Mt.	30 Mt.	14.70 Mt.	15 + 6 Mt.	-	UPPCL	To Be Modified by U/G cbl
5	1062/21-23	RRH-AAP	11 KV	9 Mt.	20.00 Mt.	9 Mt.	24 Mt.	9 Mt.	(-)1.0 Mt.	15 + 6 Mt.	-	UPPCL	By U/G & Shifting of Pole
6	1062/27-29	RRH-AAP	132 KV	26 Mt.	51.20 Mt.	-	-	26 Mt.	30.20 Mt.	15 + 6 Mt.	-	NCR	132 KV Tower Line of Rly Runs parallel.
7	1063/1-2	RRH-AAP	132 KV	26 Mt.	31.87 Mt.	-	-	26 Mt.	10.87 Mt.	15 + 6 Mt.	-	NCR	-do-
8	1063/9-10	RRH-AAP	132 KV	26 Mt.	35.75 Mt.	-	-	26 Mt.	14.75 Mt.	15 + 6 Mt.	-	NCR	-do-
9	1073/1-2	AAP-JJK	500 KV DC	36 Mt.	63.00 Mt.	36 Mt.	80 Mt.	36 Mt.	42 Mt.	15 + 6 Mt.	21.76 Mt.	PGCIL	Modification are not required
10	1077/5-7	AAP-JJK	132 KV	26 Mt.	47.39 Mt.	-	-	26 Mt.	26.39 Mt.	15 + 6 Mt.	-	NCR	132 KV Tower Line of Rly Runs parallel.
11	1077/9-11	AAP-JJK	132 KV	26 Mt.	50.00Mt.	-	-	26 Mt.	29 Mt.	15 + 6 Mt.	-	NCR	-do-
12	1077/15-17	AAP-JJK	132 KV	26 Mt.	49.50 mt.	-	-	26 Mt.	28.50 Mt.	15 + 6 Mt.	-	NCR	-do-
13	1077/21-23	AAP-JJK	132 KV	26 Mt.	50.00 Mt.	-	-	26 Mt.	29 Mt.	15 + 6 Mt.	-	NCR	-do-
14	1081/15-17	JJK-KNS	11KV	9.0Mt.	21.2 Mt	9M	32.4Mt	9.0M	0.20M	15+6 Mt.		UPPCL	11Kv U/G cable
15	1087/1-3	JJK-KNS	400V	9.0Mt.	24.9 Mt	-	-	9.0m	3.90m	15+6 Mt	-	UPPCL	Pole to be

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
													shifted.
16	1088/19	JJK-KNS	132Kv	26m	37.2 Mt	-	-	26.0 m	16.20 m	15+6 m	Tower Line of Rly runs parallel	NCR	Tower to be Shifted.
17	1088/27 - 1089/01	JJK-KNS	132 kv	26m	15.48m	-	-	26m	(-) 5.52m	15+6 m	-do-	-do-	-do-
18	1098/11-13	KNS- PHD	33 kv	14.0 m	21.0m	14.00	20.50	14m	0	15+6 m	U/ ground	UPPCL	Pole to be shifted.
19	1100/29-30	PHD- PTX	11Kv	9.0m	18.0m	9.0m	19.50	9.0m	(-) 3m	15+6 m	U/ ground	UPPCL	Pole to be shifted.
20	1100/31-33	PHD- PTX	400v	9.0m	16.50m	-	-	9.0m	(-) 4.50m	15+6 m	-	-do-	-do-
21	1100/35-1101/09	PHD- PTX	11Kv	10.0m	20.0m	-	-	10.0m	(-)1.0 m	15+6m	U/ ground	-do-	One crossing along with 5 Pole to be shifted.
22	1101/9-11	PHD- PTX	33Kv	10.0M	12.80m	10.0m	18.50 m	10.0m	(-) 8.20m	15+6m	U/ ground	UPPCL	Crossing to be shifted.
23	1101/9 to 1104/9	PHD- PTX	33Kv	10.0M	15.0 to 18.0 m	-	-	10.0m	(-)6m	15+6 m	Over head	UPPCL	Total 34 Pole to be shifted.
24	1102/1-3	PHD- PTX	400 kv	28.0m	45.60m	28.0m	100.00 m	28.0m	24.0m	15+6 m	20.0m	NTPC	400KV Kanpur to Etawah Feeder.
25	1102/1-3	PHD- PTX	33kv	10.0m	29.80m	10.0m	30.0m	10.0m	8.80m	15+6 m	U/ ground	UPPCL	Crossing to be shifted along with 2 Span Over head wire
26	1108/ 00	PATA STN	400v	10.0m	36.0m	-	-	10.0m	2.0m	28+ 6 m	-	UPPCL	Pole with Transformer to be shifted.

LIST OF ELECTRICAL /tower LINE COSSINGS SECTION:- ACHHALDA BY PASS

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
27	1012.24		132 KV										Tower Line(NCR)
28	1521.71		11 KV										Electric Pole
29	1733.37		11 KV										Electric Pole
30	1885.6		11 KV										Electric Pole
31	3540		132 KV									Tower Line(NCR)	
LIST OF ELECTRICAL /tower LINE COSSINGS Parallel Section													
32	1121/7-9	ULD- SHW	132 Kv	26.0m	41.0m	-	-	26.0m	20.0m	15+6 m	-	NCR	T No. 302
33	1121/15-17	ULD- SHW	132 Kv	26.0m	38.50m	-	-	26.0m	17.50m	15+6m	Tower Line of Rly runs parallel	NCR	T. No. 303
34	1121/25-27	ULD- SHW	132 Kv	26.0m	36.60m	-	-	26.0m	15.60m	15+6m	-do-	-do-	T. No. 304
35	1122/5-7	PTX- SHW	132kv	26.0m	34.0m	-	-	26.0m	13.0m	15+6m	Tower Line of Rly runs parallel	NCR	T. NO. 305 to be shifted.
36	1122/15-17	PTX- SHW	132kv	26.0m	32.70m	-	-	26.0m	11.70m	15+6m	-do-	-do-	T . No. 306 to be shifted.
37	1122/23-25	PTX- SHW	132kv	26.0m	29.50m	-	-	26.0m	8.50m	15+6m	-do-	-do-	T. No. 307 to be shifted.
38	1123/5-7	PTX- SHW	132kv	26.0m	26.75m			26.0m	5.75m	15+6m	-do-	-do-	T. No. 308 to be shifted.
39	1128/21-23	SHW- BNT	220kv	32.0m	50.60m	32.00m	84.0m	32.0m	29.60m	15+6 m	20.60m	NTPC	Crossing of AOR- Agi Feeder
40	1130/5-7	SHW- BNT	132 kv	32.0m	130.0m	32.0m	70.0m	32.0,	109.0m	15+6 m	18.0m	NCR	-----
LIST OF ELECTRICAL /tower LINE COSSINGS SECTION:- BHARTHANA BY PASS													

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
41	1251.86		132 KV										Tower Line(NCR)
42	2330.6		11 KV										Electric Pole
43	2911.37		220 KV										Tower Line(PGCIL)
44	6703.21		11 KV										Electric Pole
45	6703.02		11 KV										Electric Pole
46	9266.66		132 KV										Tower Line(NCR)
LIST OF ELECTRICAL /tower LINE COSSINGS Parallel Section													
47	1139/3-5	BNT- EKL	132kv	26.0m	44.0m	-	-	26.0m	23.0m	15+6m	Tower line of Rly runs parallel	NCR	T. No. 358 to be shifted.
48	1139/3-5	BNT- EKL	440 v	9.0m	20.30m	-	-	9.0m	(-) 0.70m	15+6 m	-	UPPCL	Pole to be shifted.
49	1139/5-7	BNT- EKL	400 v	9.0m	18.0m	-	-	9.0m	(-)3.0m	15+6 m	-	UPPCL	Pole to be shifted.
50	1139/11-13	BNT- EKL	132kv	26.0m	44.0m	-	-	26.0m	18.0m	15+6m	Tower	NCR	T. No. 359 to be shifted.
51	1139/13-15	BNT- EKL	33kv	10.0m	34.0m	10.0m	31.50 m	10.0m	13.0m	15+6m	U/ ground	UPPCL	Crossing pole to be shifted.
52	1139/21-23	BNT- EKL	132kv	26.0m	43.0m	-	-	26.0m	17.0m	15+6m	Tower line of Rly runs parallel	NCR	T. No. 360 to be shifted.
53	1140/1-3	BNT- EKL	132kv	26.0m	43.60m	-	-	26.0m	17.50m	15+6m	-do-	NCR	T. No. 361 to be shifted.

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
54	1140/5-7	BNT- EKL	11kv	9.m	13.m	9.0m	15.24 m	9.0m	(-) 8.0m	15+6m	U/ ground	NCR	Crossing pole to be shifted.
55	1140/11-13	BNT- EKL	132kv	26.0m	44.0m	-	-	26.0m	18.0m	15+6m	Tower Line of RLY runs parallel	NCR	T. No. 362 to be shifted.
56	1140/21-23	BNT- EKL	132kv	26.0m	46.0m	-	-	26.0m	25.0m	15+6m	-do-	NCR	T. NO. 363 to be shifted.
57	1141/3-7	BNT- EKL	440 v	9.0m	18.0m	-	-	9.0m	(-) 9.0m	15+6m	LT Line	UPPCL	Pole to be shifted.
58	1141/15-17	BNT- EKL	400kv	32.0m	65.0m	32.0m	100.0 m	32.0m	44.0m	15+6m	21.50m	PGCL	-
59	1141/37	BNT- EKL	440 v	9.0M	13.0M	-	-	9.0M	(-) 8.0M	15+6m	-	UPCCL	Pole to be shifted.
60	1143/25-27	BNT- EKL	132kv	26.0m	45.0m	-	-	26.0m	24.0m	15+6m	Tower Line Rly runes parallel	NCR	T. NO. 373
61	1144/3-5	BNT- EKL	132kv	26.0m	44.0m	-	-	26.0m	23.0m	15+6m	-do-	NCR	T. No. 374
62	1144/11-13	BNT- EKL	132kv	26.0m	43.0m	-	-	26.0m	22.0m	15+6m	-do-	NCR	T. No. 375
63	1144/19-21	BNT- EKL	132kv	26.0m	43.0m	-	-	26.0m	22.0m	15+6m	-do-	NCR	T. NO. 376
64	1144/27-1145/01	BNT- EKL	132kv	26.0m	43.0m	-	-	26.0m	22.0m	15+6m	Tower Line of Rly runs parallel	NCR	T. No. 377
65	1145/9-11	BNT- EKL	132kv	26.0m	42.0m	-	-	26.0m	21.0m	15+6m	-do-	NCR	T. No. 378
66	1145/19-21	BNT- EKL	132kv	26.0m	38.0m	-	-	26.0m	17.0m	15+6m	-do-	NCR	T. No. 379

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
67	1146/1-3	BNT- EKL	132kv	26.0m	44.0m	-	-	26.0m	23.0m	15+6m	-do-	NCR	T. No. 380
68	1146/13-15	BNT- EKL	132kv	26.0m	31.0m (from Loop)	-	-	26.0m	10.0m	15+6m	-do-	NCR	T. No. 381
69	1146/23-25	BNT- EKL	132kv	26.0m	23.0m (from Loop)	-	-	26.0m	2.0m	15+6m	-do-	NCR	T. No. 382
70	1146/31-33	BNT- EKL	132kv	26.0m	39.0m	-	-	26.0m	18.0m	15+6m	-do-	NCR	T. No. 383
71	1147/1-5	BNT- EKL	11kv	9.0m	15.0m	9.0m	28.0m	9.0m	(-)6.0m	15+6m	-do-	NCR	U/G Cable with 2 span over head to be shifted.
LIST OF ELECTRICAL /tower LINE COSSINGS Etawah by pass													
72	268		132Kv	----							Tower Line(NCR)		
73	2326		132 Kv								Tower Line(NCR) T No. 391		
74	3578		11 Kv								Electric Pole		
75	3835		11 Kv								Electric Pole		
76	4950		33 Kv								Electric Pole		
77	5220		11 Kv								Electric Pole		
78	7158		11 Kv								Electric Pole		
79	7350		132 Kv								Tower Line -UPPCIL (Trans)		
80	8435		11 Kv								Electric Pole		
81	11560		11 Kv								Electric Pole		
82	15156		11 Kv								Electric Pole		

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
83	15450		11 Kv								Electric Pole		
84	15650		400 Kv								Tower Line		
85	15780		11 Kv								Electric Pole		
86	16130		11 Kv								Electric Pole		
87	16485		400 V								Electric Pole		
88	16910		11 Kv								Electric Pole		
89	17730		11 Kv								Electric Pole		
90	19910		11 Kv								Electric Pole		
91	19925		400 Kv								Tower Line		
92	21080		11 Kv								Electric Pole		
93	22330		11 Kv								Under Ground at Ext. Track 1168/6-8		
LIST OF ELECTRICAL /tower LINE COSSINGS parallel section													
94	1170/9-11	SB- JGR	132kv	26.0m	60.0m	-	-	26.0m	-	-	T. No. 462	NCR	DFC alignment increased due to new RUB under construction.
95	1170/17-17A	SB- JGR	132kv	26.0m	47.50m	-	-	26.0m	-	-	T.No. 463	NCR	DFC Boundary 52 Mtr.
96	1172/15-17	SB- JGR	Micro Wave Tower	65.0m	31.50m	-	-	65.0m	10.0m	-	Micro Wave Tower	NCR	Jaswant Nagar STN.
97	1172/29-31	JGR STN	440v	8.0m	19.0m	-	-	8.0m	4.0m	15.0m	-	NCR	4 Nos LT Pole to be Shifted.

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
98	1173/5-7	JGR- BBL	11kv	9.0m	16 to 23.0m	-	-	9.0m	-	15+6m	-	UPPCL	3 Span over head to be shifted.
99	1173/15-17	JGR- BBL	11kv	9.0m	24.0m	9.0m	19.50 m	9.0m	3.0m	15+6m	U/ground	UPPCL	Under ground to be shifted.
100	1176/25-27	JGR- BBL	132kv	26.0m	31.0m	-	-	26.0m	10.0m	15+6m	Tower line of NCR runs parallel.	NCR	Tower to be shifted.
101	1176/23-27	JGR- BBL	440v	8.0m	12.0m	-	-	8.0m	-	15+6m	-	UPPCL	3 Pole at Vill-Rajpur to be shifted.
102	1180/27-29	BBL Stn	11kv	9.0m	15.20m	9.0m	16.50 m	9.0m	-	15+6m	-	UPPCL	Xing and Transfer & 8 pole to be shifted.
103	1180/29 & 1181/7	BBL Stn	440v	8.0m	24.0m	-	-	8.0m	2.0m	16+6m	LT over head	NCR	8 Pole at STN to be shifted.
LIST OF ELECTRICAL /tower LINE COSSINGS parallel section													
104	1270/17-19	CMR- JLS	440v	8.0m	32.0m	-	-	8.0m	11.0M	15+6m	LT Pole	UPPCL	Pole to be shifted.
105	1275/31-33	CMR- JLS	440v	8.0m	43.0m	-	-	8.0m	22.0m	15+6m	-	UPPCL	----
106	1276/13-25	JLS STN	11kv	9.0m	11-16m	9.0m	24.0m	9.0m	-	7+6m	U/ ground	UPPCL	4 Pole & crossing of U/ground cable to be shifted.
107	1285/25-27	Pora STN	Mob. Tower	73.0m	18.0m	-	-	73.0m	-	15+6m	-	-	Tower to be shifted.

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
108	1286/23-25	Pora -HRS	11 kv	9.0m	17.0m	9.0m	14.0m	9.0m	(-)4.0m	15+6m	U/ ground	UPPCL	To be shifted.
LIST OF ELECTRICAL LINE COSSINGS SECTION:- HATHRUS BY PASS													
109	580		132 KV									Tower Line(NCR)	
110	1255		440 V									Electric Pole	
111	1680		440 V										E.P
112	2420		440 V										E.P
113	5240		…….								Rail crossing Hathras Quila		
114	5420		11 KV										E.P
115	5660		440 V										E.P
116	6080		440 V										E.P
117	6320		……..									Rail crossing Mathura	
118	6640		11 KV										E.P
119	6960		11 KV										E.P
120	7780		440 V										E.P
121	8140		11 KV										E.P
122	9100		132 KV									Tower Line(NCR)	
LIST OF ELECTRICAL LINE COSSINGS SECTION:- PARALLEL SECTION													
123	1305/25-27	SNS	440v	8.0m	15.0m	-	-	8.0m	0	15m	-	UPPCL	One pole to be shifted.

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
124	1305/33A-35A	SNS- MXK	33kv	20.0m	35.50m	20.0m	30.0 m	20.0m	14.50m	15+6m	-	UPPCL	-----
125	1306/27-29	SNS- MXK	440v	8.0m	35.50m	-	-	8.0m	14.50m	15+6m	-	UPPCL	-----
126	1307/17-19	SNS- MXK	400kv	40.0m	64.0m	40.0m	60.0 m	40.0m	43.0m	15+6m	22mtr	NTPC	-----
127	1308/3-5	SNS- MXK	440v	9.0m	45.0m	-	-	9.0m	24.0m	15+6m	-	UPPCL	-----
128	1308/17-19	SNS- MXK	132kv	30.0m	44.0m	30.0m	170.0 m	30.0m	23.0m	15+6m	-	UPPCL	-----
129	1311/27-33	SNS- MXK	440v	9.0m	17.0m	-	-	9.0m	(-) 4.0m	15+6m	-	UPPCL	Pole to be shifted.
130	1311/33-1312/5	MXK	11kv	9.0m	14.0m	-	-	9.0m	0	15m	-	UPPCL	6- Pole to be shifted.
131	1313/17-19	MXK- DAQ	132kv	32.0m	200m	32.0m	80.0 m	40.0m	179.0m	15+6m	13m	UPPCL	----
132	1314/5-7	MXK- DAQ	400kv	40.0m	250m	40.0m	70.0 m	40.0m	229m	15+6m	Xing under progress	NTPC	------
133	1316/15-17	MXK- DAQ	33kv	18.0m	25.50m	18.0m	21.0 m	18.0m	4.50m	15+6m	12.0m	UPPCL	To be shifted.
133A	1318/33 - 1319/1	MXK- DAR	440v	9.0m	24.0m	-	-	9.0m	3.0m	15+6m	-	NCR	Pole to be shifted.
135	1250		132 KV								Tower Line (Aligarh-Hathras Feedar)		
136	1610		11 KV										Electric Pole
137	2050		440 V										E.P
138	2100		440V										E.P

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
139	1900-3000		132 Kv						No Towers (NCR) running parallel to DFC alignment (Aprox. Dist 25-30 mtr)				
140	3740		11 KV										E.P
141	4080		11 KV										E.P
2	4980		11 KV										E.P
143	5130		33 KV										E.P
144	5140		11 KV										E.P
145	5160		33 KV										E.P
146	5990		33 KV										E.P
147	6010		33 KV										E.P
148	7110		11 KV										E.P
149	7770		11 KV										E.P
150	7840		11 KV										E.P
151	8790		33 KV										E.P
152	8820		33 KV										E.P
153	8860		11 KV										E.P
154	8890		440 V										E.P
155	9060		11 KV										E.P
156	9150		11 KV										E.P
157	9920		11 KV										E.P

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
158	12180		440 V										E.P
159	12440		440 V										E.P
160	12690		11 KV										E.P
161	13920		11 KV										E.P
162	15150		11 KV										E.P
163	16020		440 V										E.P
164	16800		440 V										E.P
165	17680		440 V										E.P
166	18110		440 V										E.P
167	18740		440 V										E.P
168	19220		440 V										E.P
169	19500		440 V										E.P
170	21340		440 V										E.P
171	21450		440 V										E.P
172	23060		11 KV										E.P
173	23270		440 V										E.P
174	23740		11 KV										E.P
175	25310		11 KV										E.P
176	26090		11 KV										E.P

Sr. No.	Location of Exist Rly Track	Section	Voltage	Left Side Exist		Right Side Exist		Adjouning Span of DFCC		Distance Between Main Track & Proposed By DFCC	Prop.Ht of lowest Conductor from DFCC	Related Electricity Board/ Power Grid	Remarks
				Ht of Pole	Distance	Ht of Pole	Distance	Ht of Pole	Distance				
				Phasing to DLI Side									
177	26300		132 KV										Tower Line(NCR)
178	1352/13-15	SOM/DAR	11 Kv	-	32.75	-	26.35	-	4.20m	22.55+6	-	UPPCL	SOO(I) Caldiggi Aligarh
179	1365/31-1	DAR - KHJ	132 Kv	-	52.95	-	59.55	-	22.95	24+6	-	NCR	Sr. DEE/TRD/ALD
180	1368/3-5	DAQ-KHJ	33Kv	-	26.90	-	27.50	-	(-) 3.10	24+6	-	UPPCL	To be shifted.

ANNEXURE-2.2

DETAILS OF MINOR RUB

SR. NO.	Prop. Bridge No.	PRO.CH.	PROPOSED SPAN	Project Sheet No.
BHAUPUR FLYOVER RUB				
1	1	3834.108	1X5.5X3.5	1
2	2	4942.520	1X5.5X3.5	1
Total RUB - 02				
ACCHALDA BY PASS				
3	AC 1	1521.714	1x 5.5x 3.5	52
4	AC 2	1733.164	1x 5.5x 4.5	52
5	AC 3	1865.594	1x 5.5x 3.5	52
6	AC 4	2288.074	1x 5.5x 3.5	52
7	AC 5	2422.304	1x 5.5x 4.5	52
8	AC 6	3486.314	1x 5.5x 3.5	52
9	AC 7	3675.504	1x 5.5x 3.5	52
10	AC 8	3916.594	1x 5.5x 3.5	52
Total RUB - 8				
BHARTHANA BY PASS				
11	BR 1	1168.043	1x 5.5x 3.5	63
12	BR 2	2330.812	1x 5.5x 3.5	63
13	BR 3	3629.607	1x 5.5x 3.5	63
14	BR 4	3802.862	1x 5.5x 3.5	63
15	BR 5	4576.110	1x 5.5x 3.5	63
16	BR 6	5521.398	1x 5.5x 3.5	64
17	BR6A	5980.507	1x 5.5x 3.5	64
18	BR 7	6537.813	2x 5.5x 3.5	64
19	BR 8	7020.084	1x 5.5x 3.5	64
20	BR 9	7802.181	1x 5.5x 4.5	64
21	BR 10	8222.781	1x 5.5x 3.5	64
22	BR 11	8400.876	1x 5.5x 3.5	64
23	BR 12	8648.516	1x 5.5x 3.5	64
24	BR 13	9234.960	1x 5.5x 4.5	64
Total RUB - 14				
ETAWAH BY PASS				
25	ET 1	1445.690	1x 5.5x 4.5	70
26	ET 2	2189.620	1x 5.5x 5.5	70
27	ET 3	2547.790	1x 5.5x 5.5	70
28	ET 4	3527.410	1x 5.5x 3.5	70
29	ET 5	3785.300	1x 5.5x 3.5	70

30	ET 6	4127.650	1x 5.5x 3.5	70
31	ET 7	4748.470	1x 5.5x 4.5	70
32	ET 8	4929.240	2x 7.5x 5.5	70
33	ET 9	5225.600	1x 5.5x 4.5	71
34	ET 10	7590.910	1x 5.5x 5.5	71
35	ET 11	8241.920	2x 7.5x 5.5	71
36	ET 12	9786.680	1x 5.5x 3.5	71
37	ET 13	11088.162	1x 5.5x 4.5	72
38	ET 14	11548.820	2x 7.5x 5.5	72
39	ET 15	12183.490	1x 5.5x 3.5	72
40	ET 16	13251.957	1x 5.5x 3.5	72
41	ET 17	14151.040	1x 5.5x 3.5	72
42	ET 18	14688.570	1x 5.5x 3.5	72
43	ET 19	15656.420	2x 7.5x 5.5	73
44	ET 20	16279.680	1x 5.5x 5.5	73
45	ET 21	16579.800	1x 5.5x 4.5	73
46	ET 22	17405.427	1x 5.5x 3.5	73
47	ET 23	17710.740	1x 5.5x 3.5	73
48	ET 24	19921.780	1x 5.5x 3.5	73
49	ET 25	20069.680	1x 5.5x 4.5	74
50	ET 26	22521.640	1x 5.5x 4.5	74
51	ET 27	23349.293	1x 5.5x 3.5	74
Total RUB - 27				
HATHRAS BY PASS				
52	HT 1	22/881.263	1x 5.5x 3.5	130
53	HT 2	23/162.498	1x 5.5x 3.5	130
54	HT 3	24/586.461	1x 5.5x 3.5	131
55	HT 4	25/577.853	1x 5.5x 3.5	132
56	HT 5	26/374.935	1x 5.5x 3.5	132
57	HT 6	26/632.878	1x 5.5x 3.5	133
58	HT 7	28/467.976	1x 5.5x 3.5	134
59	HT 8	29/455.236	1x 5.5x 3.5	135
Total RUB - 8				
ALIGARH BY PASS				
60	ALG 1	3112.694	2x7.5x 5.5	146
61	ALG 2	6825.400	1x5.5x 4.5	147
62	ALG 3	7046.554	1x5.5x 3.5	147
63	ALG 4	7430.524	1x5.5x 3.5	147
64	ALG 5	8801.547	2x7.5x 5.5	147

65	ALG 6	11041.385	1x5.5x 3.5	148
66	ALG 7	116.10.836	1x5.5x 3.5	148
67	ALG 8	11630.050	1x5.5x 3.5	148
68	ALG 9	12461.703	2x7.5x 5.5	148
69	ALG 10	12915.287	1x5.5x 3.5	148
70	ALG 11	14041.505	1x5.5x 3.5	148
71	ALG 12	14643.982	1x5.5x 4.5	148
72	ALG 13	15016.000	1x5.5x 3.5	149
73	ALG 14	15362.188	1x5.5x 3.5	149
74	ALG 15	16283.952	1x5.5x 3.5	149
75	ALG 16	16968.503	1x5.5x 3.5	149
76	ALG 17	18012.871	1x5.5x 3.5	149
77	ALG 18	18870.770	1x5.5x 3.5	149
78	ALG 19	19776.117	1x5.5x 3.5	149
79	ALG 20	21345.000	1x5.5x 3.5	150
80	ALG 21	23442.470	1x5.5x 3.5	150
81	ALG 22	24852.061	1x5.5x 3.5	150
82	ALG 23	26673.254	1x5.5x 3.5	151
Total RUB - 23				
Total RUB(BHAUPUR TO KHURJA = 82				

CHAPTER-3: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This chapter reviews the existing institutional and legislative set-up pertaining to the project at the National and state levels. The chapter also elaborates on the various clearances and permissions required for the project from Government of Uttar Pradesh, Ministry of Environment and forests, Government of India.

3.1 INSTITUTIONAL SETTING

The project has been initiated and is being carried out by the DFCC. The primary responsibility of the project rests with the DFCC in providing encumbrance free ROW to the concessionaire who shall implement the project. The main government agencies who uphold the implementation of the various environmental legislations are:

- Ministry of Environment and Forests, Government of India (MOEF), New Delhi formulates and regulates all country level legislations besides giving prior environmental clearances through a committee for category A projects, wild life clearances and forest diversion clearances.
- State Level Environmental Impact Assessment Authority (SEIAA), Hyderabad, gives prior environmental clearances to category B projects.
- Central Pollution Control Board (CPCB) monitors and implements pollution related legislations.
- State Pollution Control Board monitors and implements pollution related legislations in the state besides giving NOC for establishing and operating plants under air and water acts.
- State Department of Forests gives permission for forest diversion and felling of trees.

3.2 THE LEGAL FRAMEWORK

The Governments of India, Uttar Pradesh and the World Bank have formulated a host policy guidelines; acts and regulations aimed at protection and enhancement of environmental resources. The following sections discuss the various legal issues associated with the project.

3.2.1 Country Level Environmental Legislations

Table 3.1 provides the legislations pertaining to the project that has been framed by the Government of India.

Table 3.1: Country Level Environmental Laws & Regulations

Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
1	The Environmental (Protection) Act. 1986, and Rules	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	MoEF, State Department of Environment, CPCB and UPPCB
2	The EIA Notification, 2006	Railway projects are exempted from this notification	No	Railway projects are exempted	N/A
3	The Water (Prevention and Control of Pollution) Act, 1974	Central and State Pollution Control Board to establish/enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction/operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	UP Pollution Control Board
4	The Air (Prevention and Control of Pollution) Act. 1981	Empowers SPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of plants and crushers	UP Pollution Control Board
5	Noise Pollution (Regulation And Control) Act, 2000	Standards for noise emission for various land uses	Yes	construction machineries and vehicles to conform to the standards for construction	UP Pollution Control Board
6	Forest (Conservation) Act, 1980	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the act	Yes	Involvement of forest land diversion for the project	State Forest Department, MoEF
7	Wild Life Protection Act, 1972	Protection of wild life in sanctuaries and National Park	No	No sanctuaries / national park in the project area	N/A
8	Ancient Monuments and Archaeological sites and Remains (Amendment and Validation) Act, 2010	To protect and conserve cultural and historical remains found.	Yes	Normally not applicable, but applies to chance find	Archaeological Survey of India, Dept. of Archaeology
9	The Motor Vehicle Act. 1988	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions.	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
10	The Explosives Act (& Rules) 1884 (1983)	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying.	Yes	If new quarrying operation is started by the concessionaire / contractor	Chief Controller of Explosives
11	Public Liability And Insurance Act,1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials shall be used for road construction	
12	Hazardous Wastes (Management, Handling and Transboundary) Rules, 2008	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	UP Pollution Control Board
13	Chemical Accidents	Protection against chemical	Yes	Handling of	District & Local

Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
	(Emergency Planning, Preparedness and Response) Rules, 1996	accident while handling any hazardous chemicals resulting		hazardous (flammable, toxic and explosive) chemicals during road construction	Crisis Group headed by the DM and SDM
14	The Petroleum Rules,2002	Storage of diesel, petroleum products for operation of construction equipment etc.	Yes	Storage of Petroleum products is restricted as per The PESO	CCoE or DM
15	National Green Tribunal (Prevention and Protection) Rules, 2011	For settling dispute if any in connection with forest, wenvironmental issues	Yes	Project requires forest land diversion and observation of environmental laws during construction	MoEF
16	Railway(Amendment) Act,2008	Compensation for land	Yes	Some land will be acquired for the project	DFCCIL

3.2.2 State Level Environmental Legislation

The consent under Air and Water Act are under the preview of UP Pollution Control Board. Moreover, clearances for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts, establishing new quarries and establishment of new tube-wells / bore-holes is from SPCB, State Department of Mining and Sate Ground Water Boards / Authorities respectively.

3.2.3 Other Legislations Applicable to Road Construction Projects

The concessionaire shall ensure that other legislations like Child Labour (prohibition and Regulation) Act; 1986, Minimum Wages Act; 1948, The factories Act; 1948, The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 etc. are followed.

3.2.4 World Bank Operational Policies

The operational policies of the Bank, both triggered and non triggered, the details and the applicability to the Project road are provided in the Table 3.2. The World Bank environment assessment (EA) requirements are based on a three-part classification system such as Category A, Category B and Category C as defined by the World Bank OP 4.01. A Project designated as Category A, requires a full environmental assessment (EA) whereas Category B projects require a lesser level of environmental investigation. Category C projects require no environmental analysis beyond that determination.

Table No. 3.2: World Bank Safeguard Policies

Sl. No.	Safeguard Policy	Subject Category	Triggered	Triggered By	Mitigation Measures	Documentation
1.	OP 4.01	Environment Assessment	Yes	Sensitive areas and impacts on environmental and social components	Mitigation measures incorporated	EIA and EMP prepared
2.	OP 4.04	Natural Habitats	Yes	Reserve forests issues	Incorporated	EIA and EMP
3.	OP 4.11	Physical Cultural Resources	Yes	Risk to cultural properties	Adequate mitigation measures if affected	EMP & RAP prepared
4.	OP 4.36	Forestry	Yes	Diversion of forest land	To be carried out as	Not Applicable

Sl. No.	Safeguard Policy	Subject Category	Triggered	Triggered By	Mitigation Measures	Documentation
					per Forest (conservation) Act, 1980	

3.2.5 Type of Project

For projects with potential to have significant adverse environmental impacts (Category A) an environmental impact assessment (EIA) is required. Category B projects are judged to have some adverse environmental impacts, but of lesser degree or significance than those for category A projects and require an Environmental Assessment (EA) to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the EA is regarded as the final environmental assessment report as is the case for this project. The project railway line passes through very small patches of degraded forests area. No presence of endangered fauna and flora along the project railway line envisaged. It may also be mentioned that there is only marginal acquisition for forest land due to the proposed project. The Government of India has issued Environmental Impact Assessment Notification in 1994 as a part of Environmental (Protection) Act, 1986 and amendments in September 2006. Railway projects do not fall under any category requiring an environmental clearance from MoEF. Only No Objection Certificate (NOC) is required from SPCB under the Air and Water Acts.

It has been established that there is a need for improving the infrastructure capacity of the transport sector to cater the projected demand for freight and good movement. By building up the rail infrastructure which uses $1/6^{th}$ the fossil fuel consumption as compared to road, overall improvement n environmental condition is envisaged. Over and above since traction in this case would be electricity based, there is a possibility that this electricity can come from the budding nuclear capacity of the nation. Thus there can not be more eco-friendly and efficient transport system to meet with the demand of India's growth economy.

Since this is a large scale project and likely to have some reversible impacts on environment during construction phases & some impact, not of much significance, during operation, this project is being considered as **'A' category** project as per the World Bank safeguard policy. This will help not only in tweaking the construction stage to be more eco-compliant but setting systems to have better and more environment friendly construction in forthcoming railway projects. DFCCIL is committed to establish most efficient and eco-friendly system.

3.2.6 Clearance Requirements for the Project

The summary table showing time requirements for agency responsible for obtaining clearance, and a stage at which clearance will be required is given below:

Table No. 3.3: Summary of Clearances & NOCs

Sl. No	Type of clearance	Statutory Authority	Applicability	Project stage	Time required	Responsibility
1	Prior Environmental Clearance	SEIAA	Not applicable	Pre construction	-	DFCC
2	Permission for Activities near archaeological protected area	Archaeological survey of India / the state department of Archaeology	Not applicable	Pre construction	-	DFCC
3	Clearance for working / diversion of sanctuary land	Chief Wild Life Warden	Not applicable	Pre construction	-	DFCC
4	Forest Clearance	State Department of Environment and Forest and MoEF	Diversion of Forest land	Pre construction	6-8 months	DFCC
5	Tree felling permission	Forest department	Felling of trees	Pre construction	15 days	DFCC
6	NOC And Consents Under Air , Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For establishing plants	Construction (Prior to work initiation)	2-3 months	Concessionaire / Contractor
7	NOC And Consents Under Air , Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For operating Hot mix plants, Crushers and batching plants	Construction (Prior to work initiation)	1-2 months	Concessionaire / Contractor
8	Permission to store Hazardous Materials	State Pollution Control Board	Storage and Transportation Of Hazardous Materials and Explosives	Construction (Prior to work initiation)	2-3 months	Concessionaire / Contractor
9	Explosive license	Chief controller of explosives	Storage of explosive materials	Construction (Prior to work initiation)	2-3 months	Concessionaire / Contractor
11	PUC certificate for use of vehicles for construction	Department of Transport	For all construction vehicles	Construction (Prior to work initiation)	1-2 months	Concessionaire / Contractor
12	Quarry lease deeds and license	Dept. of Geology and Mines	Quarrying and borrowing operations	Construction (Prior to work initiation)	2-3 months	Concessionaire / Contractor
13	NOC for water extraction for construction and allied works	Ground Water Authority	Ground water extraction	Construction (Prior to work initiation)	2-3 months	Concessionaire / Contractor

3.3 CONCLUSION

Review of environmental regulations indicates that the project requires no prior environmental clearance. However, clearance for the diversion of forest land and permission for cutting the trees within the proposed right of way of the alignment, will be required from the Forest Department. In addition to the above, the concessionaire would require the following NOCs & licenses from the authorities during construction:

- NOC And Consents Under Air , Water, EP Acts & Noise rules of SPCB for establishing and operating plants from SPCB
- PUC certificate for use of vehicles for construction from Department of Transport
- Quarry lease deeds and license and Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for water extraction for construction and allied works from Ground Water Authority

The Contractor shall obtain above NOC for construction work. Apart from the above clearances, the concessionaire also has to comply with the following:

- Clearance of Engineer for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of Engineer for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents responding to involving fuel & lubricants before the construction starts. Submit a Quarry Management Plan to the Engineer along with the Quarry lease deeds

CHAPTER-4

ENVIRONMENTAL PROFILE OF THE PROJECT INFLUENCE AREA

4.1 INTRODUCTION

This section presents the environmental profile of the project influence area and its salient features. The objective of the profile is to ascertain the environmental sensitivity of the project, and identify the likely impact zones of the project.

Considering the nature of the project alignment, an area of about 5.0 km on either side of the corridor has been considered for studying the profile. The environmental features such as reserved forest, sanctuaries / national parks, rivers, lakes and ponds, religious structures, archaeological monuments, natural habitats, schools, irrigation canals along with other sensitive receptors were mapped in the profile through detailed field inventories and presented on the topo sheets (on a scale of 1:50,000) of Survey of India.

In addition to the above, the detailed walk through surveys were carried out to map specific environmental features within the Right of Way (ROW) of the proposed alignment. These features were presented on strip maps. Sections below, presents the details of both these surveys.

4.2 METHODOLOGY

The methodology followed in the preparation of the environmental profile of the project influence area and strip maps comprised the following:-

- **Collection of Toposheets (scale 1:50000 & 1:250000 of Survey of India** from Survey of India and demarcation of the proposed alignment on the toposheets.
- **Field reconnaissance of the proposed alignment through detailed walk through surveys**
- Mapping of **sensitive receptors** such as schools, religious structures, hospitals etc.
- Interactions with **local villagers and resource persons to understand the importance of various** sensitive features and other local resources (if any).

The data collected from the above tasks was mapped on the detailed Kilometer wise strip maps and topo sheets on a scale of 1:50,000.

4.3 ENVIRONMENTAL PROFILE OF THE PROJECT INFLUENCE AREA

The environmental profile of the influence area (within 5.0 km on either side of the proposed alignment) presented in **Annexure-4.1**, indicates that

- the alignment generally runs through plain areas of indo-gangetic plains and is devoid of sensitive environmental features
- at many of the locations, lower ganga canal and its distributaries cris-crosses the alignment

- The alignment also crosses through three seasonal river named Aril River (1054 km. near Roshanmau), Pandu River (Km 1155 near Manipur, Sanghi River (1143 km near Kandeshi).

In addition to the above, no sensitive features such as wild life sanctuary, national park, wetland, eco-sensitive area was observed in the project influence area.

4.4 ENVIRONMENTAL FEATURES WITHIN PROJECT RoW

The environmental features within the right of way (RoW) of the project were recorded through the kilometre wise strip maps, as presented in Annexure 4.1, indicate that the proposed alignment,

- does not pass through any wild life sanctuary or sensitive natural resources
- does not affect wetlands
- does not require acquisition of reserve / protected forest areas However, as presented in table 4.1, small parcels of forest land in totalling to about 7.36 ha would need to be acquired at locations of the proposed alignment.

Table 4.1: Details of forest land acquisition

Name of District	Name of Tehsils	Name of Village	Gata No.	Acquired Area	Category	District wise Acquired Land
Kanpur Dehat	**Derapur**	Injua Rampur	134	0.123	reserved	0.123
Auraiya	**Bidhuna**	Kanho	1186m	0.300	reserved	3.396
		Kanho	1438	0.239	reserved	
		Kanho	1439m	0.161	reserved	
		kanho	1454	0.356	reserved	
		Kamara	94m	0.874	reserved	
		Kamara	942k	0.498	reserved	
	Auraiya Sadar	Jamuha	30	0.040	reserved	
		Singanpur	65	0.336	reserved	
		Singanpur	66	0.280	reserved	
		Singanpur	67	0.312	reserved	
Etawah	**Bharthana**	Seehpur	556	0.184	reserved	0.438
		Seehpur	551b	0.056	reserved	
		Seehpur	552	0.198	reserved	
Ferozabad	**Ferozabad**	Sofipur	293	0.150		2.234
		Sofipur	249	0.886		

Name of District	Name of Tehsils	Name of Village	Gata No.	Acquired Area	Category	District wise Acquired Land
		Sofipur	270	0.253	reserved	
		Sofipur	870	0.023	reserved	
		Sofipur	905	0.922	reserved	
Mahamayanagar	Hathras	Garhi Khurti	248	0.003	reserved	0.674
			244	0.026	reserved	
			245	0.315	reserved	
			250	0.289	reserved	
			254	0.041	reserved	
		Gangauli	170	0.219	reserved	
		Mendu Khas	208	0.072	reserved	
			209	0.031	reserved	
		Dariyapur	492	0.024	reserved	
	Sadabad	Khreya	99	0.144	reserved	0.493
			98	0.003	reserved	
Total				**7.358**		**7.358 Say 7.36 ha**

- Considering dense settlements and developments along the existing railway line near the towns of Achalda, Bharthana, Etawah, Tundla, Hathras and Aligarh, the project proposes six detours at all these locations.

- The project alignment runs through 3 seasonal rivers and number of small water bodies.

- The alignment also crosses the lower Ganga Canal and its distributaries at number of locations (km. 1061, 1064, 1063, 1110, 1092, 1123, 1127, 1138, 1152, 1154, 1182, 1281, 1273, 1267, 1290, 1295, 1391, 1315, 1345, 1358, 1353, 1364, 1366). The impacts on the canal however are mitigated in the design by providing adequate cross drainage works at al the locations.

- Number of religious structures (23) , schools / educational institutions (16), and Hospitals (04) are located along the proposed alignment. The details of these structures are presented in **Table 4.2**.

- The proposed is expected to involve the cutting of 1966 trees. Most of these tree species comprise common species such as neem, papal, mango, eucalyptus, etc., and doesn't involve cutting of any sensitive / endangered species.

Table 4.2: Details Sensitive Receptors

S.N.	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Remarks
Religious Structures						
1	Old Shiva Temple	Maitha /1049	Parallel	25	L	
2	Small Temple	Roshanmau/1056	Parallel	60	L	
3	Temple	Jhinhak/1081	Parallel	95	R	
4	Big Hanuman temple	Kanchosi/1091	Parallel	10	L	Falling in alignment
5	Temple	Phaphund/1101	Parallel	100	R	
6	Small Temple	Samhon/1128	Parallel	30	L	
7	Small Temple	Ekdil/1147	Parallel	110	R	
8	Small Temple	Ekdil/1147	Parallel	120	R	
9	Devi Temple	Ekdil/1147	Parallel	40	L	
10	Hanuman Temple	Ekdil/1147	Parallel	20	L	
11	Small temple	Balrai/1181	Parallel	40	L	
12	Temple	Kawrai Khurd / 1199	Parallel	50	R	
13	Masjid	Nr. Ghasipur village/Aligarh	Detour	10	L	
14	Temple	Raju Nagla village/1344	Parallel	30	L	
15	Temple	Nr. Somane village/1348	Parallel	50	L	
16	Temple	Nagla kat/1360	Parallel	45	L	
Educational Structures						
17	Primary School	Rura/1062	Parallel	90	R	
18	Junior High school	Rura/1062	Parallel	58	R	
19	School	Sahapura/1084	Parallel	100	L	
20	Girls Inter College	Achalda	Detour	15	L	the college is not directly affected, however, boundary may get affected. The noise and vibration mitigation measures need to be applied
21	Primary School	Achlda	Detour	30	L	
22	Primary School	Samhon/1128	Parallel	20	L	
23	Ramnerash Inter College	Samhon/1128	Parallel	30	L	
24	JwaharNavoday School	Samhon/1129	Parallel	150	L	
25	Primary School	Ekdil/1147	Parallel	100	R	
26	Primary School	Ekdil/1147	Parallel	40	L	
27	College	Mamota kalan/1310	Parallel	10	L	
28	Primary school	Nr. Paliar village/Aligarh	Detour	50	L	

S.N.	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Remarks
29	Primary school	Chiroolia village (Aligarh)	Detour	60	R	
30	Primary school	Nr. Saharpur village (Aligarh)	Detour	90	L	
31	Primary school	Nr. Choorpur (Aligarh)	Detour	20	L	
32	Primary school	Nr. Dabour village/1359	Parallel	60	L	
33	Primary school	Nr. Nagla kat/1360	Parallel	45	L	
Hospitals						
34	Institutional Hospital	Jaswantnagar / 1173	Parallel	80	R	
35	Maitha Hospital	Maitha/1049	Parallel	30	L	
36	Hospital under construction	Maitha/1049	Parallel	45	L	
37	Veterinary Hospital	Rura/1062	Parallel	80	R	

CHAPTER-5
BASELINE ENVIRONMENTAL PROFILE

5.1 INTRODUCTION

This chapter assesses the nature, type and dimensions of the study area and describes the relevant physical and biological environmental components along the proposed railway line. The data on various environmental components related to the project area has been assembled from various secondary sources and primary environmental surveys on ambient air quality, noise and vibration levels, water quality and soil quality, aquatic and terrestrial ecology. A deailed profile prepared based on the above information is presented in the subsequent sections of this chapter.

5.2 BASELINE ENVIRONMENTAL SURVEYS

As presented in table 5.1 below, detailed base line environemental surveys were carried out for the key components of environment (ambient air, water quality, soil, noise, vibration, terrestrial and aquatic ecological parameters) during December, 2008 and May, 2009 (Winter and pre monsoon seasons). Data on meteorology has been collected from the nearest IMD stations at Aligarh, Agra and Kanpur. The environmental monitoring was done along the proposed freight corridor covering detour as well as parallel sections.

Table 5.1: Details of Baseline Data Collection Schedule

Field	Parameters	No. of Sampling Locations	Sampling Duration	Frequency	Criteria for selection of no. of samples and locations
Ambient Air Quality	SO_2 NOx SPM RPM CO	18	24 hrs continuous	During December 2008 to February 2009 and May 2009	Covering residential, commercial and industrial locations as per NAAQ standards, 1994. The no. of samples have been selected to represent the baseline ambient air quality covering parallel as well as detour locations
Meteorology	Wind Speed Wind Direction Ambient Temperature Rainfall Humidity Atmospheric Pressure	03	December 2008 to February 2009 and March 2009 to May 2009	Long term data at 8:300 and 17:30 IST	Nearest IMD stations viz. Aligarh, Agra and Kanpur to represent the meteorological condition of the study area
Water Quality (Surface & Ground Water Sample)	**Physical Parameters** pH, BOD, Chloride, Sulphate, Iron, Phosphate, Sodium, Total Hardenss etc.	26 (22 ground water & 04 surface water)	Random	December-Feb. 2009, once at each location	As per IS Standards covering ground water and surface water
Noise	L_{eq}	18	24 hrs continuous	May 2009, once at each location	The monitoring was done to represent sensitive, residential locations as per NAAQ 1994 standards w.r.t. Noise covering parallel as well as detour locations
Vibration	L_{max}	17	24 hrs continuous / during passing of various trains	May 2009	The sensitive and residential locations have been covered in parallel as well as detour locations

Soil	pH, N, P, K, etc.	25	Random	December-Feb. 2009, once at each locations	As per IS Standards to represent the soil quality in terms of fertility in the study area
Ecology	Aquatic	04	Random	May 2009	Terrestrial by quadrate and linetransact, aquatic by plankton and phyto and zoo benthos to assess the aquatic and terrestrial ecology, secondary data from Forest Deptt.
	Terrestrial	08	Random	May 2009	

5.3 METEOROLOGY

The project area presents tropical climatic characteristics; however, variations exist due to the difference in altitudes between various locations. The entire stretch of total 272km from Bhaupur to Khurja passess through eight districts of Uttar Pradesh i.e. Kanpur dehat, Auraiya, Etawah, Ferozabad, Hathras (Mahamaya Nagar), Agra, Aligarh and Bulandsehar. To understand the meterological features of the project area, data has been collected from the three nearest meteorological stations (monitored by Indian Meterological Department), at Aligarh, Agra and Kanpur. Table 5.2 sumarizes the meteorological characteristics of the project area.

Table 5.2: Meteorological Data During December 2008 to May 2009

Month	Ambient Temperature, ^{0C}		Atmospheric Pressure, hPa		Relative Humidity, %		Average Wind Speed, km/hr.	Pre-dominant Wind Direction	Rainfall, mm
	Daily Max.	Daily Min.	At 8:30 hrs.	At 17.30 hrs.	At 8:30 hrs.	At 17.30 hrs.			
IMD Station: Aligarh (height above msl : 187 m)									
Dec. 2008	23.0	8.7	997.2	993.7	76	55	4.8	W & NW	5.2
Jan. 2009	20.2	7.1	996.4	993.2	80	55	5.4	W	12.6
Feb. 2009	25.1	9.8	994.6	992.9	72	45	6.5	W	11.2
March 2009	31.4	15.3	992.8	988.7	60	34	7.1	W & NW	7.8
April 2009	38.6	21.5	987.7	983.2	38	25	7.6	W & NW	6.6
May 2009	41.9	26.0	984.1	979.6	40	23	8.2	W & NW	14.8
IMD Station: Agra (height above msl : 169 m)									
Dec. 2008	24.5	8.6	999.8	994.6	72	55	2.1	NW	3.4
Jan. 2009	22.3	7.2	998.5	994.1	75	50	28	NW & W	16.2
Feb. 2009	24.2	10.6	994.3	992.6	65	38	3.7	NW	11.0
March 2009	30.2	16.5	993.8	989.6	55	32	3.9	NW & SW	8.6
April 2009	40.1	23.0	989.9	984.1	39	28	4.1	NW & SW	2.0
May 2009	42.3	27.4	982.6	981.4	38	25	4.8	NW & SW	13.8
IMD Station: Kanpur (height above msl : 126 m)									
Dec. 2008	24.5	9.1	1004.1	1000.6	78	52	6.5	W & N	7.8
Jan. 2009	22.9	8.6	1003.1	1000.1	81	53	7.2	W & E	20.0
Feb. 2009	27.1	11.5	1000.1	999.6	68	39	8.9	W & NW	12.6
March 2009	31.4	16.2	998.6	995.8	55	30	10.2	W & NW	6.4
April 2009	39.2	23.1	994.1	990.7	42	27	9.8	W & NW	4.6
May 2009	42.6	27.6	989.9	986.2	38	24	10.6	W & NW	10.4

Source: IMD, Aligarh, Agra and Kanpur

5.3.1 Temperature

The meteorological data observed during the winter season shows that daily maximum temperature varies from 20.2 to 27.1 ^{0}C and the temperature characteristics in this season are relatively similar. During winter, Kanpur has the highest daily maximum temperature at 27.1 ^{0}C, and Aligarh has the minimum daily temperature of 20.2 ^{0}C. The lowest daily minimum temparature has been observed in January 2009 in Aligarh. During summer season, the average daily maximum temperature is around 42 ^{0}C during May 2009 at all the stations.

5.3.2 Relative Humidity

The relative humidity of the project area varies from 65% to 80% at 8:30 hrs during winter season and 38% to 55% at 17:30 hrs. The relative humidity decreases during summer and lowest (23%) was recorded at Aligarh in May 2009.

5.3.3 Wind Speed and Direction

Analysis of wind records shows that the winds are generally light to moderate in this area. The windrose diagrams during December 2008 to February 2009 (Winter season) and March 2009 to May 2009 (Pre-monsoon season) at Aligarh, Agra and Kanpur are presented in Figure 5.1 to 5.6. The pre-dominant wind directions are West in Aligarh and Kanpur and North-West in Agra during winter season. During summer season, the pre-dominant directions are West and North-West in Aligarh and Kanpur and North-West and South-West in Agra. Average wind speed increases during summer season as compare to winter. The maximum average wind speed was observed in May 2009 at all the stations, while, December was comparatively calm.

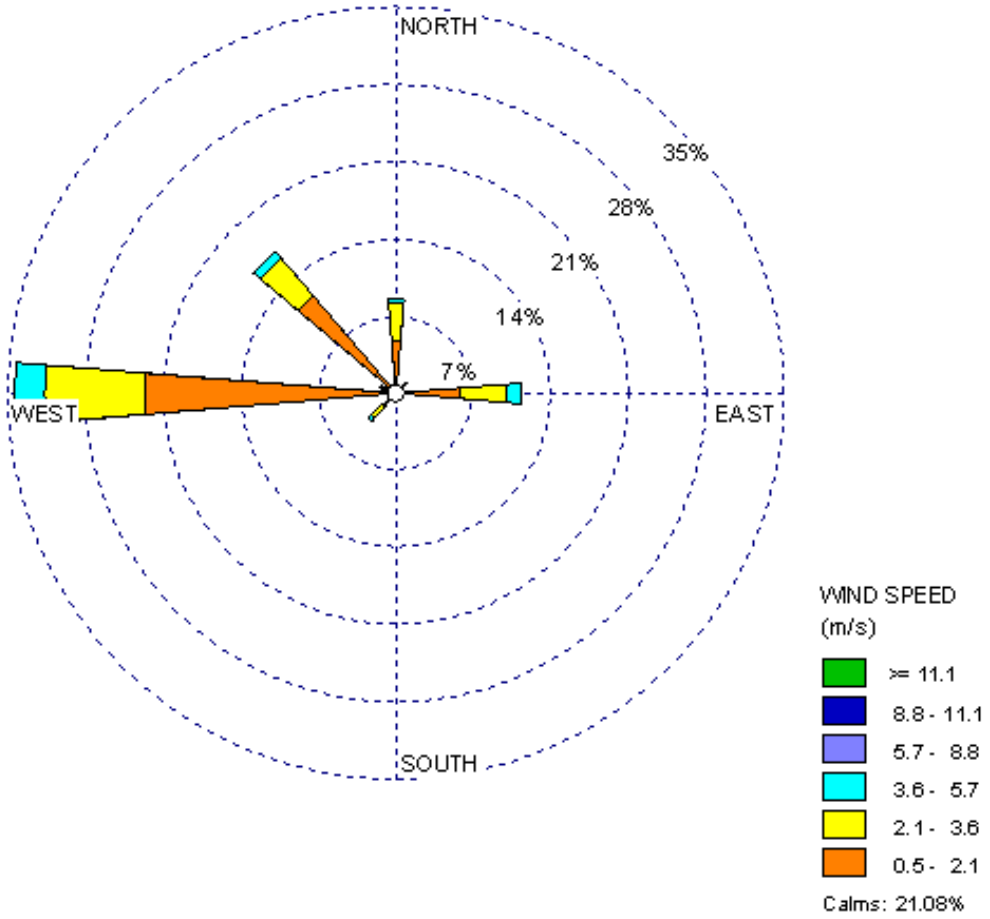


Figure 5.1: Aligarh (December 2008 to February 2009)

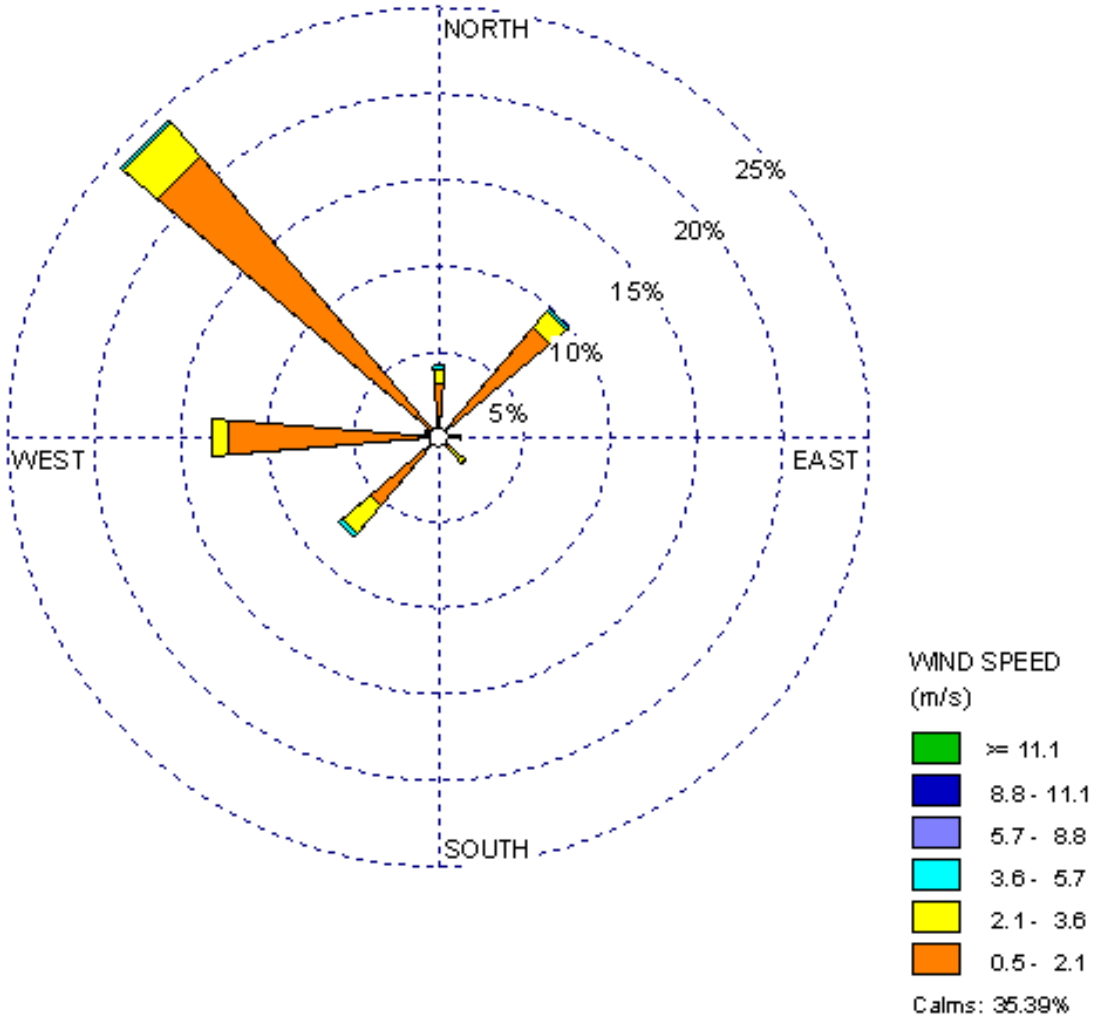


Figure 5.2: Agra (December 2008 to February 2009)

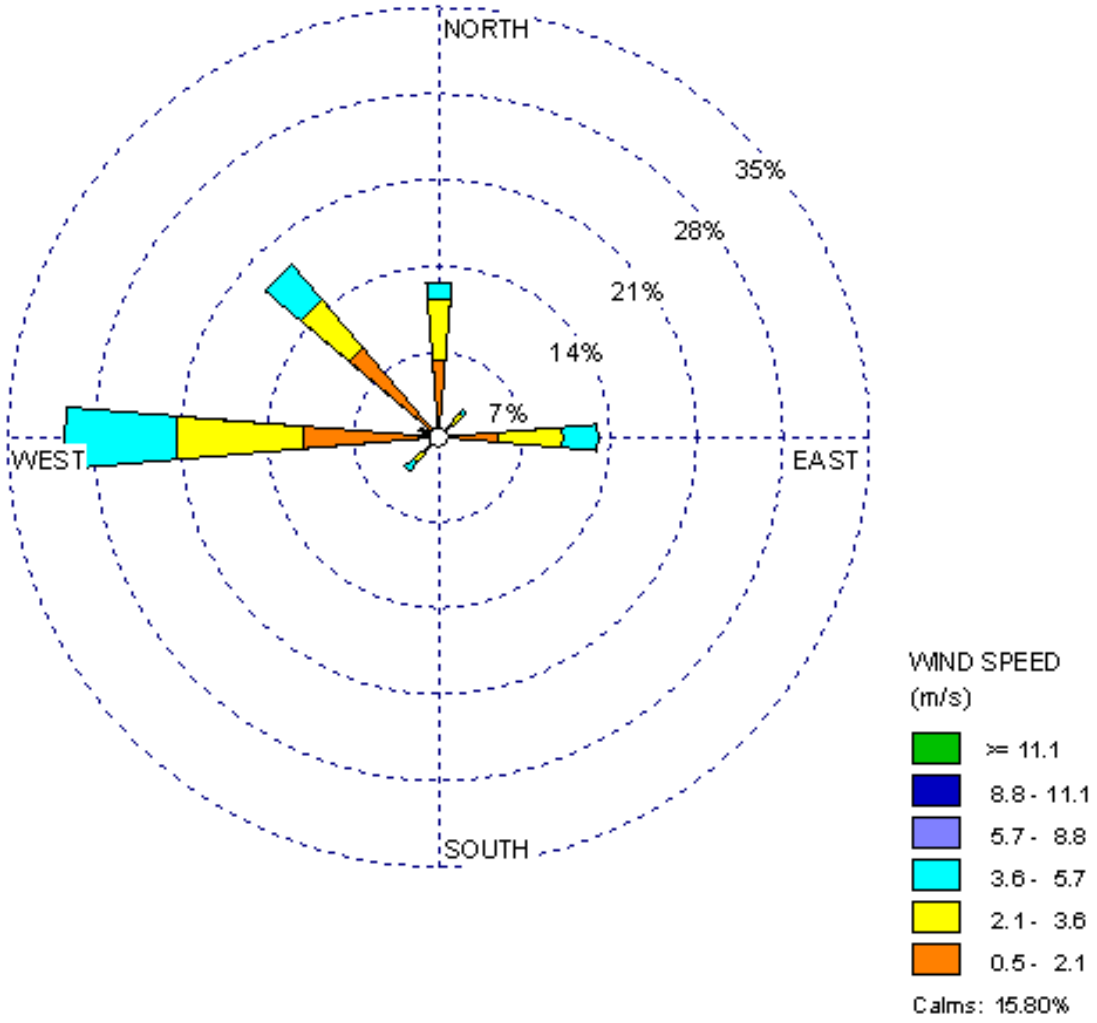


Figure 5.3: Kanpur (December 2008 to February 2009)

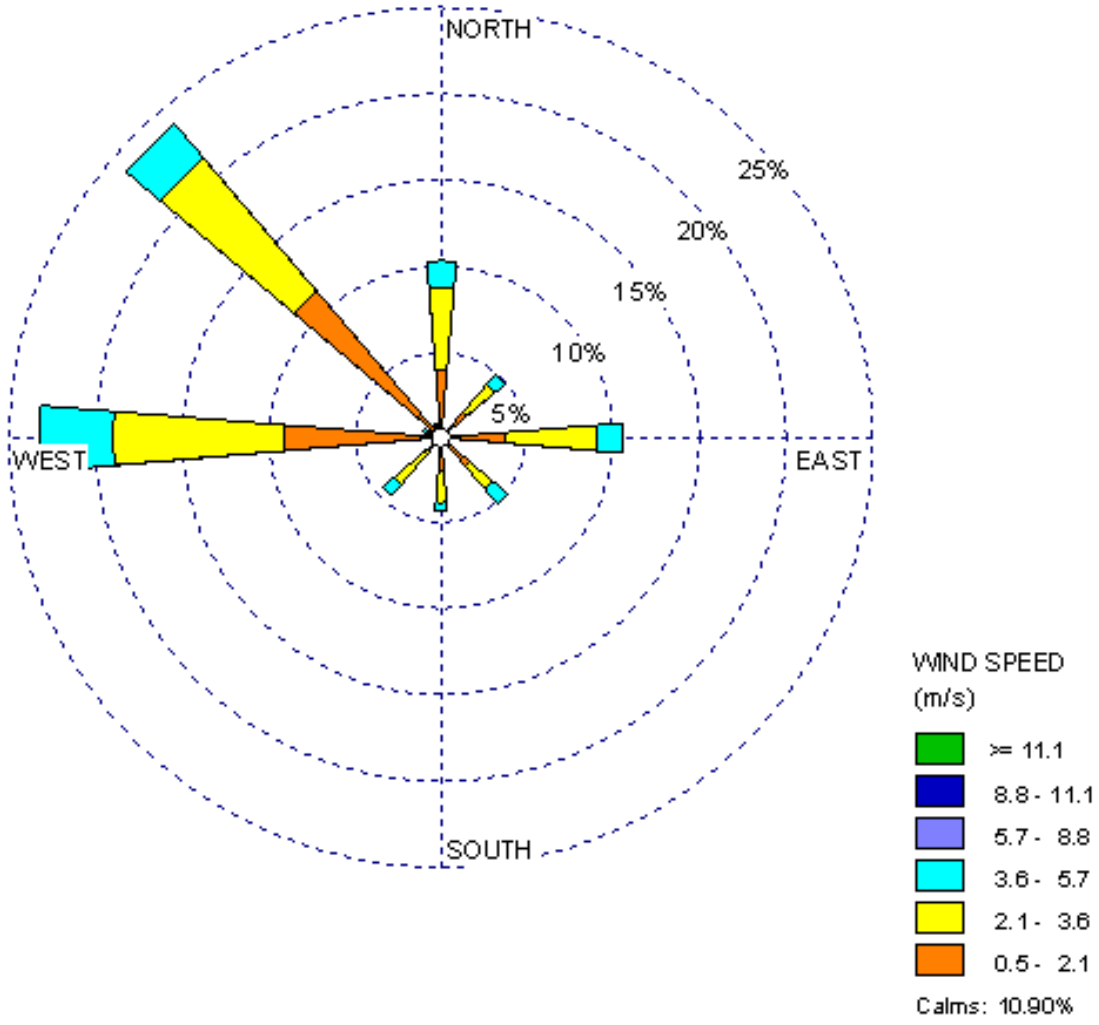


Figure 5.4: Aligarh (March 2009 to May 2009)

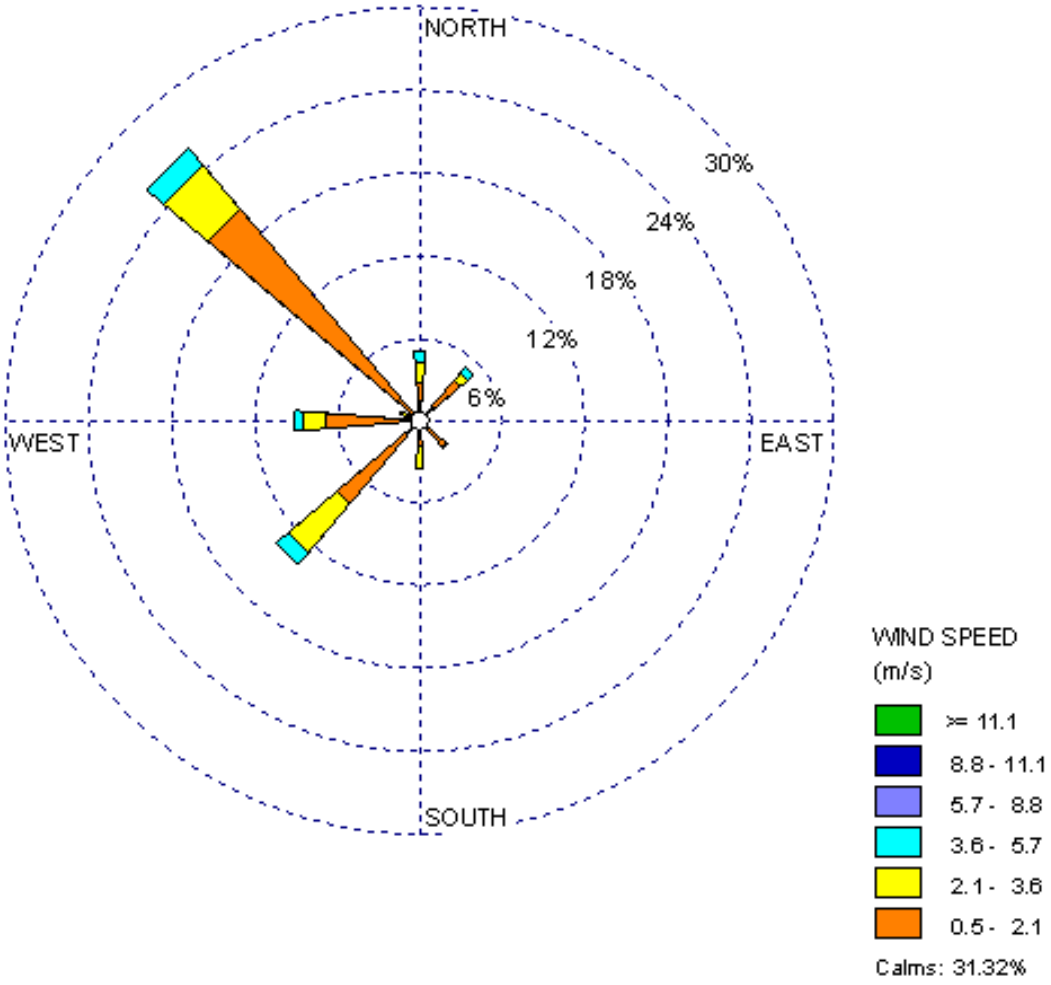


Figure 5.5: Agra (March 2009 to May 2009)

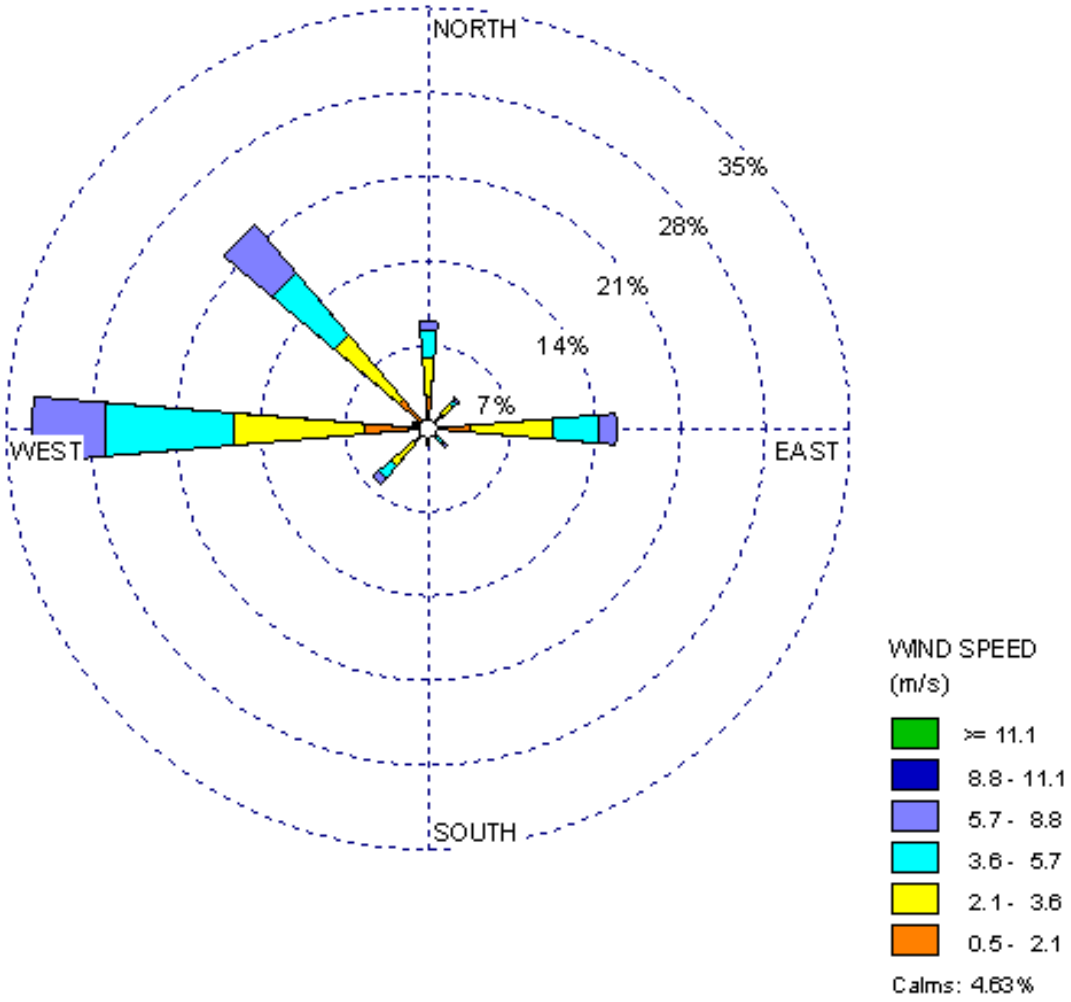


Figure 5.6: Kanpur (March 2009 to May 2009)

5.3.4 Atmospheric Pressure

The minimum and maximum monthly atm pressure varies from 982.6 to 1004.1 hPAa at 08:30hrs and from 979.6 to 1000.6 hPa at 17.30hrs.

5.3.5 Rainfall

The rainfall is generally low during the non-monsoon season. The average rainfall recorded is highest (20 mm, Kanpur) in January and lowest in April 2009 (2 mm, Agra). The month-wise total rainfall is shown in Table 5.1.

5.4 AMBIENT AIR QUALITY

Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), SPM and RSPM are the four major air pollutants, which cause concern to environment and other living beings. In order to understand the base line trends of these pollutants in the project area, ambient air monitoring was carried out at 24 critical locations

during winter and 18 locations during summer along the proposed DFCC corridor of total 272km starting from Bhaupur and ending at Khurja. The locations were selected based on impacted residential area, sensitive receptors both in parallel alignments and detour locations. Monitoring was carried out continuously for 24 hours at each station during the months of December 2008 to February 2009 and May 2009.

5.4.1 Methodology (Air Monitoring)

The air pollution analysis techniques include the evaluation of the following:

1. Suspended Particulate Matter (SPM) and RSPM
2. Sulphur dioxide (SO_2)
3. Nitrogen oxides (NO_x)
4. Carbon Monoxide (CO)

As regard the techniques for collection of sample of particulate matter, the "Respirable Dust Sampler Envirotech Model APM 460 BL" was used for air monitoring. The dust particulate matter were collected on filter paper (size GF/A 20.3 x 25.4 cm) and dust cup and the gaseous pollutants were collected simultaneously by a known volume of air through a number of bubblers of different flow rate through appropriate solution for absorbing different gases. The gaseous air pollutant samples were collected in glass impinges filled with adsorbing solvents by passing of ambient air and analyzed according to standard method.

Calculation

For particulate matter

RSPM ($\mu g/m^3$) = (weight of filter paper after sampling – initial weight of filter paper) / volume of air.

SPM ($\mu g/m^3$) = RSPM + (final weight of cyclonic cup – initial weight of cyclonic cup) / volume of air.

For gaseous pollutants

SO_2 ($\mu g/m^3$) = $(A - A_0) \times 1000 \times B \times D / V$

NO_x ($\mu g/m^3$) = $(A - A_0) \times 1000 \times B \times D / 0.82V$

Where, A = Sample Absorbance,

A_0 = Reagent blank Absorbance, and

B = Calibration factor (µg/absorbance)

D = Volume of absorbance solution in impinger during monitoring / volume of absorbing solution taken for analysis.

V = Volume of Air Sample in liters.

CO was monitored by using sensor based Non Dispersive Infrared equipment which gives direct result.

Figure 5.7: Ambient Air Quality Monitoring at Hirangaon

Figure 5.8: Ambient Air Quality Monitoring at Kanchosi

Table 5.3: Ambient Air Quality of the Study Area (December 2008 to February 2009)
Follow the same format and add remarks column

S.No	Location	Date	Category	Parameters					Remarks
				SPM, $\mu g/m^3$	RPM, $\mu g/m^3$	SO_2, $\mu g/m^3$	NOx, $\mu g/m^3$	CO, $\mu g/m^3$	
1.	Near Junction(Khurja)	20-12-2008	Residential & Rural area	192	66	14	31	ND	Within the limit of NAAQS
2.	Village Deshpura	29-12-2008	Residential & Rural area	173	57	8	19	ND	Within the limit of NAAQS
3.	Nayabas	12-01-2009	Residential & Rural area	184	60	7	17	ND	Within the limit of NAAQS
4.	Near Kulwa Station	16-01-2009	Sensitive area, near school	210	51	11	30	ND	Within the limit of NAAQS except SPM
5.	Village Parawali	05-02-2009	Residential & Rural area	169	58	6	21	ND	Within the limit of NAAQS
6.	Near Mandrak Station	21-12-2008	Residential & Rural area	189	47	8	18	ND	Within the limit of NAAQS
7.	Mamota Kala Village	07-01-2002	Residential & Rural area	167	41	6	16	ND	Within the limit of NAAQS
8.	Near Hathras Sataion	22-12-2008	Residential & Rural area	193	63	10	20	ND	Within the limit of NAAQS
9.	Village Mendu	14-01-2009	Residential & Rural area	178	44	7	18	ND	Within the limit of NAAQS
10.	Near Firozabad Station	24-12-2008	Residential & Rural area	192	72	18	29	ND	Within the limit of NAAQS
11.	Datauji Village	21-01-2009	Residential & Rural area	177	52	6	19	ND	Within the limit of NAAQS
12	Near Shikohabad Station	03-01-2009	Residential & Rural area	186	61	9	21	ND	Within the limit of NAAQS
13	Madanpura Village	17-01-2009	Residential & Rural area	159	56	7	17	ND	Within the limit of NAAQS

14.	Near Jaswant Nagar Station	05-01-2009	Residential & Rural area	188	48	7	19	ND	Within the limit of NAAQS
15.	Nagala Bhar Village	18-01-2009	Residential & Rural area	164	43	6	17	ND	Within the limit of NAAQS
16	Near Etawah Station	12-01-2009	Residential & Rural area	198	64	12	24	ND	Within the limit of NAAQS
17.	Village Etgaon	19-02-2009	Residential & Rural area	176	53	7	18	ND	Within the limit of NAAQS
18.	Near Achalda Station	12-02-2009	Residential & Rural area	185	48	8	21	ND	Within the limit of NAAQS
19.	Baldev ki Mdaiya Village	28-02-2009	Residential & Rural area	169	41	7	19	ND	Within the limit of NAAQS
20.	Near Rura Station	13-02-2009	Residential & Rural area	174	51	6	19	ND	Within the limit of NAAQS
21.	**Near Crossing (Proposed)**	**24-02-2009**	Residential & Rural area	**159**	**46**	**5**	**17**	ND	Within the limit of NAAQS
22.	Near Maitha Station	15-02-2009	Residential & Rural area	167	40	7	18	ND	Within the limit of NAAQS
23.	**Near Junction (Proposed)**	**25-02-2009**	Residential & Rural area	**152**	**38**	**6**	**16**	**ND**	**Within the limit of NAAQS**

Source: Field Monitoring

Carbon monoxide has been less than detectible limit at all sites (Less than 1 ppm)

Table 5.4: Ambient Air Quality of the Study Area (May 2009)

Sl. No.	Locations	Date	Category	Parameters					Remarks
				SPM, $\mu g/m^3$	RPM, $\mu g/m^3$	SO_2, $\mu g/m^3$	NO_x, $\mu g/m^3$	CO, $\mu g/m^3$	
Firozabad Section									
1.	Barhan	10-05-09	Residential and Rural Area(along existing track)	187	69	11	18	ND	Within the limit of NAAQS
2.	Chamrola	12-05-09	Residential and Rural Area(along existing track)	178	65	10	16	ND	Within the limit of NAAQS
3	Shiva Temple, Hiran Gao	14-05-09	Sensitive	161	58	10	14	ND	Well within the NAAQS except SPM
Kanpur Section									
4	Jaswant Nagar	14-05-09	Residential Area(along existing track)	196	78	14	24	455	Within the limit of NAAQS
5.	Jhinjak	16-05-09	Residential and Rural Area(along existing track)	172	70	11	21	157	Within the limit of NAAQS
6.	Fafund	16-05-09	Residential and Rural Area(along existing track)	190	83	13	25	210	Within the limit of NAAQS
7.	Hanumanji ka Temple, Kanchosi	18-05-09	Sensitive (along existing track)	132	56	9	17	ND	Well within the NAAQS except SPM
8.	Mehata Hospital, Metha	18-05-09	Sensitive(near existing Track)	175	64	10	22	356	Well within the NAAQS except SPM
9.	Achalda Bypass near School	20-05-09	Sensitive(Detour Section)	165	68	8	15	ND	Well within the NAAQS except SPM
10	Bharthana	20-05-09	Residential area (along existing track)	164	65	12	20	214	Within the limit of NAAQS
Aligarh Section									
11.	Madrak	22-05-09	Residential and Rural Area(along existing track)	165	57	9	18	98	Within the limit of NAAQS
12	Hathrus Bypass	22-05-09	Residential and Rural Area(Detour section)	151	48	8	15	ND	Within the limit of NAAQS
13.	Mahrera	24-05-09	Residential and Rural Area(along existing track)	179	81	9	18	ND	Within the limit of NAAQS
14.	Daud Khan	24-05-09	Residential and Rural Area(along existing track)	167	72	10	21	ND	Within the limit of NAAQS
15.	Jalesr Road	26-05-09	Residential Area(along	191	68	12	24	529	Within the limit of NAAQS

			existing track)						
16	Chuharpur	26-05-09	Residential and Rural Area(Detour track)	163	61	10	19	ND	Within the limit of NAAQS

Source: Consultant Survey

ND : Not detected

Figure 5.9: Ambient Air Quality Monitoring at Achalda Bypass Near School

Figure 5.10: Ambient Air Quality Monitoring at Madrak

A review of ambient air quality data presented in tables 5.3 and 5.4, above shows that air quality of the project area is generally good except SPM. The concentration of suspended particulate matter at some of the sensitive locations due to proximity with highway and industrial locations such as Kulwa. Overall, the result indicate that SPM levels vary from 152-215 µg/m^3, whereas RPM varies from 38-72 µg/m^3 during winter season. During summer, SPM levels were noted to be ranging from 132-196 µg/m^3 and RPM to be around 48-83 µg/m^3 during. SO_2, NOx and CO levels, well within the NAAQ standards at all the monitoring locations.

5.5 NOISE LEVELS

Noise attributed to a line project depends on factors such as traffic intensity, the type and condition of the traffic. Excessive high noise levels are a concern for sensitive receptors, i.e., hospitals, educational institutions, etc. The baseline information about the existing noise level along the railway track have been collected by monitoring the noise levels.

The Central Pollution Control Board has specified ambient noise levels for different land uses for day and night times. Importance was given to the timing of exposure and areas designated as sensitive. **Table 5.5** presents the noise standards specified by the Central Pollution Control Board.

Table 5.5: National Standards for Ambient Noise

Area Code	Category	Limits in Decibels (dB A)	
		Day Time	Night Time
A	Industrial	75	70

B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

Source: Central Pollution Control Board, New Delhi

Note: (1) Daytime: 6 AM to 10 P.M., Night-time 10 PM to 6 AM;
(2) Silence zone is an area up to 100 m around premises as hospitals, educational institutions and courts.

Locations for noise monitoring along the project route were identified based on the criteria same as those used for air monitoring but the relative importance of each criterion carries a weight age in arriving at the final set of locations. The noise monitoring was carried out at 18 locations covering commercial, residential and silence zones in May 2009 for continuously 24 hrs covering day and night as per relevant Noise standards of CPCB.

5.5.1 Methodology for Noise Monitoring

The intensity of sound energy in the environment is measured in a logarithmic scale and is expressed in a decibel (dB) scale. Ordinary

sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB. In a sophisticated type of sound level meter, an additional circuit is provided ,which modifies the received signal in such away that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB (A) .The sound levels are expressed in dB (A) scale for the purpose of comparison of noise levels, which is accepted by Central pollution Control Board (CPCB) as per Environment (Protection) Act, 1986 (29 of 1986) read with rule 5 of the Environment (Protection) Rules, 1986, the Central Government.

The noise monitoring was carried out within 30 m from railway track in each parallel location and near the receptors in detour location by using CYGNET Model 2001, which consists of data logger facility. The noise was recorded continuously for 24 Hrs. Simultaneously types of all the trains passing through the track were recorded. The Leq during day and night (6 AM to 10 PM reckoned as Day and 10PM to 6 AM as Night) were calculated as per the National Standards for Ambient Noise levels.

Figure 5.11: Noise Level Monitoring at Hirangaon

Figure 5.12: Noise Level Monitoring at Jalesar Road

Table 5.6: Noise Monitoring Results

Sl. No.	Locations	Category	Parameters			Noise Level		Remarks
			Leq dB(A) Day	Leq dB(A) Night	dB(A) (Max.)	One train is passing, max value in dB(A)	Two trains are passing, max value in dB(A)	
Firozabad Section								
1.	Barhan	Residential Area (along existing track)	66.9	60.5	92.8	87.5	92.8	Exceed the limit due to railway noise
2.	Chamrola	Residential Area (along existing track)	68.3	60.4	91.4	87.0	91.4	Exceed the limit due to railway noise
3	Shiva Temple, Hiran Gaon	Silence Zone (along existing track)	70.1	65.2	93	88.0	93.0	Exceed the limit due to railway noise
Kanpur Section								
4	Jaswant Nagar	Commercial Area (along existing track)	72.1	64.2.	92.9	88.6	92.9	Exceed the limit due to road and railway noise
5.	Jhinjak	Residential Area (along existing track)	68.5	63.7	92.6	89.0	92.6	Exceed the limit due to railway noise
6.	Fafund	Residential Area (along existing track)	67.9	60.5	92.8	87.8	92.8	Exceed the limit due to railway noise
7	Hanumanji ka Temple, Kanchosi	Silence Zone (along existing track)	65.8	60.9	91.8	87.2	91.8	Exceed the limit due to railway noise
8	Mehata Hospital, Metha	Silence Zone (near existing Track)	62.7	53.8	89.4	85.1	89.4	Exceed the limit due to road & railway noise(site is app 100m away from railway line)
9	Achalda Bypass Near Schools	Silence Zone (Detour Section))	50.6	37.8	71.5	-	-	Well within the limit in night
10	Bharthana	Commercial Area(along existing track)	71.3	64.8.	92.1	88.2	92.1	Exceed the limit due to commercial activities & railway noise
Aligarh Section								
11	Madrak	Residential Area (along existing track)	68.9	63.6	92.6	89.0	92.6	Exceed the limit due to railway noise
12	Hathrus Bypass	Residential Area (detour Section)	51.4	38.8	70.7	-	-	Well within the limit

13	Mahrera	Residential Area (along existing track)	67.9	62.7	91.8	87.0	91.8	Exceed the limit due to railway noise
14	Daud Khan	Residential Area (along existing track)	68.6	62.7	91.7	87.1	91.7	Exceed the limit due to railway noise
15	Jalesr Road	Commercial Area (along existing track)	72.7	63.8	92.8	88.6	92.8	Exceed the limit due to road & railway noise
16	Chuharpur	Residential Area (Detour Section	69.2	57.2	82.8	-	-	The Noise levels are high due to proximity with highway

Source: Consultant Survey

Figure 5.13: Noise Level Monitoring at Jhinjak

5.5.2 Result and Discussions

Review of noise levels presented in table 5.6 indicates that the noise levels exceed permissible standards at all the locations along the existing railway track (where DFC is proposed in parallel). The noise levels are even higher along these loations when two trains cross the lcoation simultaneously (maximum value of 93.0 dB(A)).

Further to understand the noise levles due to train movements, noise levels were also monitored at 12.5, 25 & 50 Meter from the center of the track (for a combination of train movements) at hirangaon Station.

Table 5.7: Noise levels for different train movements

Category of Trains	Running speed (km/hr)	Railway Noise Level dB (A)					
		Leq			Lmax		
		12.5	25.0	50.0	12.5	25.0	50.0
Passenger train	37.31	74.8	68.9	59.8	93.7	88.5	77.6
Passenger train	85.7	75.9	70.1	61.3	94.3	90.3	78.6
Passenger train	40.61	75.1	68.2	61.7	92.4	86.3	71.1
Passenger train	44.67	75.2	67.6	62.1	93.2	87.2	74.2
Passenger train	40.2	74.8	68.1	62.0	92.1	86.5	71.8
Freight train	50.4	75.6	69.10	60.7	94.0	89.8	78.1
Freight train	30.6	73.8	67.5	60.2	90.6	87.4	72.8
Freight train	36.8	74.0	67.1	61.4	93.1	88.1	73.2
Freight train	38.4	74.2	66.3	61.2	93.0	88.0	72.7
Freight train	41.7	74.1	67.2	61.0	92.7	87.8	74.0

As presented in table 5.7, above, the noise levles between passenger trains and freight trains, show a mariginal difference. However, the noise attenuation was found to be ranging from about 5 dB (A) from 12.5 to 25 m and about 10 dB (A) from 25 to 50 m, from the centre of the railway track. Similar to noise levels, the attenuation levels both for passenger and freight trains were noted to be same. This indicates no significant impact on noise levles due to the category of train.

5.6 VIBRATION

5.6.1 Background Information

Vibration assessments are a key element of the environmental impact assessment process for mass transit projects. Vibration may lead to damage of cultural assets and other establishments near railway tracks and also may have impact on the human health.

Experience has shown that vibration is among the major concerns with regard to the effects of a railway project on the surrounding community.

Vibration is often associated with noise but is a problem in its own right. Notwithstanding health effects to the passengers it impacts the inmates of the buildings close to the track in the form of scare, sleeplessness and postural discomfiture. It also affects the buildings in the form of short and long term impacts.

Vibration can also be affecting the train drivers and operators including drivers of specialist vehicle used during the construction phase. Appropriate mitigation measures will vary but may include design considerations for vehicles and equipment, control of exposure times, proper maintenance, protective clothing and alterations to working practices. A Detailed elaboration has been provided regarding the mitigation measures available.

Measurement

As discussed in the earlier sections, the proposed track runs in two different alignments.

I. One parallel to the existing track, which could involve,

- Higher amplitude vibrations impacting the buildings now coming closer to railway vibrations (within critical distance) on the side of new track
- Higher amplitude vibrations impacting all close buildings and human inmates due to instances of multiple trains running at same instance of time
- Higher frequency of such multiple train running instances resulting to higher time of exposure
- Increased impact due to increased speeds of Freight Trains.
- Increased impact due to higher No of freight trains running closer

II. Detours from the existing track passing through areas of different land use:

On detours there are no existing tracks at the moment. This will necessitate *abinitio* laying of the track which will involve movement of heavy and fast moving freight trains for transportation of material and goods. In addition there will be impact due to construction activity itself.

Finally there will be impacts due to DFC operations which will be in the form of

- Creation of a new Vibration environment along the detour effecting the building and inmates present within the critical distance of impact of vibrations
- Impacts due to trains running, at higher speeds / axle loads.

As part of the base line analysis of vibration levels, data was collected through measurement of vibration levels at several locations along parallel tracks as well as detour locations, covering all the possible scenarios mentioned above.

The data collected along with the patterns of Vibration propagation with distance, speed, axle load for single, dual and multiple train operations have been estimated. The same data has been used to predict impacts on sensitive locations along the entire corridor. The highest vibration values based on the 100km/hr speed of freight trains (containers or tankers) have been used for the prediction of impacts.

5.6.2 Standards on Vibration Measurements for Rail Projects

In absence of any Indian standard on vibration, international standards (as indicated below) have been referred for evaluating the potential impacgts for building damage and also the human response.

ISO Standards on vibration (ISO 2631/2- 1989, ISO 8041-1990, and ISO 4866-1990)

JIS Z-8735 (Method of measurement for vibration levels) and JIS C-1510 (Standard for Vibration level meter).

BS 6472
DIN 4150

While each of the above standards have specific approach to the measurement and assessment of vibration impacts, considering the fact that the feasibility study for the project was carried out based on Japanese standards (JIS 8735 and JIS 1510) and DFC is also implementing same standards in the western corrirodor, the same standards have also been in the current study. The important features of GIS 8735 are:-

- depend on one single parameter ie Lpeak as against multiple parameters such as (VDV and PPV)
- does not require further calculations after the collection of data,
- the standards suggesets single parameter to assess the vibration impacts on buildings and the residents with one common parameter.

Considering the above, the above JIS Z 8735 have been following for measuring and prediction of vibration impacts of the project .

5.6.3 Methodology

The ambient vibration levels and railway vibration levels were measured as part of the base line surveys.

While railway vibrations were measured for various train types and speeds at varying distances, the ambient vibrations were measured on Sensitive Receptors

5.6.4 Measurement Instrument

As according to JIS C 1510, vibration meter 1220E manufactured by IMV Japan, was chosen for measuring vibration.The instrument provides vibration measurements in all the three axes and also measures velocity or acceleration parameters. The instrument, also captures and stores values at predefined intervals and calculates maximum and minimum or percentile values.

Specifications of the selected instrument are below:

5.6.5 Features

- Conforms to JIS C1510-1995.
- Measures vibration pollution from factory, construction site and traffic

- Calculates Vibration level Lv, Vibration acceleration level Lva, Max. value Lmax, Min value Lmin, Time rate vibration level (Lx : 5-value), Power averaged level (Leq) in 3-direction and displays with selection

Model	VM-1220E
Frequency Range	1 - 80 Hz
Measuring Range	30 - 120 dB
Level Range	20 dB step, 2-range 30 -90dB, 50 -110dB
Linearity	75dB
Measured Item	Vibration level Lv, Vibration acceleration level Lva, Max. value Lmax, Min value Lmin, Time rate vibration level (Lx: 5-value),Power averaged level (Leq)

Measuring Time	1s,3s,5s,10s,1min,5min,10min,15min,30min,1h,8h,24h Manual (Max 199h59min59s)
Ambient Condition	Temperature Range: 10 -50^{0}C Humidity: 30 - 90% (not dew condensation)

5.6.5 Vibration Levels

Based on the approach formulated above, the vibration levels were measures at the following locations presented in Table 5.8 along the project corridor.

Table 5.8: Ambient Railway Vibration

S.No.	Location
1.	Barhan
2.	Chamraula
3.	Jhinjhak
4.	Mandrak
5.	Pata Station (SR + Detour)
6.	DaudF Khan (SR + Detour)
7.	Achalda By Pass (SR + Detour)
8.	Hathras By Pass (Bhopat Village) (SR + Detour)
9.	Kheria near School (SR + Detour)
10.	Kheria near Hut (SR + Detour)
11.	Hiran Gaon and Dataunji) (SR + Detour)
12.	Maitha (SR + Detour)
13.	Kanchausi (SR + Detour)
14.	Phaphund (SR + Detour)
15.	Khandesi Pachar (SR + Detour)
16.	Samho (SR + Detour)
17.	Marera (SR + Detour)
18.	Jalesar road (SR + Detour)
19.	Daud Khan (SR + Detour)

Table 5.9: Vibrations Measured at Chamraula (12.5m., 25.0m. & 50m. as per Japanese Standards

Speed	Vibration in dB at 12.5m.	Vibration in dB at 25m.	Vibration in dB at 50m.
Passenger Up Trains			
97.2	73.9	65.5	40.3
103.2	79.8	60.7	51.3
83.853	70.7	62.8	55.3
92.52	68	62.8	57.3
71.91	64.8	55.6	46.3
30.15	73.9	62.8	59.6
67.5	71.2	60.7	45.5
80.226	72.7	61.2	43.7
97.2	73.7	53.1	45.8
60.75	71.7	59.7	36.3
15.516	70.3	60.4	51.8
87.66	71.3	57	47.8
107.28	72.6	54.6	44.3
28.413	63.7	62.7	44.2
95.22	71.9	60.8	50
30.753	70.2	60.6	58.8
93.15	68.8	63.3	44.8
70.434	63.7	59.9	54.9
24.543	67.1	51	41
21.285	73.9	64.9	56.7
17.379	77.1	63.8	60.6
81	74	54.3	48.9
50.49	66.9	53.9	49.1
Freight Open Wagon Up Trains			
92.52	73.6	62.3	49.7
96.57	70.2	61.2	46.9
68.31	78.5	55.5	48.5
102.51	68.2	64.6	58.7
104.22	71.9	65.3	57.1
51.66	68	65.6	63.9
97.2	69.9	47.3	41.2
91.8	66.8	60	53.1
102.24	71.3	64.4	48.9
95.58	72.3	64.5	52.6
97.2	65.8	55.5	47.5
66.42	64.9	59.1	62.4

Table 5.10: Vibration measured at Chamraula for Freight Closed Wagon and Other Up Trains

Category of Train	Speed	Vibration in dB at 12.5m.	Vibration in dB(at 25m.	Vibration in dB at 50m.
Closed Wagon	87.3	73.9	66.3	61.9
Cargo	97.2	65.8	55.5	47.5
Cargo	66.42	64.9	59.1	62.4

Table 5.11: Vibrations Measured at Chamraula (17.5m., 30.0m. & 55m.) as per Japanese Standards

Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Passenger Down Trains			
97.2	73.9	65.5	40.3
103.2	79.8	60.7	51.3
83.853	70.7	62.8	55.3
92.52	68	62.8	57.3
71.91	64.8	55.6	46.3
30.15	73.9	62.8	59.6
67.5	71.2	60.7	45.5
80.226	72.7	61.2	43.7
97.2	73.7	53.1	45.8
60.75	71.7	59.7	36.3
15.516	70.3	60.4	51.8
87.66	71.3	57	47.8
107.28	72.6	54.6	44.3
28.413	63.7	62.7	44.2
95.22	71.9	60.8	50
30.753	70.2	60.6	58.8
93.15	68.8	63.3	44.8
70.434	63.7	59.9	54.9
24.543	67.1	51	41
21.285	73.9	64.9	56.7
17.379	77.1	63.8	60.6
81	74	54.3	48.9
50.49	66.9	53.9	49.1
98.1	70.9	62.2	38.2
73.35	71.6	61.3	43.1
94.05	70.5	57.4	48
31.32	66.4	64.4	56.5
18.81	69.6	60.1	58.9
33.93	61.8	52.9	44.6

Table 5.12: Vibrations Measured at Chamraula for Freight Closed Wagon and Other Down Trains

Category of Train	Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Closed Wagon	38.59	76.9	58.8	53.7
Tanker	31.32	78	60.3	50.3
Cargo	54.81	68.8	52.9	35.3
Cargo	50.49	67.5	59.5	57.5
Diesel pen Wagon	16.98	68.5	60.3	50.3

Table 5.13: Vibrations Measured at Jhinjhak (12.5m., 25.0m. & 50m. as per Japanese Standards

Speed	Vibration in dB at 12.5m.	Vibration in dB at 25m.	Vibration in dB at 50m.
Passenger Up Trains			
78.43	69.5	63.5	62
32.4	65.3	60.5	53.5
86.4	70.7	71.4	58
57.5	71.8	65.7	62.8
Freight Up Trains			
88.8	70.8	68.9	66.3
99	71.9	66.4	61.2
97.2	68	67.9	60.8
94.05	70.2	67.7	59.7
91.89	70.5	63.8	54.2

Table 5.14: Vibration Measured at Jhinjhak for Freight Closed Wagon and Other Up Trains

Category of Train	Speed	Vibration in dB at 12.5 mtr	Vibration in dB at 25 mtr	Vibration in dB at 50 mtr
Closed Wagon	87.75	71.3	66	57.3
Closed Wagon	96.39	69	66.4	59.1
Tanker	79.8	71.4	65.6	55.8

Table 5.15: Vibrations Measured at Jhinjhak (17.5m., 30.0m. & 55m.) as per Japanese Standards

Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Jhinjhak DRP of Passenger Down Trains			
103.6	66.2	68.6	60.3
53.46	72.1	59.3	52.8
81.8	62.5	63.8	52.1
35.5	70.4	66.4	60.1
76.95	72.1	67.7	51.6
47.43	73.1	66.3	40.9
39.5	71.3	61.9	59.8
48.6	71.1	54.6	48.4
Open Wagon Freight Down Trains			
76.5	74.5	66	60.2
97.9	70.2	65.5	60.3
62.73	71.4	65.2	57
91.08	72.8	68.7	60.7
23.04	68	65.7	51.9

Table 5.16: Vibrations Measured at Jhinjhak for Freight Down Trains (Others)

Category of Train	Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Tanker	80.04	68.7	65.2	59.1
Cargo	91.89	69.4	63.8	61.4

Table 5.17: Vibrations Measured at Mandrak (12.5m., 25.0m. & 50m.) as per Japanese Standards

Speed	Vibration in dB at 12.5m.	Vibration in dB at 25m.	Vibration in dB at 50m.
Passenger Up Trains			
99.63	75.8	66.3	65.8
83.3	66.7	66.4	64.8
17.04	66	66.2	58.7
99.9	70.7	65.2	63.8
88.36	70.8	65.9	61.5
Open Wagon Freight Up Trains			
49.84	71.9	63.7	62.3
100.2	73.1	67.6	64.3

Table 5.18: Vibration Measured at Mandrak for Freight Up Train (Others)

Category of Train	Speed	Vibration in dB at 12.5m.	Vibration in dB at 25m.	Vibration in dB at 50m.
Cargo	45	64.9	63.3	57.2

Table 5.19: Vibrations Measured at Mandrak (17.5m., 30.0m. & 55m.) as per Japanese Standards

Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Passenger Down Trains			
48.6	66.8	64.3	60.3
100.2	71.9	67.9	66
14.94	64.8	61.2	56.2
92.52	72	67.7	65.5
82.44	71.5	64.6	62.6
102.6	73.9	64.9	66
90	73	67.4	63.7
97.2	70.6	65.8	62.8
Open Wagon Freight Down Trains			
99.18	70.2	68.8	65.2

Table 5.20: Vibration Measured at Mandrak for Freight Down Train (Others)

Category of Train	Speed	Distance 17.5 mtr	Distance 30 mtr	Distance 55 mtr
Cargo	90	71.3	63.3	60.3

Table 5.21: Vibrations Measured at Barhan (12.5m., 25.0m. & 50m.) as per Japanese Standards for all Categories Up Trains

Category of Train	Speed	Vibration in dB at 12.5m.	Vibration in dB at 25m.	Vibration in dB at 50m.
Passenger	81	74.3	67.4	58.7
Passenger	64.8	70.6	65.9	59.8
Open Wagon	69.75	71.6	72.5	70.1
Closed Wagon	93.6	63.4	65	64.2
Cargo	97.2	56.9	60.1	58.1

Table 5.22: Vibration Measured at Barhan for All Categories of Down Trains

Category of Train	Speed	Vibration in dB at 17.5m.	Vibration in dB at 30m.	Vibration in dB at 55m.
Passenger	46.8	73	66.7	58.2
Open Wagon	100.7	70.3	65.2	57.4

Source: Consultant Survey

5.6.6 Measured Vibrations Levels on Sensitive Receptors

Measurements in industrial / commercial/ residential sensitive receptors located closest to the track / proposed track were collected. This data, collected during Railway Vibrations, on plain routes was used for calculation / extrapolation of vibration levels on SRs that were not physically covered during vibration measurement process. While doing so, it was presumed that buildings which were in the line of alignment will be removed and will not to be included in prediction. The land between the proposed track and selected receptors was identical to similar situations elsewhere. The measurements on similar locations were therefore directly transposable to similar uncovered locations in order to assess the impact on such locations.

Values of maximum vibrations recorded on those receptor / important locations which can help in prediction of vibrations on all SRs are presented in Table 5.23.

Table 5.23: Vibration Levels on Sensitive Receptors

Name of Location	Distance	LMAX, dB
Hiran Gaon (Shiv Mandir)	15 mtrs	89.8
Maitha (Primary Health Centre)	70 mtrs	78
Kanchausi (Hanuman Mandir)	25 mtrs	78.1
Phaphund (Mandir near Railway Crossing)	44 mtrs	65.4
Khandesi Pachar (Primary Health Centre)	35 mtrs	67.7
Jaswant nagar (Beg. Of Detour)	5 mtrs	90.1
Samho(Near Inter College)	30 mtrs	79.9
Marera (Kumhar Ka Ghar)	12.5 mtrs	75.8
Jalesar (Primary School)	30 mtrs	60.3

DETOURS			
S.No	**Name of Location**	**DISTANCE**	**LMAX**
1.	Achalda By Pass(DeTour) near Mulayam Singh Inter College	30 mtrs	45.4
2.	Hathras By Pass (Bhopatpur - DeTour)	3 mtrs	67.8
3.	Daud Khan (DeTour)	45 mtrs	62.1
4.	Kheria Near LC Hut (DeTour)	15 mtrs	51.9
5	Kheria Near School (DeTour)	1 mtr	46.4
6.	Pata Station (NearbySchool)	110 mtrs	51.3

*At this location DFC would be crossing the national highway which is very busy. The existing Max Vibration Levels due to Road Traffic is more than 90dB and it persists for long stretches of time. This is to be addressed while considering the impacts of DFC on this stretch.

Vibrations due to the rail traffic at sensitive locations such as residential areas, religious places, educational institutons, etc., located close to the track / proposed track were also measured. The measurements were carried out both with and without train crrosing the measuremen location. As presented in the table 5.24 and figure 5.14 below, the vibration levels wary from 89.8 dB during train movement and 33.4 dB during other periods of the day. The data

further indicates high vibration levels close to the track and gradual decrease as the receptor distance increase from the track. This data and analysis formed the basis for calculation / extrapolation of vibration levels on similar SRs that could not be measured during the field measurements.

Table 5.24: ASR Ambient Vibration Levels
(Minus data of train Passage time)

S. No	Name of Location	Distance	Lmax, dB
1	Marera (Kumhar Ka Ghar)	12.5 mtrs Marera (Kumhar Ka Ghar)	53.3
2	Kanchausi (Hanuman Mandir)	25 mtrs	63.7
3	Jalesar (Primary School)	55 mtrs Jalesar (Primary School)	47.4
4	Khandesi Pachar (Primary Health Centre)	35 mtrs	67.5
5	Phaphund (Mandir near Railway Crossing)	44 mtrs Phaphund (Mandir near Railway Crossing)	57.4
6	Samho(Near Inter College)	30 mtrs Samho(Near Inter College)	32.5
7	Maitha (Primary Health Centre)	70 mtrs	58.9
8	Hiran Gaon (Shiv Mandir)	15 mtrs	33.4
9	Pata Station (NearbySchool)	110 mtrs	39.8
10	Jaswant Nagar	5 mtr	43.6

Source: Consultant Survey

The pictorial representation of the changes in Vibration Levels due to movement of train(s) is provided below.

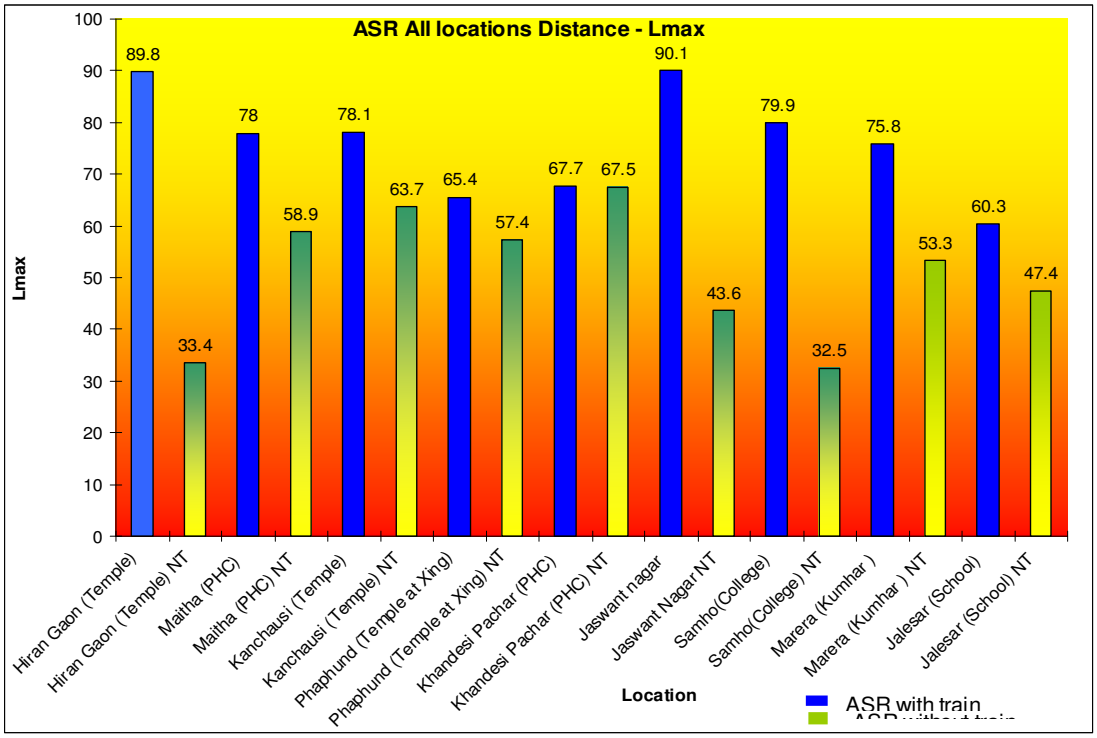


Figure 5.14:

5.7 WATER: HYDROLOGY AND DRAINAGE

5.7.1 Surface water & Drainage

The project area from Bhaupur to Khurja is a part of the Ganges basin, which contains the largest river system on the subcontinent comprising the Rivers of Ganga, Yamuna and number of other rivers. The flow in the basin is largely contributed by the southwesterly monsoon winds from July to October, as well as on the flow from melting Himalayan snows in the hot season from April to June. Tropical cyclones originating between June and October in Bay of Bengal also contribute to water flows in the basin. The average annual rainfall varies from 760 mm at the western end of the basin to more than 2,290 mm at the eastern end.

The proposed alignment of DFC does not cross any of the perennial rivers of Ganga Basin or any other river systems. The general slope of the area was noted to be from North West to South East with elevation ranging from 126 MSL at Kanpur to 222 MSL Bulandshehar. Passing through the districts of Kanpur, Auraiya, Etawah, etc. these areas are located in the central plains and South Western Semi Arid agro-climatic zones of Uttar Pradesh.

Important rivers and streams in the project area are part of Yamuna drainage basin and comprises of River Kuwari, Sengar and its tributary Sirsa, Arind and its tributaries Ahenya, Puraha and Pandu. These rivers seasonal in nature and does not serve any irrigation or drinking water requirements of the reason.

5.7.2 Ground Water

The project area is underlain by thick pile of quaternary sediments which comprises sands of various grades, clays and *kankar*. The quaternary sediments overlain the pre-existing Vindhyan Basement with the thickness varies from 286 to 380 meters. The Vindhyan basin tends to grow deeper from west to east.

The Central Ground Water Board, Aligarh demarcates the project area in to a three tier aquifer system occurring down to bed rock, as indicated below.

I Aquifer Group	00.00 - 130.00 mbgl – Quality fresh
II Aquifer Group	100.00 - 150.00 mbgl – Quality Brackish to saline
III Aquifer Group	130.00 - 300.00 mbgl – Quality brackish to saline

The ground water is encountered in the first aquifer group, while deeper aquifers are under semi-confined to confined conditions. Overall, the depth of ground water in the project area generally varies from 2.57 to 21.00 m below ground level, during pre-monsoon period and ranges between 0.13 m and 16.73 m below ground level during post-monsoon period. The ground water levels are observed to be rainging between 0.32 and 7.24 m , with an overall fluctuations of about 2 meters.

With good to moderate water yield capacities, the first aquifer group is fit for domestic and industrial consumption. The yield is expected to be around 2000-3000 lpm through tube wells and 1000-2000 lpm through shallow tube wells in the eastern part of project area.

5.8 WATER QUALITY

As presented in section 5.7 above, there are no major or perennial water bodies in

the project area. While there is no major irrigation or drinking water uses, few domestic uses such as animal bathing, washing, etc. were observed.

Table 5.25: Water Quality Criteria and Standards for Freshwater Classification (CPCB, 1979)

Parameters	BOD mg/l	pH	D.O. in mg/l	Oil & Grease mg/l
CPCB standard Class A (drinking water without conventional treatment but after disinfections)	≤ 2.0	6.5 – 8.5	≥ 6.0	---
CPCB standard Class B (for outdoor bathing)	≤ 3.0	6.5 – 8.5	5.0	--
CPCB standard Class C (drinking water after conventional treatment and disinfections)	≤ 2.0	6 – 9	≥ 4.0	--
CPCB standard Class D (for propagation of wild life, fisheries)	--	6.5 – 8.5	≥ 4.0	≤ 0.1
CPCB standard Class E (for irrigation)	--	6.0-8.5	--	--

' --' Indicates not applicable/relevant

In order to assess the base line water quality of these water bodies, samples were collected from 22 hand pumps / tube wells, 2 irrigation canals, Arind River and a pond near Maitha (km. 1050.3). As presented in table 5.26, ground water in the project area presents a high hardness, chlorides and sulphides. However, the surface water quality was observed to be within the CPCB standards of surface water bodies.

Table 5.26: Water Quality Results for Surface and Ground Water

S. No.	Location/ Sample Sources / Distance from corridor (Meter)	pH	BOD mg/l	Chloride mg/l	Fluoride mg/l	Sulphatemg/l	Iron mg/l	Phosphate mg/l	Sodium mg/l	Total Hardness mg/l
	KHURJA JUNCTION – 1369									
1.	Near Junction (Khurja) (HP) -150	6.8	Nil	547.21	0.3	415.87	0.14	0.0013	160.52	454.27
2.	Village Nagla Kat (TW) – ROW	7.1	Nil	415.02	0.3	254	0.06	0.0011	92.48	425.63
3.	Kulwa Station (HP) – 45	7.8	Nil	178.01	0.4	458.43	0.04	0.0021	124.65	415.4
	ALIGARH STATION – 1327									
4.	Village Chuharpur Nehriya (TW) - 600	7.8	Nil	42.09	0.5	156.43	0.31	0.02	154.67	284.75
5.	Village Parhawali (TW) - 70	7.6	Nil	142.98	0.4	135.71	0.06	0.0018	96.04	310.45
	MANDRAK STATION – 1313									
6.	Near Mandrak Station (HP) – 70	8.1	Nil	56.12	0.2	98.28	0.43	0.0037	83.97	284.75
7.	Mamota Kala Village (TW) - 1200	7.7	Nil	168.37	0.4	238.96	0.18	0.0013	133.76	398.66
	HATHRAS STATION – 1296									
8.	Village Sithoroli (TW) - 85	6.8	Nil	378.83	0.5	614.72	0.20	0.0235	145.23	417.64
9.	Canal – Cutting across corridor	7.4	16.84	32.67	0.1	74.51	0.38	0.0012	5.89	184.06
	TUNDLA STATION – 1249									
10.	Hirangaon / Crossing (HP) - 800	7.1	Nil	154.34	0.4	479.96	0.14	0.0019	118.48	360.69
11.	Bhikhanpur Bakal pur(TW) - ROW	7.2	Nil	182.4	0.2	256.1	0.08	0.0013	126.12	265.77
	FEROZABAD – 1232									
12.	Kaurara Khurd (TW) - 900	7.4	Nil	70.15	0.5	84.87	0.37	0.0235	76.43	417.64

S. No.	Location/ Sample Sources / Distance from corridor (Meter)	pH	BOD mg/l	Chloride mg/l	Fluoride mg/l	Sulphate mg/l	Iron mg/l	Phosphate mg/l	Sodium mg/l	Total Hardness mg/l
	SHIKOHABAD – 1212									
13.	Near Shikohabad Station (HP) – 120	8.1	Nil	143.57	0.4	94.08	0.51	0.0024	68.12	219.31
14.	Madanpura Village (TW) – 350	7.8	Nil	98.01	0.4	165.42	0.28	0.017	69.71	186.38
	JASWANT NAGAR – 1173									
15.	Lowever Ganga Canal Cutting across corridor	7.5	17.98	43.08	0.6	47.82	0.26	0.001	41.72	175.84
16.	Nagala Bhar Village (TW) – 650	7.3	Nil	84.18	0.4	98.61	0.31	0.0019	76.43	455.61
	ETAWAH – 1157									
17	Sarai Bhopat Station (TW) – 65	7.4	Nil	28.06	0.3	158.07	0.40	0.018	57.84	265.77
18	Ekdil station / Crossing (HP) – 400	7.1	Nil	174.08	0.5	223.41	0.02	0.0021	48.09	346.84
	ACHALDA – 1117									
19	Near Achalda Station (HP) – 55	7.4	Nil	175.48	0.4	187.68	0.16	0.0013	57.64	278.57
20.	Baldev ki Mdaiya Village (TW) – ROW	7.5	Nil	42.09	0.6	147.52	0.42	0.016	53.1	246.79
	RURA – 1062									
21	Phaphund Station (HP) – 45	7.1	Nil	187	0.4	78.56	0.39	0.0017	75.41	310.74
22.	Near Crossing (Proposed) (TW) – 950	7.5	Nil	175.41	0.5	154.08	0.08	0.0012	64.57	289.35
	BHAUPUR – 1040									
23	Near Junction (Proposed) (TW) – 250	7.5	Nil	28.06	0.4	176.5	0.13	0.016	47.59	227.8
24.	Arind River Cutting across corridor	7.3	18.09	29.42	0.3	64.09	0.46	0.0023	3.69	145.02
25.	Pond near Maitha 100	7.5	28.06	40.63	0.2	74.80	0.30	0.012	16.20	190.00

Source: Sample Analysis

5.9 GEOLOGY

As discussed earle, the proposed alignment of the project is a part Ganga plain lying between the rocky Himalayan belt in the north and the southern hilly tract comprising Pre-Cambrian rocks. Flexing of the Indian lithosphere in response to the compressive forces due to collision, and thrust fold loading produced the Ganga Plain foreland basin. The basin is filled with recent alluival sediments which is at places more than 1,000 m thick and an amalagamation of sand, silt, clay in varying proportions. As presented in figure 5.15, the project alignment from Bhaupur (Kanpur) to Khurja (Bulandshahar) is located in the younger alluvium of Ganga Basin and generally there is no significant variation in geology.

Figure 5.15

5.10 GEOGRAPHY AND SOIL QUALITY

Since the project is situated in the younger alluvium of Ganga Basin, the soil is prone to erosion. The entire alluvial plain along the alignment can be divided into three sub-regions These include, the eastern tract know as scarcity areas wth highest population density and lower per capita land, the central tract and western tract comprising well developed irrigation system.

However, being alluvial the land is very fertile and cultivation of rice, wheat, millets, gram, barley and sugar cane, etc are the chief crops of the region. Some areas of Etawah district are also sodic in nature.

In order to establish the base line soil profile, samples were collected from twenty five locations, spread across the project area. As presented in table 5.27 below, the soil in the project area is good for agricultural and plantation purposes and NPK ratio is favourable.

Table 5.27: Soil Analysis Report

S. No.	Location/ Distance from corridor (Meter)	Date of Sampling	PH	Nitrogen	Phosphate	Potassium	Sodium	Sample Sources
	KHURJA JUNCTION – 1369							
1.	Near Junction(Khurja) 200	20-12-2008	8.1	0.371	0.119	23.6	160.52	Agricultural land
2.	Village Nagla Kat 70	29-12-2008	6.4	0.603	0.021	18.4	92.48	Orchard Land
3.	Kulwa Station 250	12-01-2009	7.3	0.714	0.107	59.3	124.65	Agricultural land
	ALIGARH STATION – 1327							
4.	Village Chuharpur Nehriya 75	16-01-2009	7.4	0.108	0.081	20.47	154.67	Agricultural land
5.	Village Parhawali 90	05-02-2009	7.1	0.519	0.115	29.18	96.04	Orchard Land
	MANDRAK STATION – 1313							
6.	Near Mandrak Station 350	21-12-2008	7.8	0.573	0.048	16.92	83.97	Agricultural land
7.	Mamota Kala Village 150	07-01-2002	6.3	0.672	0.051	17.34	133.76	Agricultural land
	HATHRAS STATION – 1296							
8.	Village Sithoroli 40	22-12-2008	7.6	0.416	0.108	25.83	145.23	Agricultural land
9.	Village Mendu 35	14-01-2009	7.4	0.801	0.093	21.09	5.89	Orchard Land
	FIROZABAD – 1232							
10	Kaurara Khurd 100	24-12-2008	8.0	0.591	0.035	56..07	76.43	Agricultural land
	SHIKOHABAD – 1212							
11	Near Shikohabad Station 1200	03-01-2009	6.5	0.514	0.013	65.04	68.12	Agricultural land
12.	Madanpura Village 450	17-01-2009	7.9	0.086	0.017	15.58	69.71	Agricultural land
	JASWANT NAGAR – 1173							
13.	Jaswant Nagar Station 600	05-01-2009	7.4	0.726	0.006	21.51	41.72	Agricultural land
14.	Nagala Bhar Village 1100	18-01-2009	7.1	0.642	0.004	28.06	76.43	Agricultural land
	ETAWAH – 1157							
15	Sarai Bhopat Station 800	12-01-2009	6.7	0.621	0.002	12.02	57.84	Agricultural land
16.	Ekdil station / Crossing 200	19-02-2009	6.8	0.495	0.014	19.46	48.09	Agricultural land

	ACHALDA – 1117								
17.	Near Achalda Station	80	12-02-2009	6.1	0.407	0.009	38.69	57.64	Agricultural land
18.	Baldev ki Mdaiya Village	40	28-02-2009	7.8	0.706	0.016	25.61	53.1	Agricultural land
	RURA – 1062								
19.	Phaphund Station	150	13-02-2009	7.6	0.724	0.008	89.53	75.41	Agricultural land
20.	Near Crossing (Proposed)	100	24-02-2009	7.8	0.534	0.001	68.42	64.57	Agricultural land
	BHAUPUR – 1040								
21.	Near Maitha Station	200	15-02-2009	8.1	0.624	0.0027	44.08	47.59	Agricultural land
22.	Roshan Mau	90	25-02-2009	7.5	0.473	0.013	72.18	3.69	Agricultural land

Source: Sample Analysis

5.11 LAND USE

General Land Use Pattern of the area along the proposed DFC corridor is predominantly under agriculture use. The alignment passes through 229 villages in the districts of Kanpur Dehat, Auraiya, Etawah, Firozabad, Agra, Mahamaya Nagar, Aligarh and Bulandshahr in Uttar Pradesh.

Project area indicating sections, parallel & bypass, length, villages and land area affected / acquisition is given at **Table - 5.28** below.

Table 5.28 : Project Area: Salient Features

Project Stretch (From-To)	Package No	Chainage km (From-To)	Distribution of length(km)		Total length	No. of Districts	No. of Villages	LA (Ha)
			Parallel	Bypass				
Bhaupur-Bhatuara	**I**	**1040-1170**	95	40	135	3	104	570
Kaist-Biruni	**II**	**1170-1266**	30	0*	30	2	27	93
Jamal Nagar - Khurja	**III**	**1266-1370**	69	38	107	3	98	519
Total (Bhaupur-Khrja Phase-I)		**1040-1370**	**194**	78	272	8	229	1182

* Entire data of Existing Tundla detour has been deleted.

Table 5.29 indicates loss of agricultural land

Table 5.29: Project Area: Loss of Land

Package	**Land(in ha)**		**TOTAL**
	Private	**Government**	**In ha**
I	473(83%)	97(17%)	570(100%)
II	83.92(90%)	9.08(10%)	93(100%)
III	442(85%)	77(15%)	519(100%)
Total	**999(85%)**	**183(15%)**	**1182(100%)**

Package-I is between Bhaupur-**Bhataura**, Package-**II** is between Kaist-**Biruni** and Package-III is between Jamal Nagar-Khurja

Following table 5.30 gives affected residential & commercial land.

Table 5.30: Project Area: Loss of Land Residential and Commercial properties (in Sqm.)

Pack-age	**Cat-egory**	**TH**				**NTH**				**G. Total**			
		No.	**Total Area**	**Affe-cted Area**	**%**	**No.**	**Total Area**	**Affe-cted Area**	**%**	**No.**	**Total Area**	**Aff-ected Area**	**%**
I	Resi.	48	6722	2163	32	30	4228	1692	40	78	10951	3855	35 %
	Comm.	20	1746	744	43	14	1095	716	65	34	2840	1461	51 %

II	Resi.	5	432	355	82	20	1607	1085	68	25	2038	1440	71 %
	Comm.	17	1746	479	27	6	553	440	80	23	2299	920	40 %
III	Resi.	122	9407	6942	74	73	6916	5727	83	195	16323	12669	78 %
	Comm.	20	1488	974	65	6	441	246	56	26	1929	1220	63 %
Total	Resi.	175	16561	9460	57	123	12751	8504	67	298	29312	17964	61 %
	Comm.	57	4980	2197	44	26	2089	1403	67	83	7069	3600	51 %
G. Total		**232**	**21541**	**11657**	**54**	**149**	**14840**	**9907**	**67**	**381**	**36381**	**21565**	**59 %**

Package-I is between Bhaupur-Bhataura, Package-II is between Kaist-Biruni and Package-III is between Jamal Nagar-Khurja

To minimize the impacts on the PAPs, a separate social assessment studies have been commissioned by DFCCIL and a project specific Rehabilitation Action Plan has been prepared for the project.

5.12 ECOLOGY

Any project has some impact on the flora and fauna in the project area. Plant and animal communities are indicators of the environment. They respond not only to one environmental factor, but also to an interacting group of factors. These communities influence and react sensitively to change in the balance of environmental stresses.

Therefore, a detailed knowledge of the diversity of the area definitely helps in managing the area properly following suitable practices. The study was conducted in the project area to assess all possible consequences on the biological environment.

Floral and faunal surveys conducted for assessing the biological diversity and its status over a period of time that forms an integral part of Impact Assessment Techniques. The present study is highlighting the various issues pertaining to floristic diversity and the faunal wealth including Ethno-botany and silvicultural issues in the submergence area and also the area beyond the limit of the submergence. Accordingly, for the Environmental Impact Assessment (EIA) studies, the total area has been sub-divided into the following areas;

- Dedicated Freight Corridor Chainage
- About 1km surrounding area of DFC
- Natural vegetation in the study area.
- Forest area (Protected/Reserved)
- Rivers and Ponds in vicinity

Site Selection Criteria:

Three sampling locations were selected to study the terrestrial eco-system, with due consideration to the following points.

a) Major affected area
b) Natural vegetation in the study area.
c) National Parks, sanctuaries in the study area.
d) Natural Water Bodies in the study area

Terrestrial Study was conducted at eight locations across the Chainage. This study was conducted at two locations. The biological study of terrestrial flora, fauna and aquatic biota has been done for different transects. However, the surveys have also been created for the entire area in the vicinity of proposed DFC Project.

5.12.1 OBJECTIVES

The biological study of the area has been conducted in order to understand the ecological status of the existing flora and fauna to generate baseline information and evaluate the probable impacts on the biological environment.

Terrestrial Ecology

The study was undertaken with a view:

- To assess nature and distribution of the vegetation in the area.
- To assess the frequency, frequency class, relative frequency, abundance, density, diversity index.
- To evaluate the dominant species of plant and animal.
- To list the endangered species (both flora and fauna).
- To mark the wetlands and other ecologically sensitive areas such as national parks/ sanctuaries
- To asses the effect of construction and operation of the project on existing ecology
- To recognize the diversity indices of the terrestrial and aquatic communities.
- To Asses the spawning and feeding habitats of aquatic species with respect to time and location.

Aquatic Ecology

The study was carried out in the project site aiming at:

- Inventorization of different aquatic species (plankton (phyto & zoo), benthos, fishes).
- Population density of the macro invertebrates and fishes in the river.
- To identify the feeding and breeding grounds of economically important fishes.
- To assess the existing status of endangered species.

5.12.2 METHODOLOGY

Floral Study

The vegetation sampling was carried out by using the least count quadrate method and line transacts cutting method across different habitats. The line transact method was useful to describe general vegetation pattern over large area and the quadrants are useful for quantification of density and abundance of the vegetation in the study area. The size and number of quadrates needed were determined using the species area curve (Mishra, 1968) and the running mean method (Kershaw, 1973). Summarization of previously used methods and recommendations led to the use of more than often (10x10m) quadrates laid out for sampling the tree stratum and 1x1m quadrates for herbs, grasses and seedlings of tree species. However, for examining the shrub species 3x3m sample plots were laid out. The enumeration of the vegetation was done by measuring dbh individually in case of woody vegetation, and collar diameter in case of herbs and grasses using the tree caliper and electronic digital caliper. In case of grasses and sedges, each erect shoot is considered by a plant tiller, and the enumeration was done by laying 1m x 1m quadrates at random, further subdivided into 10 x 10 cm segments. Four such segments selected at random were analyzed from each quadrate by counting the tillers individually as per the method used was that of Singh and Yadava (1974).

The vegetation data collected for phytosociological information were quantitatively analyzed for density, frequency, abundance and specific diversity index according to Curtis and McIntosh (1950). The relative values of frequency, density and dominance of all the species were summed up to represent Importance Value Index (IVI). The followings are the formulae to derive frequency, density, dominance, IVI etc.

$$\text{Frequency} = \frac{\text{Total number of quadrats in which species occurred}}{\text{Total number of quadrats studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individuals of species in all quadrats}}{\text{Total number of quadrats in which species occurred}}$$

$$\text{Density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrats studied}}$$

IVI = Relative frequency + Relative dominance (basal area) + Relative density

$$\text{Relative Frequency} = \frac{\text{Frequency of the species}}{\text{Total frequency of all species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of the species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative Dominance} = \frac{\text{Dominance of the species}}{\text{Total dominance of all species}} \times 100$$

$$\text{Relative Abundance} = \frac{\text{Abundance of the species}}{\text{Total abundance of all species}} \times 100$$

Diversity of the Forest Vegetation

The tree species diversity for each stand in different forest types was determined using Shannon Wiener information function (Shannon and Wiener, 1963), which is:

$$\bar{H} = \sum_{i=1}^{S} \left(\frac{Ni}{N}\right) log_{10} \left(\frac{Ni}{N}\right)$$

Where, Ni is the total number of individuals of species i and N is the total number of all species in a stand.

Concentration of dominance

Concentration of dominance (Cd) was measured by Simpson Index (Simpson, 1949):

$$CD = \sum_{i=1}^{S} \left(\frac{Ni}{N}\right)^2$$

Where, Ni and N were the same as for Shannon Wiener information function. This index ranges from one, if all the individuals belong to one species, to (1/s) if they are equally divided among species (S).

Faunal Study

Terrestrial Fauna

A ground survey was carried out in the impact zone of the proposed DFC project. Important animal groups: butterflies (insects), birds and mammals inhabiting the area were surveyed.

For sampling butterflies, the standard '*Pollard Walk method*'; for birds '*point sampling*' along the fixed transect (foot trails) and for sampling mammals, '*direct count on open width (20m) transect*', were used on fixed transects. Sampling was carried for 3 ha in each of the tree transects at every site.

Seasonal variation in species diversity of different groups of animals (butterflies and birds) were evaluated using Shannon-diversity Index (***H'***) to

know the season of peak diversity in the area amongst the post monsoon seasons studied.

$$H' = -\Sigma^{N}_{1} Pi \ln Pi$$

(From species 1 to n; n= total number of species)
Where, **Pi** is the proportion of the individual species in the total population.

Aquatic Fauna

Zooplankton

For zooplankton analysis, 20L of subsurface water was strained through 53µ Nytex plankton net and the concentrate was transferred to labelled plankton bottle after rinsing the net with distilled water. The planktons were immediately preserved in 4% neutral formaldehyde solution for subsequent examination and quantification.

Zooplankton samples were observed in a sedimentation chamber under an inverted plankton microscope. Planktons were identified with the help of standard keys and references. For quantification, an aliquot of the concentrate was suitably diluted. After thorough mixing, one ml of the sample was transferred to a clean Sedgwick-Rafter cell and examined under the inverted microscope. Planktons were counted under the various genera identified. Three replicates were taken and averaged. The number of organisms per litre under each genus was calculated by the following formula:

No. of organisms L^{-1} = Vol. of conc. (ml) X No. of organism / Vol. of conc. Examined (ml) X Vol. of water filtered (L)

Phytoplankton

Similarly, for phytoplankton analysis, water sample were taken directly from the sites in 100 ml sampling bottles and preserved with Lugol's solution immediately. Then the samples were centrifuged in the laboratory followed by removal of desired amount of supernatant from the centrifuge tube to make the required concentration. Phytoplanktons were then analysed using a compound microscope and haemocytometer in the concentrates. The number of organisms per litre was calculated as follows:

No. of organisms L^{-1} = No. of organism X 10^{7} / Concentration factor X No. of slides examined

Benthos

For the benthic organism study, sediment samples were taken from the bottom of river manually and brought to laboratory for analysis. The samples were washed through sieves to harvest the organisms and then preserved in sampling vials using formal dehyde as preservative. Benthic organisms were enumerated using a simple microscope/ hand lens.

Fishes

Fisheries data has been collected through consultation with local fishermen and throwing nets.

Macrophytes

Macrophytes were studied visually in the field. Photographs were taken for identification assistance. The diversity was noted in visual method (1-5 grade point scale).

Phytoplankton Productivity

Phytoplankton productivity was measured using Light and Dark bottle method of Gaarder and Grann. The dissolve oxygen measurement for this purpose was done by Winkler's Iodometric method.

5.12.3 Flora of the project Area

General survey of flora has been carried out district wise from Kanpur to Khurja. On the basis of Survey and secondary data collected from forest office a large variety of Trees, herbs and shrubs found suited to climatic condition. The structure and type of vegetation depends on climatic conditions and physiographic conditions, as well as requirements of the local inhabitants of the area. The vegetation in the study area is deciduous in nature. Mainly three type of forests were found in the study area.

i. Tropical Moist Deciduous Forests:

These forests are found in the moist region of Terai. They grow in regions that record 100 to 150 cm. of rainfall annually, have an average temperature between 26˚-27˚ C. and have considerable degree of humidity.

A special feature of the forests is that deciduous trees of uneven size grow in higher altitude regions. Lower regions have several species interspersed with Bamboo, Climbers, Cand and ever green shrubs. Main trees are Sal, Ber, Gular, Jhingal, Palas, Mahua Semal, Dhak, Amla, Jamun, etc.

ii. Tropical Dry Deciduous Forests:

These forests are found in all parts of the plains, and usually in central eastern and western regions. The trees are mostly deciduous. Since sunlight reaches the ground in abundance, shrubs and grasses also grow here. Large tracts of these forests have been cleared for cultivation. Important trees are Sal, Palas, Amaltas, Bel, Anjeer etc. Neem, Peepal, Sheesham, Mango, Jamun, Babool, and Imli (Tamarind) etc. grow along riverbanks and in other moist regions.

iii. Tropical Thorny Forests:

These are mostly found in south-western parts of the State. Such forests are confined to the areas with low annual rainfall (50-70 cms), mean annual temperature between 25˚C to 27˚C and low humidity (less than 47%). Widely scattered thorny trees, such as Babool, Thorny, Legumes and Euphorbias, are found here. During rains, short grasses are also found here. The trees are generally small, forming open dry forests. Important trees of these regions are

Phulai, Khair, Kokke, Dhaman, Danjha, Neem, etc. Various types of resin and gum are also obtained from these trees.

The study area enjoys sub-tropical climatic conditions with four seasons, pre monsoon (March to June), monsoon (July to September), post monsoon season (October and November) and winter season (December to February). List of plant species and its ecological importance based on secondary data is listed below.

List of Plant Species based on Secondary data in the Study Area

Plant Species	Vernacular Name	Enthanobotanical Values
Azadirachta indica	Neem	Medical, Timber, Fuel
Acacia nilotica	Kikar	Timber, Fuel
Acacia leucophloea	Babul	Timber, Fuel
Albizzia lebbek	Siras	Timber, Fuel
Acacia catechu	Khair	Medical, Timber, Kattha
Aegle marmelos	Bel	Food, Timber, Mythological
Bauhinia variegate	Kachnar	Ornamental
Cassia fistula	Amaltas	Aesthetic, Fuel
Dalbergia sissoo	Shisham	Timber, Fuel
Delonix regia	Gulmohar	Aesthetic, Recreational
Eucalyptus hybrid	Safeda	Timber, Fuel
Emblica officinalis	Amla	Mythological, Fuel Timber,
Polyalthia longifolia	Ashok	Aesthetic, Recreational
Prosopis julifera	Kabuli kikar	Timber, Fuel
Phoenix dactylifers	Khajur	Food, MFP (Fan)
Populus sp.	Poplar	Timber
Pongamia glabra	Karanj	Medicinal
Ficus religiosa	Papal	Mythological, Timber
Ficus benghalensis	Bargad	Timber, Fuel
Holoptelea intgrifolia	Papri	Timber, Medicinal
Morus alba	Shahtoot	Food, Timber
Morus raphii	Philkhan	Timber, Fuel
Mangifera indica	Aam	Mythological, Timber, Fuel
Syzygium cumini	Jamun	Food, Timber
Tarminalia arjuna	Arjuna	Aesthetic, Recreational
Teminalia belerica	Baheda	Medicinal, Timber
Anisomeles ovata	Jangali Tulsi	Medicinal
Achyranthes aspera	Apmarg	Drugs, Medicinal
Calotropis procera	Aak	Medicinal
Mimosa pudica	Chiumui	Aesthetic
Nerium indica	Kaner	Aesthetic, Recreational
Opuntia dillenii	Nagphani	Medicinal
Sathura matel	Datura	Poison, Medicinal
Tribulus terrestris	Gokharu	Medicinal
Zizyphus numularia	Jahrberi	Food, Fodder
Cynodon dactylon	Dub	Fodder
Desmostachya bipinnata	Dab	Huts
Erianthus munja	Munj	Huts

Plant Species	Vernacular Name	Enthanobotanical Values
Saccharum spontaneum	Kans	Huts
Cuscuta reflexa	Amarbel	Medicinal
Butea monosperma	Palash	Aesthetic
Tectona grandis	Teak	Timber
Ocimum gratissimum	Ram Tulsi	Medicinal
Delonix regia	Gulmohar	Ornamental
Calotropis procera	Akman	

Source: (Data collected from Forest Deptts.)

iv. Tree felling

The proposed alignment may cause cutting of approximately 1966 trees. The major species present along the alignment are babool, neem, shisam, papal, mango, bargad, kanji, labhera, ashok, sirsa, guler, jamun, ber, eucalyptus, mahua and bel. As these trees are located all along the proposed alignment of 272 km, it is assumed that cutting of these trees will not have significant ecological impacts.

5.12.4 Biodiversity Profile

District-wise secondry data collected from Forest Department on tree, shrubs and other species are presented below:

Table 5.31: Bio-Diversity Profile of Kanpur Region

Sl. No.	Botanical Name	Common Name
1.	*Syzygium cumini*	Jamun
2.	*Shorea Robusta*	Sal, Shakhu
3.	*Anogeissus latifolia*	Bakli, Dhaura
4.	*Aegle mormelos*	Bel
5.	*Holdina cordifolia*	Haldu
6.	*Mitragyna parvifolia*	Kaim or Tekui
7.	*Mallotus philippensis*	Rohini
8.	*Modhuca longifolia var. latifolia*	Mahua
9.	*Dalbergia sissoo*	Sheesham
10.	*Ficus religiosa*	Peepal
11.	F. auriculata	Timla
12.	F. semicordata	Khainu
13.	*F. virens*	Pakad
14.	*F. benghalensis*	Bargad
15.	*Acacia catechu*	Khair
16.	*Albizia lebbeck*	Siris
17.	*Terminalla alata*	Asna, Asain
18.	*T. bellirica*	Bahera
19.	Streblus asper	Sehore
20.	Butea monosperma	Dhak, Palas
21.	*Buchanania lanzon*	Chirongi
22.	*Cassia fistula*	Amaltas
23.	*Lannea coromandelica*	Jigma, Jhingan
24.	*Pongamia pinnata*	Karanj

25.	*Tectona grandis*	Teak
Shrubs		
1.	*Murraya koenigii*	Gandela, Kathneem
2.	*Holarrhena pubescens*	Kachr
3.	*Lantana camara*	Kuri
4.	*Zisiphus mauritiana*	Ber
5.	*Z. oenoplia*	Makoi
6.	*Colebrookea oppositifolia*	Chavova, Binda
7.	*Glycosmis arborea*	Gutahru
8.	*Ardisla solanacea*	Jalkaima
9.	*Grewia hisuta*	Seetachabeni
10.	*G. subinaequalis*	Pharsa
11.	*Crotalaria jumcea*	Bansa
12.	*Adhatoda vasica*	Bansa, Adusa
13.	*Jatropha gossypifolia*	Lal arand
14.	*Zanthoxylum armatum*	Timur
15.	*Rubus ellipticus*	Hisalu
16.	*Berberis lycium*	Kingor

Source: Forest Department

Table 5.32: Bio-Diversity Profile of Auriya Region

Sl. No.	Botanical Name	Common Name
1.	*Syzygium cumini*	Jamun
2.	*Shorea Robusta*	Sal, Shakhu
3.	*Anogeissus latifolia*	Bakli, Dhaura
4.	*Aegle mormelos*	Bel)
5.	*Holdina cordifolia*	Haldu
6.	*Mitragyna parvifolia*	Kaim or Tekui
7.	*Mallotus philippensis*	Rohini
8.	*Modhuca longifolia var. latifolia*	Mahua
9.	*Dalbergia sissoo*	Sheesham
10.	*Ficus religiosa*	Peepal
11.	*F. auriculata*	Timla
12.	*F. semicordata*	Khainu
13.	*F. virens*	Pakad
14.	*F. benghalensis*	Bargad
15.	*Acacia catechu*	Khair
16.	*Albizia lebbeck*	Siris
17.	*Terminalla alata*	Asna, Asain
18.	*T. bellirica*	Bahera
19.	*Holoptelea integrifolia*	Dhamina
20.	*Streblus asper*	Sehore
21.	*Butea monosperma*	Dhak, Palas
22.	*Buchanania lanzon*	Chirongi
23.	*Cassia fistula*	Amaltas
24.	*Lannea coromandelica*	Jigma, Jhingan
25.	*Pongamia pinnata*	Karanj
Shrubs		
1.	*Murraya koenigii*	Gandela, Kathneem
2.	*Holarrhena pubescens*	Kachri

3.	*Lantana camara*	Kuri
4.	*Zisiphus mauritiana*	Ber
5.	*Z. oenoplia*	Makoi
6.	*Colebrookea oppositifolia*	Chavova, Binda
7.	*Glycosmis arborea*	Gutahru
8.	*Ardisla solanacea*	Jalkaima
9.	*Grewia hisuta*	Seetachabeni
10.	*G. subinaequalis*	Pharsa
11.	*Crotalaria jumcea*	Bansal
12.	*Adhatoda vasica*	Bansa, Adusa
13.	*Jatropha gossypifolia*	Lal arand
14.	*Zanthoxylum armatum*	Timur
15.	*Rubus ellipticus*	Hisalu
16.	*Berberis lycium*	Kingor
17.	*Ocimum basilicum*	Bantulsi
18.	*Cassia tora*	Chakwar
19.	*Clerodendrum viscosum*	Bhant
20.	*Boerhavla diffusa*	Punarnava
21.	*Curculigo orchioides*	Kali musli
22.	*Chlorophytum tuberosum*	Safed musli
23.	*Malvastrum coromandelianum*	Bariari
24.	*Vernonia cinerea*	Sahdevi
25.	*Argemone mexicana*	Bhabhanda
26.	*Solanum surattense*	Bhatkataiya
27.	*Tribulus terrestris*	Gokhuru

Source: Forest Department

Table 5.33: Bio-Diversity Profile of Etawah Region

Sl. No.	Botanical Name	Common Name
1.	*Butea monosperma*	Dhak
2.	*Emblica officinalis*	Aonla
3.	*Terminalia arjuna*	Arjun
4.	*Polyalthia longifolia*	Ashok
5.	*Terminalia alata*	Asna
6.	*Terminalia bellirica*	Bahera
7.	*Ficus bengalensis*	Bargad
8.	*Artocarpus lakoocha*	Barhal
9.	*Aegle marmelos*	Bel
10.	*Eucalyptus tereticornis*	Eucalyptus
11.	*Ficus glomerata*	Gular
12.	*Delonix regia*	Gul Mohar
13.	*Suzygium cumini*	Jamun
14.	*Feronia limonia*	Kaitha
15.	*Artcarpus heterophyllus*	Kathal
16.	*Acacia indica*	Khair
17.	*Madhulka indica*	Mahua
18.	*Naphelim litchi*	Litchi
19.	*Azadirachata indica*	Neem
20.	*Ficus religiosa*	Pipal
21.	*Tectona grandis*	Sagon

22.	*Grevilea robusta*	Silver Oak
23.	*Albizia lebbek*	Kala siris
24.	*Albizia lebbek*	Safed Siris
25.	*Dalbergia sissoo*	Shisham
Shrubs		
1.	*Cynedon dactylon*	Dub
2.	*Enlaliopis bineta*	Baib
3.	*Saccharum spontaneum*	Kans

Source: Forest Department

Table 5.34: Bio-Diversity Profile of Ferozabad Region

Sl. No.	Botanical Name	Common Name
1.	*Butea frondosa*	Dhak
2.	*Butea monosperma*	Palas
3.	*Vetiveria zinzanoides*	Ganra
4.	*Saccharum munja*	Munj
5.	*Eulaliopsis binta*	Baib
6.	*Desmostachya bipinnata*	Dab
7.	*Saccharum spontaneum*	Kans
8.	*Cynodon dactylon*	Doob

Source: Forest Department

Table 5.35: Bio-Diversity Profile of Agra Region

Sl. No.	Botanical Name	Common Name
1.	*Syzygium cumini*	Jamun
2.	*Shorea Robusta*	Sal, Shakhu
3.	*Anogeissus latifolia*	Bakli, Dhaura
4.	*Aegle mormelos*	Bel
5.	*Holdina cordifolia*	Haldu
6.	*Mitragyna parvifolia*	Kaim or Tekui
7.	*Mallotus philippensis*	Rohini
8.	*Modhuca longifolia var. latifolia*	Mahua
9.	*Dalbergia sissoo*	Sheesham
10.	*Ficus religiosa*	Peepal
11.	*F. auriculata*	Timla
12.	*F. semicordata*	Khainu
13.	*F. virens*	Pakad
14.	*F. benghalensis*	Bargad
15.	*Acacia catechu*	Khair
16.	*Albizia lebbeck*	Siris
17.	*Terminalla alata*	Asna, Asain
18.	*T. bellirica*	Bahera
19.	*Holoptelea integrifolia*	Dhamina
20.	*Streblus asper*	Sehore
21.	*Butea monosperma*	Dhak, Palas
22.	*Buchanania lanzon*	Chirongi
23.	*Cassia fistula*	Amaltas
24.	*Lannea coromandelica*	Jigma, Jhingan
25.	*Pongamia pinnata*	Karanj

Source: Forest Department

Table 5.36: Bio-Diversity Profile of Hatras Region

Sl. No.	Botanical Name	Common Name
1.	*Syzygium cumini*	Jamun
2.	*Shorea Robusta*	Sal, Shakhu
3.	*Anogeissus latifolia*	Bakli, Dhaura
4.	*Aegle mormelos*	Bel
5.	*Holdina cordifolia*	Haldu
6.	*Mitragyna parvifolia*	Kaim or Tekui
7.	*Mallotus philippensis*	Rohini
8.	*Modhuca longifolia var. latifolia*	Mahua
9.	*Dalbergia sissoo*	Sheesham
10.	*Ficus religiosa*	Peepal
11.	*Auriculata*	Timla
12.	*F. semicordata*	Khainu
13.	*F. virens*	Pakad
14.	*F. benghalensis*	Bargad
15.	*Acacia catechu*	Khair
16.	*Albizia lebbeck*	Siris
17.	*Terminalla alata*	Asna, Asain
18.	*T. bellirica*	Bahera
19.	*Holoptelea integrifolia*	Dhamina
20.	*Streblus asper*	Sehore
21.	*Butea monosperma*	Dhak, Palas
22.	*Buchanania lanzon*	Chirongi
23.	*Cassia fistula*	Amaltas
24.	*Lannea coromandelica*	Jigma, Jhingan
25.	*Pongamia pinnata*	Karanj

Source: Forest Department

Table 5.37: Bio-Diversity Profile of Aligarh Region

Sl. No.	Botanical Name	Common Name
1.	*Syzygium cumini*	Jamun
2.	*Shorea Robusta*	Sal, Shakhu
3.	*Anogeissus latifolia*	Bakli, Dhaura
4.	*Aegle mormelos*	Bel
5.	*Holdina cordifolia*	Haldu
6.	*Mitragyna parvifolia*	Kaim or Tekui
7.	*Mallotus philippensis*	Rohini
8.	*Modhuca longifolia var. latifolia*	Mahua
9.	*Dalbergia sissoo*	Sheesham
10.	*Ficus religiosa*	Peepal
11.	*F. auriculata*	Timla
12.	*F. semicordata*	Khainu
13.	*F. virens*	Pakad
14.	*F. benghalensis*	Bargad
15.	*Acacia catechu*	Khair
16.	*Albizia lebbeck*	Siris

17.	*Terminalla alata*	Asna, Asain
18.	*T. bellirica*	Bahera
19.	*Holoptelea integrifolia*	Dhamina
20.	*Streblus asper*	Sehore
21.	*Butea monosperma*	Dhak, Palas
22.	*Buchanania lanzon*	Chirongi
23.	*Cassia fistula*	Amaltas
24.	*Lannea coromandelica*	Jigma, Jhingan
25.	*Pongamia pinnata*	Karanj

Source: Forest Department

5.12.5 QUANTITATIVE ANALYSIS OF TREE, SHRUB AND HERB BY QUADRATE METHOD

Location No.1 : Achalda Detour Location

The survey revealed that the highest dominance of 100% was showed by *Parthenium hysterophorus* followed by *Saccharum spontaneum*, *Acacia nilotica* and *Butea monosperma*. *Adhatoda zeylanica, Capparis sepiaria* and *Lantana indica* are the most abundant shrub species. The ground vegetation is mostly covered by *Sida acuta* and *Setaria verticillata*. The overall species diversity index for study area was computed as 0.710.

Location No.2: Mandrak Parallel Section

During the study 23 species were observed. *Acasia nilotica* was found to be the most dominant species, followed by *Prosopis juliflora and Butea monosperma*. Density and diversity index of different species observed during the studies was 0.735. It may be observed that *Prosopis juliflora* is the most abundant species followed by *Dalbergia sisoo, Delonix regia*.

Location No.3: Bhaupur

Cynodan dactylon was found to be the most dominant species, followed by *Pisium sativum, Pennisetum typhoides*. *Parthenium hysterophorous* was found very common in the study area. It may be observed that *Pennisetum typhoides* is the most abundant and frequent specie. The overall species diversity index for study area was computed as 0.685.

Location No.4: Samaspur R.F.

Saccharum spontaneum and *Calotopis procera* were found to be the most dominant species, followed by *Ocimum gratissimum. Parthenium hysterophorous* was found to be very common in the study area. It may be observed that *Saccharum spontaneum* is the most abundant and frequent specie. The overall species diversity index for study area was computed as 0.904.

The diversity, abundance and species diversity index of all four locations are given in **Annexure No. 5.1.**

Figure 5.16: Quantative Analysis of Tree, Shrub & Herb by Quadrate Method at Mandrak

5.12.6 QUANTITATIVE ANALYSIS OF TREE, SHRUB AND HERB BY LINE TRANSACT METHOD

Location No.5: Sofipur (R. F.)

Tree species recorded in the area included *Tactona grandis, Cedrus deodara, Pistacia integerina* and *Quercus ilex. The density of Tactona grandis (110 trees/ha) was found highest followed by Cedrus Deodara (50 trees/ ha) and Pinus Wallichiana (40 trees/ha). The IVI of Quercus ilex (119.43), Oleo cuspidate (45.83) and Cedrus deodara (44.50) was found maximum.* Species diversity H'-1.70.

Table 5.38: Phytosociological analysis of the tree species

S. No.	Name of the Species	Density/ha	Abundance	Frequency (%)	Importance Value Index
1.	*Tactona grandis*	110	1.4	80	119.44
2.	*Alnus nitida*	10	1.0	10	12.85
3.	*Cedrus deodara*	50	1.7	30	44.50
4.	*Pistacia integerina*	30	1.0	30	27.70
5.	*Punica granatum*	20	1.0	20	17.79
6.	*Olea cuspidata*	30	1.0	30	45.83
7.	*Pinus wallichiana*	40	1.3	30	31.89
	Total	290			300.00

Source: Consultant Survey

The common understorey species in the area include *Plectranthus rugosus, Rubus lasiocarpus, Urtica dioica, Daphne oleoides* and *Debreagasia hypoleuca.* Amongst these *Plectranthus rugosus* showed high dominance with density 2917 plants/ha and IVI of 83.7 followed by *Myrsine Africana* (2500 plants/ha; IVI: 65.85). Species diversity H' was 1.80 .

Table 5.39: Phytosociological analysis of the under storey species

S. No.	Name of the Species	Density/ha	Abundance	Frequency (%)	Importance Value Index
1.	*Debraegesia hypoleuca*	917	1	82.5	37.02
2.	*Prinsepia utilis*	1000	2.25	40	25.77
3.	*Plectranthus rugosus*	2917	3.28	80	83.7
4.	*Urtica dioica*	556	1.05	47.5	23.62
5.	*Rubus ellipticus*	361	1.3	25	11.02
6.	*Myrsine africana*	2500	2.9	77.5	65.85
7.	*Daphne oleoides*	1667	2.22	67.5	53.01
	Total	9917			300.00

Source: Consultant Survey

The common herbs found in the area included *Solanum nigrum, Oxalis corniculata, Viola serpens, Achyranthes bidentata, Trifolium repens, Malva* sp*, Chenopodium album, Plantago* sp*, Dicliptera roxburghiana, Euphorbia* spp and *Fragaria vesca. The species Thymus linearis (0.43 plants/m^2), Origanum vulgare (0.43 plants/m^2) and Euphorbia sp. (0.43 plants/m^2) have the maximum density followed by Rumex hastatus (0.38 plants/m^2). Plantago lanceolata showed an IVI of 48.97 considerably more than Euphorbia sp (30.71) and Origanum vulgare (20.91).* Species diversity H' was observed to be 2.85**.**

Table 5.40: Phytosociological analysis of the herbacious species

S. No.	Name of the Species	Density/m^2	Abundance	Frequency (%)	Importance Value Index
1.	*Ajuga bracteosa*	0.23	1.56	15	9.56
2.	*Euphorbia sp*	0.43	1.3	33.33	30.71
3.	*Artemisia gmelli*	0.23	1.4	16.67	11.41
4.	*Chenopodium album*	0.13	1.6	8.33	6.7
5.	*Cynodon dactylon*	0.4	2	20	15.7
6.	*Origanum vulgare*	0.43	1.44	30	20.91
7.	*Mentha longifolia*	0.12	1.4	8.33	8.88
8.	*Micromeria biflora*	0.3	1.8	16.67	13.25
9.	*Nasturtium officinale*	0.08	1.67	5	4.12
10.	*Plantago lanceolata*	0.2	1.71	11.67	48.97
11.	*Plantago major*	0.07	2	3.33	3.78
12.	*Poa sp*	0.37	1.69	21.67	15.39
13.	*Polygonum capitatum*	0.2	1.5	13.33	10.3
14.	*Rumex hastatus*	0.38	1.64	23.33	19.07
15.	*Rumex nepalensis*	0.22	1.86	11.67	11.35
16.	*Solanum nigrum*	0.18	1.57	11.67	7.14
17.	*Tagetes minuta*	0.35	1.62	21.67	17.52
18.	*Thymus linearis*	0.43	1.86	23.33	15.62
19.	*Trifolium pratense*	0.32	1.9	16.67	14.97
20.	*Trifolium repens*	0.2	1.33	15	9.34
21.	*Viola canescens*	0.12	1.4	8.33	5.33
	Total	5.39			300.02

Source: Consultant Survey

Location No.6: Singhpura (R. F.)

The common tree species found in the area included *Alnus nitida, Acacia nilotica* and *Cedrus deodara, Juglans regia, Morus serrata, Celtis australis, Populus ciliata* and *Rhododendron arboreum.* The dominant tree species found are Alnus nitida (210 trees/ha) followed by *Acacia nilotica* (170 trees/ha). Among the species found, the IVI of *Alnus nitida* (92.89) the highest, followed by *Quercus Itex* (56.17) and *Olea cuspidata* (29.42). The tree species diversity index (H`) for the area is 2.02.

Table 5.41: Phytosociological analysis of the tree species

S. No.	Name of the Species	Density/ha	Abundance	Frequency (%)	Importance Value Index
1.	*Acacia nilotica*	170	2.13	80	56.17
2.	*Alnus nitida*	210	3.5	60	92.89
3.	*Cedrus deodara*	60	2	30	18.4
4	*Juglans regia*	40	1.33	30	18.37
5.	*Acer spp*	20	1	20	7.65
6.	*Aesculus indica*	30	1	30	21.78
7.	*Celtis australis*	40	1.33	30	13.17
8.	*Morus serrata*	20	1	20	8.15
9.	*Olea cuspidata*	90	1.5	60	29.42
10.	*Prunus armeniaca*	10	1	10	3.79
11.	*Rhododendron arboreum*	40	0.8	50	19.78
12.	*Populus ciliata*	30	1.5	20	10.42
	Total	760			299.99

Source: Consultant Survey

Among the 12 species of shrubs and saplings found in the area, *Sacchraum spontaneum* (3056 plants/ ha), *Plectranthus rugosus* (2389 plants/ha) and *Myrsine africana* (2083 plants/ha) were the dominant species .The IVI of *Berberis lyceum* (54.94) and *Prinsepia utilis* (40.46) was found maximum in case of shrub of the area. The other shrubs recorded in the area included *Cotoneaster acuminata*, *Debraegesia hypoleuca, Desmodium microphyllum* and *Rhamnus virgatus.* Species diversity index (H')-2.34.

Table 5.42: Phytosociological analysis of the under storey species

S. No.	Name of the Species	Density/ha	Abundance	Frequency (%)	Importance Value Index
1.	*Saccharum Spontaneum*	3056	3.33	82.5	54.94
2.	*Cotoneaster acuminata*	1500	3.38	40	23.67
3.	*Debraegesia hypoleuca*	1167	3.82	27.5	23.2
4.	*Prinsepia utilis*	1778	2.29	70	40.46
5.	*Plectranthus rugosus*	2389	2.77	77.5	36.02
6.	*Desmodium microphyllum*	778	2.33	30	15.62
7.	*Rhamnus virgatus*	806	3.63	20	16.2
8.	*Buddleja asiatica*	889	2.67	30	17.07
9.	*Myrsine africana*	2083	3.57	52.5	28.67
10.	*Rosa moshata*	278	1.11	22.5	8.42
11.	*Lonicera quinquelocularis*	667	2.18	27.5	14.52
12.	*Daphne oleoides*	1083	1.39	70	21.2
	Total	16472			299.99

Source: Consultant Survey

During the study period, 28 herbs were recorded in the study area. Among the recorded species, the density of Valeriana *jatamansi* (0.32 plants/ m^2),

Lonicera quinqueloculans (0.28 plants/m^2) and *Artemisia Dracunculus* (0.27 plants/m^2) was maximum. In terms of IVI, *Lonicera quinqueloculans* (75.9) was the most dominant, followed by *Artemisia Dracunculus* (22.6) and *Valeriana jatamansi* (20.5). Species diversity index (H')-2.87.

Table 5.43: Phytosociological analysis of the herbacious species of downstream area

S. No.	Name of the Species	Density/m^2	Abundance	Frequency (%)	Importance Value Index
1.	*Ajuga bracteosa*	0.03	1	3.3	2.3
2.	*Artemisia dracunculus*	0.27	1.5	18.3	22.6
3.	*Artemisia gmelli*	0.07	1.3	5.0	4.4
4.	*Bergenia ciliata*	0.08	1.7	5.0	5.4
5.	*Chenopodium album*	0.07	1.3	5.0	4.2
6.	*Cynodon dactylon*	0.08	1.3	6.7	5.7
7.	*Duchesnea indica*	0.02	1.0	1.7	1.7
8.	*Foeniculum vulgare*	0.05	1.0	5.0	3.8
9.	*Fragaria vesca*	0.02	1.0	1.7	1.3
10.	*Lonicera quinqueloculans R)*	0.28	1.7	16.7	75.9
11.	*Mentha longifolia*	0.05	1.5	3.3	3.9
12.	*Micromeria biflora*	0.03	2.0	1.7	1.8
13.	*Nasturtium officinale*	0.12	1.4	8.3	8.0
14.	*Plantago lanceolata*	0.07	1.3	5.0	4.7
15.	*Plantago major*	0.05	3.0	1.7	3.0
16.	*Poa sp*	0.08	1.0	8.3	5.6
17.	*Polygonum capitatum*	0.22	1.2	18.3	16.0
18.	*Rumex hastatus*	0.23	1.3	18.3	13.9
19.	*Rumex nepalensis*	0.20	1.5	13.3	13.4
20.	*Salvia moorcroftiana*	0.17	1.1	15.0	11.4
21.	*Solanum nigrum*	0.15	1.1	13.3	10.2
22.	*Tagetes minuta*	0.15	1.5	10.0	9.4
23.	*Thalictrum foliolosum*	0.18	1.1	16.7	12.6
24.	*Thymus linearis*	0.12	1.2	10.0	7.5
25.	*Trifolium pratense*	0.17	1.1	15.0	12.0
26.	*Trifolium repens*	0.13	1.3	10.0	9.4
27.	*Valeriana jatamansi*	0.32	2.1	15.0	20.5
28.	*Viola canescens*	0.15	1.3	11.7	9.6
	Total	3.56			300.20

Source: Consultant Survey

Location No.7: Kanho R. F.

This community was represented by seven tree species. The most dominant species among them was *Tactona grandisalnus. Alnus nitidia* was second in order of dominance (IVI 87.98). The least dominance was shown by *olea cuspidata* (IVI 7.50).

Table 5.44: Phytosociological analysis of the Tree species

S. No.	Species	Freq. (%)	Den/100m^2	Rel freq.	Rel dens.	Rel domi.	IVI
1	*Tactona grandis*	100	5.40	67.24	76.25	74.23	**143.25**
2	*Delonix regia*	60.00	0.50	45.56	28.79	34.25	**56.76**
3	*Alnus nitida*	80.00	3.20	45.45	66.67	75.86	**87.98**

4	*Quercus ilex*	70.00	0.80	31.82	16.67	12.32	**60.81**
5	*Populus ciliata*	20.00	0.40	9.09	8.33	9.31	**26.73**
6	*Aesculus indica*	20.00	0.30	9.09	6.25	1.64	**16.98**
7	*Olea cuspidata*	10.00	0.10	4.55	2.08	0.87	**7.50**

Source: Consultant Survey

Under shrub layer only four species have shown their presence in this community. *Viburnum nervosum* was found to be the most dominant species with the highest IVI value i.e., 162.23. *Principia utilis* was next in order of dominance (IVI 65.92) followed by *Desmodium tiliaefolium* (IVI 26.61). The least dominance was shown by *Rosa brunonii* (IVI 19.11).

Table 5.45: Phytosociological analysis of the Understorey Vegetation

S. No.	Species	Freq. (%)	Den/9m^2	Rel freq.	Rel den.	Rel dom.	IVI
1	*Viburnum nervosum*	90.00	4.50	40.91	69.23	52.09	**162.23**
2	*Prinsepia utilis*	60.00	0.70	27.27	10.77	27.88	**65.92**
3	*Desmodium tiliaefolium*	30.00	0.50	13.64	7.69	5.28	**26.61**
4	*Rosa brunonii*	20.00	0.40	9.09	6.15	3.86	**19.11**

Source: Consultant Survey

This community was represented by 17 species under herbaceous layer, out of them 14 species were herbs and grasses and three species were present in the form of seedlings (Table 6.25). The most dominant species in herbaceous layer were *Viola canescens, Pilea scripta, Oplismenus burmanii* and *Arundinella nepalensis.* Their IVI values were in between the range of 36.51 to 50.69. *Rubia cordifolia* was the least dominant species being least IVI value 1.71.

Table 5.46: Phyto- sociological analysis of the herbacious species

S. No	Species	Freq. (%)	Den/m^2	Rel freq.	Rel den.	Rel dom.	IVI
1	*Viola canescens*	90.00	13.60	12.68	19.43	18.58	**50.69**
2	*Pilea scripta*	90.00	18.70	12.68	26.71	11.21	**50.61**
3	*Oplismenus burmanii*	80.00	10.10	11.27	14.43	22.46	**48.15**
4	*Arundinella nepalensis*	70.00	2.70	9.86	3.86	22.79	**36.51**
5	*Cirsium arvens*	20.00	0.20	2.82	0.29	13.88	**16.98**
6	*Perilla frutescens*	40.00	6.10	5.63	8.71	2.39	**16.73**
7	*Frageria indica*	50.00	2.30	7.04	3.29	0.90	**11.23**
8	*Stellaria media*	20.00	5.50	2.82	7.86	0.32	**10.99**
9	*Hedera napalensis*	60.00	0.90	8.45	1.29	0.35	**10.09**
10	*Phytolaca acinosa*	20.00	0.60	2.82	0.86	3.90	**7.57**
11	*Oxalis corniculata*	20.00	2.10	2.82	3.00	0.19	**6.00**
12	*Geranium lucidum*	20.00	2.10	2.82	3.00	0.12	**5.94**
13	*Polygonum capitatum*	30.00	0.90	4.23	1.29	0.41	**5.92**

14	*Rubia cordifolia*	10.00	0.20	1.41	0.29	0.02	**1.71**
	Seedlings						
15	*Plectranthus rugosus*	20.00	3.10	2.82	4.43	0.84	**8.08**
16	*Dioscorea belophylla*	30.00	0.30	4.23	0.43	0.16	**4.81**
17	*Viburnum nervosum*	10.00	0.10	1.41	0.14	0.32	**1.87**

Source: Consultant Survey

Endangered/Sensitive Flora: There is no sensitive terrestrial flora in the study area.

Figure 5.17: Quantative Analysis of Tree, Shrub & Herb by Line Transact Method at Sofipur, RF

5.12.7 FAUNA

The domestic animals observed in the study area are mainly mammals and avis as listed in the **Table 5.47**. In absence of natural forest (National parks and Sanctuary), there is a dearth of wild animals in the study area. Peacocks can be easily seen in the study area, even in villages. Infact, peacocks are treated as pet birds in this area. A list of birds, reptiles, amphibians and rodents based on information gathered from local enquiries and Forest department is presented in **Table 5.46.**

Table 5.47: List of Domestic Fauna Observed in the Study Area

S. No.	Zoological Name	Common Name	Schedule
1.	*Bos indicus*	Cow	
2.	*Bubalus indicus*	Buffalo	
3.	*Boselaphus tragocamelus*	Nilgai	III
4.	*Cains familieris*	Dog	
5.	*Capra hircus*	Goat	
6.	*Equus cabilus*	Horse	
7.	*Equus hermionus*	Ass	
8.	*Felis domesticus*	Cat	
9.	*Ovius polic*	Sheep	
10.	*Sus cristatus*	Pig	
11.	*Suborder ruminantia*	Camel	
12.	*Nigicollis*	Monkey	

13.	*Lepus ruficandatus*	Hares	
14.	*Vulpes bengalensis*	Indian fox	

Source: Consultant Survey & Data from Forest Department

Table 5.48: List of Birds, Reptiles, Amphibians and Rodents observed in the Study Area

Sl. No	Scientific Name	Common Name	Schedule
Birds			
1.	*Alcedo atthis*	Common Kingfisher	IV
2.	*Cucculus micropterus*	Indian Cuckoo	IV
3.	*Columba livia*	Rock Pigeon	IV
4.	*Corvus splendens*	House Crow	V
5.	*Eudynomys scolopacea*	Asian Koel	
6.	*Prinia hodgsonii*	Grey-breasted Prinia	
7.	*Pycnotus jacosus*	Red-whiskered Bulbul	IV
8.	*Ploceus philippinus*	Baya Weaver	
9.	*Pavo cristatus*	Peafowl	I
10.	*Polyplectron bicalearaturn*	Peacock pheasants	I
11.	*Streptopelia chinensis*	Spotted Dove	IV
12.	*Grus nigricollis*	Crane	I
Reptiles			
1.	*Calotes versicolor*	Garden lizard	
2.	*Varanus monitor*	Monitor lizards	
3.	*Bangarus caearulus*	Karait	
Amphibian			
1	*Bufo malanostidus*	Toad	
2	*Rana cynophlyctis*	Frog	
3	*Rana tigrina*	Frog	
Rodent			
1	*Bandicota indica*	Bandicoot rat	V
2	*Mus muscatus*	Mouse	V
3	*Ratus ratus*	House rat	V
4	*Ratufa indica*	Squirrel	

Source: Consultant Survey & Data from Forest Department

Endangered / Sensitive Species of Fauna:

As per list of **The Indian Wildlife (Protection) Act, 1972,** Fauna coming under the **schedule - I** is treated as endangered species. The **schedule - I** fauna as per reconnaissance survey are *Pavo cristatus, Polyplectron bicalearaturn, Grus nigricollis.* Although these are very common species and found in every locality, even in villages, certain steps should be taken to conserve the critical wild life:

1) Programs for the conservation of wildlife will be formulated and implemented outside the protected areas by educating the local communities with help of local public agencies, and other stakeholders including the environment division officers of our company, in order to reduce the scope of man-animal conflict.

2) It will be ensured that human activities on the fringe of the protected areas do not degrade the habitat.

Over all, the status of wildlife in a region is an accurate index of the state of ecological resources, and thus, of the natural resources base of human well-being. This indicates the interdependent nature of ecological entities (the web of life), in which wild life is a vital link and a base of eco-tourism. Thus, the importance of conserving and protecting wildlife will be spread among the local people.

5.12.8 AQUATIC ECOLOGY

The biological species are the best indicators of environmental quality. This includes different species, such as, phytoplankton, zooplankton, benthos, fishes etc. Studies on biological aspects of certain ecosystems are an important part of any environmental impact assessment in view of the need for conservation of environmental quality and safety of aquatic life.
From the baseline survey on existing aquatic environmental conditions in and around the proposed DFC Project on the river Arind and Sangai the following data's were generated:

- Biological characteristics of river water
- Estimation of coliform organisms
- Inventorization of phytobenthos and Zoobenthos
- Present status of riverine fish fauna: Identification of fish species
- Migratory pattern, feeding and breeding grounds of the fish fauna
- Assessment of local catches during the field trips to asses the fish fauna.

5.12.9 Study Sites

Aquatic Sampling was carried out on Upstram & Downstream of Arind and Sangai River. The details of the study area to assess the aquatic fauna are given in **Table 5.49**.

Table 5.49: Description of selected study sites in the river Arind and Sangai of the proposed DFC Project.

Sites	Sampling Location	Source
I	Arind River	Upstram
II	Arind River	Downstram
III	Sangai River	Upstram
IV	Sangai River	Downstram

5.12.10 Assessment of Aquatic Fauna

Water sample was collected from surface of the stream with minimum disturbances. The collected samples were assessed for plankton, periphytons, phyto- and zoo benthos samples using standard methods (APHA 1992, 1998).

Plankton samples were collected using a tericot ring net and the periphyton were obtained by scraping of 3 cm^2 area of the boulders and preserved in 1 ml of Lugol's solution. **Benthic macro-invertebrates** were collected from the pebbles, cobbles and gravels form the surface collected up to 15 cm sediment depth at different elevations. All collected specimens were preserved in 8% formalin solution or 70 % alcohol and were identified up to generic level by using Pennak (1953), Ward and Whipple (1959), Needham and Needham (1962), Trivedy and Goel (1984), Edington and Holdren (1995) and APHA (1992, 1998).

Fish occurrences were determined by collecting samples using different fishing gears like cast net, scoop net, hand net, hook-line, pot and open local devices methods. Also visual observations in different habitats were made. Fishes were identified up to the species level with the help of keys of Jayaram (1981), Menon (1987) and Talwar and Jhingran (1997). IUCN red data list (2006) was compared to assess threatened, endangered and vulnerable species in the study area.

List of Fishes in the Study Area

Fish species reported in the area are listed in **Table 5.48**. Main fishes are *Notopterus notopterus, Catla catla, Labeo calbasu, Labeo rohita, Labeo bat, Mystus vittatus, Rita rita, Barbus spp*. and *Cirrinus raba*.

Table 5.50: List of Fishes Reported in the Study Area

S. No.	Fish Species
1	*Notopterus notopterus*
2	*Catla catla*
3	*Labeo calbasu*
4	*Labeo rohito*
5	*Labeo bata*
6	*Cirrihinus mrigala*
7	*Cirrihinus raba*
8	*Clarius batrachus*
9	*Wallago attu*
10	*Heteropneustres fossiliis*
11	*Mystus vittatus*
12	*Mystus aor*
13	*Hilra ilisha*
14	*Barbus spp.*
15	*Rita rita*

Source: Consultant Survey

5.12.11 River Morphology

The river /stream morphology is a significant component that provides ecological stability as it helps in maintaining river flow. Hence, the morphology contributes to the biological integrity of the aquatic ecosystem, which has been assessed using the criteria described by Rosgen (1996). Arind and Sangai Rivers both have scarce water. The flow of water is very low at the rate of 0.5 to 1m/sec. Depth of water is 5 to 10cm only. The river bed comprises of sand, pebbles, gravels, cobbles. The bank side has excessive

sand or silt. Khans and some green herbaceous plants are very common on the both side of river bank.

Figure 5.18: Flora near the river bank

5.12.12 DISCUSSIONS

The biology of a system in terms of its macro and micro flora and fauna best indicates the status of any ecosystem, and acts as a source of early warning of any environmental problem, thus allowing people to take efficient control measures.

Planktons

The composition density and diversity of phytoplankton and zooplankton of a particular aquatic ecosystem are indicators of environmental stress. The biota of any ecosystem thus, provides information regarding various physico-chemical characteristics of water such as pH, conductivity, nutrients, BOD, alkalinity etc. As evident from the composition and diversity of phyto- and zoo-planktons, the water quality of Arind and Sangai river is of oligo to eutrophic in nature. The water is polluted with only some agricultural wastes and thus has very low level of pollution, which, in turn, is indicated by the species composition of the following micro organisms:

Macrophytes: There are only a limited number of macrophyte species present at the study site. Although this aspect could have indicated that the study site must be polluted but at the same time, the low density of these macrophytes is an indicative of low pollution level.

Benthos and Fishes:

The benthic fauna of the study site is represented by Insecta, Annelida and Mollusca. The high diversity of benthos is indicative of low pollution level at the study site. Similarly, major fish groups are represented by carps, catfishes. The diversity indices of benthos and fishes are also indicative of the non-polluted status of the study site.

Rare and Endangered Species

In reference to Red Data Book of Botanical Survey of India and Wildlife (Protection) Act 1972, no endangered species of flora and fauna have been found during the study period.

Ecologically Sensitive Areas

There are no ecologically sensitive locations within the study area.

The results of aquatic ecological sampling are presented in **Annexure No. 5.2.**

Figure 5.19: Aquatic Sampling in Arind River

Figure 5.20: Aquatic Sampling in Sangai River

5.13 SOCIO-ECONOMIC CHARACTERISTICS OF THE STUDY AREA

5.13.1 Socio -Economic Characteristics of the Project Area

Most of the people in the project districts are dependent on the agricultural activities. The Table below indicates that the project area has poor performance on important development indices such as work participation rate. The socio-cultural indicators point to low development indices. Total literacy rates range between 58.48 to 74.37 percent. The female literacy rate ranges from 42.48 to 67.46 percent. Also, this region has a high decadal population growth rate of above 25 percent. (Table 5.49).

Table 5.51 Socio-economic data on affected people

Status on Indebtedness

Amount of debt	0 - 10000	10000-25000	25000-50000	50000-above	reported cases
Percentage of cases	20.62%	28.02%	26.46%	24.90%	257

Status on Income Level

Income per year in Rs.	0-25000	25000-50000	50000-100000	above 100000	Nos. of families
Percentage	63%	22%	9%	6%	8595

Education Status

Education level	Un Educated	Educated	8th	10th	Intermediate	Graduate	Total PAPs
Percentage	25.60%	16.89%	20.75%	14.95%	11.75%	10.06%	46646

Occupation Profile

Occupation	Service	Business	cultivator	Students	House Wife	Labour	Un-Employed	Workers	Total PAPs
Percentage	5%	2%	21%	20%	34%	12%	6%	1%	46646

Status of Project affected houses

Category	Pakka	Semi - Pakka	Kacha	Total
TH	93.97%	1.29%	4.74%	232
NTH	97.32%	2.01%	0.67%	149
TH and NTH taken together	95.28%	1.57%	3.15%	381
No of household having separate kitchen	207			
No of households having separate Bath	205			

Above table shows literacy level as well.

5.13.2 Social Stratification Profile of the Project

Most important religious group in the project area is Hindus. Other important religious communities are Muslims, Jains and Sikhs. In the project area, there is a presence of several important scheduled castes of the state constituting about 20 -21 percent of the total populations of the districts. Also, in all the districts of the project area, there is a presence of scheduled tribes, constituting about 0.01 to 0.02 percent of the total population of the districts. Some of the important scheduled castes of the area are Chamars, Kori, Khatiks and Balmiki. Some of the important scheduled tribes of the area are Bhotia, Juansari and other generic tribes (Table 5.52).

Table 5.52: Social Stratification in the Project Districts

Project District	Scheduled Castes					Scheduled Tribes				
	Chamar	Dhanuk	Khatik	Balmiki	Kori	Bhotia	Juansari	Tharu	Raji	Generic Tribes
Kanpur Dehat	☑	☑			☑			☑	☑	☑
Auraiya	☑	☑			☑	☑		☑		☑
Etawah	☑	☑			☑	☑		☑		☑
Firozabad	☑		☑		☑	☑	☑			☑

Agra	☑			☑	☑	☑	☑			☑
Mahamaya Nagar	☑		☑		☑	☑	☑			☑
Aligarh	☑		☑	☑		☑	☑			☑
Bulandshahr	☑		☑	☑						☑

Source: Census of India, 2001

Table 5.53: Social Strata of PAFs

Sl. No.	Contract Package	BPL	ST	SC	OBC	GEN	WHH
1	I	2335	0	783	1777	637	376
2	II	1191	3	224	1106	541	3
3	III	1600	0	794	827	971	544
Total		5126	3	1801	3710	2149	923

Above table provides information that no tribal in true sense of 'indigenous people' is involved. Therefore OP 4.10 safeguard policy is triggered and separate Tribal Development Plan is required.

5.13.3 Social Profile of the PAPs

(i) Age-Sex Composition: Among families that will loose agricultural land due to the project, there are 25976 males (55.69%) and 20760 females (44.31%). total 46646. It is examined from Table 5.54 that the sex ratio is 799 for the project stretch. The Table also presents distribution of the age-sex composition of PAFs loosing agricultural land in the project.

Table 5.54: Age-Sex Composition in percentage (n=46646)

Type of Impact	0-6		6-15		15-18		18-45		45-59		59-Above		Total	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Land	1.02	0.76	4.32	3.06	5.51	3.95	30.33	24.80	6.08	5.22	5.76	4.62	53.01	42.41
Structure	0.17	0.15	0.46	0.28	0.24	0.18	1.29	0.95	0.32	0.19	0.20	0.15	2.67	1.91
Total	1.19	0.91	4.78	3.34	5.74	4.13	31.63	25.75	6.40	5.42	5.95	4.77	55.69	44.31

(ii) Vulnerability Status: Table 5.55 presents number of PAPs under vulnerable categories as per NRRP 2007. Among the PAPs, there are 15493 vulnerable persons. Out of these, 11708 are old people above the age of 50 years. Other significant categories are widows (1851) and unmarried girls above the age of 18 years (1162). This would become significant while planning for the women's income generation and restoration strategies. These vulnerable categories of PAPs will be supported by the project but within the purview of NRRP 2007.

Table 5.55 Vulnerability Status of the PAPs

Package	Vulnerability Categories (land + Structure)							Total
	BPL (PAFs) land	BPL (PAFs) Structure	Disabled / Orphan	Widow	Un Married Girls above 18 years	Abandoned Women	Women above 50 years	
I	2335	57	362	792	572	0	5103	6829
II	1191	7	301	531	400	0	3109	4341
III	1600	98	109	528	190	0	3496	4323
Total	5126	162	772	1851	1162	0	11708	15493

Package-I is between Bhaupur-Bhataura, Package-II is between Kaist-Biruni and Package-III is between Jamal Nagar-Khurja

5.14 ECONOMIC PROFILE

(i) Occupational Background: In the families loosing agricultural land, about 34 % PAPs are housewives thus not contributing to the economic productive occupations. Another, 20% are students thus again not economically active. About 12% PAPs are labours in the agricultural sector or otherwise. About 2% of the PAPs are engaged in business activities (trade and petty business). Many of these businesses people are associated with the small economic activities such as tiffin centers, tea centers, general stores, etc. The details are presented in table 5.56.

Table 5.56: Occupation Profile of PAPs

Package	**Occupation profile(PAPs)**								**Total PAPs**
	Service	**Business**	**cultivator**	**Students**	**House Wife**	**Labour**	**Un-Employed**	**Workers**	
I	1142	355	5340	4350	7939	2453	1705	243	23527
II	236	107	1320	1725	2441	910	465	147	7351
II	825	298	2977	3030	5661	2304	559	114	15768
Total	**2203 (5%)**	**760 (2%)**	**9637 (21%)**	**9105 (20%)**	**16041 (34%)**	**5667 (12%)**	**2729 (6%)**	**504 (1%)**	**46646 (100%)**

Package-I is between Bhaupur-Bhataura, Package-II is between Kaist-Biruni and Package-III is between Jamal Nagar-Khurja

(ii) Out of the total 469 families loosing structures in the project area, 298 (62.7%) families belong to residential category in both title holders and non title holders category. (Table 5.57).

Table 5.57: Project Affected Families (PAFs)

Package Wise	Titleholders		Non Titleholders (Squatters, Tenant & Kiosks)				Total
	Resi	Comm	Resi	Comm	Tenants	Kiosks	
I	48	20	30	14	0	18	**130**
II	3	13	20	6	0	26	**68**
III	122	20	73	6	31	19	**271**
Total	**175**	**57**	**123**	**26**	**31**	**63**	**469**

Package-I is between Bhaupur-Bhataura, Package-II is between Kaist-Biruni and Package-III is between Jamal Nagar-Khurja

(iii) Resettlement and Rehabilitation Options: This will be as per RAA 2008 and prevailing Goverentment guidelines

5.16 OTHER SOCIAL STATUS

(i) Illness: The people of the project area are suffering from different diseases. Most common diseases cited are: Tuberculosis, blood pressure, heart problems, paralysis, and skin diseases. Special care has to be taken while implementing the health care system of resettlement and rehabilitation. Most of the diseases cited are illnesses requiring long-term medications like T.B, blood pressure etc., thus incurring costs for the families and increasing the vulnerability of the population.

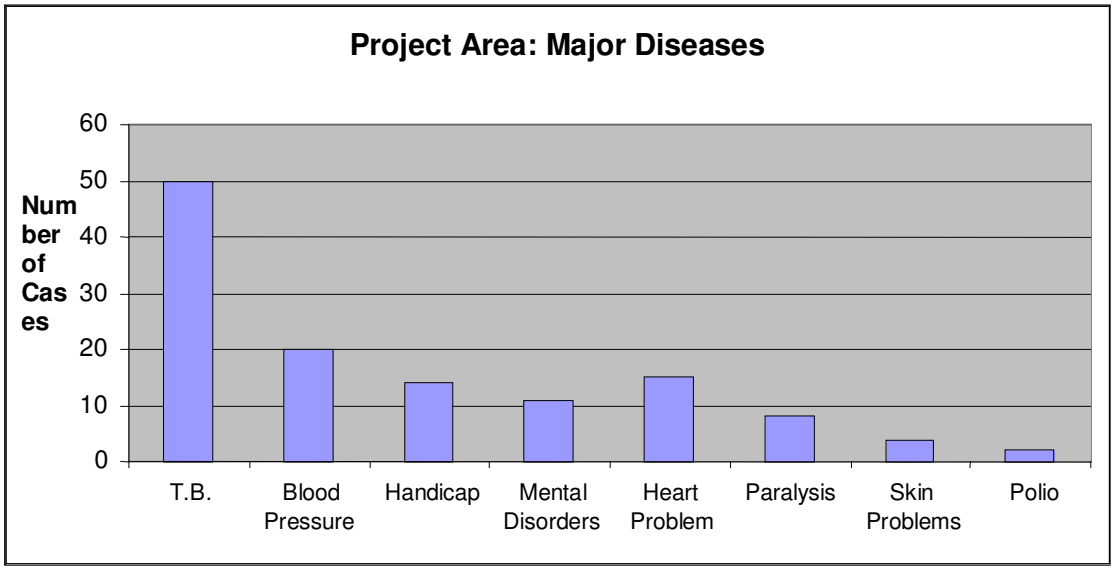


Figure 5.21: Illness and Diseases reported by PAPs

(ii) Migration: Information given in Table 5.60 suggests that about 41% of the people have migrated at some point in time. About 69% of the migrants have migrated within the district. About 17% have migrated outside the district but within the same state. About 43% of the total migrants migrate in the summer season. Another 42% migrate during summer, winter and rainy seasons.

Table 5.58: Migration Status

District	Summer Season	Summer & Winter Season	Summer, Winter & Rainy Season	Total
Kanpur Dehat	5 (6.1)	36 (43.9)	41 (50.0)	**82** (12.3)
Auraiya	8 (11.3)	8 (11.3)	55 (77.5)	**71** (10.6)
Etawah	86 (57.0)	8 (5.3)	57 (37.7)	**151** (22.6)
Firozabad	109 (66.9)	8 (4.9)	46 (28.2)	**163** (24.4)
Agra	8 (28.6)	5 (17.9)	15 (53.6)	**28** (4.2)
Mahamaya Nagar	60 (56.1)	14 (13.1)	33 (30.8)	**107** (16.0)
Aligarh	3 (7.5)	1 (2.5)	36 (90.0)	**40** (6.0)
Buland Shahar	11 (42.3)	12 (46.2)	3 (11.5)	**26** (3.9)
Sub Total	**290** (43.4)	**92** (13.8)	**286** (42.8)	**668** (100.0)

5.16 SOCIAL AND CULTURAL RESOURCES

5.16.1 Critical stretches

The sensitive social cultural receptors viz., temples, mosque, school and hospitals and archaeological sites etc. along the existing RoW of existing railway line and proposed track are surveyed and details are present in environmental profile and strip plan. The summarized table of impacted receptors and sensitive receptors are presented in Table 4.2 of Chapter-4

5.17 ACCIDENT REPORTED DURING LAST 3 YEARS IN PROJECT ALIGNMENT

The accident reported in stations along the alignment and outside the stations are presented in the following Table 5.61. The results shows increase in the accidents. The accidents within the stations are less as compared to the outside the stations. The total 114, 128 and 132 casualties were reported in 2006, 2007 and 2008 respectively.

Table 5.59: Accident Reported in Stations

S. No.	Station	2006			2007			2008		
		Within station	Outside the station	Total	Within station	Outside the station	Total	Within station	Outside the station	Total
1	Ekdil	3	10	**13**	5	12	**17**	2	5	**7**
2	Bharthna	5	9	**14**	6	18	**24**	10	27	**37**
3	Somho				5	8	**13**	2	4	**6**
4	Achlda	6	15	**21**	5	10	**15**	9	19	**28**
5	Pata	4	12	**16**	2	4	**6**	5	9	**14**
6	Fafund	10	16	**26**	9	10	**19**	9	16	**25**
7	Kanchosi	5	12	**17**	6	16	**22**	2	7	**9**
8	Jhijhank	2	5	**7**	5	7	**12**	2	4	**6**
	Total	**35**	**79**	**114**	**43**	**85**	**128**	**41**	**91**	**132**

Source: Railway Departmen, Allahabad

5.18 SUMMARY OF BASELINE DATA AND ENVIRONMENTAL, ECOLOGICAL AND SOCIAL SENSITIVITY OF THE PROJECT AREA

The primary and secondary data have been collected during field survey for preparing baseline environmental profile. The following are the sensitivity of the project based on the environmental, ecological and social point of view:-

1. The noise and vibration level due to the proposed track, specifically in detour location where the present levels are well within the limits.
2. The displacement of sensitive receptors which are falling within the RoW of the proposed alignment, specifically in Achalda detour where a girl inter college will get impacted & local population opposing the detour alignment.
3. Acquisition of fertile agriculture land in detour section.
4. Acquisition of residential structure in villages along the alignment.
5. Impact on accessibility due to the division of agriculture land in detour section.
6. Cutting of approximately 1966 nos. of trees, which fall within RoW, however impact on ecology of the area is not significant considering these are spread in 272 km length.
7. Acquisition of approx. 7.36 ha reserves forest land in Kanpur Dehat, Auraiya, Etawah and Ferozabad districts.

Annexure No. 5.1

QUANTITATIVE ANALYSIS OF TREE, SHRUB AND HERB BY QUADRATE METHOD

5.24.1 Location No.1: Achalda Detour Location

A. Diversity, Abundance and Species Diversity Index

Sl. No.	Name of Species	No. of Quadrate Studies										Total No.of Species (n)	Density	Pi = n/N	log Pi	Pi x log Pi	Total No. of Quadrate Occurred	Abundance
		1	2	3	4	5	6	7	8	9	10							
1	*Cassia fistula*	-	-	-	-	-	2	1	-	-	-	3	0.3	0.006	-2.196	-0.014	2.000	0.15
2	*Acacia nilotica*	-	12	-	10	5	-	7	-	-	-	34	3.4	0.072	-1.142	-0.082	2.000	1.70
3	*Dalbergia sissoo*	-	-	2	-	-	3	-	-	-	-	5	0.5	0.011	-1.974	-0.021	2.000	0.25
4	*Delonix regia*	2	-	-	-	3	-	-	-	-	-	5	0.5	0.011	-1.974	-0.021	2.000	0.25
5	*Butea monosperma*	2	-	4	-	-	5	-	-	-	-	11	1.1	0.023	-1.632	-0.038	3.000	0.37
6	*Saccharum spontaneum*	10	14	12	-	18	-	7	9	25	-	95	9.5	0.202	-0.695	-0.140	3.000	3.17
7	*Thevetia peruviana*	-	-	4	-	-	3	-	-	-	-	7	0.7	0.015	-1.828	-0.027	2.000	0.35
8	*Pongamia pinnata*	-	2	-	-	-	-	-	-	-	-	2	0.2	0.004	-2.372	-0.010	1.000	0.20
9	*Parthenium hysterophorus*	11	25	21	27	45	29	17	26	14	34	249	24.9	0.529	-0.277	-0.146	10.000	2.49
10	*Prosopis juliflora*	-	-	12	-	5	8	2	-	-	-	27	2.7	0.057	-1.242	-0.071	4.000	0.68
11	*Zizyphus mauritiana*	-	-	-	-	2	-	-	-	-	-	2	0.2	0.004	-2.372	-0.010	1.000	0.20
12	*Ficus religiosa*	1	-	-	2	-	-	-	-	-	-	3	0.3	0.006	-2.196	-0.014	2.000	0.15
13	*Tamrindus indica*	-	-	-	-	-	2	-	-	-	-	2	0.2	0.004	-2.372	-0.010	1.000	0.20
14	*Alianthus exceles*	-	-	6	-	-	5	-	-	-	-	11	1.1	0.023	-1.632	-0.038	2.000	0.55
15	*Azardirachta indica*	-	-	-	3	-	2	-	-	-	-	5	0.5	0.011	-1.974	-0.021	2.000	0.25
16	*Capacious Cactus*	-	-	-	-	-	3	-	-	-	-	3	0.3	0.006	-2.196	-0.014	1.000	0.30
17	*Acacia catechu*	-	-	2	-	-	-	1	-	-	-	3	0.3	0.006	-2.196	-0.014	2.000	0.15
18	*Bambusa vulgaris*	-	-	-	-	-	-	-	-	-	4	4	0.4	0.008	-2.071	-0.018	1.000	0.40
19	*Melia azedarach*	-	-	-	-	-	-	-	-	16	-	16	1.6	0.034	-1.469	-0.050	1.000	1.60
20	*Artocarpus heterophyllus*	-	-	-	-	-	-	-	-	-	17	17	1.7	0.036	-1.443	-0.052	1.000	1.70
21	*Brassica oleracea*	-	-	-	-	-	-	-	17	-	-	17	1.7	0.036	-1.443	-0.052	1.000	1.70
22	*Daucus carota*	-	-	-	-	-	-	-	-	21	-	21	2.1	0.045	-1.351	-0.060	1.000	2.10
												471	**-0.710**					

Species Diversity Index = 0.710

B. Frequency and Frequency%

Sl. No.	Name of Species	No. of Quadrate Sampled										Total No. of Quadrate Occurred	Total No. of Quadrate Sampled	% Frequency	Frequency Class
		1	2	3	4	5	6	7	8	9	10				
1	*Cassia fistula*	-	-	-	-	-	+	+	-	-	-	2.000	10	20	B
2	*Acacia nilotica*	-	+	-	+	-	-	-	-	-	-	2.000	10	20	B
3	*Dalbergia sissoo*	-	-	+	-	-	+	-	-	-	-	2.000	10	20	B
4	*Delonix regia*	+	-	-	-	+	-	-	-	-	-	2.000	10	20	B
5	*Butea monosperma*	+	-	+	-	-	+	-	-	-	-	3.000	10	30	C
6	*Saccharum spontaneum*	+	+	+	-	+	-	+	+	+	-	7.000	10	70	D
7	*Thevetia peruviana*	-	-	+	-	-	+	-	-	-	-	2.000	10	20	C
8	*Pongamia pinnata*	-	+	-	-	-	-	-	-	-	-	1.000	10	10	A
9	*Parthenium hysterophorus*	+	+	+	+	+	+	+	+	+	+	10.000	10	100	E
10	*Prosopis juliflora*	-	-	+	-	+	+	+	-	-	-	4.000	10	40	C
11	*Zizyphus mauritiana*	-	-	-	-	+	-	-	-	-	-	1.000	10	10	A
12	*Ficus religiosa*	+	-	-	+	-	-	-	-	-	-	2.000	10	20	B
13	*Tamrindus indica*	-	-	-	-	-	+	-	-	-	-	1.000	10	10	A
14	*Alianthus excels*	-	-	+	-	-	+	-	-	-	-	2.000	10	20	B
15	*Azardirachta indica*	-	-	-	+	-	+	-	-	-	-	2.000	10	20	B
16	*Capacious Cactus*	-	-	-	-	-	+	-	-	-	-	1.000	10	10	A
17	*Acacia catechu*	-	-	+	-	-	-	+	-	-	-	2.000	10	20	B
18	*Bambusa vulgaris*	-	-	-	-	-	-	-	-	-	+	1.000	10	10	A
19	*Melia azedarach*	-	-	-	-	-	-	-	-	+	-	1.000	10	10	A
20	*Artocarpus heterophyllus*	-	-	-	-	-	-	-	-	-	+	1.000	10	10	A
21	*Brassica oleracea*	-	-	-	-	-	-	-	+	-	-	1.000	10	10	A
22	*Daucus carota*	-	-	-	-	-	-	-	-	+	-	1.000	10	10	A

The survey revealed that the highest dominance of 100% was showed by *Parthenium hysterophorus* followed by *Saccharum spontaneum*, *Acacia nilotica* and *Butea monosperma*. *Adhatoda zeylanica, Capparis sepiaria* and *Lantana indica* are the most abundant shrub species. The ground vegetation is mostly covered by *Sida acuta* and *Setaria verticillata*. The overall species diversity index for study area was computed as 0.710.

5.24.3 Location No.2: Mandrak Parallel Section

A. Diversity, Abundance and Species Diversity Index

Sl. No.	Name of Species	No. of Quadrate Studies										Total No.of Species (n)	Total No. of Quadrate	Density	Pi = n/N	log Pi	Pi x log Pi	Total No. of Quadrate Occurred	Abundance
		1	2	3	4	5	6	7	8	9	10								
1	*Cassia fistula*	-	-	-	4	6	-	-	-	-	-	10	10	1	0.026	-1.587	-0.041	2.000	0.50
2	*Acacia nilotica*	-	2	5	-	-	-	2	-	-	-	9	10	0.9	0.023	-1.632	-0.038	3.000	0.30
3	*Dalbergia sissoo*	-	4	-	-	-	4	-	-	-	-	8	10	0.8	0.021	-1.683	-0.035	2.000	0.40
4	*Delonix regia*	-	2	-	8	-	-	-	-	-	-	10	10	1	0.026	-1.587	-0.041	2.000	0.50
5	*Butea monosperma*	2	-	4	6	-	-	-	-	-	-	12	10	1.2	0.031	-1.507	-0.047	3.000	0.40
6	*Thevetia peruviana*	-	-	4	-	-	3	-	-	-	-	7	10	0.7	0.018	-1.741	-0.032	2.000	0.35
7	*Pongamia pinnata*	-	2	-	-	-	-	-	-	-	-	2	10	0.2	0.005	-2.286	-0.012	2.000	0.10
8	*Parthenium hysterophorus*	11	25	21	27	45	29	17	17	14	34	240	10	24	0.622	-0.206	-0.128	10.000	2.40
9	*Prosopis juliflora*	-	4	4	-	5	-	2	-	-	-	15	10	1.5	0.039	-1.410	-0.055	4.000	0.38
10	*Zizyphus mauritiana*	-	-	-	-	2	-	-	-	-	-	2	10	0.2	0.005	-2.286	-0.012	1.000	0.20
11	*Ficus religiosa*	1	-	4	2	-	-	-	-	-	-	7	10	0.7	0.018	-1.741	-0.032	3.000	0.23
12	*Tamrindus indica*	-	-	-	-	4	2	-	-	-	-	6	10	0.6	0.016	-1.808	-0.028	2.000	0.30
13	*Alianthus exceles*	2	-	6	-	-	5	-	-	-	-	13	10	1.3	0.034	-1.473	-0.050	3.000	0.43
14	*Azardirachta indica*	-	5	-	3	-	7	-	-	-	-	15	10	1.5	0.039	-1.410	-0.055	3.000	0.50
15	*Mangifera indica*	-	4	-	3	-	2	-	-	-	-	9	10	0.9	0.023	-1.632	-0.038	3.000	0.30
16	*Capacious Cactus*	-	-	-	4	-	3	-	-	-	-	7	10	0.7	0.018	-1.741	-0.032	2.000	0.35
17	*Acacia catechu*	-	-	2	-	-	-	1	-	-	-	3	10	0.3	0.008	-2.109	-0.016	2.000	0.15
18	*Bambusa vulgaris*	-	6	-	5	-	-	-	-	-	-	11	10	1.1	0.028	-1.545	-0.044	2.000	0.55
19	*Melia azedarach*	-	2	4	-	-	-	-	-	-	-	6	10	0.6	0.016	-1.808	-0.028	2.000	0.30
20	*Solanum melongeana*	-	-	-	-	-	-	-	14	-	-	14	10	1.4	0.036	-1.440	-0.052	1.000	1.40
21	*Brassica oleracea*	-	-	-	-	-	-	-	-	27	-	27	10	2.7	0.070	-1.155	-0.081	1.000	2.70
22	*Oryza sativa*	-	-	-	-	-	-	-	-	-	45	45	10	4.5	0.117	-0.933	-0.109	1.000	4.50
23	*Daucus carota*	-	-	-	-	-	-	-	21	-	-	21	10	2.1	0.054	-1.264	-0.069	1.000	2.10
												386					**-0.735**		

Species Diversity Index = 0.735

B. Frequency and Frequency%

Sl. No.	Name of Species	No. of Quadrate Sampled										Total No. of Quadrate Occurred	Total No. of Quadrate Sampled	% Frequency	Frequency Class
		1	2	3	4	5	6	7	8	9	10				
1	*Cassia fistula*	-	-	-	+	+	-	-	-	-	-	2	10	20	B
2	*Acacia nilotica*	-	+	+	-	-	-	+	-	-	-	3	10	30	B
3	*Dalbergia sissoo*	-	+	-	-	-	+	-	-	-	-	2	10	20	B
4	*Delonix regia*	-	+	-	+	-	-	-	-	-	-	2	10	20	B
5	*Butea monosperma*	+	-	+	+	-	-	-	-	-	-	3	10	30	B
6	*Thevetia peruviana*	-	-	+	-	-	+	-	-	-	-	2	10	20	B
7	*Pongamia pinnata*	-	+	-	-	-	-	-	-	-	-	1	10	10	A
8	*Parthenium hysterophorus*	+	+	+	+	+	+	+	+	+	+	10	10	100	E
9	*Prosopis juliflora*	-	+	+	-	+	-	+	-	-	-	4	10	40	C
10	*Zizyphus mauritiana*	-	-	-	-	+	-	-	-	-	-	1	10	10	A
11	*Ficus religiosa*	+	-	+	+	-	-	-	-	-	-	3	10	30	B
12	*Tamrindus indica*	-	-	-	-	+	+	-	-	-	-	2	10	20	B
13	*Alianthus exceles*	+	-	+	-	-	+	-	-	-	-	3	10	30	B
14	*Azardirachta indica*	-	+	-	+	-	+	-	-	-	-	3	10	30	B
15	*Mangifera indica*	-	+	-	+	-	+	-	-	-	-	3	10	30	B
16	*Capacious Cactus*	-	-	-	+	-	+	-	-	-	-	2	10	20	B
17	*Acacia catechu*	-	-	+	-	-	-	+	-	-	-	2	10	20	B
18	*Bambusa vulgaris*	-	+	-	+	-	-	-	-	-	-	2	10	20	B
19	*Melia azedarach*	-	+	+	-	-	-	-	-	-	-	2	10	20	B
20	*Solanum melongeana*	-	-	-	-	-	-	-	+	-	-	1	10	10	A
21	*Brassica oleracea*	-	-	-	-	-	-	-	-	+	-	1	10	10	A
22	*Oryza sativa*	-	-	-	-	-	-	-	-	-	+	1	10	10	A
23	*Daucus carota*	-	-	-	-	-	-	-	+	-	-	1	10	10	A

During the study 23 species were observed. *Acasia nilotica* was found to be the most dominant species, followed by *Prosopis juliflora and Butea monosperma*. Density and diversity index of different species observed during the studies was 0.735. It may be observed that *Prosopis juliflora* is the most abundant species followed by *Dalbergia sisoo, Delonix regia*.

5.24.4 Location No.3: Bhaupur

A. Diversity, Abundance and Species Diversity Index

Sl. No.	Name of Species	No. of Quadrate Studies										Total No. of Species (n)	Density	Pi = n/N	log Pi	Pi x log Pi	Total No of Quadrate Occurred	Abundance
		1	2	3	4	5	6	7	8	9	10							
1	*Acacia nilotica*	-	-	-	-	-	-	-	6	8	-	14	1.4	0.021	-1.679	-0.035	10.000	0.14
2	*Prosopis juliflora*	-	-	-	-	-	9	-	15	12	-	36	3.6	0.054	-1.269	-0.068	6.000	0.60
3	*Cynodan dactylon*	35	27	32	21	33	25	22	21	28	27	271	27.1	0.405	-0.392	-0.159	8.000	3.39
4	*Acacia lecophloea*	8	4	-	-	-	-	-	-	-	-	12	1.2	0.018	-1.746	-0.031	4.000	0.30
5	*Datura metel*	-	-	3	2	-	-	-	-	-	-	5	0.5	0.007	-2.126	-0.016	4.000	0.13
6	*Azadirachta indica*	-	5	-	4	-	-	-	-	-	-	9	0.9	0.013	-1.871	-0.025	7.000	0.13
7	*Pisium sativum*	25	22	18	24	28	32	-	-	-	12	161	16.1	0.241	-0.619	-0.149	5.000	3.22
8	*Pennisetum typhoides*	12	18	9	23	28	25	12	-	-	14	141	14.1	0.211	-0.676	-0.143	7.000	2.01
9	*Tribulus terrestris*	-	-	-	4	-	-	-	-	-	-	4	0.4	0.006	-2.223	-0.013	4.000	0.10
10	*Calotropis procera*	-	-	-	-	-	-	-	-	4	3	7	0.7	0.010	-1.980	-0.021	5.000	0.14
11	*Azadirecta Indica*	-	-	-	3	-	2	-	-	2	2	9	0.9	0.013	-1.871	-0.025	6.000	0.15
												669	**-0.685**					

Species Diversity Index = 0.685

B. Frequency and Frequency%

Sl. No.	Name of Species	No. of Quadrate Sampled										Total No. of Quadrate Occurred	Total No. of Quadrate Sampled	% Frequency	Frequency Class
		1	2	3	4	5	6	7	8	9	10				
1	*Acacia nilotica*	-	-	-	-	-	-	-	+	+	-	2	10	20	A
2	*Prosopis juliflora*	-	-	-	-	-	+	-	+	+	-	3	10	30	B
3	*Cynodan dactylon*	+	+	+	+	+	+	+	+	+	+	10	10	100	E
4	*Acacia lecophloea*	+	+	-	-	-	-	-	-	-	-	2	10	20	A
5	*Datura metel*	-	-	+	+	-	-	-	-	-	-	2	10	20	A
6	*Azadirachta indica*	-	+	-	+	-	-	-	-	-	-	2	10	20	A
7	*Pisium sativum*	+	+	+	+	+	+	-	-	-	+	6	10	60	D
8	*Pennisetum typhoides*	+	+	+	+	+	+	+	-	-	+	8	10	80	E
9	*Tribulus terrestris*	-	-	-	+	-	-	-	-	-	-	1	10	10	A
10	*Calotropis procera*	-	-	-	-	-	-	-	-	+	+	2	10	20	A
11	*Azadirecta Indica*	-	-	-	+	-	+	-	-	+	+	4	10	40	C

Cynodan dactylon was found to be the most dominant species, followed by *Pisium sativum, Pennisetum typhoides*. *Parthenium hysterophorous* was found very common in the study area. It may be observed that *Pennisetum typhoides* is the most abundant and frequent. The overall species diversity index for study area was computed as 0.685.

5.24.5 Location No.4: Samaspur R.F.

A. Diversity, Abundance and Species Diversity Index

Sl. No.	Name of Species	No. of Quadrate Studies										Total No. of Species (n)	Density	Pi = n/N	log Pi	Pi x log Pi	Total No. of Quadrate Occurred	Abundance
		1	2	3	4	5	6	7	8	9	10							
1	*Ocimum gratissimum*	5	7	-	10	-	9	3	8	-	-	42	4.2	0.13125	-0.8819	-0.115	10	0.42
2	*Saccharum spontaneum*	11	8	6	7	2	12	4	3	-	-	53	5.3	0.165625	-0.780	-0.129	2	2.65
3	*Calotropis procera*	15	12	17	15	11	2	5	8	2	2	89	8.9	0.278125	-0.55576	-0.154	2	4.45
4	*Butea monosperma*	-	-	-	-	1	-	-	-	4	2	7	0.7	0.021875	-1.6600	-0.036	1	0.70
5	*Acacia nilotica*	-	-	-	-	-	-	-	2	4	3	9	0.9	0.028125	-1.5509	-0.043	1	0.90
6	*Agrimonia pilisa*	6	-	-	8	9	-	4	6	-	-	33	3.3	0.103125	-0.9866	-0.101	4	0.83
7	*Ageratum adenophora*	8	9	-	-	-	10	-	-	-	8	35	3.5	0.109375	-0.96108	-0.105	3	1.17
8	*Dhatura sumonium*	2	4	5	-	-	3	-	-	9		23	2.3	0.071875	-1.14342	-0.082	2	1.15
9	*Lavandula montevidensis*	-	-	-	-	-	-	-	-	6	8	14	1.4	0.04375	-1.35902	-0.059	2	0.70
10	*Enterolobium contortisiliquum*	-	-	-	-	-	-	-	3	4	2	9	0.9	0.028125	-1.55090	-0.043	3	0.30
11	*Delonix regia*	-	-	-	-	-	-	-	-	2	4	6	0.6	0.01875	-1.72699	-0.032	2	0.30
											Total	**320**			**-0.904**			
		Species Diversity Index = 0.904																

B. Frequency and Frequency%

Sl. No.	Name of Species	No. of Quadrate Sampled										Total No. of Quadrate Occurred	Total No. of Quadrate Sampled	% Frequency	Frequency Class
		1	2	3	4	5	6	7	8	9	10				
1	*Ocimum gratissimum*	+	+	-	+	-	+	+	+	-	-	6	10	80	E
2	*Saccharum spontaneum*	+	+	+	+	+	+	+	+	-	-	8	10	80	E
3	*Calotropis procera*	+	+	+	+	+	+	+	+	+	+	10	10	100	E
4	*Butea monosperma*	-	-	-	-	+	-	-	-	+	+	3	10	30	B
5	*Acacia nilotica*	-	-	-	-	-	-	-	+	+	+	3	10	30	B
6	*Agrimonia pilisa*	+	+	+	+	+	+	+	+	+	-	9	10	90	E
7	*Ageratum adenophora*	+	+	+	+	+	+	-	-	+	+	8	10	80	E
8	*Dhatura sumonium*	+	+	+	-	-	+	-	-	+	-	5	10	50	C
9	*Lavandula montevidensis*	-	-	-	-	-	-	-	-	+	+	2	10	20	A
10	*Enterolobium contortisiliquum*	-	-	-	-	-	-	-	+	+	+	3	10	30	C
11	*Delonix regia*	-	-	-	-	-	-	-	-	+	+	2	10	20	A

Saccharum spontaneum and *Calotopis procera* was found to be the most dominant species, followed by *Ocimum gratissimum. Parthenium hysterophorous* was found very common in the study area. It may be observed that *Saccharum spontaneum* is the most abundant and frequent. The overall species diversity index for study area was computed as 0.904.

Annexure No.5.2

Aquatic sampling Results
[ARIND RIVER]

Phytoplankton

COMMON SPECIES	GROUP	%		DIVERSITY INDEX	
		Up Stream	Down Stream	Up Stream	Down Stream
Rhizoclonium sp.	Chlorophyceae	25.3	24.2	3.2	29.9
Ankistrodesmus sp.					
Chlorella sp.					
Pediastrum sp.					
Chlosterium sp.					
Spirogyra sp.					
Scenedesmus sp.					
Staurastrum					
Pandorina sp.					
Peridinium sp.					
Cosmarium sp.					
Chlamydomonas sp.					
Navicula sp.	Bacillariophyceae	17.0	15.5		
Centronella sp.					
Synedira sp.					
Fragillaria sp.					
Melosira sp.					
Cyclotella sp.					
Gomphonema sp.					
Nitzeschia sp.					
Trabellaria sp.					
Amphora sp.					
Euglena vedinas sp.	Euglenaineae	7.6	8.2		
Lagerheimia					
Trachelomonas sp.					
Phacus sp.					
Oscillatoria sp.	Cyanophyceae	10.0	9.0		
Anabaena sp.					
Microcystis sp.					
Phormidium sp.					
Synechosystis					
Spirullina sp.					
Merismopaedia sp.					
Aphanothece sp.					

Zooplankton

	Group	%		DIVERSITY INDEX	
		Up Stream	Down Stream	Up Stream	Down Stream
Vorticelia sp.	Protozoa	11.0	12.0	2.3	2.1
Paramecium					
Didinium					
Asplanchna	Rotifera	32.0	33.0		
Brachionus					
Euchlanis					
Horaella					
Polyarthra					
Rotaria					
Daphinia sp.	Cladocera	30.0	29.5		
Ceriodiaphnia cornusa					
Bosmina loniotris					

Daphinia lumphasia					
Daphnirosoma sp.					
Moina					
Mesocyclops Hyalimus	Copepoda	20.0	19.5		
Cyclops					
Microcyclops varicous					
Heliodiaptomus sp.					
Diaptomus					
Mesocydops.					
Nauplii	Crustacea	5.0	6.0		

	%		Diversity Index	
	Up Stream	**Down Stream**	**Up Stream**	**Down Stream**
	2.2	2.1	3.0	2.7
Oligochaeta	14.7	13.2		
	2.3	2.3		
	2.0	2.5		
	51.0	49.5		
Ephemeroptera	18.0	17.0		

[B] SANGAI RIVER Phytoplankton

Common Species	**Group**	**%**		**Diversity Index**	
		Up Stream	**Down Stream**	**Up Stream**	**Down Stream**
Desmidium	Chlorophyceae	20.1	20.4	**1.3**	1.8
Gonium,					
Ankistrodesmus sp.					
Chlorella sp.					
Pediastrum sp.					
Chlosterium sp.					
Spirogyra sp.					
Eudorina					
Peridinium sp.					
Pandorina					
Uronema					
Navicula sp.	Bacillariophyceae	18.3	19.8		
Diatoma					
Synedira sp.					
Centronella					
Cyclotella					
Fragillaria sp.					
Melosira sp.					
Cyclotella sp.					
Nitzeschia sp.					
Trabellaria					
Euglena vedinas sp.	Euglenophyceae	14.5	15.6		
Trachelomonas					
Phacus sp.					
Oscillatoria sp.	Cyanophyceae	22.6	24.2		
Anabaena sp.					
Microcystis sp.					
Phormidium sp.					
Merismopaedia sp.					
Aphanothece sp.					
Synechosystis sp.					
Spirulina sp.					
Lyngbya sp.					

Zooplnakton

Common Species	**Group**	**%**	**Diversity Index**

		Up Stream	Down Stream	Up Stream	Down Stream
Verticelia sp.	Protozoa	6	7	1.3	1.1
Brachionus	Rotifera	18	17		
Keretella					
Polyartha vulgaris					
Daphinia sp.	Cladocera	24	23		
Bosmina loniotris					
Daphnirosoma sp.					
Mesocyclops hyalimus	Copepoda	15	14		
Cyclops					
Diaptomus					
Heliodiaptomus sp.					

Benthos

Phylum	%		Diversity Index	
	Up Stream	Down Stream	Up Stream	Down Stream
	1.2	1.4	**0.5**	0.5
Oligochaeta	5.0	5.0		
Decapoda	3.0	3.0		
Coleoptera	3.3	3.2		
Diptera	5.0	6.0		
Ephemeroptera	10.0	9.0		
Hemiptera	2.3	2.2		
Lepidoptera	1.4	1.2		
Odonata	1.7	1.8		
Trichoptera	3.3	3.2		

ANALYSIS OF ALTERNATIVES

6.1 BACKGROUND

The present project consists of laying out the double line broad gauge railway line (272 km) for freight trains associated facilities such as bridges, electrical facilities including signal, electric sub-stations and junctions & crossing stations etc. The detailed description of the facilities are presented in Chapter-2.

6.2 ALIGNMENT

Present section starts at the Delhi end of Bhaupur station (km 1040.00) & ends at Khurja (km 1369.82). There are 32 IR stations on the existing lines. Out of these 32 stations, 6 are surrounded by heavy structures where the DFC line is not feasible. To avoid such heavily built up area, detours have been proposed at these locations. Since the proposed DFC track generally runs on the left side of the IR tracks, proposed detours are not considered for the right hand side (RHS) of the IR network because of technical constrains and high cost of construction for underpass / flyover to the IR tracks. However, various alternatives have been analyzed keeping in view environmental, social and technical parameters. The details of the parallel and detour locations are given below in the table No. 6.1 and table 6.2. All the detours are on the left side w.r.t. railway alignment from Bhaupur to Khurja (south side) of the railway track except Etawah, where it is proposed on right hand side (north side) of the existing railway track. All the parallel alignments are on the left hand side of the existing railway track.

Table-6.1: Locations of the Parallel Alignment

Sl. No.	From	To	P/D	Start	End	Length (km)
1	Bhaupur stat	Achalda Detour Start	parallel	1040.00	1115.00	75.61
2	Achalda Detour End	Bharthana Detour Start	parallel	1119.00	1131.00	12.00
3	Bharthana Detour End	Etawa Detour Start	parallel	1140.00	1147.00	7.00
4	Etawa Detour End	Tundla section Start	parallel	1170.00	1200.00	30.00
5	Tundla sectionr End	Hathras Detour Start	parallel	1266.00	1290.00	24.00
6	Hathras Detour End	Aligarh Detour start	parallel	1299.00	1319.00	20.00
7	Aligarh Detour End	Khurja	parallel	1345.00	1369.82	24.82

Table-6.2: Locations of the Detour Alignment

Sl. No.	From	To	P/D	Start	End	Length (km)
1	Achalda Detour Start	Achalda Detour End	detour	1115.00	1119.00	4.73
2	Bharthana Detour Start	Bharthana Detour End	detour	1131.00	1140.00	10.48
3	Etawa Detour Start	Etawa Detour End	detour	1147.00	1170.00	25.24
4	Hathras Detour Start	Hathras Detour End	detour	1290.00	1299.00	10.245
5	Aligarh Detour Start	aligarh detour	detour	1319.00	1345.00	28.03

The objective of examining various alternatives was screening of the manifest features of the environment for assessing which of the alternative alignments are likely to have the most significant environmental impacts. Three alternatives i.e. parallel alignment, right side alignment and left side alignment have been considered along the critical area, where environmental and social impacts are significant.

6.3 ANALYSIS OF ALTERNATIVES

The various alternatives for each detour are discussed below:-

6.3.1 Achalda Detour

Achalda is a semi-urban area with ribbon development along the existing railway track. Issues related to the detour as per various options are discussed in Table 6.3 and shown in Figure 6.1.

Table 6.3: Issues related to Achalda Detour

Sl. No.	Issues	Parallel along existing IR track	On north side of existing IR track	On south side of existing IR track	Recommendation
1.	Land width	10-12 meter additional width is required	Proposed width is 60 meter	Proposed width is 60 meter	The detour is recommended on south side of the existing track. Appropriate measures to mitigate noise and vibration such as appropriate reduction of RoW and construction of noise barriers shall be taken near sensitive receptors (Mulayamsingh Girls Inter College). Special attention shall be given to farmers who will lose fertile agriculture land for income restoration
2.	Acquisition of structures	About 35 structures and 50 families will be displaced	Passes through agriculture land and crosses water bodies such as Ahneya river and canal, ST line	Passes through agricultural and barren land	
3.	Issues of ROB	Construction of ROB at LC gate will displace about 100 houses	None	None	
4.	Technical constrains	Need modification of yard	Need additional bridges along the water bodies. HT lines shall have to be shifted four times adding to the cost	Need underpasses at crossing locations	
5.	Public Opinion	Not favourable	Not favourable as villages such as bansi, gangauli, gawahari are directly impacted	Lose of land and livelihood, need good communication strategies and consultation	
6.	Environmental issues covering noise, vibration and impact on sensitive receptors	Noise and vibration impact on residential and sensitive receptors	Impact on the surrounding villages due to construction of new track	Impact are less as less structures are impacted, however, a girl inter college which is located close to the alignment have noise and vibration impacts	
7.	Site suitability for various facilities such as freight stations, electric substation etc.	Not suitable due to congestion along the track	Suitable as sufficient land is available along the track	Suitable as sufficient land is available along the track	
8.	Ecological impact such as tree cutting	Not significant	Not significant	Not significant	
9.	Other impacts	Remaining houses will have impacts of vibration and noise pollution	Increased noise and associated impacts on villages	Less impacts but houses close to the proposed line may have some vibration and noise impacts	

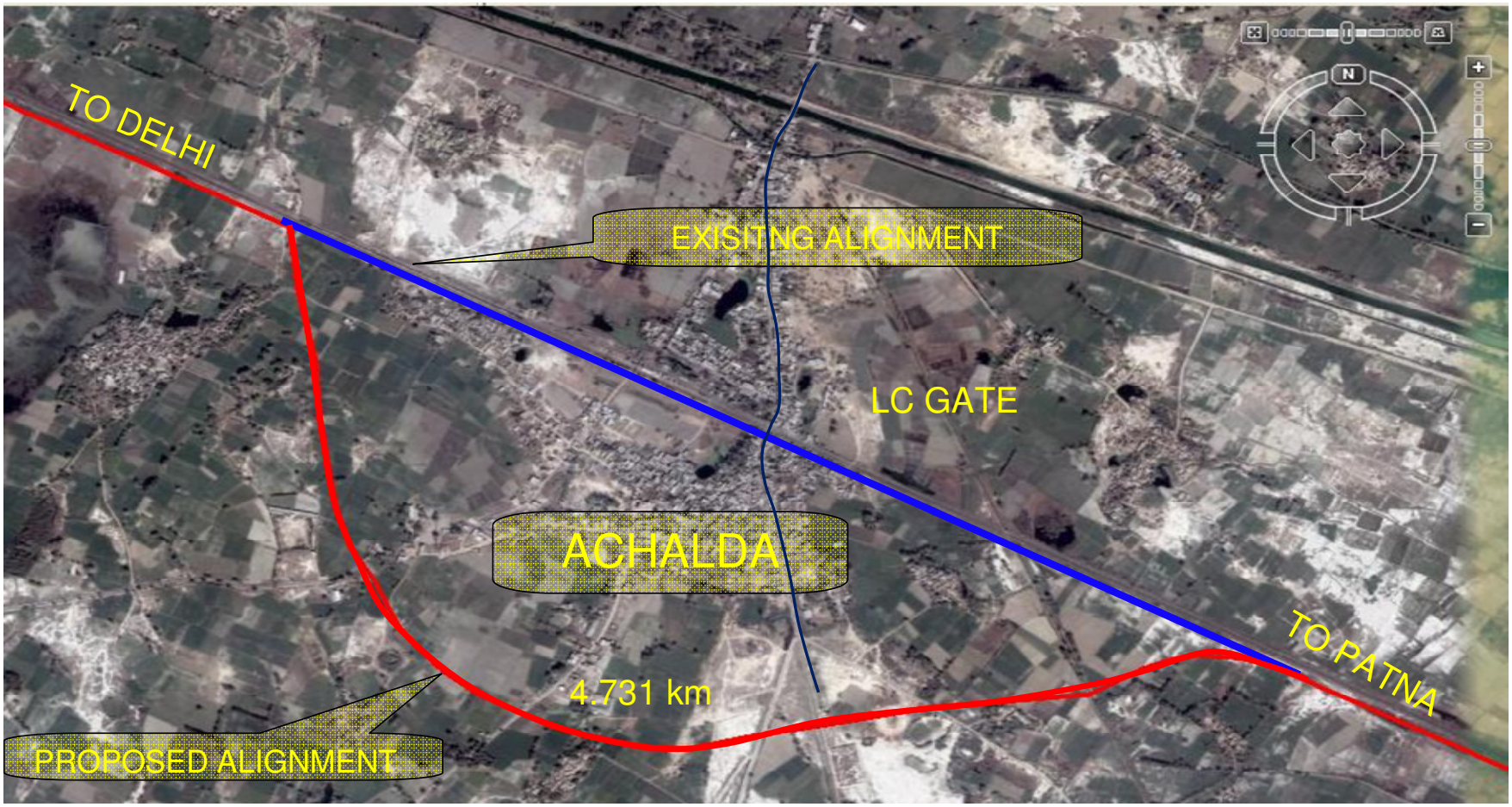


Figure 6.1: Achalda Detour

6.3.2 Bharthana Detour

Bharthana is the tehsil headquarters. A 200 m stretch along the existing railway line is very congested. There are number of commercial establishment on both sides of the LC gate. Issues related to the detour as per various options are discussed in Table 6.4 and shown in

Table 6.4: Issues related to Bharthana Detour

Sl. No.	Issues	Parallel along existing IR track	On north side of existing IR track	On South side of existing IR track	Recommendation
1.	Land width	8-12 meter additional width is required	Proposed width is 60 meter	Proposed width is 60 meter	The detour is recommended on south side of the existing track, due to a potentially lower impact, as compared to parallel or the right side alignment
2.	Acquisition of structures	About 55 structures and 50 families will be displaced	Passes through agriculture land and crosses water bodies such as Senger tributary and number of canals, hospital	Passes through agricultural and barren land	
3.	Issues of ROB	Construction of ROB at LC gate will displace about 100 houses and 100 commercial establishment	None	None	
4.	Technical constrains	Need modification of yard	Need additional bridges along the water bodies and changing the alignment from left to right causes technical complications, HT lines shall have to be shifted four times adding to the cost	Need underpasses at crossing locations	
5.	Public Opinion	Not favourable	Not favourable as villages such as Naglamohan, Ramain are directly impacted	Lose of land and livelihood, Land losers are apprehensive and ask for specific R & R packages	
6.	Environmental issues covering noise, vibration and impact on sensitive receptors	Noise and vibration impact on residential and sensitive receptors	Impact on the surrounding villages due to construction of new track	Impact are less as less structures are impacted	
7.	Site suitability for various facilities such as freight stations, electric substation etc.	Not suitable due to congestion along the track	Suitable as sufficient land is available along the track, however, water bodies are more at this site causing hindrance	Suitable as sufficient land is available along the track	
8.	Ecological impact such as tree cutting	Not significant	Not significant	Not significant	
9.	Other impacts	Remaining houses will have impacts of vibration and noise pollution	Increase noise and associated impacts on villages	Less impacts, but houses are closed to the proposed line may have some vibration and noise impacts	

Figure 6.2: Bharthana Detour

6.3.3 Etawah Detour

Etawah is the district headquarters and extremely congested along the existing railway track. Issues related to the detour as per various options are discussed in Table 6.5 and shown in Figure 6.3.

Table 6.5: Issues related to Etawah Detour

Sl. No.	Issues	Parallel along existing IR track	On north side of existing IR track	On south side of existing IR track	Recommendation
1.	Land width	6-7 meter additional width is required	Proposed width is 60 meter	Proposed width is 60 meter	The detour is recommended on north side of the existing track
2.	Acquisition of structures	About 275 structures and 500 families will be displaced	Passes through agriculture land and crosses water bodies but not any perennial river	Passes through reserve forest, agricultural and broken land	
3.	Issues of ROB	Construction of RUB at NH-2 crossing	Construction of new ROB at NH-2	Construction of new ROBs	
4.	Technical constrains	Need modification of yard establishment at station building, dense habitation	Need additional bridges along the water bodies and changing the alignment	Need underpasses at crossing locations and high cost due to major bridge construction over river Yamuna, constrain due to ravine terrain and geography location also causes problems	
5.	Public Opinion	Not favourable	Apprehensions of villages on agriculture land, however, good compensation package, livelihood restoration address the concern of the PAPs	Not favourable	
6.	Environmental issues covering noise, vibration and impact on sensitive receptors	Noise and vibration impact on residential and sensitive receptors	Impact on the surrounding villages due to construction of new track	Major environmental issues on the location of reserve forest, high concentration of trees, proximity with Chambal and Yamuna river	
7.	Site suitability for various facilities such as freight stations, electric substation etc.	Not suitable due to congestion along the track	Suitable as sufficient land is available along the track	Not suitable as reserve forest land is required for additional facilities	
8.	Ecological impact such as tree cutting	Not significant	Less significant as compare to left side alignment	Significant impact due to cutting of trees	
9.	Other impacts	Remaining houses will have impacts of vibration and noise pollution	Increased noise level and associated impacts on village	Less impacts, but houses are close to the proposed alignment may have vibration and noise impacts	

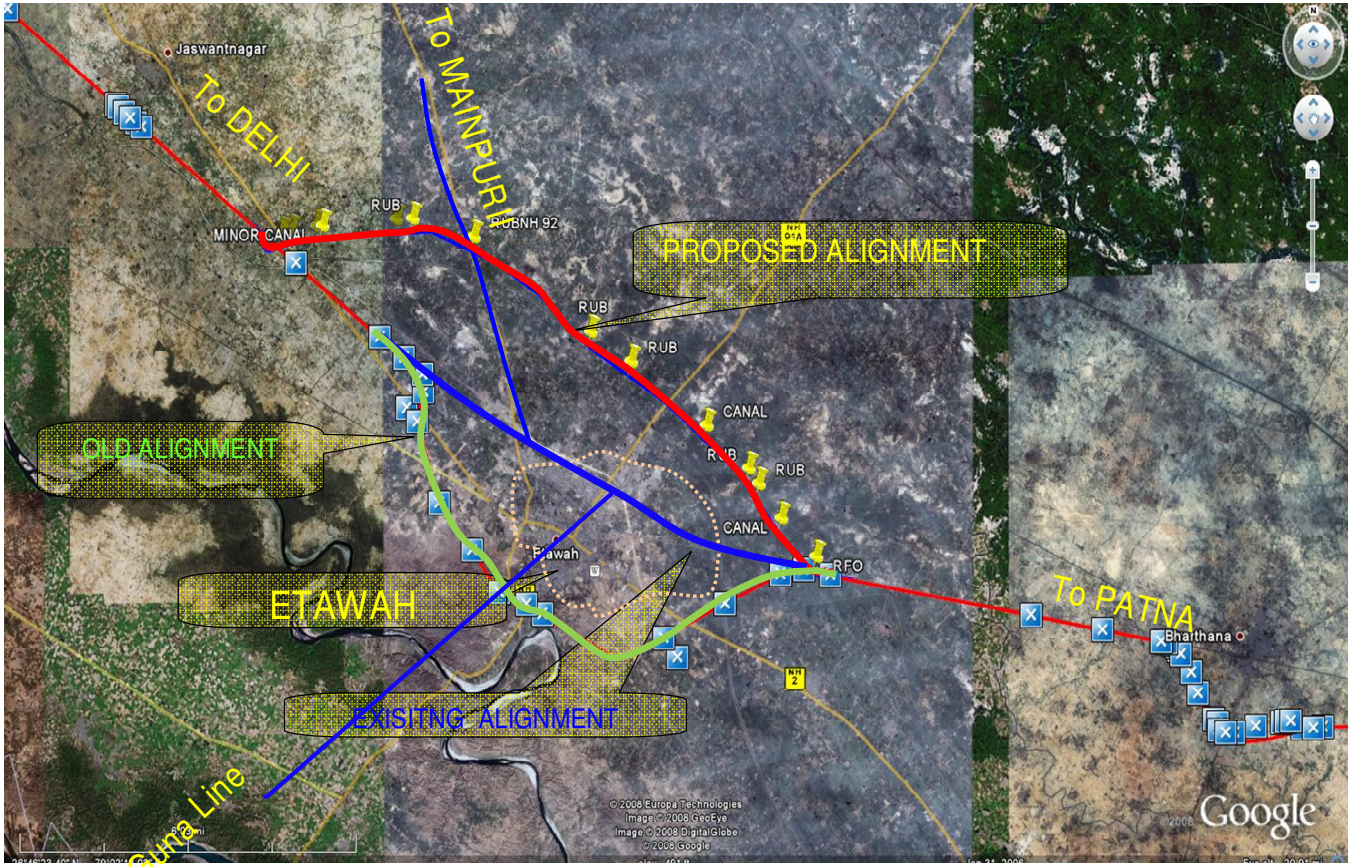


Figure 6.3: Etawah Detour

6.3.4 Hathras Detour

Hathras is the headquarters of the Mahamaya Nagar district and at this location, approximately a 500 meter stretch along the existing track is very congested. Issue related to the detour as per various options are discussed in Table 6.6 and shown in Figure 6.4.

Table 6.6: Issues related to Hathras Detour

Sl. No.	Issues	Parallel along existing IR track	On north side of existing IR track	On south side of existing IR track	Recommendation
1.	Land width	8-12 meter additional width is required	Proposed width is 60 meter	Proposed width is 60 meter	The detour is recommended on south side of the existing track.
2.	Acquisition of structures	About 200 structures, mostly commercial and 700 families will be displaced	Passes through agriculture land and crosses water bodies, pond etc.	Passes through agricultural and barren land	
3.	Issues of ROB	Construction of ROB at LC gate will displace about 400 houses	Need underpasses near the villages / road intersection	Need underpasses near the villages / road intersection	
4.	Technical constrains	Need modification of yard	No such displacement, however crossing of the tracks may require additional land and cost	No such impacts	
5.	Public Opinion	Not favourable	Not favourable due to more acquisition of land	People are not apposing the bypass	
6.	Environmental issues covering noise, vibration and impact on sensitive receptors	Noise and vibration impact on residential and sensitive receptors	Impact on the surrounding villages due to construction of new track	No significant impact as villages are away from the proposed track	
7.	Site suitability for various facilities such as freight stations, electric substation etc.	Not suitable due to congestion along the track	Suitable as sufficient land is available along the track	Suitable as sufficient land is available along the track	
8.	Ecological impact such as tree cutting	Not significant	Not significant	Not significant	
9.	Other impacts	Remaining houses will have impacts of vibration and noise pollution	Impact on receptors in the villages	Not significant	

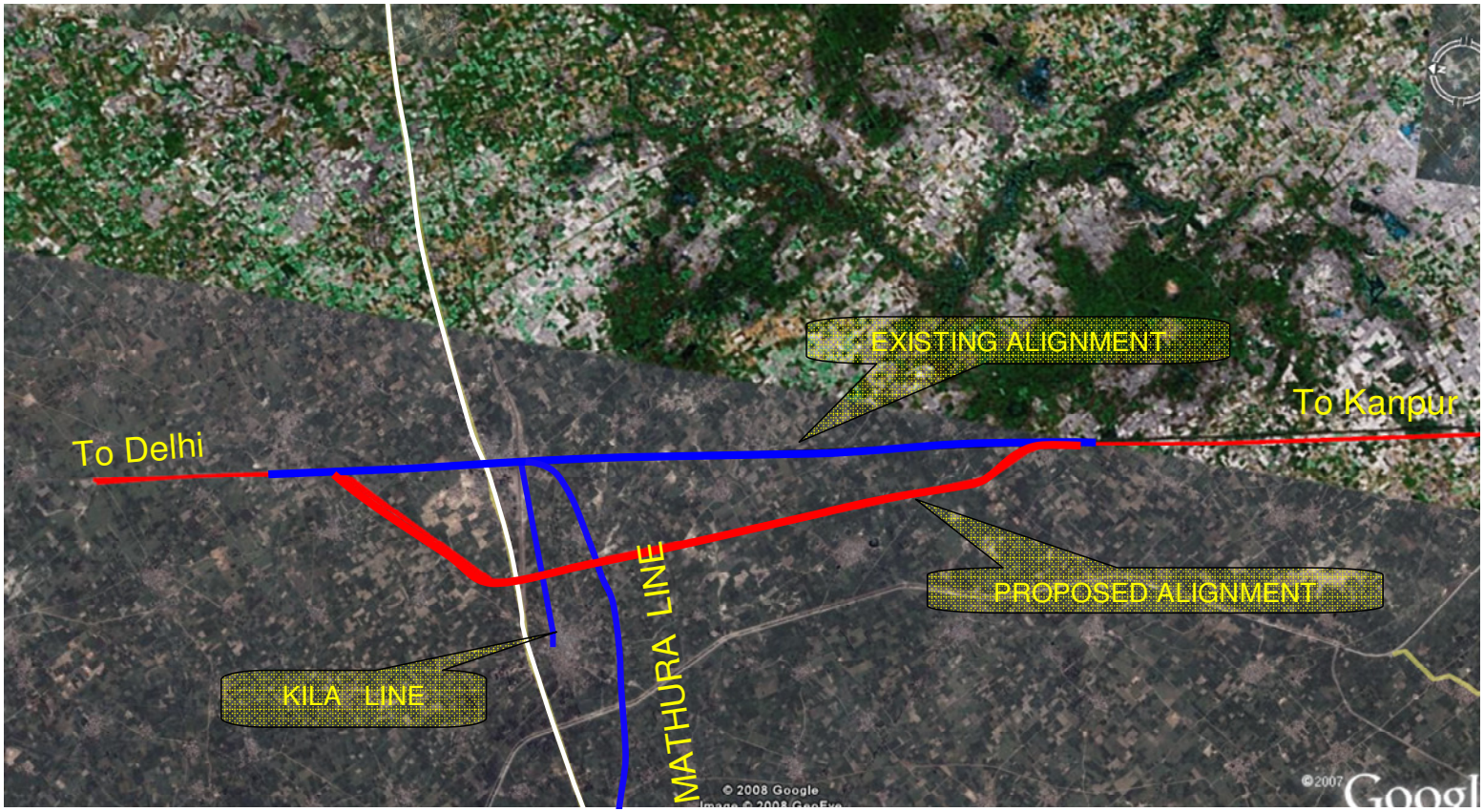


Figure 6.4: Hathras Detour

6.3.5 Aligarh Detour

Aligarh is the district headquarters and is considered both, a historical and an educational centre of India. Approximately a 300 m. stretch along the existing track is congested as houses and commercial establishment have been built extremely close to the track. A third line from Khurja to Aligarh is already under construction, therefore, land is not available for further expansion parallel to the existing track. Issues related to detour as per various options are discussed in Table 6.7 .

Table 6.7: Issues related to Aligarh Detour

Sl. No.	Issues	Parallel along existing IR track	On north side of existing IR track	On south side of existing IR track	Recommendation
1.	Land width	3-6 meter additional width is available	Proposed width is 60 meter	Proposed width is 60 meter	The detour is recommended on south side of the existing track
2.	Acquisition of structures	About 200 structures and 700 families will be displaced	Passes through agriculture land and high tension line	Passes through agricultural land	
3.	Issues of ROB	Construction of ROB at LC gate will displace about 400 houses	No such displacement	No such displacement	
4.	Technical constrains	Need modification of Aligarh yard	Crossing the alignment from left to right may cause technical complication	Need underpasses at crossing locations	
5.	Public Opinion	Not favourable	Not favourable	People are not apposing the bypass	
6.	Environmental issues covering noise, vibration and impact on sensitive receptors	Noise and vibration impact on residential and sensitive receptors, specifically mosque near the additional track	Impact on the surrounding villages due to construction of new track	Impact are less as less structures are affected	
7.	Site suitability for various facilities such as freight stations, electric substation etc.	Not suitable due to congestion along the track	Suitable as sufficient land is available along the track	Suitable as sufficient land is available along the track	
8.	Ecological impact such as tree cutting	Not significant	Not significant	Not significant	
9.	Other impacts	Remaining houses will have impact of vibration and noise pollution	Impact on receptors in the villages	Not significant	

ENVIRONMENT IMPACT ASSESSMENT

7.1 INTRODUCTION

Environmental impact assessment involves prediction of potential impacts by development of the project on the surrounding area. Based on the baseline environmental status described in earlier section and the proposed project activities, potential impacts have been assessed and predicted, and appropriate mitigation measures are suggested to avoid / reduce / compensate for the potential adverse impacts to enhance its positive impacts. The impacts due to the development of the proposed Dedicated Freight Corridor have been assessed for the planning phase, construction phase and implementation phase.

7.2 IMPACT ASSESSMENT METHODOLOGY

To assess the impact of the project, a simple qualitative method that determines potential existence of impact has been employed. Thereby, the judgments related to the magnitude and importance of the impacts caused by the project is presented. This involves development of Matrix summarizes environmental impacts of the DFC project. The following parameters and scale is adopted for developing matrix. Parameters and scale of impact matrix is presented in Table 7.1.

Table 7.1: Parameter and Scale of Impact Matrix

Parameter	Scale		Remarks	
Significance	No impact	E	Positive:+	Negative:-
	Negligible impact	D	Positive:+	Negative:-
	Insignificant impact	C	Positive:+	Negative:-
	Relatively significant impact	B	Positive:+	Negative:-
	Significant impact	A	Positive:+	Negative:-

For the assessment of impacts, the following criteria is adopted

Scale A: If National Parks, Wildlife Sanctuaries or any designated natural reserve, protected species of any kind are directly affect.

Scale B: If large areas of forest, grassland, cultivable land or any natural environment for tourism are indirectly affected.

Scale C: If impacts are insignificant

Scale D: If impacts are negligible

Scale E: No impacts or not applicable to assessment.

Section below assess the impacts following the above method.

7.3 DESCRIPTION OF EXPECTED IMPACTS

The description of impacts on natural resources is as follows:-

7.3.1 Impact on Topography and Geology

1) Planning Phase

The project has been planned to minimize the impacts on topography by avoiding sensitive topographic features such as tunnels, rivers/hills etc. However, impacts due to high embankments are expected due to the project.

2) Construction Phase

- During construction phase changes in topography are envisaged due to the clearing of land, felling of trees, cutting and filling, and due to the construction of structures.
- Construction of railway embankment is also likely to cause aesthetic changes in the landscape. However, suitable landscaping and plantation activities, slope protection activities are envisaged to minimize the aesthetic impacts.
- Filling and cutting of land will be required in the detour stretches, where the track traverses through undulating topography. However, changes will be limited within RoW of the track hence overall impact will be localized.
- No impact is envisaged on geology due to the project.

3) Operation Phase

- Since the alignment runs on high embankment, issues of access of local communities and storm water drainage are anticipated during the operation phase of the project. These impacts are minimized by providing adequate ROBs, RUBs, CD Works etc.

7.3.2 Impact on Soil

1) Planning Phase

- The high embankment in water bodies are avoided during the planning stage to minimize the soil erosion.

2) Construction Phase

- Clearing of land, cutting of trees, excavation of borrow areas are likely to trigger soil erosion. Movement of vehicle / machinery / equipments and working force is also likely to cause soil erosion.
- The detour section is likely to traverse through agricultural and forested areas which will require clearing of the land.
- Soil in the agricultural regions is fertile and consists of alluvial deposits. Thus, loss of fertile soil is likely to occur.
- Borrow areas will be required for the project. Most portion of the DFC is embankment. The borrow areas are likely to cause soil erosion and affect agricultural areas. Appropriate measures for borrow area management are suggested in Chaoter-7.
- Pits can be formed due borrowing, which may cause harm to local residents in the vicinity.
- Debris generated due to dismantling of structures

- Oil spills from the operation of the diesel pumps and diesel storage, during transportation and transfer, parking places and diesel generator sets.

- Operation of the emulsion sprayer and laying of hot mix in service road

- Operation of the residential facilities for the labour and officers

- Storage and stock yards of bitumen and emulsion

3) Operation Phase

- Due to change in land use, impact is envisaged on soil during operation phase. However, the impacts are within the RoW.

7.3.3 Impact on Air Quality

1) Planning Phase

- Currently the cargo is transported by railway and road. It is estimated one litre of fuel can move 24 ton-km of freight by road, 85 ton-km by rail. Therefore, once the DFC is active in the area the consumption of fuel is likely to decrease which may subsequently decrease emission in the area. Moreover, proposed movement of freight trains would be by electricity, therefore, emissions are negligible. By planning the freight corridor, the overall ambient air quality will improve.

2) Construction Phase

- During the construction phase, the air quality is likely to be affected due to generation of dust from construction activities and gaseous emissions from construction vehicles. However, the impact will be localized, short-termed and reversible.

3) Operation Phase

It is basically an eco-friendly project. By decreasing dependency on roads it will help to the cause of Green House effect.

- The movement of trucks during loading / unloading may have some impact near freight stations, however, these impacts are localized and concentrated in a specified area only.

- Plantation along the DFC is likely to improve the air quality of the area.

7.3.4 Impact on Ground Water

1) Planning Phase
- No impact is envisaged on ground water in planning phase as water requirement is very nominal.

2) Construction Phase
- During construction phase pollution of groundwater is likely to occur due to seepage and runoff from construction site. However, the impact will be negligible. The total water requirement during construction period will be 3600 cubic meter per kilometre spread over the construction period of about 3 years. The daily requirement per kilometre length during the construction period will be 5000 litre

and will be met through the local water supply. There will be no appreciable impact on ground water. The labour camp, which may be established during construction period, should have proper sanitation facilities and discharge of wastewater through soak pit. Hence, no impact is predicted on ground water quality.

- The impact on water resources due to the proposed project is tabulated in Table 7.2.

Table 7.2: Impact on Water Resources due to the Proposed Project

Impacts due to construction	Indicators	Remarks
Loss of water bodies	Area of water bodies affected	Not affected in parallel section
Loss of other water supply sources	Number of well affected	Some tube-well and hand pumps may be shifted / compensated
Alteration of drainage, run-off, flooding	No. of cross drainage channels	May have impact on detour section, sufficient cross drainage structures are proposed
Depletion of ground water recharge	Decrease in water table depth	Not appreciable impact as water requirement is not very high
Use of water supply for construction	Quantum of water used	Not significant
Contamination from fuel and lubricants	Nature and quantum of contaminations	Not significant
Contamination from improper sanitation and waste disposal in construction camp	Area of camp/disposal site and proximity to water bodies/channels	Proper sanitation facilities at construction camp will minimize it

3) Operation Phase

- No impact is envisaged on water quality during the post construction phase as no wastewater will be generated during operation. However, the facilities near the stations may release sewage water which shall be disposed in a properly designed treatment facilities.

7.3.5 Hydrological Condition (Rivers / Canal and Lakes)

1) Planning Phase

- No impact is envisaged on hydrological cycle during planning phase.

- There is no perennial river crossing the present alignment.

- The small tributaries which cross the alignment are the Sengar, Sirsa, Arind, Ahenya, Puraha and Pandu. Besides these, a number of canal also cross the proposed alignment.

2) Construction Phase

- Drainage and flooding problem during construction due to stockpiling of materials, debris and construction of temporary approach road and yards would have impact of temporary nature.
- Local drainage may be affected during construction phase due to formation of embankments. The slope of project alignment is towards east. During the construction phase the embankment should be designed in such a way that the natural drainage pattern is not disturbed in order to avoid any water logging in the low lying area.
- Drainage pattern of the area may be studied in detail and suitable management plan may be prepared in the detailed design stage.

3) Operation Phase

- Local drainage is likely to be affected due to the formation of Railway Embankment. However, sufficient number of cross drainage structure will minimize the impact.

7.3.6 Flora

1) Planning Phase

- Tree plantation of local species is proposed during planning stage at appropriate places along the alignment.

2) Construction Phase

- The construction activity involving clearing of site, felling of trees, settlement of construction camps and office is likely to affect the flora of the area.
- The proposed alignment may cause felling of approx. 1966 trees. The major species present along the alignment are babool, neem, shisam, papal, mango, bargad, kanji, labhera, ashok, sirsa, guler, jamun, ber, eucalyptus, mahua and bel.
- Acquisition of the forest land and construction activity likely to disturb the habitat. However, the forest land having mainly babool plantation, there will be no specific impact in terms of habitat loss etc.
- The species likely to be affected do not fall under the rare, threatened and/or endangered category, and are common in distribution.

3) Operation Phase

- No impact envisaged on flora during post construction phase. However, development of the green belt is suggested near stations and maintenance of plantation may be undertaken by Railway Dept. Plantation carried out along the alignment and as compensatory aforestation is likely to enhance the ecological condition of the area.

7.3.7 Fauna

1) Planning Phase

- No impact envisaged on fauna in planning phase as there is no wildlife sanctuary / national park is falling in the proposed alignment.

2) Construction Phase

- Nilgai-Boselaphus tragocamelus is the most common wildlife found in the study area. Construction activity is likely to affect the movement of the animal. However, to compensate, sufficient number of underpasses are provided at the detour section.
- Felling of trees have some but insignificant impact on the avifauna.
- Any construction near water bodies may impact the aquatic life. However no major water bodies are significantly affected due to this project.
- The impact on habitat is likely to be permanent, as the DFC will fragment the area which will restrict the movement of animals on either side.

3) Post Construction Phase

- The movement of freight train is likely to restrict the movement of animal on either side of the track, specifically in the detour section.
- Possibilities of collision of domestic animals with freight train.
- Disturbance of domestic animals due to the noise produced during the passage of trains.

7.3.8 Other Sensitive Structures

A number of sensitive structures will be impacted as described in Table 3.1 and 3.2. Sensitive receptors include school, hospitals and religious structures. Some of the sensitive receptors need to be completely shifted (Table 3.1) and some are impacted due to noise and vibration at the time of railway operation (Table 3.2). Appropriate mitigation measures shall be undertaken as suggested in this Chapter.

7.3.9 Impact due to Construction of Freight Station, Electric-sub Stations, various Signaling Facilities etc.

No majorsignificant impact is expected because these facilities are planned on barren / agriculture land along the alignment, and limited land is required for their construction. However, safety features shall be provided along these structures as per the railway manual and safety norms.

7.3.10 Social Impact of the project

It is estimated that a total of 8601 families would be affected as a result of project. Out of these land of 8126 families and 212 structures of 475 families will be affected. The project stretch involved acquisition of about 1182 ha of land, out of which approx 999 ha (85%) is private land and 183 ha (15%) is Government Land. The project affects 475 PAFs private built-up properties. Total PAPs affected is estimated to be 46646 (25976 Male, 20670 Female).

7.4 ENVIRONMENTAL MATRIX

Based of the potential impacts on natural resources in planning construction and operation phase an impact matrix has been created. The scale of impact is discussed above under individual parameter with mitigation measures. The Environmental Impact Matrix for pre-construction and construction stages are provided in **Table 7.3** and **7.4**.

Most of the impacts are localized, insignificant and temporary in nature, except those related to noise and vibration during the operation phase.

Table 7.3: Impact Matrix (Pre-Construction & Construction Stage)

No.	Items	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage											
										Construction Works for railway line and related structures							
			Surveying of Planned Areas and Sites	Selection of the Project Location and Sites	Land Acquisition and Resettlement	Extraction of Building Materials (stones, aggregates, sand, soil, etc.) at Quarries and Borrow Areas	Earth Moving: Cutting and Filling of the Construction Works	Preparation of Construction Plants, and Warehouses, Work Camps, etc.	Operation of Construction Plants, Machines and Vehicles for Construction Works	(A) Construction Works for Railway Lines and Installation of Related Facilities (signals, rails, etc.)	(B) Construction Works for ICDs and Freight Logistic Parks	(C) Construction Works for Stations (Terminal, Junction and Crossing)	(D) Construction Works for ROBs and RUBs	(E) Construction Works for Bridges	(F) Construction Works for Tunnels	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works
1	Topography and Geology		D	D	D	C	C	C	C	C	C	D	D	C	E	E	C
2	Soil		D	D	E	B	B	C	C	C	C	B	D	D	E	E	E
3	Groundwater		D	D	C	D	D	D	D	D	D	D	D	D	E	E	E
4	Hydrological Condition		E	E	E	D	E	D	D	D	D	D	D	C	E	C	C
5	Fauna, Flora and Biodiversity		D	C	C	C	C	D	C	C	D	D	D	D	E	D	D
6	Protected Areas / sanctuaries		D	D	D	D	D	D	D	D	D	D	D	D	E	D	D
7	Landscape		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
8	Local Meteorological Conditions		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
9	Global Warming		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D

Table 7.4 Environmental Impact Matrix (Post Construction Phase)

No.	Project Activities / Items of the Environment Subject to Positive / Negative Changes	Traffic conditions of passenger trains	Logistic conditions of goods, raw materials, agro & industrial products	Traffic condition of roads	Operation & maintenance of railway lines & related structures	Employment opportunities (whole country / local level)	Freight oriented business opportunities	Passenger oriented business opportunities	Promoting development of surrounding areas	Increase in settlers & vision to the project area
1	Topography and Geology		D	D	D	C	C	C	C	C
2	Soil		D	D	E	E	E	C	C	C
3	Groundwater		D	D	C	D	D	D	D	D
4	Hydrological Condition		C	C	C	D	C	D	D	C
5	Coastal and Marine Environment		E	E	E	E	E	E	E	E
6	Fauna, Flora and Biodiversity		D	C	C	C	C	D	C	C
7	Protected Areas / sanctuaries		D	D	D	D	D	D	D	D
8	Landscape		D	D	D	D	D	D	D	D
9	Local Meteorological Conditions		D	D	D	D	D	D	D	D
10	Global Warming		D	D	D	D	D	D	D	D

Table 7.5: Scaling of Impacts on Natural environment due to DFC project

S.No.	Natural Environment Contents	Scaling	Reasons (during construction phase)	Reasons (after-construction phase)
1	Topography and Geology	D	• During construction, marginal changes in geology are likely to take place because of excavation, construction of bridges etc. • No significant change in Topography is expected.	Negligible change is expected.
2	Soil Erosion	D	• During construction marginal effect on soil because of erosion is likely to take place due to the loss of upper crust of soil in the local area. • The impact will be marginal only since the project is linear in nature.	Negligible change is expected. .
3	Ground water	D	No significant impact is likely to occur	Only marginal impact is supposed to be felt.
4	Hydrological Condition	D	It will have only marginal impact as no river or big water body is affected.	Negligible impact.
5	Costal and Marine Environment	E	N/A	No impact.
6	Fauna, Flora and bio diversity	D	1) Loss of marginal herbal cover is eminent so it will have very little impact	Negligible impact is supposed to be felt.
7	Protected areas, Natural/ecological reserves and sanctuaries	D	Negligible Impact is likely to be felt as no such area is getting directly affected.	Negligible Impact
8	Landscape	D	No Impact is likely to be felt.	Negligible impact is likely to be felt.
9	Local meteorological condition	D	Neglogible impact is likely to occur	No significant impact is likely to occur
10.	Global Warming	E	No impact	Positive impact as shifting of freight transportation from road to rail will decrease the emission of greenhouse gaseous
11.	Air Pollution	D	Negligible impact	Positive impact due to shifting of freight transport from road to rail as rail transport requires six times less fuel as compared to road

7.5 IDENTIFICATION, PREDICTION & EVALUATION OF IMPACTS DUE TO VIBRATION

Vibrations are a complex phenomenon. Railway vibrations are generated by motion of heavy loads on tracks. Vibrations become more complex as speeds of motion change. Further complications are introduced by complex scenarios of multiple trains running in the same or opposite directions to each other. Vibrations require a medium for their transmission. Any variation in the medium present between the track and point of impact plays a significant role and complicates the assessment further.

Most studies in other developed countries have ignored the variation due to multiple factors. Types of trains, speeds have always been considered by them. However impact of variations in medium (ground) between the track and point of impact has mostly not been included in these studies. It did not bring great inaccuracy in their estimations and predictions since a wide strip on both sides of the track was of only one kind / medium. They did not have the variety of the magnitudes we see in India. The advantage of this simplicity was easy use of formulas and correlations in those studies.

We have included factor of variations in this medium in our studies and therefore been able to follow an assessment of impact that is more close to the ground scenario along the corridor.

In our study we have depended heavily on live data from real vibrations caused by trains. From this data we have picked up the highest vibration generating trains / speeds / loads / grounds and situations. These are all live values and are not estimations. Having picked up these values, graphical extrapolation is used to estimate the vibration levels for train speeds of 100 Km / Hr. Thereafter standard mathematical calculations have been applied to estimate the vibration levels due to multiple trains running together.

In chapter 4.5 we had provided a detailed justification for using Japanese As standards JIS Z8735 and JIS 1510. We have further explored the Laws relating to factory act, labor laws and laws for occupational health for co-relating norms. We have however not found any standards or limits relating to building vibrations or human annoyance due to vibrations. Most these laws cover are the whole body or hand arm vibrations caused by tools and equipment used by the workers. So we have remained aligned to Japanese standards quoted above and have used Db as units of measurements. This unit also helps in calculating combined effect of two adjacent vibration levels by way of simple formula. The formula used is

$$\mathbf{Lmax_{eq} = Lmax_{\ track\ 1} - Lmax_{track2} + Lmax_{\ track\ 3}}$$

As No of variables existing in this study are over a dozen we have not used co-relational equations to estimate as we expected it to introduce mathematical errors in the calculations. Instead we depended on Real time values and graphical assessment and extrapolation.

Methodology Study was carried out as per following steps:

1 Identification of Impacts of Freight trains. having different kinds of wagons.

2 Identification of category of train (wagons) causing highest vibrations.

3.Identification of impact of train speeds on vibrations

4.Identification of impact of train axel loads on vibrations

5 Identifying Highest vibration level from above data

6. Extrapolating this highest level of vibration for train speed of 100 Km / Hr

7. Calculation of change in this value of vibration of single train due to presence of multiple trains running together

8. Purifying this highest value for any effects of medium variation between the track and measurement point

9. Predicting the Maximum vibrations for plain route and for populated areas

10. Transposing vibration levels so estimated on to Sensitive Receptors identified and predicting the impact..

Identification of Impacts:

We have identified several kind of impacts from the data collated in previous chapters Typical these impacts could be of following types

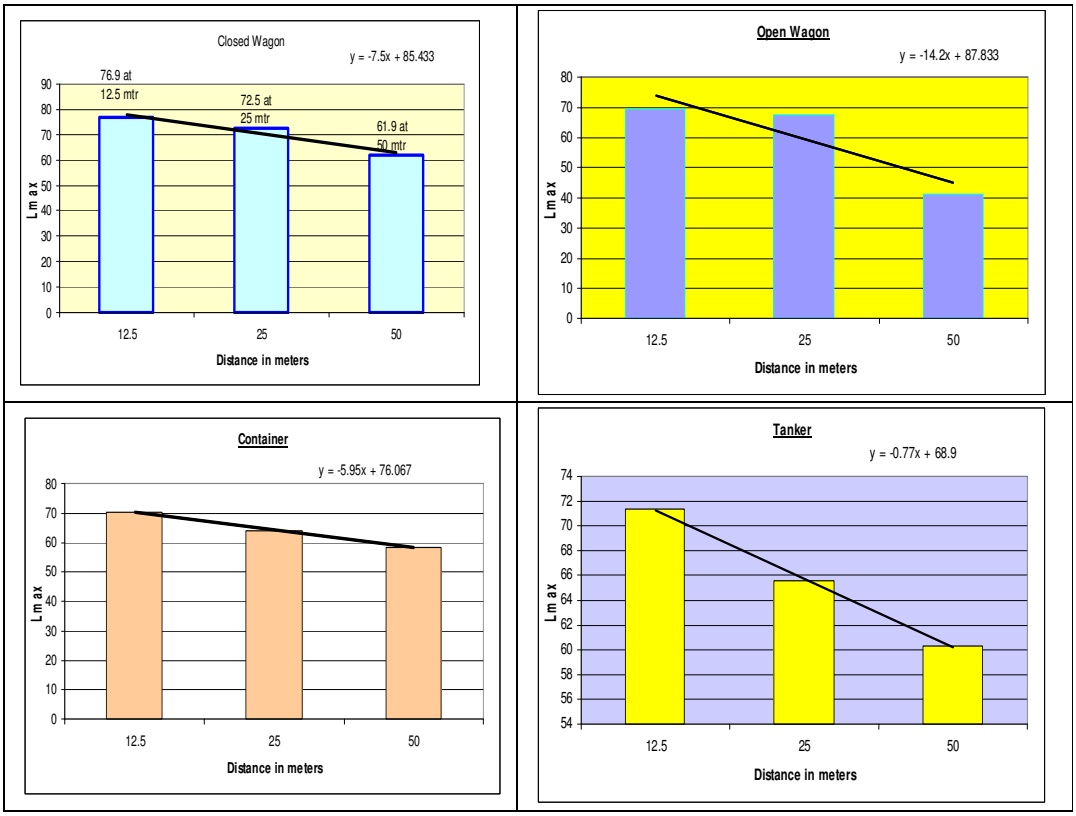
1. **Impacts in Plane areas ie** travel of Vibration; reverberations at 90 degree to the track will affect all the buildings, archeological Monuments, inmates of the building. These variations in vibrations could be due to following factors;
   - Distances from the track
   - Speed and
   - Axel loads
   - Train Crossings

2. **Impacts due to train crossings ie** trains while crossing each other or while running parallel to each other in 2 or more numbers cause overall vibrations to increase or reduce. This aspect is to be taken into consideration for estimating maximum impacts in each of the above two situations

3. **Impacts in Populated Areas ie** travel of Vibrations, reverberations through the variety of ground conditions existing between the track and point of measurement / impact assessment. Varieties existing included mix of plain, embankment, hard standing platform of building floors, and roads. .

7.5.1 Impacts in Plain areas vis a vis distances from the track

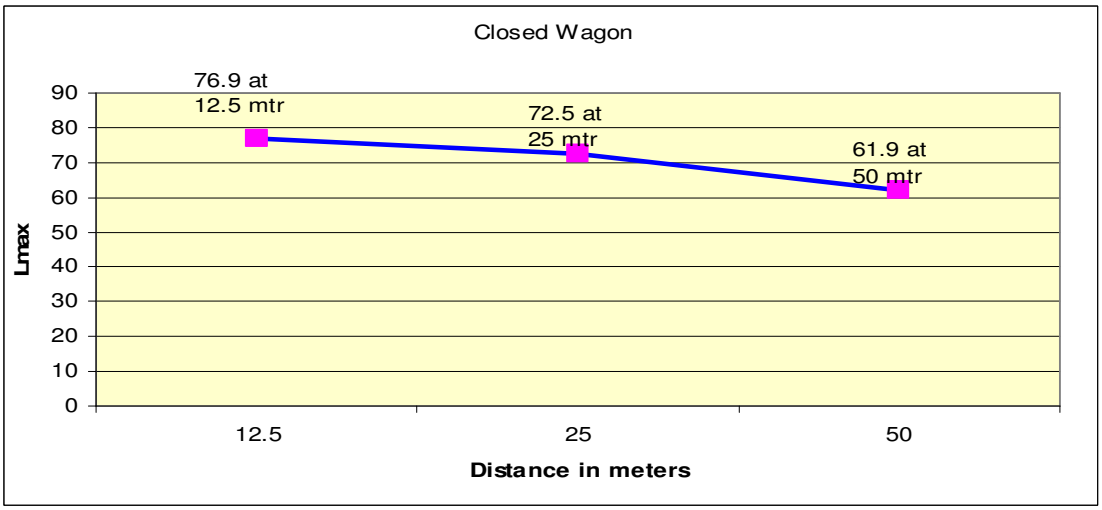
We have compared the existing distance based vibration levels being generated by the trains running on the existing tracks. For the four categories of freight trains considered by us, the levels of vibrations generated in plane areas are provided in the figures below.



From the graphs above, we can select the highest vibration levels of all the categories of train for one distance (say 12.5 or 25 or 50 meters) as the upper limit for that distance, for estimating the impact at 90 degree to the track. This is tabulated below.

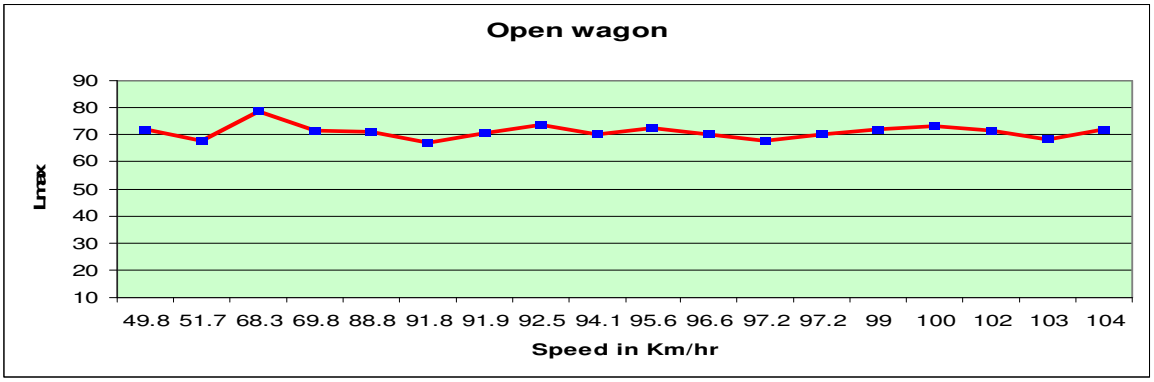
Distance	Maximum dB
12.5	76.9
25	72.5
50	61.9

These values for all the three distances coincidentally correspond to only one categories of freight train that is **Closed Wagon**; Graph for this is produced below:

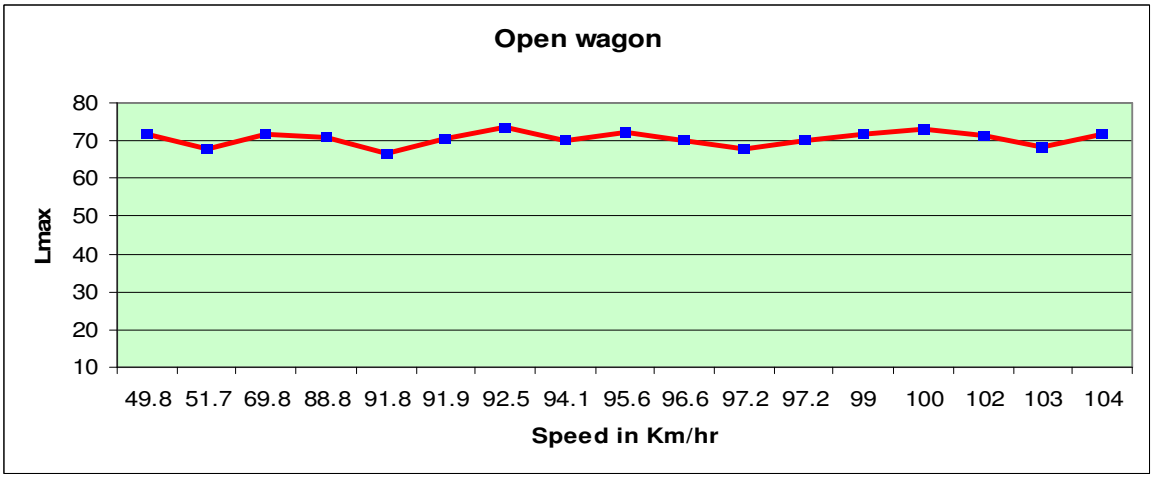


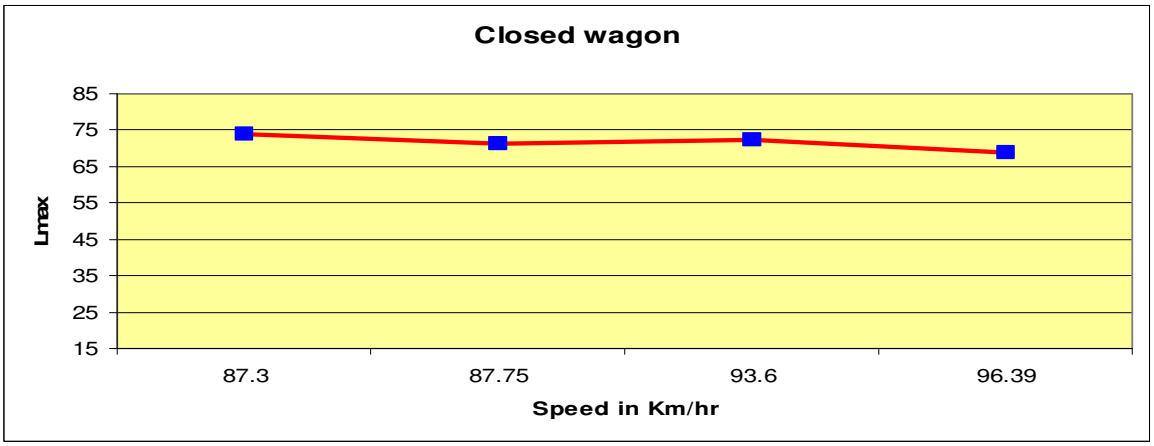
7.5.2 **Impacts with speed and axel load** were also similarly evaluated. These were identified for

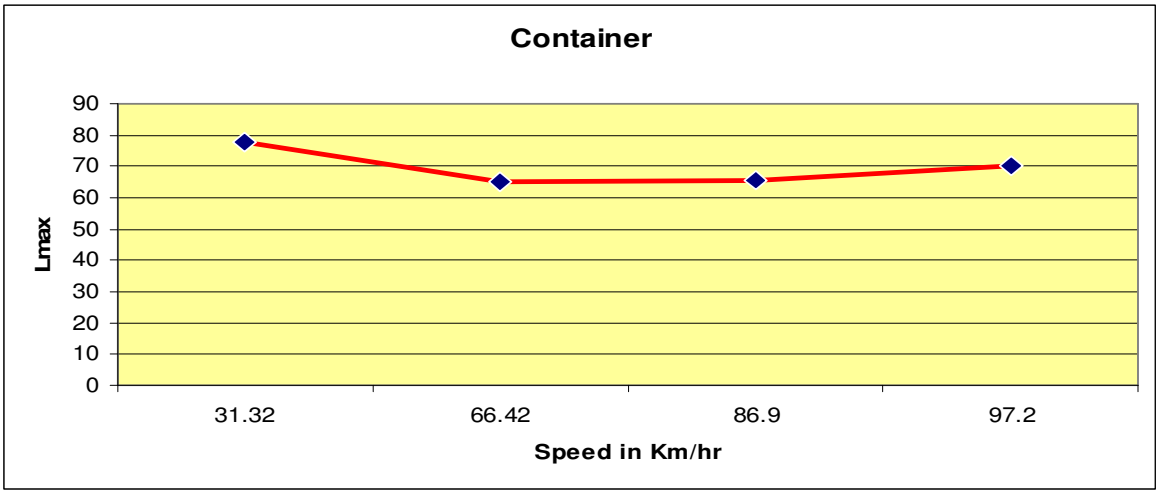
- maximum speeds of trains in each category as well as for
- maximum vibration in these categories and are as placed below:

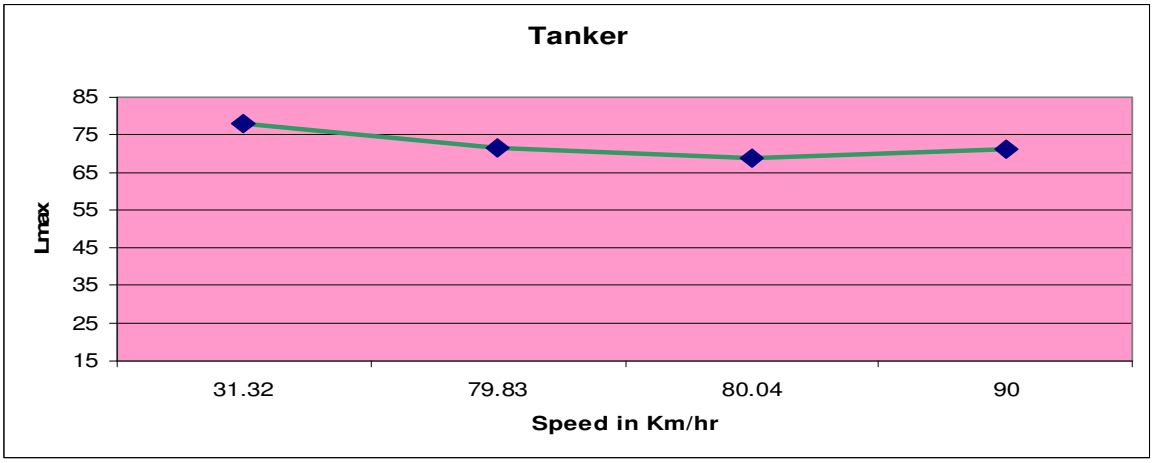


The single occurrence of high vibrations of above 78 dB level looks to be an isolated occurrence in the graph so this isolation is to be eliminated to purify the data. Purifying the above graph the new graph is as below: The highest vibration in this case has come down substantially







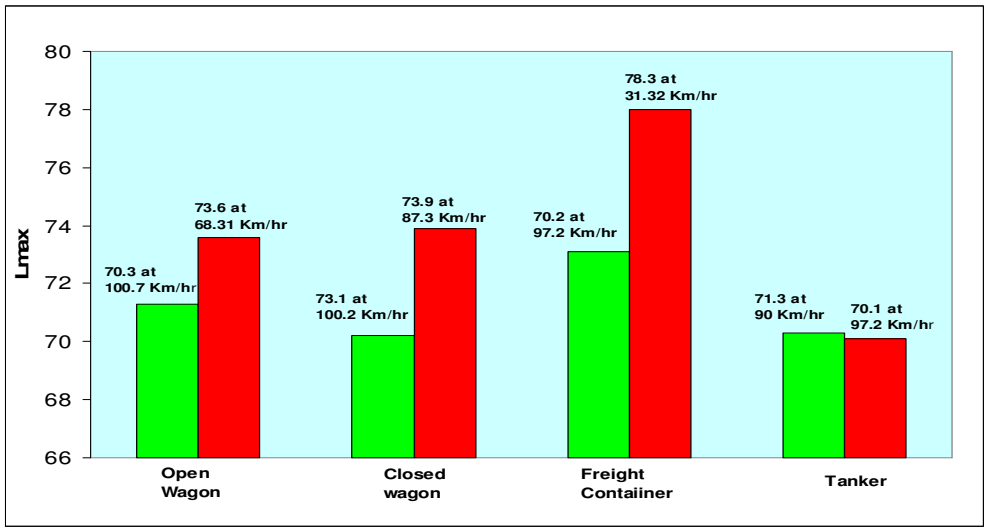


Patterns Identified Here we have plotted two kinds of patterns

1. Relating to Vibration levels corresponding to the maximum speed of the train considered in each category and

2. The maximum vibration levels in each category irrespective of speed

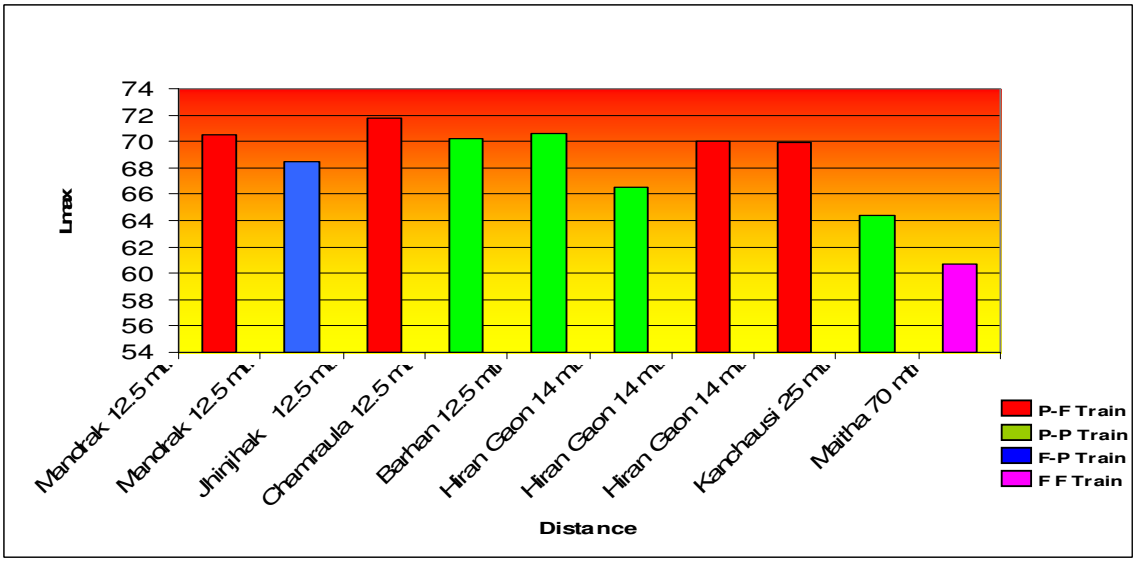
Both these patterns are depicted in the figure below:



It is apparent that the maximum vibrations are not occurring on maximum speeds but at other speeds. Highest vibrations were found to occur for closed wagons and Containers. The total variations across train categories however are of the order of 8-10 dBs

7.5.3 Impacts of Two Train Crossings

The data available includes several occasions of crossings of trains. These are in the form of Passenger – Passenger crossing (P-P), Passenger – Freight crossing (P-F), Freight – Passenger Crossing (F-P) and Freight – Freight crossing (F-F). These crossings are representation of similar crossing likely to take place on DFC on parallel tracks. F-F crossing is representation of similar crossing on detours. A graphical representation of vibration levels of various kinds of crossings observed by us on existing tracks is provided below as Lmax v/s distance graph:



From this representation it is observed that the maximum vibration for two train crossing occurred at 12.5 was 71.8 dB.

7.5.4 **Impacts in populated areas** on residential / commercial / Industry/ Social structure. It is quite possible to generate similar charts for residential/ industrial /

commercial complexes including sensitive receptors. However it will not be completely appropriate to use these graphs for assessing impacts on other buildings etc along the track. The variation will be due to dis-similarities of the grounds between the railway track and point of measurement for different structures considered for estimation of impacts. Additionally impact of vibration caused by road traffic and other movements in corresponding locations may further complicate the estimation. Therefore the data collected for such location has also been assigned as reference vibration levels for typical structures interfacing the track and the measurement point, The reference data is appended below:

S. No	Name of Location	Distance	Lmax	Interfacing Structure
1	Jaswant Nagar (Beginning of Detour)	5 mtrs	90.1	Plain (No Emb)
2	Maitha (Primary Health Centre)	70 mtrs	78	Plain (No Emb)
3	Kandhesi Pachar (Primary Health Centre)	35 mtrs	67.7	Plain + Emb
4	Samho (Near Inter College)	45 mtrs	79.9	Plain + Emb
5	Kanchausi (Hanuman Mandir)	25 mtrs	78.1	Emb + Road
6	Phaphund (Mandir near railway crossing)	44 mtrs	65.4	Road
7	Hiran Gaon (Shiv Mandir)	15 mtrs	89.8	Plain + Road + Emb
8	Jalesar (Primary School)	30 mtrs	60.3	Platform + Road + Plain
9	Marera (Kumahar Ka Ghar)	12.5 mtrs	75.8	**Road + Plain**

These reference vibration levels for different interfacing ground studies can be transposed to impacted structures under assessment at any location with similar interfacing structure.

7.5.5 Prediction of Impacts

The Vibration measurements carried out fall into two groups broadly: For the portion of corridor that will run parallel to the existing track and portion of the corridor that will go through the detours. Parallel track, running of the trains will engage maximum of four parallel tracks, of these two would be occupied by the freight trains and two by Passenger trains. The corridor will be completely together and will be parallel to the existing track. Average distance between the centre of passenger and freight trains is expected to be 23 meters

The levels of vibration on 2 tracks have been examined in previous section. Since the 3rd track scenario was not available for actual evaluation in locations where trains were running at reasonable speeds, we have mathematically calculated the same. Vibrations on parallel tracks for trains running together on these tracks have also been evaluated below.

Of all possibilities, maximum vibrations will be generated by the various combinations of trains running on 3 closest tracks as these trains have maximum influence of individual vibrations on each other. From the graphs of two trains crossing each other as placed in previous section, we notice the highest Vibration Level for two train crossed is 78.1 dB for Passenger – Freight combination. This is however very much below the levels caused by single freight train running on the nearer track. The reason for this phenomenon to occur is the fact that both the trains are running opposite to each other and are therefore canceling effect of vibration waves generated by them individually.

7.5.6 Calculations

Check for vibrations for 100 Km/Hr train speed:
By examining the trend of change in Vibration Levels with the increase in speed in the graphs in previous sections we notice that in most cases the vibration levels reduce with increase in speed except for the Freight Containers. We have extrapolated this trend of vibration of freight container & estimated the **vibration level at 100 km/hr to be 74 dB**. This however is lower than the maximum vibration level for single freight train being considered by us and therefore not relevant

Check for multiple train running:
From the measurements and graphs as discussed earlier the maximum level of Vibrations occurring for any Freight container Train on any track and at 12.5 mts from the center of the concerned track (Container) = **78.3 dB**

The Mathematically Attenuated value calculated for vibration at 35 meters in reference to the train running on the 3rd track = **75.8 dB** (Refer variation of vibrations with distance for containers)

Combined effect of these two Vibration Levels at the same measurement location that is 12.5 meters from the nearer track can be calculated as follows.
$\mathbf{Lmax_{eq} = Lmax_{track\ 1} - Lmax_{track2} + Lmax_{track\ 3}}$

In the light of this discussion for predictions, **78.3 dB** as highest vibrations for freight trains have been used in our calculations below.

Predicted Vibration Levels for multiple trains running together– These estimations workout as below.

<u>On DFC side of parallel Track</u>

1. On the freight corridor side, two freight trains running in opposite directions with a gap of 5 meters from each other.

   - Highest value of Vibration level by one freight train = **78.3dB**
   - This level attenuated to 17.5 mts for second freight train = **74.5 dB**.

   For these trains running in opposite directions, resultant level is difference of the 2 vibration levels.

   $\mathbf{Lp_{F\text{-}F} = 10*LOG\ (10\text{^}(78.3/10)-10\text{^}(74.5/10))}$ = **75.9 dB**.
2. One freight train running closer to the 12.5 mts measurement point in the same direction from a passenger train 10 mts away

   - Highest value of Vibration level by one freight train = **78.3**
   - Highest value of Vibration level of passenger train attenuated to 35mtrs = **75.9**

   Since both the trains are running in same direction the relevant level will be addition of the two levels

   $\mathbf{Lp_F + Lp_{Psngr} = 10*LOG\ (10\text{^}\ (78.3/10) +10\text{^}\ (75.9/10)) = 80.2}$

3. A Freight train running on the 2nd track farther from the 12.5 meter measurement point and a passenger train running opposite to its direction in the third track.

- Highest value of Vibration Level of Passenger train attenuated to 35 meters = **75.9**
- Highest Value of Vibration level by one Freight train attenuated to 20 meters = **74.5**

Since the trains are running in opposite directions. Therefore, resultant value is difference of the 2 vibration levels.

Lp_{F-P} = 10*LOG (10^ (75.9/10)-10^ (74.5/10)) = 70.3 dB

4. The next scenario is for vibrations on parallel tracks for three trains running together on the first three Tracks.
   - Highest Value for the Vibration Level by Freight – Passenger in First and Second Track running in opposite direction: **75.9**
   - Highest Value of Vibration level by one Freight train running in 2nd track attenuated to 20 meters = **74.5**

Since this is a scenario of parallel running of the trains in composite manner

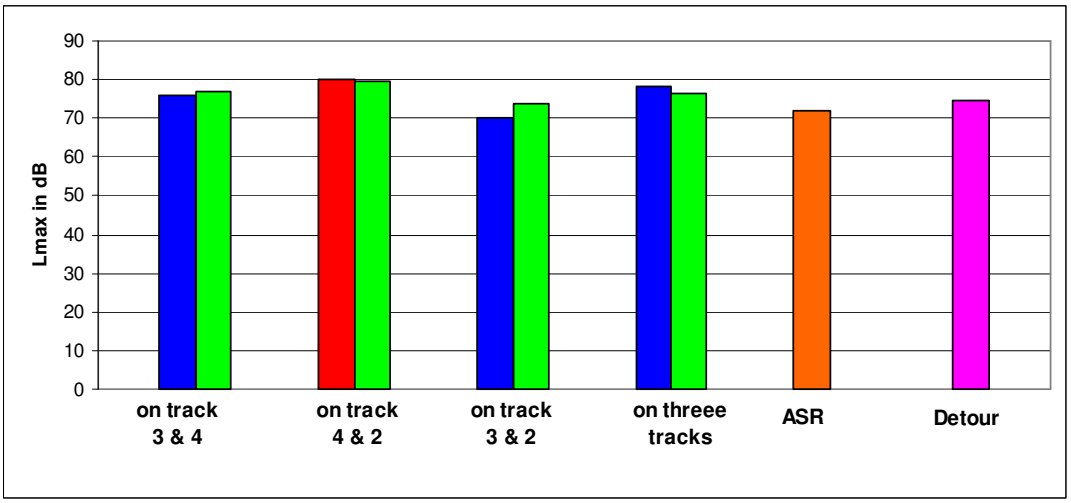
Lp_{F-F-P} = 10*LOG(10^(76.02/10)+10^(75.94/10)) = 78.2 dB

<u>On Passenger Track Side</u>

5. On the other side of all four tracks the situation will be driven by passenger train in similar four possibilities. The evaluated highest Lmax for these four possibilities are:
   a. 2 Passenger trains running on track 4 and 3 opposite to each other= **77.1 dB**
   b. 1 Passenger in track 4 and one freight on track 2 both in same direction=**79.8 dB**
   c. 1 Passenger on track 3 and one freight on track 2 both in opposite direction-**73.9 dB**
   d. 2 Passengers on track 4 and 3 and one freight on track 2 = **76.3 dB**

6. The other less effective combinations would be different mixes of trains running on, third and fourth tracks.

From all the above calculations we consider the worst case scenario for plain routes and select the maximum vibration levels as upper limit expected to be encountered , The maximum possible vibrations as calculated above = **80.2 dB. I**t occurs when 2 freight and one passenger trains run together on first 3 track of DFC track side.

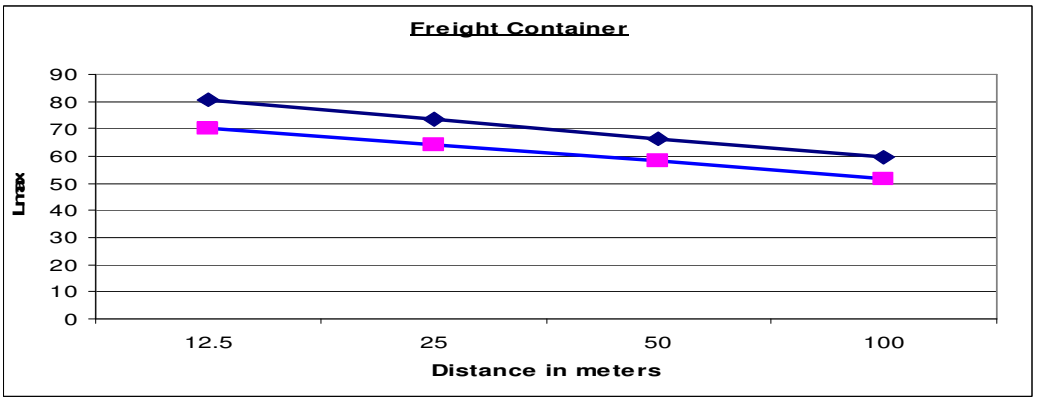


Predicted highest Vibration Levels for the Detour track – These estimations workout as below

For the detour locations the scenario will always be two Freight trains crossing each other in opposite directions for which we have calculated highest Vibration level as **74.5 dB** at 12.5 meters measurement point, when the interfacing ground is plain ground.

However this value is lower than the highest Vibration Levels generated by running of Single Freight train.

Therefore predicted highest vibration levels for the detour portions = **74.5dB** at 12.5 meters from nearer track for freight containers. These being below the vibrations estimated for parallel track, remain irrelevant. Please refer the graph below

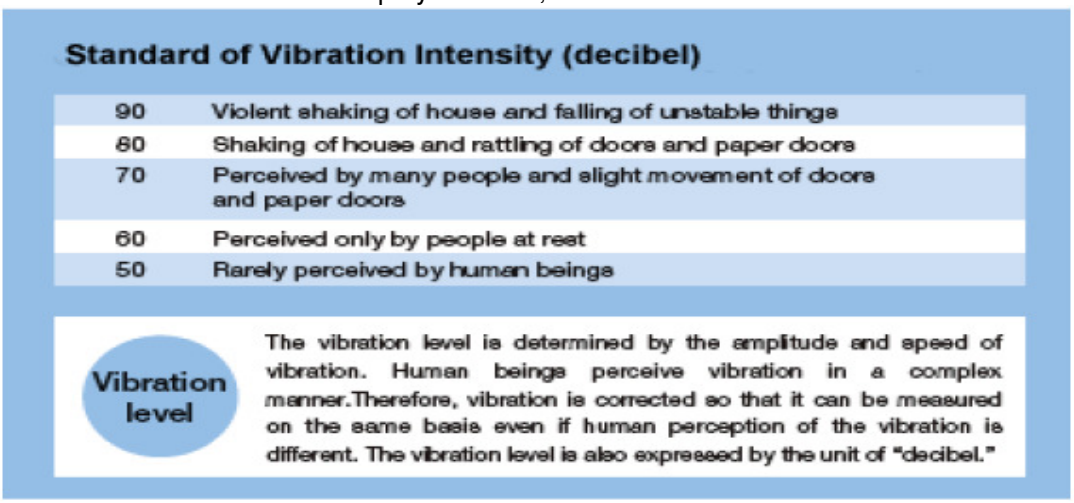


7.5.7 Evaluation of Impact

Based on the predicted values, evaluation of the impacts has been carried out in following steps:

1. We have examined the Japanese standards for Permissible Vibration values in Habituated and Plane areas. The pictorial information in this regard which also

includes the level of complaints received by procure department of railway vibration in 2006 is displayed below;



From the extract above it is apparent that standards 70 dB vibration level defines the acceptability criteria in general, however in densely habituated areas the lower level will have to be allowed based on these criteria the permissible limits for vibrations are provided below.

As worked out in the prediction process above, various highest vibration levels likely to occur in different portions of the DFC are as below:

Plain route: 80.2 as against permissible levels of 70dB

Populated areas 80.2 as against permissible levels of 65dB

Therefore vibration levels have to reduced by

10.2 dBs - for Plain areas
15.2 dBs - Populated areas
10.2 to 15.2 dBs - plain / SR area

7.5.8 Prediction of Impacts on Sensitive Receptors

Prediction of Impacts on Sensitive Receptors based on the methodology described above has been carried out. The SRs have been identified during survey of the track alignment. From these listed receptors, those falling within the track alignment have been eliminated as they would require removal replacement or shifting. The balance receptors have been listed and predicted levels have been estimated. These details are given in **Table 7.6**.

Table 7.6: List of sensitive Receptors and Predicted Vibration Levels on them

S.N.	Type of Receptors	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Predicted max Vibration before mitigation
1.	Religious	Old Shiva Temple	Maitha /1049	Parallel	25	L	86
2	Hospital	Maitha Hospital	Maitha/1049	Parallel	30	L	84
3	Hospital	Hospital under construction	Maitha/1049	Parallel	45	L	78
4	Religious	Small Temple	Roshanmau/1056	Parallel	60	L	68
5	Hospital	Veterinary Hospital	Rura/1062	Parallel	80	R	55
6	Educational	Primary School	Rura/1062	Parallel	90	R	52
7	Educational	Junior High school	Rura/1062	Parallel	58	R	59
8	Religious	Temple	Jhinhak/1081	Parallel	95	R	42
9	Educational	School	Sahapura/1084	Parallel	100	L	50
10	Religious	Big Hanuman temple	Kanchosi/1091	Parallel	10	L	n/a
11	Religious	Temple	Phaphund/1101	Parallel	100	R	53
12	Educational	Girls Inter College	Achalda	Detour	15	L	88
13	Educational	Primary School	Achlda	Detour	30	L	78
14	Educational	Primary School	Samhon/1128	Parallel	20	L	83
15	Educational	Ramnerash Inter College	Samhon/1128	Parallel	30	L	82
16	Educational	Jwahar Navoday School	Samhon/1129	Parallel	150	L	42
17	Religious	Small Temple	Samhon/1128	Parallel	30	L	82
18	Educational	Primary School	Ekdil/1147	Parallel	100	R	50
19	Religious	Small Temple	Ekdil/1147	Parallel	110	R	49
20	Religious	Small Temple	Ekdil/1147	Parallel	120	R	48
21	Educational	Primary School	Ekdil/1147	Parallel	40	L	78
22	Religious	Devi Temple	Ekdil/1147	Parallel	40	L	78
23	Religious	Hanuman Temple	Ekdil/1147	Parallel	20	L	83
24.	Hospital	Institutional Hospital	Jaswantnagar / 1173	Parallel	80	R	54
25.	Religious	Small temple	Balrai/1181	Parallel	40	L	78
26.	Religious	Temple	Kawrai Khurd / 1199	Parallel	50	R	56
27	Educational	College	Mamota	Parallel	10	L	n/a

S.N.	Type of Receptors	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Predicted max Vibration before mitigation
			kalan/1310				
28	Educational	Primary school	Nr. Paliar village/Aligarh	Detour	50	L	56
29.	Religious	Masjid	Nr. Ghasipur village/Aligarh	Detour	10	L	n/a
30	Educational	Primary school	Chiroolia village (Aligarh)	Detour	60	R	55
31.	Educational	Primary school	Nr. Saharpur village (Aligarh)	Detour	90	L	52
32.	Educational	Primary school	Nr. Choorpur (Aligarh)	Detour	20	L	86
33.	Religious	Temple	Raju Nagla village/1344	Parallel	30	L	82
34.	Religious	Temple	Nr. Somane village/1348	Parallel	50	L	64
35	Educational	Primary school	Nr. Dabour village/1359	Parallel	60	L	68
36	Religious	Temple	Nagla kat/1360	Parallel	45	L	60
37	Educational	Primary school	Nr. Nagla kat/1360	Parallel	45	L	60

7.6 PREDICTION AND EVALUATION OF IMPACTS ON NOISE ALONGSIDE RAILWAY LINES

The detailed railway noise survey was conducted at 18 locations along the existing railway track as well as detour locations. The result shows that during train operation along the railway track the noise level always exceeds the statutory limit; however, at detour locations the noise levels are less and within the statutory limits except one location where noise levels are high due to proximity with National Highway. For the prediction purposes, the highest noise level i.e. 95 dB(A) recorded at 12.5m from the centre of the existing track used as a reference for maximum noise level prediction. The Leq noise level recorded at 12.5 m is around 75 dB(A) from the centre of the track is taken as reference for Leq noise level prediction.

Examination of Prediction Method

1) Railway Noise

Regarding railway noise generated by conventional trains (local trains, express trains and limited express trains), main causes include (1) traction movements, (2) structures and (3) machines equipped to the train. Among them, the traction movement contributes to the generation of noise greatly.

Several types of prediction equations were proposed for various types of railway track structures, such as the elevation, embankment and cutting.

Therefore, prediction was carried out applying the actual data of railway noise level, running speed (V) of trains, and the distance from center of the nearest railway track (D).

Based on the obtained the data of railway noise, the empirical equation was extracted by using a simple regression and correlation analysis. The following equation is used for noise prediction.

Assuming V is constant, D is only one variable, and the empirical equation is shown below. A predicted railway noise level is shown in the below table.

$$L_2 = L_1\text{-}20 \text{ Log } D_2/D_1 \qquad \text{---------- (1-1)}$$

$$L_{Aeq} = 10 \text{ Log } (10^{N1/10} + 10^{N2/10} + 10^{N3/10} + \text{.....})/T$$

Where,

L_1 and L_2 are the noise levels at D_1 and D_2 distance.

N_1, N_2, N_3 are the noise pressure levels at a different time interval. T is the number of reading.

Reference: JICA Study on DFCC Corridor

1) Condition of Prediction

Following conditions are assumed:

- Type of traction: electrified traction (electric locomotive)
- Running operation: 150 trains/direction/day with the same time interval (approximately one train for every five minutes)
- Maximum running velocity: 100 km/h
- Majority of the existing railway line structures is the embankment structures with approximately 2 to 5 m high from the ground level at the site.
- Railway noise and vibration generation level due to planned dedicated freight train; remains the same as the existing freight train,
- DFCC plan would have various factors contributing to reduction in railway noise.

2) Prediction and Evaluation Points

a) Sites along the existing railway lines within the parallel sections of the DFCC Project.

1. Sites along the planned detour routes where no railway noise was observed as a reference point of the background level monitoring.

Prediction and Evaluation Results

1) Prediction of Railway Noise Levels

Estimated noise levels (L_{Aeq}) were evaluated by comparing with (i) the ambient noise standard in India, (ii) existing ambient noise levels at SR and (iii) existing railway noise at SR.

The noises level predicted are presented in **Table 7.7**.

Table 7.7: Prediction of Noise Level on Sensitive Receptors

S.N.	Type of Receptors	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Predicted max noise, dB(A)	Predicted Leq Noise Level, dB(A)
1.	Religious	Old Shiva Temple	Maitha /1049	Parallel	25	L	88.98	68.98
2	Hospital	Maitha Hospital	Maitha/1049	Parallel	30	L	87.40	67.40
3	Hospital	Hospital under construction	Maitha/1049	Parallel	45	L	83.87	63.87
4	Religious	Small Temple	Roshanmau/1056	Parallel	60	L	81.37	61.37
5	Hospital	Veterinary Hospital	Rura/1062	Parallel	80	R	78.87	58.87
6	Educational	Primary School	Rura/1062	Parallel	90	R	77.85	57.85
7	Educational	Junior High school	Rura/1062	Parallel	58	R	81.67	61.67
8	Religious	Temple	Jhinhak/1081	Parallel	95	R	77.38	57.38
9	Educational	School	Sahapura/1084	Parallel	100	L	76.93	56.93
10	Religious	Big Hanuman temple	Kanchosi/1091	Parallel	10	L	Falling in alignment	
11	Religious	Temple	Phaphund/1101	Parallel	100	R	76.93	56.93
12	Educational	Girls Inter College	Achalda	Detour	15	L	Partially affected	
13	Educational	Primary School	Achlda	Detour	30	L	87.40	67.40
14	Educational	Primary School	Samhon/1128	Parallel	20	L	90.91	70.91
15	Educational	Ramnerash Inter College	Samhon/1128	Parallel	30	L	87.40	67.40
16	Educational	Jwahar Navoday School	Samhon/1129	Parallel	150	L	73.41	53.41
17	Religious	Small Temple	Samhon/1128	Parallel	30	L	87.40	67.40
18	Educational	Primary School	Ekdil/1147	Parallel	100	R	76.93	56.93
19	Religious	Small Temple	Ekdil/1147	Parallel	110	R	76.11	56.11
20	Religious	Small Temple	Ekdil/1147	Parallel	120	R	75.35	55.35
21	Educational	Primary School	Ekdil/1147	Parallel	40	L	84.90	64.90
22	Religious	Devi Temple	Ekdil/1147	Parallel	40	L	84.90	64.90
23	Religious	Hanuman Temple	Ekdil/1147	Parallel	20	L	90.91	70.91
24.	Hospital	Institutional Hospital	Jaswantnagar / 1173	Parallel	80	R	78.87	58.87
25.	Religious	Small temple	Balrai/1181	Parallel	40	L	84.90	64.90
26.	Religious	Temple	Kawrai Khurd / 1199	Parallel	50	R	82.96	62.96
27	Educational	College	Mamota kalan/1310	Parallel	10	L	Directly Affected	
28	Educational	Primary school	Nr. Paliar village/Aligarh	Detour	50	L	82.96	62.96
29	Religious	Masjid	Nr. Ghasipur	Detour	10	L	Directly Affected	

S.N.	Type of Receptors	Name	Location/ Chainage	Parallel / detour	Distance from the centerline of the DFCC alignment (Meter)	Side (w.r.t Kanpur to Khuja)	Predicted max noise, dB(A)	Predicted Leq Noise Level, dB(A)
			village/Aligarh					
30	Educational	Primary school	Chiroolia village (Aligarh)	Detour	60	R	81.37	61.37
31	Educational	Primary school	Nr. Saharpur village (Aligarh)	Detour	90	L	77.85	57.85
32	Educational	Primary school	Nr. Choorpur (Aligarh)	Detour	20	L	90.91	70.91
33.	Religious	Temple	Raju Nagla village/1344	Parallel	30	L	87.40	67.40
34.	Religious	Temple	Nr. Somane village/1348	Parallel	50	L	82.96	62.96
35.	Educational	Primary school	Nr. Dabour village/1359	Parallel	60	L	81.37	61.37
36.	Religious	Temple	Nagla kat/1360	Parallel	45	L	83.87	63.87
37	Educational	Primary school	Nr. Nagla kat/1360	Parallel	45	L	83.87	63.87

Analysis of Evaluated Results

The noise levels have been predicted at all the sensitive receptors located up to 150 m from the centre of the proposed track. The predicted noise level shows that noise level is considerably high at all the locations up to 100 m from the centre of the track. However, no barrier has been considered during the prediction, therefore, the actual noise level may be less due to attenuation of noise. The noise levels were also monitored at five sensitive receptors and combined impact due to the proposed DFCC project is given in **Table 7.8.**

Table-7.8: List of Sensitive Receptors

Sl. No.	Sensitive Receptors	Monitored Noise Level		Predicted Noise Level, dB(A)	Resultant Noise Level, dB(A)		CPCB Standards,		Remarks
		Leq, dB(A), Day	Leq, dB(A), Night		Day, dB(A)	Night, dB(A)	Day, dB(A)	Night, dB(A)	
1	Shiva Temple, Hiran Gaon, existing track but detour for DFCC	70.1	65.2	-	70.1	65.2	50	40	No impact as location is bypassed
2	Hanuman Temple, Kanchosi, parallel section	65.8	60.9	75.00	75.49	75.16	50	40	Exceeds the CPCB noise standards
3.	Maitha Hospital, Metha, parallel section	62.7	53.8	67.40	68.66	67.58	50	40	Exceeds the CPCB noise standards
4.	Inter College near Achalda detour	50.6	37.8	75.00	75.01	75.00	50	40	Exceeds the CPCB noise standards

As predicted in the table, the noise levels are going to exceed considerably near the proposed track at detour section. However, the impact may be less near Budhiya ka Taal (ASI protected monument) as noise levels are already very high at this location due to proximity with highway. The noise level is already high along the existing railway section as compare to the CPCB standards and further level will increase after introducing the DFCC track.

Railway lines are located in the urban area and city area, the existing noise levels are already higher, and it is recommended that DFCC alignment should avoid the urban and city areas not to increase the noise levels.

Although in the detour routes the impacts to residents would be small, the railway noise would be newly added to the residents' life, and the appreciate mitigation measures should be prepared for residences along the railway line.

In the detour section where the additional impact of the noise is more, it is suggested to adopt necessary mitigation measurement such as providing the green belt and / or soundproof wall in the Detailed Design stage.

CHAPTER-8

MEASURES FOR THE MITIGATION OF ENVIRONMENTAL IMPACTS

8.1 DESCRIPTION OF MITIGATION MEASURES

The measures to mitigate the negative environmental impacts due to the development of proposed DFC during various phases of the project are described hereunder.

8.1.1 Mitigation Measures of Land Environment

Land acquisition, soil erosion and contamination of soil have emerged as major sources of land impact especially in urban areas and nearby watercourses. Due to the proposed project aimed at enhancing the efficiency of rail transport system, which will result in economic growth in the region over time.

Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
1.	Change in topography	Marginal impact	Due to embankment raising	Balancing culverts will be provided
2.	Change in geology	Direct, long term, negative impact	Extraction of materials (borrow earth, coarse & fine aggregates)	• No blasting is envisaged • Quarry redevelopment plan need to be enforced
3.	Change in seismology	No negative impact	Natural process	Cross drainage structures are checked and complied with the seismological settings of the region
4.	Change in land environment	Direct negative impact	May be due to construction activities	Preventive measures against pollution of land/ soil to be taken
a.	Loss of land	Direct, long term negative impact	Land acquisition change in land use pattern	Land acquisition to be minimized with provision of retaining walls
b.	Generation of debris	Negative impact	May contaminate air, water and land, if not disposed properly	Disposed properly to avoid contamination
c.	Soil erosion	Moderate, direct, long term negative impact	• Slopes and spoils near the bridges • Construction of new bridges and culverts • quarry and borrow areas	• Embankment protection • For Emb, ht.>3 m stone pitching, • Emb ht. < 3m. turfing • Residual spoil need to be disposed properly • silt fencing need to be provided, • quarries need to be reclaimed
5.	Contamination of soil	Direct, long term negative impact	• Scarified bitumen wastes • Oil & diesel spills • Emulsion sprayer and lying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labor and officers • Routine and periodical maintenance	• Hazardous Waste (Management and Handling Rules, 1989) to be enforced. • Oil interceptor will be provided for accidental spill of oil and diesel • Rejected material will be layed in village roads or as directed by engineer • Septic tank will be constructed for waste disposal
6.	Soil quality monitoring		• Effectiveness / shortfall (if any) • Any unforeseen impact	Measures will be revised & improved to mitigate / enhance environment due to any unforeseen impacts

- Plantation programme will be carried out to improve the aesthetic look of the construction area. The plantation all along the railway line will be carried out to improve aesthetic along the existing as well as detour locations.

8.1.2 Mitigation Measure for Borrow Area Management

Borrow areas will be finalized either form the list of locations recommended by DPR consultants or new areas identified by contractor. The finalization of locations identified by DPR consultant or identified by contractor depends upon the formal agreement between landowners and contractor and its suitability from civil engineering as well as environmental consideration. Meeting the guidelines/notifications as stipulated from time to time by the Ministry of Environment and Forests, Government of India, and local bodies, as applicable shall be the sole responsibility of the contractor.

Besides this certain precautions have to be taken to restrict unauthorized borrowing by the contractor. No borrow area shall be opened without permission of the Engineer/EO. The engineer in addition to the established practices, rules and regulation will also consider following criteria before approving the Borrow areas.

To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. Redevelopment of the borrow areas to mitigate the impacts will be the responsibility of the contractor. The contractor shall evolve site-specific redevelopment plans for each borrow area location, which shall be implemented after the approval of the Enginner-in-Charge.

To ensure that the spills, which might result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day-time only. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. Borrowing of earth shall be carried out at locations recommended as follows:

Non-Cultivable Lands: Borrowing of earth will be carried out upto a depth of 2.0 m from the existing ground level.

Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical in 4 horizontal.

Productive Lands: Borrowing of earth shall be avoided on productive lands. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. The conservation of topsoil shall be carried out as described in section of this chapter. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

Elevated Lands: At locations where private owners desire their fields to be levelled, the borrowing shall be done to a depth of not more than 2 m or up to the level of surrounding fields.

Borrow pits along Roadside: Borrow pits shall be located 5m away from the toe of the embankment. Depth of the pit should be such that the bottom of the pit shall not fall within an imaginary line of slope 1 vertical to 4 horizontal projected from the edge of the final section of the bank. Borrow pits should not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains should be cut through the ridges to facilitate drainage.

Borrow pits on the riverside: The borrow pit should be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood.

Community / **Private Ponds**: Borrowing can be carried out at locations, where the private owners (or in some cases, the community) desire to develop lands (mostly low-lying areas) for pisciculture purposes and for use as fishponds.

Borrow Areas near Settlements: Borrow pit location shall be located at least 1.0 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

After identification of borrow areas based on guidelines. Contractor will fill reporting format as under and submit the same for approval to the "Engineer" Once approved the contractor will adhere to the recommendation for borrow area to the satisfaction of Engineer.

(1) In no case the depth of borrow area should exceed 2m from the existing ground level.
(2) Borrow pits slope should be maintained, no steeper than 1 Vertical: 2 Horizontal.
(3) Water pooling to be avoided/managed so that NO disease spread due to water stagnation.
(4) Precautionary measures as the covering of vehicles will be taken to avoid spillage during transportation of borrow area.
(5) The unpaved surfaces used for the haulage of borrow materials should be maintained properly for dust suppression.
(6) Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction facility is operating at the place of deposition, to minimize dust pollution.
(7) During rains appropriate measures to be taken to minimize soil erosion, silt fencing to be provided as directed by Engineer/EO.

The Contractor will keep record of photographs of various stages i.e., before using materials from the location (pre-project),for the period borrowing activities construction Phase) and after rehabilitation (post development), to ascertain the pre and post borrowing status of the area.

8.1.3 Mitigation Measures to Minimize Soil Erosion

1) Construction Phase

- Suitable protection measures consisting of bio-engineering techniques such as plantation of grass and shrubs, may be provided to control erosion. The measures shall be applied along the slopes at high embankment where bridges will be constructed.
- Borrow areas may be finalized in concern with ecological sensitivity of the area. Agriculture land may not be sued as borrow areas. Priority may be given to degraded area for excavation of borrows material. Rehabilitation of borrow area may be taken under the project.
- Construction work may be avoided during rainy season to evade erosion and spreading of loose material.

- Top soil removed from agricultural land may be stored separately in bunded areas and utilized during plantation or refilling of excavated area.
- Selection of borrow areas may be done considering the waste land available in the district. Agricultural areas may be not used as borrow areas.
- A separate borrow area management plan may be made providing location, ownership details, timing of borrowing and rehabilitation measures.

2) Post-Construction Phase

- No impact is envisaged on soil during post implementation phase.

8.1.4 Mitigation Measures to Improve the Ambient Air Quality

1) Pre Construction Phase

The dust generation due to pre-construction activities will be temporary in nature and localized and will be effectively countered by sprinkling of water.

2) Construction Phase

During the construction stage, there are two major sources: the first one is construction activities at working zones, which cause primarily dust emission and second are from operation of the construction plant, equipments and machinery, which causes gaseous pollutants. The specific measures include:

- Locating Plant at a significant distance from nearest human settlement in the predominant down wind direction.
- Vehicles delivering fine materials like soil and fine aggregates shall be covered to reduce spills on existing roads.
- Water will be sprayed on earthworks, temporary haulage and diversions on a regular basis.
- Batch type hot mix plants fitted with the bag filter / cyclone and scrubber will be installed for the reduction of the air pollution.
- Pollution control systems like water sprinkling and dust extractors and cover on conveyors will be installed for the crushers.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the emission levels conform to the SPCB/CPCB norms.
- Air pollution monitoring plan has been delineated for construction phase separately for checking the effectiveness of the mitigation measures adopted during the construction phase of the Contract
- Air quality monitoring shall be conducted during construction period as per CPCB norms. The location and frequency of air monitoring is covered in Chapter-9.
- Impact on air quality is likely to be temporary and reversible.

3) Operation Phase

- Air quality of the area is likely to be improved as reduction in emissions due to shifting of freight from road transportation to railway transportation.
- Plantation along the DFC is likely to improve the air quality of the area.

8.1.5 Mitigation Measures on Water Quality

Due to the proposed project there will be some direct and indirect long term impacts on the water resources. Table below presents the major adverse impacts on the water resources and the mitigation measures taken.

Sl. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1.	Loss of water bodies	Not significant as no major water bodies is fully affected	• Part or acquisition of source of water	• Land acquisition to be minimized with provision of retaining walls • Relocation of ground / surface water sources
2.	Alternation of cross drainage	Very low impact	• One major bridge over existing causeway • Widening of minor bridges and culverts	• Construction of new bridges and bridging of existing causeways, there will be an improvement in the drainage characteristics of the project area
3.	Runoff and drainage	Direct impact	• Siltation of water bodies • Reduction in ground recharge • Increased drainage discharge	• Silt fencing to be provided • Recharge well to be provided to compensate the loss of previous surface • Continuous drain is provided, unlined in rural area and lined in urban areas.
4.	Water requirement for project	Direct impact	• Water requirement for construction activity. • Water requirement of labour	• Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. This is required to avoid depletion of water resources.
5.	Water Quality			
a.	Increased sedimentation	Direct impact	• Increased sediment laden run-off alter the nature & capacity of the watercourse	• Guidelines for sediment control to be enforced
b.	Contamination of water	Direct adverse impact	• Scarified bitumen wastes • Oil & diesel spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the lbor and officers • Routine and periodical maintenance	• Hazardous Wastes (Management & Handling) Rules, 1989 to be enforced • Oil interceptor will be provided for accidental spill of oil and diesel • Rejected material will be layed in village roads or as directed by engineer • Septic tank will be construction for waste disposal
6.	Water quality monitoring		• Effectiveness / shortfall (if any) • Any unforeseen impact	• Measures will be received & improved to mitigate / enhance environment due to any unforeseen impact

8.1.6 Water Quality

a. Contamination of water

- Oil interceptor will be provided at plant site and material trucks lay byes.
- Construction work close to the streams or water bodies will be avoided during monsoon.
- The discharge standards promulgated under the Environmental Protection Act, 1986 will be strictly adhered to. All wastes arising from

the project will be disposed off in a manner that is acceptable to the State Pollution Control Board (SPCB).

- All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 will be adhered to.
- Construction labourers' camps will be located at least 1000m away from the nearest habitation.
- Unless otherwise authorised by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the workplace suitably approved by the local medical health or municipal authorities will be made.
- All approach roads to rivers and other surface water bodies need to be closed permanently to avoid vehicle washing and to avoid major pollution sources. This applicable to all areas including the secondary construction sites.
- Automotive service centres will be discouraged from establishing along the corridors with out installing preventive measures against petroleum and oil contamination.
- Water quality shall be monitored regularly near the construction site.

8.1.7 Noise Environment – Mitigation Measures

Environmental noise particularly railway noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency and speed of the trains.

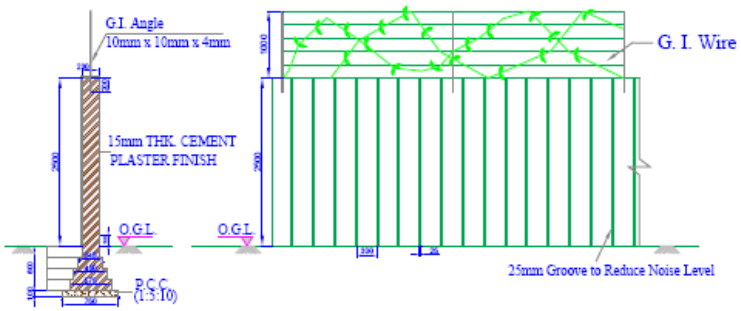
Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
1	Sensitive receptors	Direct impact	• Increase in noise pollution	• Noise barrier to be provided
2	Noise pollution (pre-construction)	Direct impact, short duration	• Man, material and machinery movements • Establishment of labor camps onsite offices, stock yards and construction plants	• Area specific and for short duration • Machinery to be checked & complied with noise pollution regulations. • Camps to be setup away from the settlements, in the down wind direction.
3	Noise Pollution (Construction Stage)	Marginal impact	• stone crushing, asphalt production plant and batching plants, diesel generators etc • Community residing near to the work zones	• Camps to be setup away from the settlements, in the down wind direction. • Noise pollution regulation to be monitored and enforced. • Temporary as the work zones will be changing with completion of construction
4	Noise Pollution (Operation Stage)	Marginal impact	• due to increase in traffic (due to improved facility)	• will be compensated with the uninterrupted movement of heavy and light vehicles till the facility reaches the level of service C.
	Noise Pollution Monitoring		• Effectiveness / shortfall (if any) Any unforeseen impact	• Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

8.1.8 Sensitive Receptors – Mitigation Measures

All schools, hospitals and cultural properties have been identified and those that are close to the project roads ie with in 100 m distance will require noise control measures, however the noise barriers shall be provided at these six locations to reduce the noise level which is very much critical. The noise level may be reduced upto 10-15 dB(A) barrier to accommodate the long term impact of the improved road. List of sensitive receptors along the project corridor is presented in table below.

Sl. No.	Chainage, km.	Name of Receptor	Distance from the proposed track (m.)	Impact	Mitigation / Enhancement
1.	1049.00	Maitha Hospital and old shiva temple, Metha	30 & 25	Direct impact, high noise level	Noise barrier shall be created of 300 m length as per the conceptual drawing shown below
2.	1062.00	School, hospital near Rura crossing	58, 80 & 90	Direct impact, high noise level	Noise barrier shall be created of 200 m length as per the conceptual drawing shown below
3.	Achalda Detour	Girls Inter college, Achalda	30	Direct impact, high noise level	Noise barrier will be created of 250 m length as per the conceptual drawing shown below
4.	1128.00	School, college, temple in Samoha	20 & 30	Direct impact, high noise level	Noise barrier will be created of 300 m length as per the conceptual drawing shown below
5.	1147.00	Devi temple, Ekdil	40	Direct impact, high noise level	Noise barrier will be created of 50 m length as per the conceptual drawing shown below

Schematic drawing of noise barrier wall is given below:



8.1.9 Mitigation Measures for Noise during Construction Phases

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90dB(A). If required, high noise producing generators such as concrete mixers, generators, graders, etc. must be provided with noise shields.

- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.

- Workers in the vicinity of high noise levels will be provided earplugs/ earmuff, helmets and will be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8 hour shift.

- During construction vibratory compactors will be used sparingly within the urban areas. In case of complaints from roadside residents, the engineer will ask the site engineer to take suitable steps of restricting the work hours even further or use an alternative roller.

- Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage.

- People will be convinced / educated to prevent sensitive land uses from developing up adjacent to the project corridors.

8.1.10 Mitigation Measures for Hydrological Condition (Rivers and Lakes)

1) Construction Phase

- Provision of temporary drainage arrangement due to construction activities must be made by contractor and suitable and strict clause must be incorporated in general conditions of the contract document for its effective implementation.
- Silt fencing may be provided near water bodies.
- Proper drainage may be planned in the area to avoid water logging.

2) Implementation Phase
- Local drainage is likely to be affected due to formation of Railway Embankment.
- Cross drainage structures shall be provided at appropriate locations.

8.1.11 Mitigation Measures for Flora

1) Construction Phase

- Felling of trees must be undertaken only after obtaining clearance from the Forest Dept.-forest areas, Railway Dept and local bodies outside forest area.
- Trees falling outside the RoW should not be felled.
- Compensation must be provided before initiating construction activity.
- Fruit bearing trees shall be compensated including 5 years fruit yield.
- Labour camps and office site shall be located outside and away from the forest area.
- Compensatory affirestation against diversion of 7.36 ha forest land to be undertaken and completed within 2 years time from date of NOC from Forest Dept.

2) Post Construction Phase

- No impact envisaged on flora during post construction phase however, development of green belt is suggested near stations and maintenance of plantation may be undertaken by Railway Dept. The plantation carried along

alignment and as compensatory afforestation is likely to enhance the ecological condition of the area.

- Plantation of trees along DFC to be undertaken post-construction period against trees felled for clearing project site and completed within 1 year time.

8.1.12 Mitigation Measures for Fauna

1) Construction Phase

- Crossing passages must be made for animal movement by provision of under pass followed with some plantation so that it resembles with the habitat.
- Water bodies may be developed inside forest areas, as the birds prefer water bodies.
- Borrow areas can be also developed as ponds with grasses and shrubs planted around it.
- Silt fencing may be used near water bodies to avoid runoff into the water bodies.
- Construction activity may be avoided during night hours in forest area.
- Poaching must be strictly banned in the forest area. It may be ensured by the contractor that no hunting or fishing is practiced at the site by any of the worker and that all site personnel are aware of the location., value and sensitivity of the wildlife resources.
- Awareness programme on Environment and Wildlife Conservation may be provided to the work force. Forest Act and Wildlife Act may be strictly adhered to.

2) Post Construction Phase

-
- Animal underpasses made for animals near forest area must be camouflaged to match the surrounding environment with plantation of shrubs and trees.
- Fencing may be provided along DFC in areas to avoid collision, wherever feasible.

8.1.13 Landscape

1) Construction Phase

- Landscaping Plan may be formulated for restoration, leveling and landscaping of the area once construction activities are over. This can involve the following:-
- The stockpiles may be designed such that the slope does not exceed 1:2 (vertical to horizontal) and the height of the pile to be restricted to 2 m.
- Stockpiled topsoil may be used to cover the disturbed areas and cut slopes. The top soil shall be utilized for redevelopment of borrow areas, landscaping along slopes, incidental spaces etc.
- Incorporation of suitable and effective contractual clauses for rehabilitation and restoration of borrow areas and other temporary works and landscaping it with surrounding area immediately after its use.
- Landscaping of surrounding area with plantation, ornamentals plants may be planted near station.

2) Post Construction Phase

- No impact envisaged on landscape in operation phase, however the green belt development is suggested.

8.1.14 Mitigation Measures for Vibration

In order to mitigate the negative impacts due to noise and vibration the impact area are divided in three broad categories;

- Areas identified in Reconnaissance Survey as sensitive residential commercial industrial or social sites.
- Areas identified as reference locations for carrying out measurements of vibrations along EDFC
- Areas having buildings and structures within existing or proposed railway land.
- Buildings and structures of importance for ASI or other similar agency

For all these target locations following scheme shall be applied.

1. Targets falling within the ROW - Pick out and exclude all such target locations from consideration of mitigation measures.
2. Targets located at distances falling in no impact zone are also isolated from the list of locations requiring mitigation measures. For this trend line of attenuation of vibrations with distance for each type of location has been established. Using this trend distance for permissible vibration level has been identified. All locations farther to this distance have been isolated from assessment of mitigation measures.
3. Targets that have special character due to their historical or archeological or communal importance. Such targets have to be considered in special manner irrespective of level of impacts assessed in their case.

Based on these 3 isolations the identified target locations have reduced from >40 to 21. These 21 locations will need mitigation measures to reduce the impact on them. The distribution of these locations indicates that is in plain areas but on parallel track, is in habituated areas and in detour locations. Due to these distinctions the levels to which vibration impacts are to be mitigated are also different.

The following mitigation measures are recommended.

It has been found that the vibration levels originate at the interaction of rail and wheel because of various factors which include the following

- The construction of Wagons
- Condition of Wagons , rails and wheels
- Design , engineering , superiority in terms of track support systems, soil conditions and embankment heights

Efficient Track and wheel maintenance:- Effective maintenance of track and wheel can reduce upto 10 dB(A) noise and vibration levels. The Condition of the rails and wheels- If not maintained in good condition. Some maintenance procedures that are particularly effective at avoiding increases in ground-borne vibration are:

- Rail grinding on a regular basis. Rail grinding is particularly important for rail that develops rail irregularities which in their turn cause impacts and low frequency excitation.

- Wheel truing to re-contour the wheel, provides a smooth running surface, and removes wheel flats. The most dramatic vibration reduction results from removing wheel flats and out of roundness.

- Implement vehicle reconditioning programs, particularly when components such as suspension system, brakes, wheels, and slip-slide detectors will be involved.

- Install wheel-flat detector systems to identify vehicles which are most in need of wheel truing. These systems are becoming more common on railroads and intercity passenger systems, but are relatively rare on transit systems.

- Install wheel geometry measurement devices (e.g. laser based systems installed at entrance of depot) with possibility of detecting out of roundness, difference of wheel diameter of wheels on the same axle, wheel wear. (**Vibration reduces more than 10 dB)**

Therefore we estimate that a reduction of up to **7.5dB** Vibrations could be achieved as compared to highest Vibration level measured on existing tracks. Therefore predicted vibration levels will come down by around 7.5 dBs through maintenance efficiency and planning alone.

The DFCC has already designed to operate on elevated embankment of 2mtrs of more. This means that there will be at least 1 meter additional height all along the corridor due to embankment. Researches and studies have shown the height of embankment increases the attenuation rate by **1- 2 dBs** per meter height of embankment. Therefore at least **1- 2dBs** (for one meter additional height of embankment) will be reduced for entire corridor, In portions of track where there is no embankment currently this reduction will be for 2 meter height and will be around 2-3 dBs. Therefore taking a conservative estimate, this inbuilt measure will provide reduction of Vibration levels by **2dBs**.

Considering all the above conditions, we conclude that the Overall vibrations will be reduced by a total of 10 dB.

As discussed earlier in the evaluation process maximum vibrations permissible on any site is

Plain route or detour upto: 70dB

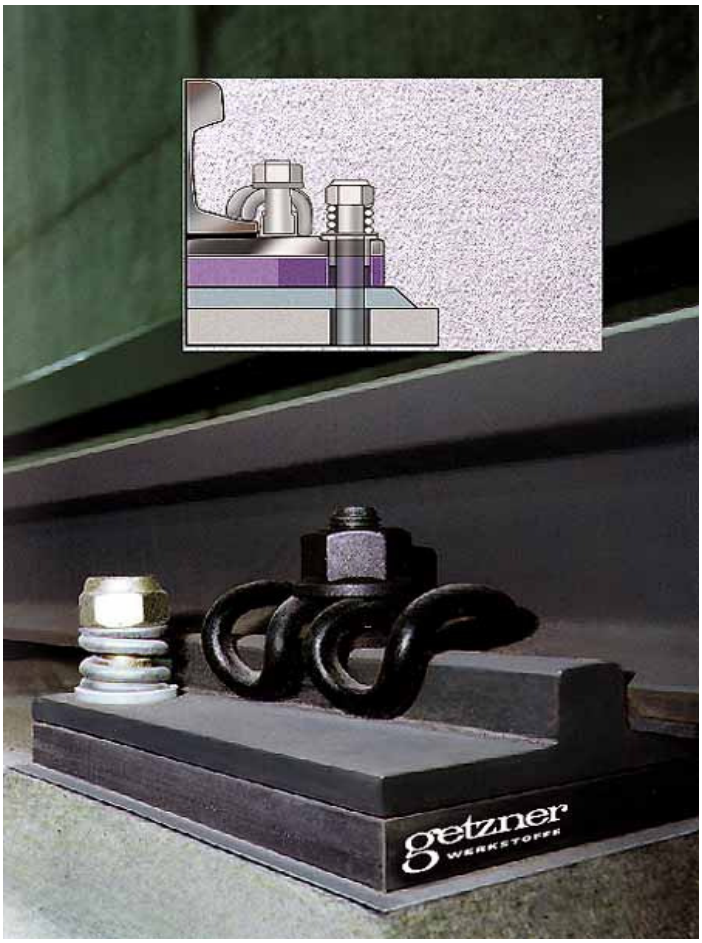
Receptors: upto 65 dB

There are 19 locations on the parallel / detour tracks, For these permissible limits for vibration is 70dB and maximum vibration levels after above mentioned mitigation measures will be reduced to 70.2 dB

Similarly there are 2 locations of Receptors, for these permissible limits for vibrations is 65 dB and maximum vibration levels after above mentioned mitigation measures will be reduced to 70.2 dB.

Therefore additional mitigation measures are required to take care of balance impacts of 0.2 dBs on Parallel / detour tracks and 5.2 dB for receptor locations.

Resilient Fasteners: Resilient fasteners are very common fastening equipment used in modern track constructions. We believe these must also be included in design of track installation by DFCC. If so these become another existing resource that will help mitigate the impacts of vibrations. These fasteners are used to fasten the rail to concrete track slabs. Standard resilient fasteners are rather stiff in the vertical direction, usually in the range of 40 kN/mm (dynamic stiffness), although they do provide vibration reduction compared to classical rigid fastening systems. Special fasteners with vertical dynamic stiffness in the range of 8 kN/mm will reduce vibration by as much as 15 dB at frequencies above 30 Hz. (Conservatively these could **reduce vibrations by 5 to 10 dBs)**



8.2 Mitigation measures for Community Property Resources

SIA had identified 485 CPRs within the proposed ROW and indicated in RAP. Efforts were made to minimize the impact on these CPRs by reducing Corridor of impact (COI) to a minimum (about 17 m). As a result, number of CPRs need relocation is reduced to 22 (Table 2.8). Consultation with the community suggests that these facilities are used by people very often. Therefore these facilities will be replaced in consultation with the communities who are using it, irrespective of ownership of these CPRs. Remaining 463 CPRs will be outside of RoW, hencer will not be affected. Enhancement of these CPRs (463) along with environmental measures such as plantation of trees is being planned. Wherever required suitable boundary wall will be constructed to mitigate noise and vibration impact. All these community properties will be enhanced in consultation with community. The relocation of the affected community structures shall be done in consultation with the affected custodians and communities in a manner acceptable to the beneficiaries of the CPRs. The affected facilities and the structures will be reconstructed/replaced as a part of the project.

Table 8.1 : Affected Community Properties Resources (CPRs)

Package	Temple	Mosque	Hospital	School	Hand pump	Others	Total
I	4	-	-	-	-	2	6
II	1	-	-	-	-	-	1
III	8	-	-	-	2	5	15
Total	13	0	0	0	2	7	22

8.3 Archaeological Structure

There is no archaeological structure affected, directly or indirectly, on the alignment. However,such structures/ articles found during construction stage along the alignment, shall be dealt as per the Act and procedure detailed in Environmental Management Framework.

Annexure 8.1

Affected/Displaced Community Property Resource (CPR) in Phase - I

Sl. No.	Package	Chainage	District	Tahsil	Village	Measurement		Area (Sq m.)	Type	ID No	Name of CPRs	Cost of CPR	Cost of Enhancement*	Total Budget	Reconstruction Agency
						Length	Breadth								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	I	1096/21-22	Aauriya	Bidhuna	Bijhai	1.40	1.40	1.96	Pakka	9	Temple Shankar Ji	10780	10780	21560	DFCC
2	I		Etawa	Bharatana	Thari	3.17	2.80	8.88	Pakka	1	Temple	48818	48818	97636	DFCC
3	I		Etawa	Bharatana	Thari	2.35	2.35	5.52	Pakka	7	Temple	30374	30374	60748	DFCC
4	I	1139/3	Etawa	Bharatana	Kanchusi Pachar	3.50	4.75	16.63	Pakka	3	Santoshi Mata	91438	91438	182875	DFCC
5	I	1181	Etawa	Jasvant Nagar	Etawa	1.85	2.00	3.70	Pakka	1	Samadhi	20350	20350	40700	DFCC
6	I	1181	Etawa	Jasvant Nagar	Etawa	2.50	1.75	4.38	Pakka	1	Samadhi	24063	24063	48125	DFCC
7	II		Firozabad	Shikohabad	Bhadan	2.00	2.00	4.00	Pakka	1	Hanuman Mandir	22000	22000	44000	DFCC
8	III	1351/11	Aligarh	Gabhana	Dorau Chandpur	5.35	4.60	24.61	Pakka	1	Hanuman Mandir	135355	135355	270710	DFCC
9	III	1351/13	Aligarh	Gabhana	Dorau Chandpur					7	Govt. Hand Pump	10000	10000	20000	DFCC
10	III	1351/19	Aligarh	Gabhana	Dorau Chandpur	4.50	2.00	9.00	Pakka	42	Temple	49500	49500	99000	DFCC
11	III	1351/19	Aligarh	Gabhana	Dorau Chandpur	1.60	1.75	2.80	Pakka	2	Temple	15400	15400	30800	DFCC
12	III	1351/19	Aligarh	Gabhana	Dorau Chandpur					55	Govt. Hand Pump	10000	10000	20000	DFCC

Sl. No.	Package	Chainage	District	Tahsil	Village	Measurement		Area (Sq m.)	Type	ID No	Name of CPRs	Cost of CPR	Cost of Enhancement*	Total Budget	Reconstruction Agency
						Length	Breadth								
13	III	1351/19	Aligarh	Gabhana	Dorau Chandpur	1.20	1.00	1.20	Pakka	56	Temple	6600	6600	13200	DFCC
14	III		Aligarh	Gabhana	Somana	3.50	7.50	26.25	Pakka	3	Daramshala /Temple	144375	144375	288750	DFCC
15	III		Aligarh	Gabhana	Somana	2.50	3.50	8.75	Temple	11	Temple of Bala Ji	48125	48125	96250	DFCC
16	III	1344/5	Aligarh	Gabhana	Nagala Raju	3.60	3.60	12.96	Pakka	1	Samadhi	71280	71280	142560	DFCC
17	III	1445/27	Aligarh	Gabhana	Kanohi	1.80	1.25	2.25	Pakka	1	Samadhi	12375	12375	24750	DFCC
18	III	1345/27-29	Aligarh	Gabhana	Kanohi	9.60	43.65	419.04	Semi Pakka	1	Sidhnath Muniya Baba Asharam	2304720	2304720	4609440	DFCC
19	III	1272/29	Mahamaya Nagar	Saadabad	Mahrara	3.70	3.80	14.06	Pakaa	1	Temple	77330	77330	154660	DFCC
20	III		Mahamaya Nagar	Saadabad	Kadiya	4.50	7.60	34.20	Pakka	1	Shiv Temple	188100	188100	376200	DFCC
21	III		Mahamaya Nagar	Saadabad	Kadiya	20.70	12.90	267.03	Pakka	2	Dharamshala	1468665	1468665	2937330	DFCC
22	III	1305/21	Mahamaya Nagar	Saaski	Jalalpur	9.80	10.50	102.90	Pakka	1	Post Office	565950	565950	1131900	DFCC
											Total	**5355597**	**5355597**	**10711194**	
*100% of actual cost.											Say			1.07 Crores	

CHAPTER-9

PUBLIC CONSULTATION & DISCLOSURE

9.1 INTRODUCTION

The Public Consultation meetings for the proposed Eastern Dedicated Freight Corridor were conducted in the affected villages during May & June 2009. The villages were selected which were environmentally sensitive and may be affected due to the proposed project. The overall objective of public consultation was to provide information to the stakeholders and collect feedback on environmental issues from them at village level.

9.2 OBJECTIVES OF PUBLIC CONSULTATIONS

Public consultations intend at obtaining people's participation. It is an ongoing process which can improve communication, interaction and joint decision making between different stakeholders. Through public participation, all parties become better informed about the range of views on proposals and issues. Most importantly, a good public participation process will result in better decisions that are more sensitive and responsive to public concerns and values.

It is widely acknowledged that public participation processes should vary according to the size, complexity and level of interest in any one issue, policy or plan.

The broad objectives of Public Consultation Meetings were as follows:

- To understand the view of the people affected
- To identify all major environmental characteristics of the villages to enable planning and implementation.
- To resolve the issue related to environment i.e. water, soil, air, pollution and vibration
- Disseminate information to the lowest possible hierarchy of the social system

9.3 METHODOLOGY OF ORGANIZING MEETINGS

These meetings were organized at village level through the project office of DFCC at Aligarh, Agra and Kanpur. Project officers of DFCC have been working in the project area since long and have fairly a good idea of the issues involved at village level. Moreover, the technical drawings, maps and other papers of the alignments were readily available with them and these could be used while disseminating information and answering questions of the stakeholders. They have developed a network of field functionaries and these field functionaries have established good rapport with the villagers and stakeholders.

The details of the identification of villages, participants, methodology for conducting the meetings and issues emerged during the meetings are briefly described below:

A. Selection of villages

Villages were selected based on degree of environmental impact.

S.No.	Name of Village	Environment Issue
1	Primary School, Aligarh Bypass Road Near Daudkhan Station	Noise pollution Safety of children
2	By pass Gandha Nala (Aligarh Mathura Road)	Chances of raw material falling down, water of the Nala is polluted
3	Talispur khurd, Aligarh	Impact on milk dairy and old huge trees
4	Salempurhafi	Old structures getting affected
5	Lt Bhawani Kashyap School	School only 200mts away from the proposed track
6	Chikavati village	Old dried fish pond and a dairy
7	Mehrara village, Mahamaya nagar	Very near to the track, noise level high
8	Chuarpur Nagariya school	Noise level increase and safety issues of children
9	Village Bhopatpur, Mahamaya Nagar	Villagers very sensitive on environment issues like height of the track, noise level and accidents
10	Ullau khera near Hiren gaon station	Both sides train
11	Village Barhan near Barhan station	Noise and safety
12	Rura opposite Metha Station	Animal run over and noise
13	Jhinjhak	Dust, Noise and smoke
14	Phaphund/Dibiyapur	Noise, cracks in houses
15	Kanchausi	Water, noise and safety
16	Bharthana	Cracks in house and noise
17	Achchalda	Impact on girls college

B. Participants

In the selected villages, the informations were disseminated through the contact person of the project office of DFCC office in advance and the village head / influential persons was requested one day in advance to arrange the meeting by informing others in his village and nearby villages at a fixed place and at a fixed time.

C. Methodology of conducting the meeting

At the outset, the consultant team and project manager of DFCC introduced themselves and welcomed all esteemed guests.

The project manager with the help of the technical designs of the proposed project introduced the project and its relationship with the concerned village/villages. The public consultation specialist introduced the subject of Environment like air, water, noise, vegetation plantation and trees, bio-diversity, birds, animals etc and possible or likely impact of the new track on environment. She invited the participants to air their views frankly in the context of their villages.

The stakeholders one by one were presenting their point of view and sometimes their misconceptions about the project were being answered by the consultant team and the project manager. The views and concerns expressed by the participants are being recorded in performa sheet by the consultant accompanying the public consultation specialist.

During the meeting and deliberations some participants were very much out spoken and wanted that project should not pass through village/villages. The team members therefore gave all informations and shared their concerns and requested them to offer their suggestions to make the project environment friendly. The records of the participants covers gender, profession etc. of the participants. Same has been

enclosed as Annexure – 9.1. It requires special mention here that few participants were apprehensive to reveal their identity. Photo documentation of the meetings are enclosed as Annexure – 9. 2

D. Issues and concerns emerged from the consultation

The issues and concerns shared and mitigation suggested in a tabulated form are given below:

S. No.	Date	Venue	ISSUES SHARED	MITIGATION MEASURES	REMARKS
1	23-05-2009	Primary School, Aligarh Bypass Road Near Daudkhan Station	1. Noise level if increases due to this additional track, would affect the educational activity more than the present scenario. 2. Safety of children would be affected as school is placed in between the existing track and proposed track.	Wall for the safety of children as well as noise.	Existing track is in any case affecting the educational activities as well as hearing abilities of the students and the faculty. School has no boundary wall at present.
2	23-05-2009	Bypass Ganda Nala, Aligarh Mathura Road	1. While construction possibilities are there that some raw material may fell down in it. 2. Its water is not at all suitable for construction purpose. Hence no adverse effects would be there.	The water of this Nala should not be utilized for construction purpose	Its water is black and at some places washer men/ women were washing cloths.
3	23-05-2009	Talispur Khurd, Aligarh	1. Fish Pond, 2. Milk Diary and 3. Old huge trees would be destroyed.	Plantation of Trees by the side of track. Diary and Pond could be shifted to some other place.	Fish Pond is man made and was constructed by the owner for procreation and selling of Fish.
4	24-05-2009	Salempurhafi	This structure is very old and people have sentiments for it.	Nil	An old small structure is there but it is not an Archeological building.
5	24-05-2009	Lt. Bhawani Kashyap School	School is 200 mts away hence noise	Wall should be constructed	
6	24-05-2009	Chikavati Village	A corner of an old dried fish Pond and a diary would go but no issues were raised by	Nil	Nil

S. No.	Date	Venue	ISSUES SHARED	MITIGATION MEASURES	REMARKS
			the family.		
7	24-05-2009	Mehrara village, Mahamaya Nagar	Vibration and noise level is high due to the existing track if it increases further it would affect the day to day life.	Wall for the safety of children as well as noise.	Houses are very close to existing track. People are use to present situation. People have encroached railway land also for houses.
8	25-05-2009	Chuarpur Nagariya School	1. School Building is close by. Noise level if increases due to this track, would affect the educational activities. 2. Safety of children would be affected.		Existing track is in any case affecting the educational activities.
9	25-05-2009	Village Bhopatpur, Distt. Hathras, Mahamaya Nagar	1. Height (4 mts.) of track would affect the passage of air. 2. Water level would go down. 3. Noise pollution 4. Number of Accidents would increase, birds, animals and human being would hit by the trains especially Peacock and Neelgaay 5. Migratory birds would not come due to high level of noise as they get frightened by loud voices. 6. Children would born deaf. 7. Premature delivery of babies due to vibration and noise.	Box Bridge should be made to take cattle from one side of the track to another.	Not environment issues but people expressed and requested to further give for submission Requests: People have expressed that local labour should be employed in the project. Employment according to their talent and caliber should be given to one person in the family whose land has been acquired.
10	28-05-2009	Village Ullau Khera near Hiren Gaon	Due to train track on both sides normal	Boundary wall in South direction to	

S. No.	Date	Venue	ISSUES SHARED	MITIGATION MEASURES	REMARKS
		Station	life would be affected Animal safety Children safety	protect school.	
11	28-05-2009	Barhan Village near Barhan Station	Noise and safety	Tree plantation to reduce noise effect and it would work as fencing.	Very close to station already have high level of noise and vibration
12	28-05-2009	Rura opposite Metha Station	1. Animal run over 2. Noise pollution 3. Noise trouble for patients	Over bridge	
13	29-05-2009	Jhinjhak	1. Dust, Noise & smoke would increase. 2. Busy market place so safety is concern.	• Tree plantation to control dust, noise and smoke • Over bridge to cross track	People are pro national development and very much willing to have this
14	29-05-2009	Phaphund/ Dibyapur	Cracks in houses	When train passes it is difficult to sleep	Wall should be constructed
15	29-05-2009	Kanchausi	Fear of water shortage	Water from this place should not be used in construction. Green belt is required. Over bridge is required.	Hanuman Mandir is not at all getting affected by the proposed track. People need time to relocate hence requested information in time.
16	30-05-2009	Bharthana	Noise level increases due to the train passing/crossing Cracks in house	Wall/fencing near the residential areas	
17	30-05-2009	Achchalda, Aurriya	Impact on girls college	Alignment should save the collage	Villagers are unhappy because this is the only inter college for girls and they cannot send their girls to far away places.
18	30-05-2009	Kandhesi Pachar, Tehsil Bhartana, Distt. Etawah	1. Noise 2. Accidents 3. Closeness of primary health center 4. Vibration has no	Green belt	Health centre came up later, it is new and the existing track is older. So if same

S. No.	Date	Venue	ISSUES SHARED	MITIGATION MEASURES	REMARKS
			effect as such by the existing track.		level of noise would be there it would not generate an additional impact.

Second round of consultations have been done with the objective of providing various information to relevant stakeholders on environmental effects to avoid controversies and delays in decision making at latter stages for better understandings.

S. No.	DATE	VENUE	No. OF PARTICIP-ANTS	ISSUES SHARED	MITIGATION MEASURES	REMARKS
1	04-01-10	Tehsil Khurja-Dist Bulandshahar, village maina Maujpur	65	1. Noise level if increases due to this additional track, 2. Loss of Cultivation. 3. More accidents 4. Tube wells will be affected 5. Suicide rates will be increased.	Wall for the safety of children as well as noise. Construction of tube wells, Construction of under passes	Farmers not agreeing for land acquisition because of loosing their fertile lands
2	04-01-10	Palisallu Nagaria – Nala River crossing	58	1. Noise level pollution 2. Engineering college and other educational institutions will be affected 3. Trees will be affected 4. One colony developed by villagers will be affected 5. Asaram Bapu Rustampur Ashram will be affected. 6. Vibration would affect the houses as houses are Kacha Makans- not build by cement	Villagers are demanding Re Survey	
3	04-01-10	Rajpur Junir High School, Hathras, Mahamaya Nagr	52	1. Noise Pollution 2. Bank not giving loans because of notification 3. No clear cut ideas of compensation	Publicity of Env programmes Planting more trees Jobs in railways . Compensation rates should be fixed as soon as possible	Villagers are too angry because of non clarity of compensation etc. Yamuna Vikas Pradhikaran is offering more compensation for lands. Due to DFCC notification farmers are denying loans from banks .
4	05-01-2010	Village Batthroah, Tehsil – jaswant Nagar, Dist Etawah	45	The notification issued on 07-11-200 is suitable to villagers but later it was disapproved. Overbridge would create probles as the line would be high. Village is coming in between the proposed	Saftyy measurements for preventing accidents, and noise pollution. Demand of one job per family in railways.	

S. No.	DATE	VENUE	No. OF PARTICIP-ANTS	ISSUES SHARED	MITIGATION MEASURES	REMARKS
				wxisting proposed track. Land is fertile	Line proposed on 07-11-2009 should be considered. Payments should be cleared at one go. Tree plantation required.	
5	06-01-2010	Village Sahajpur-Barthna Bypass – Disttrict Etawah	36	Rs.12 lac per hectare is the cost of land. Under pass required for human passage Noise pollution	Nil	Nil
6	06-01-2010	Samoha n – Tehsil – Barthna , Dist Etawah	55	Vibration and noise level is high due to the existing track if it increases further it would affect the day to day life.	5.4 meter road alongwith track under pass No gates would be made Safty of overbridge is concern for villagers Number of educational institutions are near to proposed track	.
7	06-01-2010	Achalda, Near Railway crossing	38	1. People are demanding proposed tract would e made parallel to existing track		The situation is tensed here.
8	06-01-2010	Rura	40	1. Main concern is Jal Nikasi 2. Important Governemnt offices are on one side of the tact and population other side 3. People dmand clear cut policy	Culvert to be provided near by rural Construction of underpasses at crossings Trees to be planted to avoid noise pollution	

9.4 SUMMARY AND MAJOR FINDINGS

1. At most of the places stakeholders raised the issue of increased noise level and suggested that the boundary wall near the rail track, schools, hospitals and habitations should be constructed.
2. Ground water level due to the proposed track may go down and therefore they suggested that for construction purposes the water of the existing water channels should not be utilized.

3. In some villages issues on safety of children were raised by the villagers and according to them due to the proposed project accidents would increase, birds, animals and human beings would be hit by the trains especially Peacock and Neelgaay. Migratory birds may not pass this way due to high level of noise as they get frightened by loud voices. Some villagers expressed the fear that children born would be deaf. Premature delivery of babies due to vibration and noise may take place and therefore effective measures to control these factors should be adopted.

4. Villagers suggested that there should be sufficient underpasses to cross the track so that accidents of animals/birds are reduced (Village Bhopatpur, District Mahamaya Nagar).

5. There were suggestions from many villagers that walls near the track should be constructed to protect animals, human lives and for reducing the noise level. Boundary wall was a major suggestion.

6. Some villagers were fearful that the rate of suicide among women would go up due to this track. It has been a common practice that after domestic fights women go for suicide on the track in anger as this will be very near to the villages and the men folk will not be able to protect them as the distance is very meager. Therefore they suggested that railway track should not be near the villages and should be far away. Awareness should be generated among both genders for the safety issues.

8 Majority of the people want to know clear cut rules for compensation

9 JP Yamuna Expressway Project is providing compensation @Rs.440 per square meter, which is Rs.44 lac per hectare whereas DFCCIL is giving the ciricle rate plus 60%.

10 Job announcement of Railway Minister should be clarified and assured

11 Temple at Rudau is lying under the alignment. It is connected with the emotions of 11 villages. People want to shift the track alignment to save religious sentiments.

12 Villlagers suggested that there should be an adequate number of underpasses to cross the track in order to reduce accidents (Village Bhopatpur, District Mahamaya Nagar).

ENVIRONMENT MANAGEMENT PLAN

10.1 INTRODUCTION

Environmental Management Plan is an implementation plan to mitigate and offset the potential adverse environmental impacts of the project and enhance its positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted in order to minimize adverse impacts. The process of implementing mitigation and compensatory measures, execution of these measures, agencies responsible for the implementation of these measures and indicative costs are discussed in this chapter.

The project has overall positive impacts by providing a competitive, cost effective, congestion free reliable mode of dedicated freight service. It will certainly reduce the load on the roads and facilitate fast transfer of goods. Railway being an eco-friendly mode will also enhance or at least will not degrade the environmental quality.

The development of DFC entails civil work, including excavation, filling, construction of RUB/ROB, bridge and cross drainage structures, and utility shifting etc., which are likely to cause adverse impacts on natural and social environment. The impacts can not be fully avoided; however, appropriate mitigation measures are suggested to minimize and compensate the potential adverse impacts and enhance positive impacts. Most of the impacts are temporary in nature and are limited to the construction phase. These impacts can potentially be minimized and managed by proper planning and execution. The environmental management plans includes activities for pre-construction phase, construction phase and operation phase.

10.2 ENVIRONMENTAL MANAGEMENT PROCESS

Environmental management is based on the potential impacts assessed for the project. Assessment of potential impacts is based on the review of secondary data substantiated by site visits – environmental monitoring, public consultation, household survey and discussion with concerned Govt. Dept. The implementation of Environmental Management Plan (EMP) requires the following:-

- An organizational structure
- Assign responsibilities
- Define timing of implementation
- Define monitoring responsibilities

10.3 EMP DURING CONSTRUCTION & OPERATION

The project activities will be executed in a phased manner, pre-construction phase, construction phase and operation phase. The major activities to be undertaken are described below.

10.3.1 Construction Phase

The environmental issues during construction stage generally involve equity, safety and public health issue. The contractor is required to comply with the laws with respect to environment protection, pollution prevention, forest conservation, resettlement and safety and any other applicable law. Environmental pollution during the construction phase will be less but control of pollution during this phase is of considerable importance. The EMP is an executable part of project, and the activities are to be guided, controlled, monitored and managed as per the provision provided. Following activities require attention during construction phase.

1. Social Impact Management Plan

Minimum land acquisition and disturbance to existing features will be prime objective of the design. Socially sensitive stretches have been avoided and alternatives have been selected with bypass around settlements and realignments. Rehabilitation of PAFs and removal of affected structures will be planed in consultation with the PAFs and local authrorities to ensure minimum disturbance to the PAFs. This is required to minimize impacts within the limitation of technical requirements with emphasis on cost effectiveness.

2. Land Acquisition / Diversion Plan

Acquisition of land is indispensable for construction of DFC. The proposed alignment traverses through forest, settlement and agricultural areas. Approximately 7.36 ha of forest land and extensive agricultural land are likely to be acquired for the project.

- At the outset as a part of the Land Acquisition Plan, the Right of Way (RoW) along the entire DFC alignment has to be established and confirmed from the State Forest, Agriculture and Land Revenue Departments.

- Diversion of 7.36 ha. forest land will be carried in compliance to Forest Conservation Act, 1980.

- The acquisition of land and private property shall be carried out in accordance to the Resettlement Action Plan (RAP).

It has to be ensured that all R & R activities including the payment of the compensation may be reasonably completed before construction activities starts, on any section of the DFC. RAP is to be referred for the purpose. No construction work will start before total compensation has been paid to the PAPs.

3. Utility Shifting Plan

There are some utility services along the proposed DFC alignment such as electric lines, telephone lines, cable line, pipe lines etc which may be shifted on consultation with the concerned department before commencement of construction activity. There are road crossing with the DFC. Construction of bridges will be required to maintain

their utility. These structures will be shifted in consultation with the concerned departments.

4. Construction / Labour Camp Management

- During the construction phase, the construction / labor camp will be located along the project area. Large numbers of labour are likely to move
- into the project area. A proper Construction Camp Development Plan has to be formulated to control degradation of the surrounding landscape due to the location of the proposed construction camp. The contractor must provide, construct and maintain necessary living condition and ancillary facilities. These must be included in contract documents provided to the contractor.

- Sufficient supply of potable water must be provided at camps and working sites. If the drinking water is obtained from the intermittent public water supply, then storage tanks must be provided. All water supply storage may be at lest 15 m away from the toilets or drains.

- Adequate and clean washing and bathing facilities must be provided that also have sufficient drainage.

- Adequate sanitary facilities may be provided within every camp. The place must be cleaned daily and maintain strict sanitary conditions. Separate latrine must be provided for women. Adequate supply of water must also be provided.

- The contactor must ensure that there is proper drainage system to avoid creation of stagnant water bodies.

- Periodic health check ups may be conducted. These activities may be provided by the construction contractor in consultation with State Public Health Department.

- At every camp, first aid facilities with suitable transport must be provided to take injured or ill person to the nearest hospital.

- Adequate supply of fuel in the form of kerosene or LPG may be provided to construction labourers, to avoid felling of trees for cooking and other household activities. No open fires may be allowed in camps.

- The sites should be secured by fencing and proper lighting.

- The construction contractor may ensure that all construction equipments and vehicle machinery may be stored at a separate place / yard. Fuel storage and refilling areas may be located 500 m away from the water bodies and from other cross drainage structures.

- All the construction workers should be provided with proper training to handle potential occupation hazards and on safety and health which include the following:-
    - Environmental awareness programme
    - Medical surveillance
    - Engineering controls, work practices and protective equipment
    - Handling of raw and processed material
    - Emergency response

- Construction / labour camps may be located away from forest areas, settlements, cultural heritage and historical sites and water bodies and dry river beds.

- It should be ensured by the construction contractor that the camp area is cleared of the debris and other wastes after the completion of construction. On completion of construction, the land should be restored back to its original form.

5. Borrow Area Management Plan

An appropriate Borrow Area Management Plan will be formulated to control the degradation of the surrounding landscape due to the excavation work. The national standard which applies to the manual borrowing of earth is the IRC-10:1961.

- Borrowing of earth shall not be done continuously. Slopes of edges shall be maintained not steeper than 1:4.

- Top soil (15 cm) from all areas may be preserved in stockpiles and utilized for redevelopment of borrow/quarry areas.

- Borrow pit should be developed as far as possible from the river side, where the inner edge of any borrow pit should be not less than 15 m away from the toe bank. As per as the borrow pits on the rear on landside are considered, it is to be avoided. Where it is unavoidable a berm, at least 25 m wide should be left between borrow pits and toe bank. The toe of the bank on the rear side should have a cover of 0.75 m to 1.25 m over the saturation line drawn at a slope of 1:6 from the high flood level on the river side.

- Borrowing of earth shall not be carried out on productive land. In the event that such an occasion arises, the contractor has to obtain permission from the supervising engineer.

- Sources of borrow areas will be identified by the construction contractors.

- No borrow area will be opened without the prior permission from the local administrative bodies like Village Panchayats, State Department of Irrigation, Agriculture and State Pollution Control Boards etc.

- Reclamation of borrow area should be mandatory and must be included in the agreement made with the construction contractor.

- Borrow pits may be located at least 1 km away from the villages and settlements.

- All borrow pits may be reclaimed: -
    - The quarry and borrow area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized.
    - Spoils may be dumped with an overlay of stocked piled top soil with respect to MoEF/SPCB guidelines.
    - Borrow and quarry pits can be also be developed as ponds and be used for aquaculture as per local requirement. These can also serve as perk or picnic spots.
    - Landscaping of borrow and quarry area may be done, and the grasses, shrubs and tree species may be planted around the reclaimed area. Ornamental plants can also be planted on the access route.

- Reclamation of borrow area may included in the agreement of the construction contractor.

6. Public Health and Safety

The contractor is required to comply with all the precautions required for the safety of the workmen. The contractor must comply with all regulation regarding scaffolding, ladders, working platform, excavation, etc. as per SHE manual of DFCCIL.

- The contractor must supply safety goggles, helmets, earplugs and masks etc. to the workers and staff.

- Adequate precaution must be taken to prevent dander from electrical equipments. Necessary light and fencing must be provided to protect the public.

- All machines and equipments used for construction purposes must conform to relevant Indian Standards (IS) codes. This equipment must be free from patent defects, in good working condition, regularly inspected, and properly maintained as per IS provisions.

- All labourers working on mixing of asphaltic material, cement, lime mortars, concrete etc should be provided with protective footwear and protective goggles. Workers involved in welding work should be provided with welder's protective eye shields.

  No men below the age of 18 years or women of any age will be employed to work with paint products containing lead in any form. Face masks must be supplied to workers when they use any form of spray paint or work with surfaces that have been dry rubbed and scrapped with lead paint.

- All reasonable measures must be taken to prevent any damage to the public from fire, floods, etc.

- All necessary steps must be taken to prompt first aid treatment for injuries that may be sustained during the course of work.

- The contractor must conform to all anti malarial instructions, including filling up of borrow pits.

- Work that affects the use of side roads and existing accesses must not be taken without providing adequate provision.

- On completion of the works, all the temporary structures may be cleared away, all rubbish disposed, excreta and disposal pits or trenches filled in and effectively sealed off and the entire site left clean and tidy.

6. Green Belt

The green belt has been recommended as one of the major components of the EMP which will further enhance the environmental quality through:

1. Mitigation of air pollution problems
2. Attenuation of noise level
3. Maintain the Green area and improve aesthetics.

It is most important to chalk out a long-term approach to keep the air in the area clean. One such measure is using the plants for absorbing and trapping the air pollutants. The hypothesis that trees are important particulate sinks is supported by evidence obtained from studies dealing with diverse particulate matter including pollen, salt, precipitation, dust and other unspecified particles. As far as gaseous pollutants are concerned, substantial evidence is available to support the fact that plants in general, and trees in particular, function as sinks for gaseous pollutants. This is achieved through various physiological processes occurring within the plant system.

The gaseous pollutants are transferred from the atmosphere to vegetation by the combined forces of diffusion and flowing air movement. Once the gaseous pollutants come in contact with the plants, they may be bound or dissolved on exterior surface or taken up by the plants via stomata. If the surface of the plant is wet and if the gas is water soluble, the former process can be very important. As a matter of fact, plants act as bio filters for the air pollutants and play a major role in safeguarding the environment and controlling the increasing level of air and noise pollution.

A. Preparation of the Plantation Area

A green belt will be proposed along the alignment. Plantation site should be cleared from all wild vegetation. Suitable soil and water conservation measures will be adopted, if required. Since planting area is large, it should be divided into blocks inter-linked by paths laid out in such a way that every tree is accessible for all post plantation care. The planting arrangement and size should be based on the optimum use of the available land and quantum of irrigation water.

A tree requires sufficient space below and above the ground to spread its roots and branches. However, spacing varies with the type of trees, soil fertility, available moisture and purpose of plantation.

B. Preparation of Pits and Sapling Transplantation

The location of each pit should be marked according to the design and distance of the plantation. The size of the pits may vary with the type of trees. While digging the pit, care should be taken to place the topsoil on one side and bottom soil on the other side. Dug-out soil and pit should be exposed to weather for two to three months. After exposing to the weather, the pit should be filled two-third to three-fourth height with a mixture of topsoil and decayed farmyard manure.

Planting of the tree should be done with a suitable between each. While planting the trees, care should be taken that the installation structure should be difficult to see through the foliage when seen from a point outside the green envelop. For preventing the horizontal dispersion of the pollutants, the trees should be planted in alternate rows in a straight line. Tree trunks are free from foliage up to a height of 2 – 3 meters, it is advisable to grow shrubs in front of tree so as to provide coverage to the open portion.

C. Time of Plantation

Plantation should be done two weeks after the rain starts, as the trees benefit from the seasonal rains. It is advisable to avoid planting during the dry season, as this will require watering. It is advantageous to plant trees on cloudy days.

D. Protection of Greenbelt

- No pruning or lopping of branches should be done within the greenbelt for at least 10 – 15 years
- Gap filling in the greenbelt should be done in the same season to avoid future gaps.
- Protection of young plants from the ravages of cattle, sheep and goat and other animals.
- Timely replacements of damaged plant and thereafter care is important.

E. Selection of Tree Species

Plants possess a large surface area and their leaves exhibit an efficient pollutant trapping mechanism. The effectiveness of plants to control pollution depends upon the physiological, morphological traits such as leaf epidermis, size, leaf orientation, internal enzyme system, etc. Systematic screening of plants for their ability to tolerate pollutant need be undertaken. For pollution abatement purposes tree species should be fast growing, wind firm, unpalatable to animals, hardy and pollutants tolerant/resistant. List of some plant species for greenbelt plantation purpose is given in Table below:-

List of Tree Species for Green Belt Plantation

Sl. No.	5.6.6 Botanical Name	Common Name
1	*Alstonia scholaris*	Chattiyan
2	*Mimusops elengi*	Bakul
3	*Cassia fistula*	Amaltas
4	*Bauhinia purpurea*	Khairwal
5	*Zizyphus mauaritiana*	Ber
6	*Cassia siamea*	Senna
7	*Ficus religiosa*	Peepal
8	*Albizia lebbeck*	Siris
9	*Pongamia pinnata*	Karanj
10	*Polyalthia longifolia*	Ashok
11	*Diospyros melanoxylon*	Tendu
12	*Ailanthus excelsa*	Mar Maharakha
13	*Melia azedarach*	Bakain
14	*Tamarindus indica*	Imli
15	*Terminalia arjuna*	Arjuna
16	*Azadirachta Indica*	Neem
17	*Grevillea robusta*	Savukkamaram
18	**5.6.7 Shrubs & Grasses**	
	Calotropis gigantea	Akand
1	*Nyctanthus arboriristis*	Harsighar
2	*Nerium indicum*	Kaner
3		

F. Plantation for Noise Pollution Control

Trees having thick and fleshy leaves with petioles flexible and capacity to withstand vibration are suitable. Heavier branches and trunks of the trees also deflect or refract the sound waves. The density, height and width are critical factors in designing adequate noise screen with vegetation.

Combination of trees and shrubs together appears to be the best system for combating pollution. The following species are suggested for noise pollution:

- *Alstonia scholaris*
- *Azadirachta indica*
- *Melia azedarach*

- *Grevillea robusta*
- *Tamrindus indica*
- *Terminalia arjuna*

Varied plantation techniques and types will reduce noise unequally. In addition to this, it is also relies on categories of plant to block noise. Some type of trees with varying heights block noise better than trees forming a straight line, which can reduce noise up to 3.48%. The formation of plant of different heights planted such that they stand highest to lowest in straight line will have best noise blocking. Port line can reduce noise up to 4.39%. The formation of plant from the highest to lowest in alternate formation will have the best noise reduction in the fifth line which is 7.63% (Chakree, 1989).

10.3.2 Operation Phase

During operation phase, the noise and vibration control along the sensitive and residential area is most important. Regular monitoring will be done for these parameters, and appropriate measures as suggested in the report shall be implemented.

10.4 ENVIRONMENTAL MANAGEMENT PLAN & RESPONSIBILITIES

Table 10.1 presents summary of Environmental Management Plan (EMP) with the objective to minimize adverse environmental impacts as discussed. The table covers all possible environmental issues involved in the project and the necessary mitigation measures. Taking appropriate mitigation measures for the construction phase is the responsibility of the construction contractor, and of the construction projects' Environmental Engineer who will supervise the implementation of the EMP.

The mitigation measures during the operation phase will be implemented by Environmental Management Unit (EMU) of Railway Dept / DFCCIL, which includes an Environmental In-Charge who will supervise the implementation of EMP. Thus, the overall responsibility of the implementation of mitigation

measures will be with the Construction Contractor during the construction phase and with the Railway Dept during operation phase. The details of Environmental Management Programme and Environmental Management Unit (EMU) are discussed in the subsequent paragraphs.

Table 10.1: Environmental Management Plan

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
Pre-construction phase				
1.	Removal of Trees	Trees are likely to be felled in the existing and acquired area for the proposed corridor The forest land along the railway line is likely to be acquired for the project will be compensated by providing value of land as per Net Present Value (NPV) Double area of land may be provided for Forest Dept for carrying Compensatory afforestation. Compensation may be provide for plantation of trees Double area of land may be provided for Forest Dept for carrying Compensatory afforestation. Compensation may be provided for	Forest Dept. / EMU	EMU

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
		plantation of trees		
2.	Land Acquisition /Division	Ownership of land within the ROW and at Junction station should be confirmed Number of Project Affected Persons (PAPs) to be identified Resettlement Action Plan to be prepared for the PAPS and provide compensation in compliance with National Resettlement and Rehabilitation (R&R) policy Information dissemination and community consultation	EMU/NGOs as collaborating agency	Revenue Dept / DFCCIL
3.	Relocation of Cultural and Religious Properties	Religious structures to be shifted only after public consensus. Relocation should be complete before construction work is taken up.	Construction Contractor	DFCCIL
Construction Phase				
1.	Soil	Suitable protection measures consisting of bio-engineering techniques such as plantation of grasses and shrubs & check dams, may be provided to control erosion. Borrow areas may be finalized in concern with ecological sensitivity of the area. Agriculture land may not be used as borrow area. Priority may be given to degraded area for excavation of borrow material. Rehabilitation of borrow area may be taken under the project. Construction work may be avoided during rainy season to evade erosion and spreading of loose material. Top soil removed from agricultural land may be stored separately in bunded areas and utilized during plantation or refilling of excavated area.	Construction Contractor /EMU	EMU/CS
2.	Water Bodies	Provision of temporary drainage arrangement due to construction activities must be made by Contractor and suitable and strict clause must be incorporated in General Conditions of Contract document for its effective implementation. Silt fencing may be provided near water bodies Proper cross drainage structure may be planned at the crossing of the canal in consultation with Irrigation Department Proper drainage may be planned in the area to avoid water logging	Construction Contractor /EMU	EMU/CS
3.	Flora	Felling of trees must be undertaken only after obtaining clearance from the Forest Dept. forest areas, Railway Dept and local bodies outside forest areas Trees falling outside the ROW should not be felled.	Forest Dept./ Construction Contractor /EMU	EMU/CS

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
		Compensation must be provided before initiating construction activity. Fruit bearing trees may be compensated including 5 years fruit yield. Labour Camps and office site may be located outside & away from Forest area Green belt development may be undertaken in the wasteland near railway line to enhance esthetic and ecological value. Social forestry may be practiced for success of the plantation. Local people can be involved in plantation and maintenance of plantation as part of the project in consultation with Forest Department.		
4.	Fauna	Crossing passages must be made for wildlife near forest areas such as under pass followed with some plantation so that it resembles with the habitat of wildlife and facilitate crossing of wildlife in forest area. Ponds may be developed inside forest areas as the birds prefer water bodies. Borrow areas can be also developed as ponds with grasses and shrubs planted around it. Silt fencing may be used near water bodies to avoid runoff into the water bodies. Construction activity may be avoided during night hours in forest area. Poaching must be strictly banned in the Forest area. It may be ensured by the Contractor that no hunting or fishing is practiced at the site by any of the worker and that all site personnel are aware of the location, value and sensitivity of the wildlife resources. Awareness program on Environment and Wildlife Conservation may be provided to the work force. Force Act and Wildlife Act may be strictly adhered to.	Forest Dept./ Construction Contractor /EMU	EMU/CS
5.	Archaeological structure/ article	There is no archaeological structure affected, directly or indirectly, on the alignment. However,such structures/ articles found during construction stage along the alignment, shall be dealt as per the Act and procedure detailed in Environmental Management Framework.	Arch.Dept./ Construction Contractor /EMU	EMU/CS
Pollution monitoring				

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
1.	Air	Adequate dust suppression measures such as regular water sprinkling on construction sites, haul & unpaved roads particularly near habitation must be undertaken to control fugitive dust. Plantation activity may be undertaken at the construction sites Workers may be provided with mask to prevent breathing problems Trucks carrying soil, sand and stone may be duly covered to avoid spilling. Low emission construction equipment, vehicles and generator sets may be used Plants, machinery and equipment should be handled so as tom minimize generation of dust. All crusher used in construction should confirm to relative dust emission devises Air quality monitoring may be conducted at construction sites.	Construction Contractor /EMU	SPCB / SDOE/ EMU /CS
2.	Water	Silt fencing may be provided near water bodies to avoid spillage of construction material. Discharge of waste from construction / labour camp into water bodies may be strictly prohibited. Construction methodologies with minimum or no impact on water quality may be adopted, disposal of construction wastes at designated sites and adequate drainage system may be provided. Project design may take care of irrigational canal and proper culverts may be proved so that irrigation setup is not disturbed Construction activity may be prohibited during	Construction Contractor /EMU	SPCB / SDOE/ EMU
3.	Soil	Asphalt emulsifier must be handled with caution and any leakage detected must be immediately rectified. Construction work should not be done during rainy season to avoid erosion and spreading of loose material Top soil removed during excavation work should be utilized stored separately in bunded area and should be utilized during plantation or refilling of excavated area.	Construction Contractor /EMU	EMU/CS
4.	Solid Waste	Construction work must be carried in such a way that minimum or no solid waste is generated at construction site. Extra earth material produced may be utilized for refilling of borrow areas. Rainy season may be avoided to minimize spreading of loose materials. Solid waste management may be framed for camp areas. Dustbins may be provided in the Camps.	Construction Contractor /EMU	SPCB / SDOE/ EMU /CS

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
		Proper sanitation facilities must be provided in Camp by the Contractor.		
5.	Noise & Vibration	Modern technologies producing low noise may be used during construction. Construction equipment's and vehicles must be in good working condition, properly lubricated and maintained to keep noise within permissible limits. Temporary noise barriers installed at settlements and forest area, if required Noise barrier shall be provided at the location specified in Chapter-7. Plantation may be carried at the work site. Head phones, ear plugs to be provided to the workers at construction site. Noise level monitoring must conducted during construction phase. All vehicles, equipment and machinery used in construction should be fitted by exhaust silencers. Equipments should be maintained regularly and soundproof gadgets should be used. Temporary sound barriers should be installed near sensitive locations near settlements and Forest area, of required Provision of ear-plugs to heavy machinery operators Plantation along the DFC should be maintained.	Construction Contractor /EMU	SPCB / SDOE/ EMU /CS
6.	Land Subsidence	Plantation must be carried to control erosion	Construction Contractor	EMU/ CS
7.	Bottom Sediment	Silt fencing may be provided to avoid runoff into the river. Construction activity should be taken in dry season to avoid spreading of construction material and minimize impact on water quality	Construction Contractor	EMU/ CS
Operation Phase				
1.	Maintenance Plantation	Provision for maintenance of plantation must be made for at least three years. Plantation may be taken to replace dead sapling. Survey of survival of plants may be taken annually. Lopping of branches may be undertaken to remove obstruction, if any	EMU	DFCCIL
2.	Air Quality	Plantation should be conduct and maintained along DFC. Green belt development with proper specifies should be undertaken on priority basis. AAQ monitoring at all Junction station sites and along DFC under the guidance of SPCB	EMU	SPCB / SDOE (State Department of Environment)
3.	Water Quality	Waste Collection facility should be provide at all Junction station Proper drainage system should be provided at all Junction station	EMU	SPCB / SDOE (State Department of Environment)

S. No.	Environmental Issue	Action to be Taken	Implementation By	Supervision By
		Water quality monitoring at the Junction station stations under the directives of SPCB		
4.	Noise & Vibration	Noise and Vibration monitoring may be conducted in operation phase at Sensitive Receptors (SRs) mentioned in Chapter-7.	EMU	SPCB / SDOE (State Department of Environment)

10.5 ENVIRONMENTAL MONITORING

The environmental monitoring shall be undertaken during construction and operation phases as per the following details:

Table 10.2: Proposed Monitoring Programme

Construction Phase

S. No.	Environmental Component	Parameter	Standards	Location	Frequency	Implementation	Supervision
1	Air Quality	SPM, RPM, CO, NOx, SOx	CPCB standards	Stretch of DFC in progress near settlements and junctions stations. The preferred locations are Kanchosi, Metha, Achalda, Choharpur, Samoha, Rura, Ekdil, Naglakat	3 times in a year (once in every season except monsoon) during construction period	DFCCIL through contractors	CS/EMU
2	Water Quality	As per IS:10500 standards	CPCB standards	Near water bodies and construction camps	Once in three months during construction period	DFCCIL through contractors	CS/EMU
3	Noise	Noise level on dB (A) scale	CPCB standards	Junction & stations and settlements along DFC. The preferred locations are Kanchosi, Metha, Achalda, Choharpur, Samoha, Rura, Ekdil, Naglakat	4 times in a year (once in every season during construction period	DFCCIL through contractors	CS/EMU
4	Soil Quality	Parameters are NPK, Sodium Absorption Ratio, Oil & Grease	CPCB Standards	Junction & stations and settlements along DFC. The preferred locations are Kanchosi, Metha, Achalda, Choharpur, Samoha, Rura, Ekdil, Naglakat	Once in a year during construction period	DFCCIL through contractors	CS/EMU

Operation Phase							
1	Noise	Noise level on dB(A) scale	CPCB standards	Junction & stations and SR along DFC The preferred locations are Kanchosi, Metha, Achalda, Choharpur, Samoha, Rura, Ekdil, Naglakat	4 times in a year (once in three months)	DFCCIL through contractors	CS/EMU

2	Vibration level	Vibration on dB scale respectively	-	Junction & stations and SR along DFC The preferred locations are Kanchosi, Metha, Achalda, Choharpur, Samoha, Rura, Ekdil, Naglakat	4 times in a year (once in three months)	DFCCIL through contractors	CS/EMU
3	Plantation	Survival rate	Survival rate may be calculated annually	At compensatory afforestation site and along DFC	Annually for 3 years	DFCCIL through contractors	CS/EMU

10.6 ORGANIZATIONAL FRAMEWORK

The proposed project will be implemented by DFCC through its Environmental Management Unit (EMU). The EMU will be coordinating with the field level implementing agencies such as the Engineer (Supervision Consultant), Contractor and field level DFCC officials. Role and responsibilities of important officials is mentioned below.

Table 10.3: Roles and Responsibilities of Officers

Officer	Responsibility
General Manager (SEMU)	• Overview of the project implementation • Ensure timely budget for the EMP. • Coordination with different state level committee, to obtain regulatory clearances. • Participate in state level meetings • Monthly review of the progress. • Reporting to various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation
Chief Project Manager (DFCC)	• Overall responsible for EMP implementation • Coordination with PIU Staff (EMU & DFCC). • Responsible for obtaining regulatory Clearances • Review of the progress made by contractors • Ensure that BOQ items mentioned in EMP are executed as per Contract provisions.
Environmental Officer (PIU)	• Assisting CPM in overall implementation of EMP • Review of periodic reports on EMP implementation and advising Project Director in taking corrective measure. • Conducting periodic field inspection of EMP implementation • Assisting GM (SEMU) to reporting various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation • Preparing environmental training program and conducting the same for field officers and engineers of contractor.
Engineer (Supervision Consultant)	• Act as an “Engineer” for supervising EMP implementation • Responsible for maintaining quality of EMP envisioned in detail Project Report • Maintaining progress reports on EMP implementation • Periodic reporting to PIU-DFCC about the status of EMP implementation • Work in close coordination with Asst. Project Manager (package unit) and contractor.
Deputy Chief Project Manager	• Conducting need-based site inspection and preparing compliance reports and forwarding the same to the Environmental Management Unit (EMU) • Programming necessary training program on environmental issues.
Asst. Project Manager (Environment)	• Working as site-representative of Chief Project Manager • Conducting regular site inspection to all onsite and offsite works • Maintaining records of all necessary statutory compliance, to be obtained from contractor. • Maintaining records of EMP implementation including photographic records • Attending environmental and social training programs • Preparing periodic reports on EMP implementation and forwarding

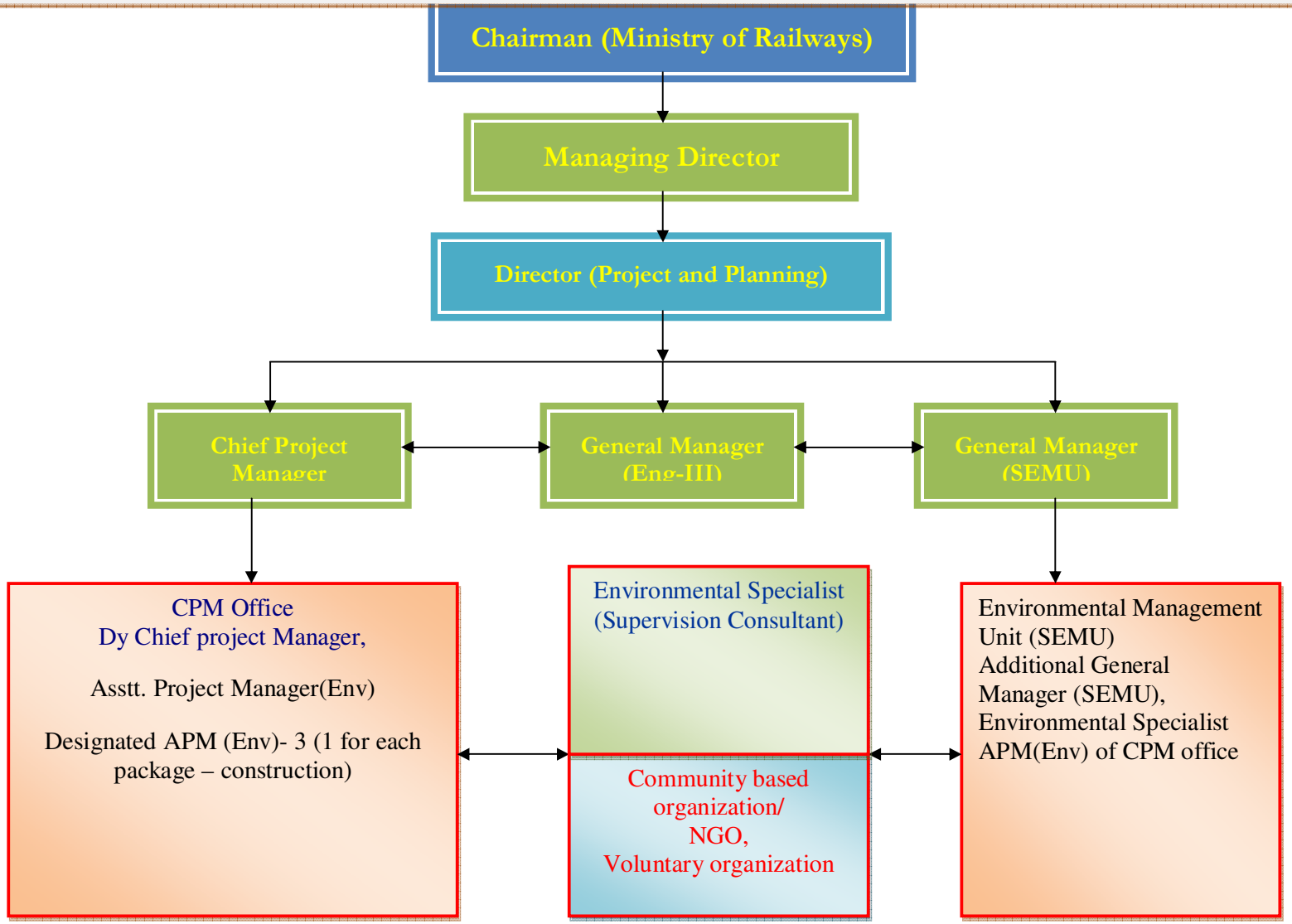
	to EE • APM (Env) will functionally report to GM/SEMU at DFCCIL HQ
Designated APM (Env)	• Will be responsible for field activity during construction period • Report to APM(Env) of CPM's office
Environment & Safety Manger of Contractor	• As detailed below

For ensuring that EMP is implemented as per provision in the document, Contractor shall nominate a qualified and experienced Environmental Specialist from the commencement to completion of the project.

The responsibilities of Environment & Safety Manager of Contractor will include the following:

- Directly reporting to the Project Manager of the Contractor;
- Discussing various environmental/social issues and environmental/social mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
- Prepare Contractor's Checklist, traffic management plan and safety plan as part of their Work Program;
- Ensure Contractor's compliance with the ESMF stipulations and conditions of statutory bodies;
- Assist the project manager to ensure social and environmentally sound and safe construction practices;
- Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers along with sensitization on social issues that may be arising during the construction stage of the project;
- Preparing a registers for material sources, labour, pollution monitoring results, public complaint/grievance redress, and as directed by the Engineer;
- Assisting the DFCC on various environmental monitoring and control activities including pollution monitoring; and
- Preparing and submitting monthly/bio-monthly reports to DFCC on status of implementation safeguard measures.
- Will be responsible for getting and maintaining the approvals or clearance for various departments and Environmental officer .

ORGANIZATION FRAMEWORK PIU-DFCC



10.7 ENVIRONMENTAL BUDGET

The cost of compliance of environmental issues must be included in the Bill of Quantity for the implementation of EMP, although most of the aspects will be covered under the head engineer such as: -

- Embankment
- Shine boards along construction sites
- Noise barrier
- Underpass for animals
- Culverts for irrigation canals

However, there are issues that are independently covered under the Environmental Budget such as plantation along DFC, monitoring, enhancement measures, noise barrier, sanitation facility at labour camp, and solid waste disposal at site. The shifting and enhancement cost of sensitive receptors such as temple, majar, school, hospital etc shall be covered in R & R under community development. Mitigation measures proposed in the EMP will be implemented by the contractor. The works to be undertaken by the contractor have been quantified and the quantities included in the respective BOQ items such as earth works, slope protection, noise barriers, road safety features and shrub plantation.

Provisional quantities have also been included for additional measures that may be identified during construction and for site fencing, which will depend on the contractors work methods and site locations. Items and quantities have also been included for enhancement measures.

More general environmental management measures to be followed by the contractor have been included in the specifications and in this EMP. These cannot be quantified and are to be included in the contract rates.

The budgetary provisions for the implementation of the environmental management plan of the project are presented in **Table 10.4**.

Table 10.4: Cost Estimates for Environmental Management

Sl. No.	Item	Unit	Rate (in '000 INR)	Quantity	Cost (in '000 INR)	Remarks
A. PRE-CONSTRUCTION PHASE						
1.	Tree Felling Permission	Number	-	1966	-	Covered under regulatory clearances
2.	Forest Clearance and land diversion cost	Ha	-	7.36	-	Covered under forest clearances
3.	Forest land Diversion Cost					
4.	Acquisition of land required for acquisition	Ha	-	1182	-	Covered under project cost
5.	Utility Shifting	-	-	-	-	Covered under regulatory clearances, engineering cost
6.	Compensation for CPRs	Lump sum	-	-	10700	Covered under project cost
B. CONSTRUCTION PHASE						
1.	**Mitigation Measures other than Good Engineering practices**					
1.1	Oil interceptors	Number	6	8	48	Will be provided near storage, vehicle repair section in construction camp
1.2	Soak pits for construction camp	Number	5	16	80	
2.	**Tree Plantation and Protection**					
2.1	**Avenue plantation including compensatory plantation**					
2.1.1	Plantation and maintenance of saplings for 3 years	Number	1	5000	5000	
2.1.2	Half brick circular tree guard	Number	0.5	5000	2500	
3.	**Monitoring of Environmental Attributes during Construction Phase**					
3.1	Monitoring of Air Quality	Per sample	5	48	240	3 x 8 x 2
3.2	Monitoring of Water Quality	Per sample	4	64	256	4 x 8 x 2
3.3	Monitoring of Noise Level	Per sample	5	64	320	4 x 8 x 2
3.4	Monitoring of Soil Quality	Per sample	6	8	48	1 x 8
C. ITEMS COVERED UNDER THE RAP BUDGET						
1.	Relocation of private properties					Covered under RAP Budget
2.	Relocation of private water points (wells, tanks, water taps and hand pumps)					
3.	Relocation of graveyards, statues, motor sheds					
4.	Relocation of other community assets including temples, majar, mosque, school etc.					

Sl. No.	Item	Unit	Rate (in '000 INR)	Quantity	Cost (in '000 INR)	Remarks
D. OPERATION PHASE						
1.	Monitoring of Noise Level	Per sample	5	64	320	Per year recurring cost
2.	Monitoring of vibration Level	Per sample	7	64	4480	Per year recurring cost
3.	Noise mitigation measures in form of noise barrier at sensitive receptors	m	6.5	1550	10075	
E. GOOD ENGINEERING PRACTICES						
1.	Dust suppression					Covered under contractors quoted rate under construction cost
2.	Erosion control measures (Turfing / Pitching / Seeding & Mulching)					
3.	Provision of cross drainage & side drainage structures					
4.	General borrow area management and maintenance of haul road related to borrow areas					
5.	Air / noise pollution control measures in construction equipments					
6.	Management and disposal of scarified waste bituminous material					
7.	Provision of informatory signs					
8.	Cattle crossings					
9.	Management of quarries					
10.	Redevelopment of borrow area					
11.	Construction camp management cost					
12.	Safety measures for workers					
F. TRAINING & MANPOWER						
1.	Training	Number	100	4	400	Twice in a year during construction period
2.	Provision of environmental expert	Number	100	24	2400	