

**Supplemental Environmental Impact Assessment
Report (Volume-I: Main Report)**

for

Mumbai-Ahmedabad High Speed Railway Project



National High Speed Rail Corporation Limited

(A Joint Venture of Government of India and Participating State Governments)

**Asia Bhawan, Plot No. 205, Sector-9,
Dwarka, New Delhi-110 077**

SEPTEMBER 2018

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Abbreviations

Abbreviations

<u>Abbreviation</u>	<u>Meaning</u>
ADB	: Asian Development Bank
AIDS	: Acquired Immune Deficiency Syndrome
ALT	: Alternative
APCCF	: Additional Principal Chief Conservator of Forests
APHA	: American Public Health Association
ASI	: Archaeological Survey of India
ATS	: Anti Terror Squad
ATP	: Auto Transformer Post
AWS	: Automatic Weather Station
AWWA	: American Water Works Association
BAU	: Business as Usual
BDI	: Biodiversity Index
BKC	: Bandra Kurla Complex
BOD	: Biochemical Oxygen Demand
CBR	: Crude Birth Rate
CBSE	: Central Board of Secondary Education
C&D	: Construction and Demolition
CDM	: Clean Development Mechanism
CDR	: Crude Death Rate
CEC	: Central Empowered Committee
CEL	: Centre for Environmental Law
CEPI	: Comprehensive Environmental Pollution Index
CEPT	: Centre for Environmental Planning & Technology
CFCs	: Chlorofluorocarbons
CGWA	: Central Ground Water Authority
CGWB	: Central Ground Water Board
CHC	: Community Health Centre
CISCE	: Council for the Indian School Certificate Examinations
CMP	: Conservation and Management Plan
CMR	: Child Mortality Rate
CPHEEO	: Central Public Health and Environmental Engineering Organisation
CPCB	: Central Pollution Control Boards
CRZ	: Coastal Regulation Zone
CTE	: Consent to Establish
CTO	: Consent to Operate
CUM	: Cubic meter
CWLW	: Chief Wildlife Warden
CWRA	: Central Wetland Regulatory Authority
CZMA	: Coastal Zone Management Authority
CZMP	: Coastal Zone Management Plans
DC	: District Collector
DFC	: Dedicated Freight Corridors
DFO	: Divisional Forest Officer
DGMS	: Director General of Mines and Safety
DNA	: Deoxyribonucleic Acid
DTEPA	: Dahanu Taluka Environment Protection Authority
DCF	: Deputy Conservator of Forests
DSS	: Distribution Substation

DyCCF	: Deputy Chief Conservator of Forests
ECR	: East Central Railway
EIA	: Environmental Impact Assessment
EMCBF	: Eastern Margin Cambay Basin Fault
EMCBF	: East Cambay Basin Boundary Faults
EMP	: Environmental Management Plan
EMoP	: Environmental Monitoring Plan
EPA	: Environment (Protection) Act
ERF	: Environment Relief Fund
ESA	: Eco Sensitive Area
ESCR	: Economic, Social, and Cultural Rights
ESM	: Enterprise Scheduling Management
ESZ	: Eco Sensitive Zone
FCA	: Forest Conservation Act
FEM	: Federal Equivalent Method
FRA	: French Railway Authority
FRM	: Federal Reference Method
FRU	: First Referral Unit
FS	: Feasibility Study
FSI	: Forest Survey of India
FTA	: Federal Transit Administration
GC	: General Consultants
GCZMA	: Gujarat Coastal Zone Management Authority
GHG	: Green House Gas
GPCB	: Gujarat Pollution Control Board
GRM	: Grievance Redressal Mechanism
GPSTPL	: GPS Technologies Pvt. Limited
GWP	: Global Warming Potential
HCFCs	: Hydrochlorofluorocarbons
HIV	: Human Immunodeficiency Virus
HSR	: High-Speed Railway
HSRC	: High Speed Rail Corporation Limited
HST	: High-Speed Train
HTL	: High Tide Line
IBA	: Important Bird Area
ICE	: Institutional Capacity Enhancement
ICESCR	: International Covenant on Economic, Cultural and Social Rights
IFC	: International Finance Corporation
ILO	: International Labour Organisation
IMD	: Indian Meteorological Department
IPP	: Indigenous Peoples Plan
ISR	: Institute of Seismological Research
ISRO	: Indian Space Research Organisation
JICA	: Japan International Cooperation Agency
JICC	: JIC Consortium
JBIC	: Japan Bank for International Cooperation
LEB	: Life Expectancy at Birth
LTL	: Low Tide Line
LU/LC	: Land Use / Land Classification
LPCD	: Liter Per Capita Per Day
MAHSR	: Mumbai-Ahmedabad High Speed Railway Project

MCZMA	: Maharashtra Coastal Zone Management Authority
MEEP	: Municipal Energy Efficiency Programme
MEMU	: Mainline Electric Multiple Unit
MF	: Membrane Filter
MMR	: Maternal Mortality Rate
MoEFCC	: Ministry of Environment, Forests and Climate Change
MoHFW	: Ministry of Health and Family Welfare
MoR	: Ministry of Railway
MPCB	: Maharashtra Pollution Control Board
MSI	: Mangrove Society of India
MSW	: Municipal Solid Waste
NAAAQS	: National Ambient Air Quality Standards
NABET	: National Accreditation Board for Education and Training
NABL	: National Accreditation Board for Testing and Calibration Laboratories
NACO	: National AIDS Control Organisation
NATM	: New Austrian Tunneling Method
NBWL	: National Board of Wildlife
NCZMA	: National Coastal Zone Management Authority
NDIR	: Non-dispersive Infra Red Absorption
NEP	: The National Environmental Policy
NFHS	: National Family Health Survey
NGO	: Non-Governmental Organization
NGT	: National Green Tribunal
NHSRCL	: National High Speed Rail Corporation Limited
NIC	: Nature Interpretation Centre
NIO	: National Institute of Oceanography
NMA	: National Monument Authority
NNM	: Neo-Natal Mortality
NNW	: North-North-West
NO	: Oxide of Nitrogen
NOC	: No Objection Certificate
NP	: National Park
NRHM	: National Rural Health Mission
NTU	: Nephelometric Turbidity Unit
NW	: North West
NWDA	: National Water Development Authority
ODS	: Ozone Depleting Substance
OHS	: Occupational Health and Safety
OP	: Operational Policy
PA	: Protected Area
PAP	: Project Affected Persons
PAS	: Public Address System
PCCF	: Principal Chief Conservator of Forests
PESA	: Panchayat Extent to Scheduled Area
PEL	: Permissible Exposure Limit
PF	: Protected Forest
PHC	: Primary Health Centre
PIU	: Project Implementation Unit
PMU	: Project Management Unit
PLHIV	: People living with HIV
PNNM	: Post Neo-Natal Mortality

PUC	: Pollution Under Control
PPE	: Personal Protective Equipment
PPP	: Public Private Partnership
PTFE	: Polytetrafluoroethylene
QCI	: Quality Council of India
RAC	: Resident Additional Collector
RAP	: Resettlement Action Plan
RCCF	: Regional Chief Conservator of Forest
RCS	: Replacement Cost Survey
RF	: Reserved Forest
RFO	: Range Forest Officer
RFP	: Request for Proposal
RO	: Regional Officer
ROR	: Records of Revenue
RoW	: Right of Way
RVNL	: Rail Vikas Nigam Limited
SAC	: Space Applications Centre
SADEC	: Station Area Development Expert Committee
SBWL	: State Board for Wildlife
SC	: Schedule Cast
SEM	: Social and Environmental Management Unit
SER	: Signaling and Telecommunication Equipment Room
SCZMA	: State Coastal Zone Management Authorities
SE	: Site Engineer
SIA	: Social Impact Assessment
S-EIA	: Supplemental Environmental Impact Assessment
SEMU	: Site Environment Management Unit
SGNP	: Sanjay Gandhi National Park
SHE	: Safety Health Environment
SHM	: Stakeholder Meeting
SP	: Sectioning Post
SPCB	: State Pollution Control Boards
SPL	: Sound Pressure Level
SPV	: Special Purpose Vehicle
SSA	: Sarva Shiksha Abhiyan
SSP	: Sub Sectioning Post
ST	: Schedule Tribe
STP	: Sewerage Treatment Plant
SWM	: Solid Waste Management
TBM	: Tunnel Boring Machine
TCLP	: Toxicity Characteristics Leaching Procedure
TCM	: Tetrachloromercurate
TCFS	: Thane Creek Flamingo Sanctuary
TDS	: Total Dissolved Solids
TERI	: Tata Energy Research Institute
TFR	: Total Fertility Rate
TO	: Tree Officer
TSDF	: Treatment, Storage & Disposal Facilities
TSS	: Total Suspended Solids
TSS	: Traction Substation
TWLS	: Tungreshwar Wildlife Sanctuary

UIC	: Union Internationale Des Chemins
ULB	: Urban Local Bodies
UMLC	: Unmanned Level Crossing
UNFCCC	: United Nations Framework Convention on Climate Change
USDA	: United States Department of Agriculture
VCTC	: Voluntary Counseling and Testing Centres
WB	: World Bank
WFF	: World Forum of Fish Harvesters and Fish Workers
WHO	: World Health Organization
WLS	: Wildlife Sanctuary
WMCBF	: West Cambay Basin Boundary Fault
WNW	: West-North-West
WPCF	: Water Pollution Control Federation
ZOI	: Zone of Influence
ZSI	: Zoological Survey of India

Symbols and Units of Measurement

<u>Symbol</u>	<u>Meaning</u>
<	: less than
≤	: less than or equal to
>	: greater than
≥	: greater than or equal to
%	: per cent
amsl	: above mean sea level
bgl	: below ground level
Ca CO ₃	: calcium carbonate
CH ₄	: methane
cm	: centimetre
CO	: carbon monoxide
CO ₂	: carbon
Cu	: copper
dB	: decibel
dB(A)	: decibel A-weighted
µg/m ³	: micrograms per cubic metre
GHz	: gigahertz
ha	: hectare
hPa	: hectopascal
hr	: hour
Hz	: hertz
kg	: kilogram
KLD	: kilolitre per day
km	: kilometre
kmph	: kilometre per hour
km ²	: square kilometre
kV	: kilovolt
kV/h	: kilovolts per hour
kWh	: kilowatt hour
µm	: micrometre
m	: metre

m ²	: square metre
m ³	: cubic metre
m/s	: metre per second
mm	: millimetre
mm/s	: millimetre per second
min	: minutes
mbgl	: Meter below ground level
mg/kg	: Miligram Per Kilogram
ML	: Million Litre
MLD	: Million Litre Per Day
MW	: megawatt
N	: nitrogen
Ni	: nickel
NO	: nitrogen oxide
NO ₂	: nitrogen dioxides
NO _x	: oxides of nitrogen
O ₂	: oxygen
PA	: per annum
Pb	: lead
PAX	: passenger unit
pH	: potential of hydrogen
pkm	: passenger kilometre
PM	: particulate matter
PM ₁₀	: particulate matter >2.5μ and <10 μ
PM _{2.5}	: particulate matter <2.5μ
PPV	: peak particle velocity
PV	: photo voltic
SO ₂	: sulphur dioxide
TJ	: trillion jules
T	: tonne
V	: volt
Zn	: zinc

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Executive Summary

Supplemental Environmental Impact Assessment (S-EIA) Report

ES.1 RATIONALE AND BACKGROUND

The Ministry of Railways (MoR), Government of India, released, The Indian Railways' VISION 2020 which envisages a two-pronged approach to bring High Speed Rail (HSR) in the country. The first strategy involves using conventional technology to increase the existing speed from 80-100 kmph to 160-200 kmph on segregated passenger corridors on trunk routes. The second approach involves identifying viable intercity routes to build advanced high speed corridors for speeds up to 350 kmph. The proposed "Diamond Quadrilateral" HSR network will link the four major metro cities of India. These are mainly high-density corridors and range from 135-991 km in length. These plans target building four corridors of 2,000 km by 2020 and planning for eight other corridors. These interventions are expected to deliver significant economic, social and environmental benefits. In this report, the benefits for energy security and mitigation of CO₂ emissions are analyzed, thereby contributing to the understanding of the impacts of HSR.

An Expert Committee constituted on Modernization of Indian National Railway in 2012 submitted its recommendation in Section 8 under High Speed Passenger Train Corridors, *"Paragraph 8.1 - Construct a High Speed railway line between Mumbai and Ahmedabad with speed of 350 kmph. This would lead to increased connectivity, traffic and faster intercity travel."*

In furtherance of the plan, Ministry of Railway has decided to implement first High Speed Rail Corridor between Mumbai and Ahmedabad- named as Mumbai-Ahmedabad High Speed Railway (MAHSR) Project.

India has inched closer to getting a bullet train of its own after Hon'ble Prime Minister Shri Narendra Modi and his Japanese counterpart HE Shinzo Abe laid the foundation for a high-speed train network. Both heads of state announced the launch of Mumbai-Ahmedabad high-speed rail (MAHSR) project in Sabarmati on 14th September, 2017. It will cost Rs 1.08 lakh crore to see this ambitious project through.

This Executive Summary has been prepared as a stand-alone extract of the S-EIA Report but also includes references to relevant sections in the S-EIA Report and its Annexures (Vol-II). The information presented in this Executive Summary as well as the S-EIA report is based on the findings of the study team¹.

ES.2 NEEDS AND IMPORTANCE OF THE PROJECT

Maharashtra and Gujarat are one of the most industrialized and affluent States of India with tremendous movement of goods and passengers between them. By 2050, it is predicted that the travel demand between Mumbai and Ahmedabad will reach 58.2 billion Passenger Kilometer (pkm) – an increase of four and half times from 2010 levels. The existing modes of

¹ The study team comprising the following organizations:

- GPS Technologies Pvt. Ltd: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

transport are unable to meet such surging demand or to reduce the travel time resulting in economic loss, loss of productivity and green house emissions.

ES.3 BENEFITS OF THE PROJECT

The major benefits envisaged are:-

- Reduction in travel time between Mumbai and Ahmedabad from 6.5 hrs to 2.5 hrs.
- High carrying capacity of about 1000 passenger per train.
- Dedicated corridor enables high frequency of operations.
- Major connectivity boost to less developed areas along the corridor, such as Palghar & Valsad with major cities like Mumbai, Ahmedabad and industrial towns like Vapi and Bharuch.
- Potential for development of new production bases and townships along the corridor.
- Boost to construction activity, technological enhancement of Railways, long term infrastructure development.
- Creation of temporary and permanent employment. The construction phase will employ about 20,000 people. Operations and Maintenance will employ approximately 4,000 people and about 16,000 indirect jobs are also expected to be generated.
- Decongestion of conventional rail, road, and air traffic between Mumbai and Ahmedabad
- Reduction in Green house gas emissions due to more efficient transport option.
- Development of State of the Art manufacturing and software ecosystem. The Japan External Trade Organization(JETRO) will be assisting the Indian government in identifying potential areas for 'Make in India' localization.

ES.4 IMPLEMENTING AGENCY

The Government of India has created a Special Purpose Vehicle (SPV)- National High-Speed Rail Corporation Limited (NHSRCL), a Joint Venture of the Government of India and participating State Governments for implementing all stages of MAHSR project development from planning to execution, construction, operation and maintenance.

The MAHSR project, qualifies (vide a letter from Ministry of Railway, dated February 15, 2018) to be designated as a 'non-Governmental Railway' within the meaning of the Section 2(25) of the Railway Act, 1989 and the Managing Director, NHSRCL as 'Railway Administration' under Section 2(32) of the Railway Act, 1989.

ES.5 PROJECT LOCATION

The MAHSR alignment of 508.17 km, begins at Bandra Kurla Complex (BKC) in Mumbai Suburban District and runs through Thane and Palghar districts of Maharashtra and then enters Gujarat in Valsad district. It runs a short course of 7.358 km through the UT of Dadra & Nagar Haveli and then re-enters Gujarat and runs through Navsari, Surat, Bharuch, Vadodara, Anand, Kheda and Ahmedabad districts of Gujarat before terminating at Sabarmati. The planned route lies between Latitude 19°03'58.52"N-Longitude 72°05'47.48"E and Latitude 23°05'39.78" N-Longitude 72°34'33.48"E.

The alignment is proposed on elevated viaduct, bridges and underground tunnels. There are 8 tunnels of 26.203 km with the longest tunnel being 20.375 km under sea at the Thane Creek. There are 23 bridges with total length of 6.421 km. The rest of alignment, 474.834 km is on viaduct. The location and extent of the MAHSR project is shown in Exhibit ES.1. Twelve stations have been proposed as given in Table ES.1.

Table: ES.1: Proposed Stations along MAHSR

S. No	Stations	Geo Co-ordinates
1	BKC, Mumbai	19° 04'02.84"N, 72°51'54.10"E
2	Thane	19°11'43.87"N, 73° 03'36.37"E
3	Virar	19°26'11.52"N, 72°50'18.43"E
4	Boisar	19°47'11.67"N, 72°46'32.10"E
5	Vapi	20°20'03.45"N, 72°56'55.84"E
6	Bilimora	20°45'57.63"N, 73°0 0'25.74"E
7	Surat	21°10'31.81"N, 72°56'09.39"E
8	Bharuch	21°41'43.50"N, 72°57'6.43"E
9	Vadodara	22°18'39.61"N, 73°10'47.31"E
10	Anand	22°38'52.21"N, 72°53'26.40"E
11	Ahmedabad	22°01'37.22"N, 72°36'08.85"E
12	Sabarmati	23° 04'29.12"N, 72°35'16.10"E

Source: Study Team

Exhibit ES.1: Index Map of MAHSR Project



Source: Study Team

ES.6 PREPARATION OF EIA

M/s GPS Technologies Private Limited, New Delhi in association with Amaltas Enviro Industrial Consultants LLP. (NABET Certificate No. NABET/EIA/1518/IA 0017) were appointed to conduct S-EIA study to review the EIA Study of joint feasibility study, assess further environmental impacts anticipated due to the construction and operation of the proposed MAHSR project and

associated facilities (Construction Yard, Railway Stations and Maintenance Depots *etc.*), and propose mitigation measures along with an environmental management and monitoring plan.

ES.7 LENDER'S CLASSIFICATION AND REQUIREMENTS FOR MAHSR PROJECT

The MAHSR project is being developed based on an official development loan from the Japan International Cooperation Agency (JICA). To encourage the appropriate consideration of environmental and social aspects in all the projects that it supports, JICA has established Environmental and Social Guidelines in April 2010.

The MAHSR project is categorised as **Category A²** as per JICA's Guidelines for Environmental and Social Consideration, April 2010.

In line with JICA's Guidelines for E&S Considerations, the following international requirements have also been followed, as relevant to the project:

- International Finance Corporation's (IFC) Performance Standards, 2012;
- EHS Sector Guidelines of IFC, 2007 (for Railways);
- General EHS Guidelines of IFC, 2007;
- World Bank Environmental and Social Safeguard Policies (R2012-0130; IDA/R2012-0161).

ES.8 ENVIRONMENTAL REGULATORY REQUIREMENTS

The MAHSR project does not attract requirements of prior Environmental Clearance (EC) as per EIA Notification, 2006 as the Railway sector is not included in the Schedule I of the notification.

However other regulatory clearances related to diversion of forest land or approvals for forest land, mangroves and wildlife (protected) areas, tree felling in various land types, coastal regulation zone will be relevant as applicable to specific sections of the alignment passing through such areas.

Other requirements (Environmental, Occupational Health & Safety as well as Labour laws) based on various Central, State and Gram Panchayat level regulation will apply (as relevant) during the construction and operational phases.

All these regulatory requirements have been addressed in the S-EIA report and responsibility allocation for compliance has been included in the EMP as well as project bid documents.

ES.9 OBJECTIVE OF S-EIA STUDY

S-EIA is supplementary to the F/s stage EIA Study and has been prepared to incorporate the revisions made in the proposed alignment, new features at the detailed design stage, compliance with recent environmental regulation and national guidelines. JICA's Environmental

²Proposed projects are classified as Category A, if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A.

and Social Consideration Guidelines, April 2010 also mandate an EIA study for Category A projects.

During the F/s stage, EIA Study was undertaken as a prerequisite for the primary impact assessment of the project in accordance with the JICA Guidelines. The output of the present EIA Study is the supplementary EIA, that is, S-EIA Report, which forms the basis for the appraisal and final approval of the MAHSR project by JICA.

ES.10 SCOPE OF S-EIA STUDY

The EIA Study has been conducted in accordance with the Guidelines of Ministry of Environment, Forest and Climate Change (MoEFCC), Environmental and Social Considerations, 2010 of JICA, regulations notified by the States of Maharashtra and Gujarat and Union Territory of Dadra and Nagar Haveli and the Terms of Reference issued by the JICA (RFP document for Environmental Consultancy Services for MAHSR Project for Detailed Design). Further details have been provided in Section 1.6, Chapter 1 of the S-EIA Report.

ES.11 PROJECT PROFILE

The proposed MAHSR alignment starts at the BKC, Mumbai, Maharashtra and ends at Sabarmati in Gujarat. The total length of MAHSR alignment is 508.17 km consisting of tunnels, viaducts, bridges and embankments. The salient features of MAHSR project are given in Table ES.2.

Table ES.2: Salient Feature of MAHSR Project

Project Component	Description
Right of Way	12.5m to 17.5 m
Tunnel	8 tunnel sections totaling 26.203 km to be constructed with NATM and TBM (largely used) Technology. The longest tunnel is 20.375 km passing undersea (30m depth) at Thane Creek.
River Crossings	23 locations consisting of major rivers, tributaries and <i>nallahs</i> .
State and national Highways Crossing	The alignment crosses Expressways, National Highways, State Highways, and other district roads, village roads, etc. at 21 locations.
Railway Crossings	The MAHSR crosses the existing Indian Railway network and the upcoming Dedicated Freight Corridor at 25 locations.
Maintenance Depots	8 maintenance depots are proposed along the corridor.
Rolling Stock Depots	2-Rolling Stock Depots are proposed at Thane and Sabarmati.
Construction Yards	At every 25 km along the alignment.
Viaduct	The elevated viaduct is approximately 474.834 km in length. The ground elevation of the viaduct is 10-12 m and the width is 12.5 m for dual carriageway.
Technical Feature	
Rolling Stock	E5 Series Shinkansen on a <i>Hayabusa</i> service, March 2011
Manufacturer	Hitachi, Kawasaki Heavy Industries
Capacity	731 (658 Standard, 55 Green, 18 Gran Class)
Operator(s)	JR East
Specification	

Project Component	Description
Car body construction	Aluminium alloy
Train length	253 m (830 ft)
Car length	26,500 mm (86 ft 11 in) (end cars) 25,000 mm (82 ft 0 in) (intermediate cars)
Width	3,350 mm (11 ft 0 in)
Height	3,650 mm (12 ft 0 in)
Doors	E514: one per side plus one cab access door per side E515: one per side E523: two per side plus one cab access door per side Other intermediate cars: two per side
Maximum speed	320 km/h (200 mph)
Weight	453.5 t (446.3 long tons; 499.9 short tons)
Traction system	MT207 AC traction motors (300 kW)
Power output	9,600 kW (12,870 HP)
Acceleration	1.71 km/(h·s) (0.48 m/s/s)
Electric system(s)	25 kV AC, 50 Hz overhead catenary
Current collection method	Pantograph
Bogies	DT209 (motored), TR7008 (trailer)
Braking system(s)	Regenerative
Safety system(s)	DS-ATC
Track gauge	1,435 mm (4 feet 8½ in)

Source: Study Team

ES.12 ANALYSIS OF ALTERNATIVES

Various project alternatives were analyzed to avoid and reduce adverse environmental and social impacts as far as practically possible, during the feasibility, planning and design stage, by the design team including engineers, environmental and social experts. This is reflected in the finalization of the cross sections, construction methods, construction materials and alignment.

Key alternatives chosen include:

- Route optimization and siting of ancillary facilities like maintenance depot, traction substations (TSS), distribution substations (DSS), sectioning post (SP), sub-sectioning post (SSP), auto transformer post, HSR stations, slipways, electricity substations, access roads so as to avoid/minimize environmentally and socially sensitive areas (such as forests and mangroves, sanctuaries, hospitals, schools, densely populated areas, etc.);
- Embankment option changed to Viaduct, thus substantially reducing the Right of Way (RoW) and subsequent requirements of land acquisition;
- Elevated viaduct also ensures continuity within pier spans, without any physical severance on ground across the alignment, allowing free movement for local community, livestock as well as wildlife;
- Japanese Shinkansen technology chosen, which is one of the most optimal among HSR, as regards noise emissions and energy efficiency (lower GHG emissions).

ES.13 DESCRIPTION OF THE ENVIRONMENT IN THE PROJECT AREA

The status of the existing environmental baseline in the project area (an impact zone of influence of 250 m on both sides of the centerline was considered for the purpose of the S-EIA) is described below:

Environmental Attributes	Finding of the S-EIA Study
Physical Environment	
Location of the Project	<p>Geo-Coordinates: The planned route is located between Latitude 19°03'58.52"N-Longitude 72°05'47.48"E and Latitude 23°05'39.78" N-Longitude 72°34'33.48"E.</p> <p>Mean Sea Level of project areas between 0 to 168 m</p> <p>The length of MAHSR project is 508.17 km</p> <p>Passing through the states of Gujarat, Maharashtra and union territory of Dadra & Nagar Haveli</p> <p>MAHSR starts from BKC, Mumbai close to Mithi River (km 0.00) in Mumbai and traverses through the districts Mumbai, Thane, Palghar, Silvassa (DNH), Valsad, Navsari, Surat, Bharuch, Vadodara, Anand, Kheda and Ahmedabad (km 508.17).</p>
Physiography and Terrain	<p>The topography of the study area can be bifurcated into two regions. The first part towards Mumbai- having undulated and coastal area while the second one, falling in the Gujarat region having plain with minor undulation. The majority of the alignment runs through plain, coastal plain and rolling terrain.</p>
Drainage	<p>Geographically, Mumbai is an island outside the mainland of Konkan separated from it by narrow Thane Creek and a somewhat wider Harbor Bay. At present, it covers the original island group of Mumbai and most of the islands of Salsette with the former Trombay island appended to it in its Southeast.</p>
Soil	<p>All rivers except Tapi, Narmada and Mahi originate in the eastern hilly tract. The rivers flow with highly meandering courses in westerly direction and cut across the alluvial plains. The flow directions of the rivers are dominated by tectonic activities e.g. Rivers like Narmada and Tapi flows through rift valleys along the Vindhyan and Satpura range in a westerly direction. There are many other small and medium streams cutting across the alignment.</p> <p>The project area has four types of soils ranging from moderately well drained to poorly drain, acidic to slightly alkaline and medium to high textured. The soils are primarily belonging to deep black soil, coastal alluvial, medium black soil and grey brown soil. Alluvial soil is found along riverbed, which is used for agriculture. Sandy soil is also found in the riverbeds. The coastal plain of project area is composed of alluvial clays with a layer of black soil on the surface.</p>
Geology and Seismology	<p>Geologically, the MAHSR alignment can be divided into two segments - Paleogene sedimentary rocks of Maharashtra, Vindhyan formation and Alluvial plains of Gujarat. On perusal of Seismic Zoning Map of India, 2002, entire MAHSR alignment falls in the intensity Zone-III as per IS 1893:2002. Zone -III represents area of moderate risk zone.</p>
Landscape	<p>The landscape of Maharashtra region of the study area is undulated with many hillocks with rich vegetation, forests and coastal plains while the landscape of the area in Gujarat shows plain agricultural land with minor undulation.</p>
Land Use	<p>The land use pattern indicates that 76.94 % of the zone of influence is agricultural land followed by built-up area of 15.71%.</p>
Ground Subsidence	<p>Most of the alignment passes through the basaltic rock or black cotton soil. The ground water extraction is minimal in the cities of proposed stations. Boring</p>

Environmental Attributes	Finding of the S-EIA Study
Climate	<p>surveys indicate the ground water level lower than 8 m, with only small water content existing in and around the surface layer.</p> <p>As per Koppens classification, climate of Gujarat and Dadra & Nagar Haveli is semi arid steppe (hot) type and that of Maharashtra as Tropical Wet-Dry or Savanna type. The climatic parameters have been discussed individually further. The details are explained in Section 4.8 of Chapter 4 of the Report.</p>
Climate Change	<p>Rise in sea level is anticipated during the project life cycle of 100 years at the 7 Coastal Regulation Zone along the alignment.</p>
Water Use/Demand	<p>In the Construction Phase – approximately 24.8 MLD and in Operational Phase – approximately 4.11 MLD water demand is envisaged. The demand will be distributed along the alignment, at the stations, construction camps, maintenance depots, rolling stock etc.</p>
Water Quality	<p>Surface Water The result of analysis of surface water (river and estuarine water) indicate that the locations in the vicinity of urban area are contaminated with domestic as well as industrial pollution and at several locations the water quality exceeds the threshold limits. (Refer Section 4.13 of Chapter 4)</p> <p>Ground Water On perusal of the results presented in the Table 4.13.3 (i) and Table 4.13.3(ii) of Annexure 4.13, Vol-II, it may be inferred that the Total Dissolved Solids and Chlorides in GW are little higher than the permissible limits in GW5 sample from Vasai in Thane District of Maharashtra. All other parameters were found within the permissible limit of the Indian Standard for the Drinking Water Quality- IS: 10500-2012. Some of the vital parameters are above permissible / desirable limits.</p>
Water Body	<p>There are 32 ponds/stagnant water body other than rivers, nallahs and estuaries.</p>
Air Quality	<p>Ambient Air Quality monitoring was carried out at 12 locations during the study. The results indicate that the air pollutants were higher than prescribed NAAQS standards at a few urban locations in the study area and the air quality in the rural areas is well within the limits.</p> <p>PM₁₀ and PM_{2.5}: Ahmedabad, Valsad and Sabarmati have the highest PM₁₀ and PM_{2.5} of all locations and higher than NAAQS standards. The PM₁₀ and PM_{2.5} though are less than NAAQS standards at other locations but quite close to it.</p> <p>SO₂ and NO_x: were found to be lower than NAAQS standards at all the locations.</p> <p>CO: was measured to be higher than NAAQS standards at multiple locations including BKC, Surat, Bharuch, Vadodara and Anand. It is pertinent to mention that these locations are Industrial belts/Urban areas.</p>
Noise	<p>The noise levels were measured at 31 locations. L_{eq} value varied between 43.4 dB(A) to 80.1 dB(A) among all locations. L_{Day} and L_{Night} value varied between 44.1 dB(A) to 81.2 dB(A) and 32.2 dB(A) to 65.3 dB(A) respectively. The highest L_{eq} value 80.1 dB(A) was recorded at Bandra Kurla Complex (BKC) due to proximity of plying vehicles and running of various equipment while the lowest L_{eq} 43.4 dB(A) was recorded at Kholvad in Surat, a slum area. The highest L_{Day} 81.2 dB(A) was recorded again at Bandra Kurla Complex (BKC) and lowest value of L_{Day} 44.1 dB(A) at Kholvad. The existing ambient noise was higher than prescribed standards at multiple locations in MH & GJ especially in Urban areas, during both day and night.</p>

Environmental Attributes	Finding of the S-EIA Study
Vibration	<p>The existing ground borne vibration (peak particle velocity) at all locations ranged between zero to 0.230 mm/sec. The highest vibration level was recorded at Ahmedabad, near the Railway track at 0.230 mm/sec during the passing of Rajdhani Express. It was pertinent to mention that at location NV108 in Vadodara city, which is in close proximity to the railway track and superfast trains regularly pass, cracks were noticed in the walls of the first row of the houses. The residents confirmed that the crack was due to the effect of ground borne vibration of the passing trains.</p>
Ecology	<p>Forest</p> <ul style="list-style-type: none"> • Tropical Moist Deciduous • Tropical Dry Deciduous • Tropical Thorn • Littoral and Swamp <p>Critically Polluted Area</p> <ol style="list-style-type: none"> 1. Vapi 2. Ankleshwar <p>Flora</p> <p>In addition of the orchids there are various kinds of non-fruit trees, bushes and grasses. Different types of trees were observed along the alignment during the field visit. These trees mainly consists of <i>Agle marmelos</i> (Bel), <i>Mangifera indica</i> (Amba), <i>Spondias pinnata</i> (Ambadi), <i>Emblica officinalis</i> (Amla), <i>Bridellia retusa</i> (Asan), <i>Himenodictyon obovatum</i> (Bhorsal), <i>Bauhinia lawii</i> (Chamel), <i>Anogissus latifolia</i> (Dhamoda), <i>Randia Uliainosa</i> (Gogda), <i>Anacardium occidentale</i> (Kaju), <i>Garuga pinnats</i> (Kakad), <i>Madhuca indica</i> (Mahudo), <i>Ficus rumphii</i> (Payar), <i>Casuarina equisetifolia</i> (Saru), <i>Oroxylum indicum</i> (Tetu), and <i>Ficus bengalensis</i> (Vad). The list of common Flora in the project area is given in Table 4.15.12 in Annexure 4.15, Vol-II.</p> <p>Fauna</p> <p>The domestic animals reported in the study area are mainly mammals and listed in Table 4.15.13 (Refer Annexure 4.15, Vol-II). In absence of natural forest (National Parks and Sanctuary other than SGNP, TWLS, TCFS), there is a dearth of wild animals in the study area. A list of avifauna, reptiles, amphibians and rodents based on information gathered from local enquiries and State Forest Department is presented in the Table 4.15.14 (Refer Annexure 4.15, Vol-II).</p>
Protected Areas	<p>The MAHSR alignment passes through the eco-sensitive zone (not core area) of two Protected Areas, namely Sanjay Gandhi National Park (SGNP), Tungareshwar Wildlife Sanctuary (TWLS) on viaduct and Core Zone & ESZ of Thane Creek Flamingo Sanctuary (TCFS) through tunnel, 30 m below the creek bed. The alignment is entirely underground in TCFS and no physical changes in the sanctuary area shall take place.</p> <p>Application for permission required from Standing Committee of NBWL/SBWL has been submitted on 18-May-2018.</p> <p>Apart from the PAs, the MAHSR alignment passes through the Dahanu Taluka ecologically fragile area located in Palghar district. NOC is required before commencement of construction activities from Dahanu Taluka Environment Protection Authority (DTEPA).</p>

Environmental Attributes	Finding of the S-EIA Study
Sensitive Locations	Apart from the protected areas, the MAHSR alignment also intersects number of sensitive locations like temples, mosque, Eidgah, churches, educational institutions, hospitals etc.
	A comprehensive list of the sensitive locations has been prepared and presented in Table 4.17.1 in Annexure 4.17, Vol-II .
CRZ Locations	<p>The MAHSR alignment passes through the CRZ at seven locations (6 in Maharashtra and 1 in Gujarat)</p> <ol style="list-style-type: none"> 1. Mithi River- BKC, Thane, Maharashtra (Cat III & IVB) 2. Thane Creek, Thane, Maharashtra (Cat IA & IVB) 3. Ulhas River-Bharodi Gaon, Thane, Maharashtra (Cat IA & IVB) 4. Ulhas River-Kevani, Bhiwandi, Thane Maharashtra (Cat IA & IVB) 5. Ulhas River- Brahmangaon, Thane, Maharashtra (Cat IA & IVB) 6. Vaitarna River- Virar, Palghar, Maharashtra (Cat IA & IVB) 7. Narmada River- Bharuch, Gujarat (Cat III & IVB)
Forest and Mangroves	<p>The application for the forest clearance has been submitted vide Proposal No. FP/MH/RAIL/31785/2018 on February 12, 2018 for the diversion of forest land to the extent of 132.2235 hectares (including the Mangrove area of 32.3902 ha.) in the Thane, Dahanu Divisions and Mangrove Cell, Thane of Thane Circle in the State of Maharashtra.</p> <p>As per the Gazette Notification dated March 15, 1973, the plantation along the NH/SH/MDR falling with RoW, and Canals has been notified as Protected Forest in the State of Gujarat. In view of this, Forest Clearance is required for the RoW of the MAHSR alignment falling within this land in the State of Gujarat. Accordingly, the application for forest clearance for diversion of forest land of 6.1034 ha. in the State of Gujarat has been submitted on 10-May-2018 vide proposal No. FP/GJ/RAIL/33381/2018.</p>
Socio-Economic Environment	
Districts within the project area	Mumbai Suburban, Thane, Palghar, Silvassa (Dadra and Nagar Haveli) Valsad, Navsari, Surat, Bharuch, Vadodara, Anand, Kheda, Ahmedabad
Population	As per Census 2011, the total population of the districts in zone of influence stood at 45,131,455.
Sex Ratio	The sex ratio in general shows positive trend except Surat. As per Census 2001, it stood at 810 females per 1000 males, which reduced to 788 in 2011. The sex ratio of districts in Maharashtra in the zone of influence stood at 858 whereas for Gujarat it was 915.
Occupational Pattern	The population of main workers in the zone of influence stands at 18,465,302 (35.29% of the total population) comprising of male – 15,024,665 and female – 3,440,637 respectively. The population of main workers is highest in Mumbai suburban at 93,515,922 followed by Thane urban at 3,045,058. The lowest population of main workers is seen at Navsari -144,902.
Education /Literacy	In the Maharashtra region, the highest literacy rate was recorded in Mumbai suburban areas as 90.9 % as per the Census 2011 compared to 86.89 % as per the Census 2001. In Gujarat region, the highest literacy rate is seen in Ahmedabad and Surat (86.65 %) in 2011 followed by Anand (85.79 %).
Ethnic/Indigenous People	The MAHSR alignment passes through several tribal villages particularly in Palghar district of Maharashtra. Land acquisition may affect their domestic and agricultural land holding. Special attention is required to be paid during the land

Environmental Attributes	Finding of the S-EIA Study			
	acquisition. The details on ethnic community and indigenous people are detailed in Section 4.20 of Chapter 4.			
HIV/AIDS	State	Adult HIV Prevalence (National Average-0.26%)	People Living With HIV (PLHIV)	Annual New HIV Infections
	Maharashtra	>0.26%	3.01 Lakh	3000-4000
	Gujarat	0.42%	1.66 Lakh	>7500
Labour Welfare and Health	During the construction phase, a large workforce will be deployed along the alignment. The construction period is assumed to be 4 years. The construction camp/housing camp for the workers is tentatively planned at every 25 km along the alignment. There will be necessity of providing welfare and health care facilities to the workforce including emergency care. Regular health check-up of the deployed workforce shall be undertaken to see any degradation in health. This facility can be provided through the construction contractors under the BOCW regulation.			
Protected Monuments	There are no archaeologically or historically important monuments or heritage sites located within the RoW of the proposed alignment.			

ES.14 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The development and operation of Mumbai-Ahmedabad High Speed Railway project is expected to generate adverse environmental impacts (long term or short term, reversible or irreversible). The potential adverse impacts and proposed mitigation measures for the project are presented below:

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
A) Long Term Impacts (Operation Phase)			
Land	Topography	<ul style="list-style-type: none"> Permanent change in the local topography of certain areas. 	<ul style="list-style-type: none"> None
	Landscape	<ul style="list-style-type: none"> Visual / landscape impact due to construction of viaduct from Mumbai to Ahmedabad and bridges across the intersecting water bodies. 	<ul style="list-style-type: none"> For the Viaduct, design comparison has been conducted in 2017, and the suitable (less impact to landscape) design was chosen. To ensure that landscaping is effectively managed and minimize temporary visual impacts during construction; To reduce as far as feasible impact and disturbance of flora; Reduce the impact of the project and structures by additional tree planting wherever feasible to reflect the existing landscape character.
		<ul style="list-style-type: none"> Permanent change in the vicinity of the proposed stations. 	<ul style="list-style-type: none"> Landscaping at the station to improve aesthetics etc.

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
	Ecology	<ul style="list-style-type: none"> • Diversion of forest (138.3269ha. including 32.3902 ha. of Mangrove). • Removal of mangrove trees (24.3981ha.). • Loss of vegetation and tree cover (@ 60000 trees are expected to be cut, including Forest, Government and private lands within the RoW). 	<ul style="list-style-type: none"> • Compensatory afforestation and planting of mangroves and trees shall be carried out as per regulatory requirement. • Construction of balancing culverts shall be considered in coastal and mangrove areas, as applicable, so as to maintain tidal water exchange.
Tunnel	Geology & Hydrology	<ul style="list-style-type: none"> • Generation of soil debris (@ 3.5 million cubic metres) from tunneling activity. • The ground water may be affected during construction as the tunnel could intersect the aquifers in few locations. 	<ul style="list-style-type: none"> • Tunnel shall be designed taking into account the potential seismic intensity, soil / rock structure and ground water table. • Excavated soil debris will be analysed for contamination and disposed / reused accordingly.
Stations	Climate Change Adaptation	<ul style="list-style-type: none"> • Impact of potential sea level rise on the alignment and station structures close to coastal area at BKC. 	<ul style="list-style-type: none"> • The structure and premises of proposed Station close to Mithi River should be designed taking into consideration of sea level rise of 1 m over a period of 100 years.
Operation of HSR	Energy Consumption and GHG Emissions	<ul style="list-style-type: none"> • Consumption of electrical energy for operation of HSR and Stations. • Associated indirect GHG emissions (this impact will also be offset to a large extent by the savings in GHG emissions due to expected modal shift from private vehicle road travel). 	<ul style="list-style-type: none"> • The Shinkansen HSR technology is relatively more efficient as compared to the conventional railway operation presently in use in India. • Energy star rated equipment and fixtures will be used to minimize the energy consumption – e.g. energy efficient motors and pumps, use of energy efficient lighting, energy efficient luminaries, adequate and illumination levels optimized as per tasks, and energy efficient HVAC.

B) Short Term Impacts (Construction phase)

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
Site clearing and Leveling (cutting, stripping, excavation, earth movement, compaction)	Local Air Quality	<ul style="list-style-type: none"> ● Fugitive Dust Emissions ● Gaseous Emissions from construction equipment & machinery. 	<ul style="list-style-type: none"> ● Use of suitable dust suppressants (e.g. water sprays). ● Equipment and construction vehicles will be inspected and maintained suitably, for controlling emissions.
	Water Quality	<ul style="list-style-type: none"> ● Run-off from vegetation stripped project area. ● Construction activities may cause change in the natural drainage pattern. 	<ul style="list-style-type: none"> ● Plantation on the slope ● Care shall be taken to avoid or mitigate any changes in the course of natural drainage.
	Soil Quality	<ul style="list-style-type: none"> ● Loss of fertile top soil ● Temporary loss of agricultural produce in farmlands. 	<ul style="list-style-type: none"> ● The top soil be preserved and reclaimed back.
	Noise & Vibration	<ul style="list-style-type: none"> ● Increase in noise levels due to running of heavy construction equipment. ● Increase in ground vibration due to underground tunneling and potential impact on TCFS. ● Noise propagation due to running of heavy construction vehicles at the construction sites. 	<ul style="list-style-type: none"> ● Where ever possible the deployed equipment shall have inbuilt noise enclosure. ● Noise abatement measures shall be adopted in tunneling activity. ● Noise barriers of suitable specifications shall be erected in locations of sensitive receptors.
	Local Climate	<ul style="list-style-type: none"> ● Due to loss of vegetation cover (tree felling and mangrove cutting) there may be rise in the local temperatures. 	<ul style="list-style-type: none"> ● Compensatory afforestation shall be taken up.
Transport, Storage and Operation of Construction Material/ Equipment	Air Quality	<ul style="list-style-type: none"> ● Gaseous emissions from construction vehicles. ● Fugitive dust emissions due to Traffic movement especially in the Gujarat region where the alignment runs through the agricultural field. ● Spillage and fugitive emissions arising out of construction materials. 	<ul style="list-style-type: none"> ● All the vehicles shall have Pollution Under Control (PUC) certificate. ● Regular sprinkling of water on unpaved ways / access roads. ● The material shall be transported in covered condition.

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
	Water Quality	<ul style="list-style-type: none"> Spillage of construction material and flow into streams particularly during the monsoon months. Run-off from Storage Areas of Construction Material. 	<ul style="list-style-type: none"> Small bunds and garland drains shall be created along the stock piles. Proper enclosure shall be created.
	Soil Quality	<ul style="list-style-type: none"> Spillage of materials, concrete slurry, fuel / oil on soil during construction. 	<ul style="list-style-type: none"> Material stock piles shall not be stored directly on ground. Spillages shall be avoided through management practices and controlled / disposed appropriately.
	Traffic on Public Roads	<ul style="list-style-type: none"> Increased flow of traffic. Congestion on roads. 	<ul style="list-style-type: none"> Alternate routes for construction vehicle shall be considered where possible to avoid congested / residential areas. Proper road signage and traffic marshals shall be provided to regulate / divert traffic during construction activities.
	Climate Change	<ul style="list-style-type: none"> Due to excessive emission from the construction vehicle, there may be increase in the concentration of CO, which will lead to climate change temporarily. 	<ul style="list-style-type: none"> All the vehicles deployed at construction site shall have the valid Pollution Under Control (PUC) certificate.
Civil Construction Activities	Air quality	<ul style="list-style-type: none"> Gaseous Emissions from Construction Machinery Fugitive Dust Emissions due to Movement of Traffic on the unpaved way. Fugitive dust emission from the batching, mixing and concreting plant. 	<ul style="list-style-type: none"> All the vehicles deployed at construction site shall have the valid Pollution Under Control (PUC) certificate. An enclosure or barricading shall be created at such locations.
	Water quality	<ul style="list-style-type: none"> Run-off from Construction Areas during curing and also from the storage area of the construction materials. 	<ul style="list-style-type: none"> Small bunds and garland drain shall be created along the stock piles. Stock piles will not be situated directly on open ground.

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
Mechanical & Electrical Installation Activities	Noise Emissions	<ul style="list-style-type: none"> High noise emissions from construction equipment. Noise generated from the running of heavy vehicles deployed in the construction activities. 	<ul style="list-style-type: none"> Adequate enclosures shall be created around the stationary equipment. Noise barriers of suitable specifications shall be erected in locations of sensitive receptors. All the equipment shall be fitted with exhaust mufflers. Appropriate personal protective equipment (PPE) shall be provided to the workers working near the high noise area.
	Vibration	<ul style="list-style-type: none"> Vibration in the nearby area due to piling. Blasting operation may lead to temporary ground borne vibration. Running of heavy construction equipment. 	<ul style="list-style-type: none"> Night-time piling activity shall be avoided near residential areas. Blasting shall be carried out in the day-time only, with advance intimation to local communities.
	Air quality	<ul style="list-style-type: none"> Air Emissions from running of construction machineries due to fuel. 	<ul style="list-style-type: none"> Adequate enclosures shall be created around the stationary equipment.
	Water quality	<ul style="list-style-type: none"> Run-off from erection areas containing spent oils, paints. 	<ul style="list-style-type: none"> Small bund and garland drain shall be created along the stock pile.
	Vibration	<ul style="list-style-type: none"> Induced vibration may be experienced due to erection activities. Running of heavy mechanical and electrical equipment. 	<ul style="list-style-type: none"> Night-time piling activity shall be avoided near residential areas. Blasting shall be carried out in the day-time only, with proper advance intimation to local community.

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
Influx of Labour & Construction of Temporary Houses and Operation of Construction Camps / Maintenance Depots	Socio-economic	<ul style="list-style-type: none"> Stress on infrastructure. Stress on social relations. Social conflict due to inflow of workforce. 	<ul style="list-style-type: none"> Construction camps will be sited 1 km away from the ESZ/habitation preferably in the downwind direction to avoid conflicts and stress on the local community and environment. Local persons shall be preferred for the construction work in the un-skilled category.
	Land use	<ul style="list-style-type: none"> Temporary change in land use pattern of the area due to coming up of labour camps. 	<ul style="list-style-type: none"> Labour camp structures shall be built in temporary manner and land shall be restored to the original condition after completion of the construction.
	Water Quality	<ul style="list-style-type: none"> Domestic effluent discharge from the labour camp and construction camp tentatively planned at every 25 km interval. 	<ul style="list-style-type: none"> Sanitation and sewage treatment facility shall be provided at the labour camps as per applicable norms. Only treated effluents shall be discharged.
	Waste Generation and Management	<ul style="list-style-type: none"> Generation of municipal solid waste and Hazardous waste from Construction camps and Maintenance Depots. 	<ul style="list-style-type: none"> Efforts shall be taken to minimize the waste generation to the extent possible, segregate and dispose /recycle to appropriate agencies as per regulatory requirement and guidance from urban local bodies.
Generation, Transport& Disposal of Construction & Demolition (C&D) Waste	Air quality and Noise emissions	<ul style="list-style-type: none"> Noise and Air Emissions from Transport Vehicles. Fugitive Dust Emissions due to Movement of Traffic on the unpaved way. Spillage and fugitive emissions during handling of C&D waste. Fugitive emission from the pile of C&D waste. 	<ul style="list-style-type: none"> C&D waste shall be handled as per the Guidelines of C&D Waste Management Rules 2016.

Project Activities	Environmental Attributes	Potential Adverse Impacts	Proposed Mitigation Measures
	Water and Soil Quality	<ul style="list-style-type: none"> • Spillage/ spread/ deposition of debris along transport routes. • Run-off from Disposal Areas. • Leaching effect from the debris disposal area. • Potential conversion of land into waste land. 	<ul style="list-style-type: none"> • Proper bund shall be created to avoid run-off of spills. • Spillage shall be avoided by using covered transport vehicles. • The excavated land shall be restored, as applicable.
	C&D Waste Generation	<ul style="list-style-type: none"> • C&D waste will be generated from excavation, casting activity, pile heads, demolition, etc. in the construction camps as well as along the alignment. 	<ul style="list-style-type: none"> • C&D waste shall be handled as per the Guidelines of C&D Waste Management Rules 2016.

Source: Study Team

ES.15 ENVIRONMENT MANAGEMENT PLAN

Environment Management Plan (EMP) has been developed outlining measures for implementation of mitigation measures to offset or mitigate them to acceptable levels. The Environment Management Plan has also outlined the responsibility of implementing and supervising the implementation of measures of ISO14001, details of this is included in Chapter 6 of the S-EIA Report. The budgetary provision for cost of environmental protection measures for implementation of the Environmental Management Plan has been discussed in detail in Chapter 6 of the S-EIA Report. The EMP budget has been estimated at INR 1642.509 Million.

In addition to the above cost, 0.25% of the capital investment shall be allocated towards Corporate Environmental Responsibility (CER) as a part of the Corporate Social Responsibility (CSR) provision for the implementation of various activities over a period of 10 years like Community Health Improvement, Community Education Facilities, Community Welfare Activities, Infrastructural Developmental, Community Water Conservation, Afforestation Programs, Community Capacity Building, Community Sanitation facilities and Skill development etc.

The EMP also presents an institutional structure for implementing the EMP and communication between the key agencies such as NHRCL, its Project Implementation Unit (PIU) and State level Chief Project Managers (CPMs), State level Social and Environmental Management Units (SEMUs), Contractors (as per various packages), Supervision Consultants and Regulatory/ Administrative Authorities. A grievance redressal mechanism shall be established at the level of each SEMU (for systemic E&S concerns) and Contractors (to handle issues at a local level from local community).

ES.16 DISASTER MANAGEMENT PLAN

Disaster/emergencies such as land subsidence, accidents, fire hazards, structure collapses, etc. may arise during construction phase while Natural Disaster-Earthquake, Floods, Cyclones, Landslides, Tsunami; Train Accident Related Disaster- Collision, Train Marooned, Derailment, Tunnel Collapse, Fire Explosion in train etc. and Man-made Disaster-Act of Terrorism and

Sabotage could happen during operation stage which can result in substantial loss of life or human suffering or damage to and destruction of property or damage to degradation of environment and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. In order to prevent such emergencies from occurring and to ensure adequate control and management, should an emergency still happen due to unforeseen circumstances, a disaster management plan, has been prepared. The DMP includes preventive action, communication protocol, Emergency Action Committee for incident control and emergency control measures.

ES.17 PUBLIC CONSULTATIONS

In order to understand concerns of stakeholders, local community and fishermen communities, public consultations were conducted during the feasibility stage of the project and additional consultations has been conducted at the detailed design stage in each district. The consultations also involved discussions with environmental experts and local NGOs. Outcomes of these public consultations were recorded, analyzed and incorporated in the S-EIA Report, as relevant. Suitable recommendations will also be made in project planning, design and operation based on relevant outcome of the consultation process, if so required.

ES.18 ENVIRONMENTAL MONITORING PROGRAMME

A comprehensive Environment Monitoring Programme (EMoP) has been developed to monitor the surrounding environment and check the effectiveness of the EMP implementation during the construction as well as the operational stages of the project. Performance indicators have been identified which include parameters on ambient air quality, noise, vibration, surface and ground water quality, soil quality, survival rate of compensatory plantations, borrow area rehabilitation. Monitoring parameters, frequency and sampling protocols have been outlined in the Environment Monitoring Programme (Refer Table 6.13.2, Chapter 6).

During the construction and operational phases of the MAHSR, periodic inspections and audits shall also be conducted by NHRCL through third party competent agencies so as to track the implementation of the EMP and ensure that all adverse impacts are effectively mitigated.

A separate budgetary provision has been made for implementation of Environmental Monitoring Plan for the construction phase INR 287 Million and for the operation phase INR 525 Million.

ES.19 CONCLUSION

Based on the findings of the S-EIA study and recommendations on regulatory compliance, mitigation measures and management plan, it is concluded that the MAHSR project is in compliance with JICA E&S guidelines as well as National, State and local environmental regulation.

Also, the effective implementation of the proposed mitigation measures, environmental management and monitoring plan are adequate to minimize and control the adverse environmental impacts likely, due to the project.

Chapter 1
Project Description

Chapter 1

Project Description

1.0 PROJECT BACKGROUND

In recent decades, India has undergone rapid economic growth, resulting in the increased movement of people and goods around the country. To meet this demand, Dedicated Freight Corridors (DFC) is being constructed to haul freight from Delhi to Mumbai and Kolkata. As for passenger transport, in December 2009, Ministry of Railways (MoR), Government of India, formulated the “Indian Railway Vision 2020”. This vision aims to modernize existing conventional lines and enhance capacity as well as develop high speed railway lines. Seven routes were selected as candidates for the high speed railway system. Among them, the Mumbai-Ahmedabad route was given top priority by the Experts Committee on Modernization of India’s National Railway. Based up on further prefeasibility and feasibility studies, the Mumbai-Ahmedabad High Speed Railway (MAHSR) Project is being implemented.

Against this backdrop, India and Japan issued a joint statement on May 29, 2013, that included a decision to conduct a joint study on the construction of the High-Speed Railway (HSR) between Mumbai and Ahmedabad. In response, Japan International Cooperation Agency (JICA) and the Ministry of Railways, Government of India, signed a Memorandum of Understanding (MoU) for joint feasibility study on October 7, 2013. Based on this decision, a Joint Feasibility Study (Joint F/S) for Mumbai-Ahmedabad High Speed Railway (MAHSR) project was conducted from December 2013 to July 2015. The Prime Minister’s of Japan and India issued a joint statement in December 2015 agreeing to introduce the Shinkansen High Speed Railway System on the Mumbai-Ahmedabad route.

The Joint Coordination Committee agreed that the Japan International Cooperation Agency (JICA) would provide consultants to implement the project. JICA and MoR signed a Record of Discussion (R/D) for this purpose on 16th September 2016. After the public tender process initiated by the JIC Consortium (JICC), led by Japan International Consultants for Transportation Co. Ltd., in association with Nippon Koei Co. Limited and Oriental Consultants Global Co. Ltd. JICC has been retained as the consultants by JICA to provide General Consultancy (GC) services for assisting the MoR and National High Speed Rail Corporation Limited (NHSRCL), which is a Special Purpose Vehicle (SPV) created by Government of India to implement Mumbai-Ahmedabad High Speed Railway Project along a new alignment of about 508.17 km.

India has inched closer to getting a bullet train of its own after Hon’ble Prime Minister Shri Narendra Modi and his Japanese counterpart HE Shinzo Abe laid the foundation for a high-speed train network. Both heads of state announced the launch of Mumbai-Ahmedabad High Speed Railway (MAHSR) Project in Sabarmati on 14th September, 2017. It will cost Rs 1.08 lakh crore to see this ambitious project through.

1.1 IMPORTANCE OF THE PROJECT

In the “Indian Railway Vision 2020”, comparison between Railway Transport, Road Transport and Air Transport was conducted and it concluded that the Railway Transport takes significant advantage of less emission of greenhouse gases, of high capacity of passenger transport, etc. The vision identified the need for introducing the High Speed Railway (HSR) system in India. The Expert Committee on Modernization of Indian National Railway, 2012,

stated in its report based upon the fundamental drivers of Safety and Growth, to drive modernization of Railways, identified 15 focus areas. As part of the strategy to explore new revenue model's to meet the funding requirement for growth and modernization, the Committee recommended PPP model, land and airspace utilization, Dedicated Freight Corridors (DFC's) and High Speed Rail (HSR). The committee further recommended developing Public Private Partnership (PPP) models in different areas of Railways to attract private investment to augment core capabilities related to Stations and Terminals, HSR Corridors, elevated rail corridors, private freight terminals etc.

The necessity for developing HSR corridors has been felt in view of meeting the various needs of rapidly growing and expanding economy and to curb the high road based greenhouse gas emissions. Railways have been the catalyst for high national economic growth by providing faster, cheaper, cleaner and reliable mode of transportation for mass movement of people and goods. The main items which HSR satisfies are:

- (1) Safety
- (2) High Capacity & Frequency
- (3) High Energy Efficiency and Low Emission of Greenhouse Gas (Reduce impact of Climate Change)
- (4) Travel time reduction
- (5) Employment generation
- (6) Strong Infrastructure and HSR System for Natural Disaster

The MAHSR corridor links important economic centre's in western India. The corridor runs from Mumbai in Maharashtra to Ahmedabad in Gujarat interlinking major industrial cities, such as Silvassa (DNH), Surat, Vadodara, Anand etc. on the way. Both the states, which are highly industrialized with multiple industrial cities and towns, have highly developed services sector and major tourism destination that results in high movement of people and goods. By 2050, the travel demand within the corridor is projected to reach 58.2 billion Passenger Kilometers (pkms) – an increase of four and half times from 2010 levels. The conventional railway is unable to meet such surging demand and neither is able to reduce the travel time significantly resulting in economic loss and loss of productivity.

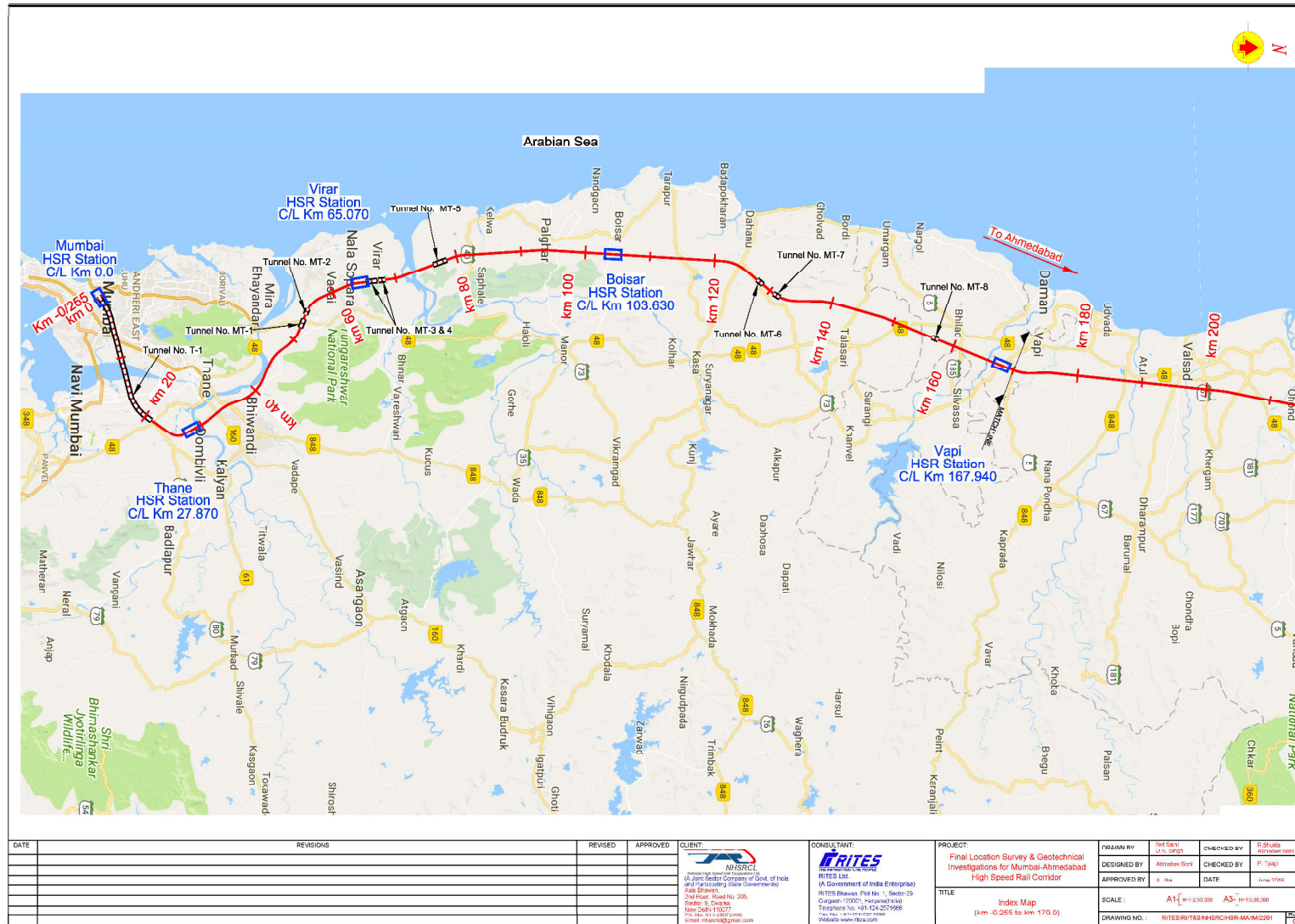
1.2 PROJECT LOCATION

The MAHSR alignment of 508.17 km long, begins at Bandra Kurla Complex (BKC) in Mumbai Suburban District and runs through Thane and Palghar districts of Maharashtra and then enters Gujarat in Valsad district and runs a short course of 7.358Km through the UT of Dadra & Nagar Haveli and then re-enters Gujarat and runs through Navsari, Surat, Bharuch, Vadodara, Anand and Ahmedabad districts of Gujarat before terminating at Sabarmati. The planned route lies between Latitude 19°03'58.52"N-Longitude 72°05'47.48"E and Latitude 23°05'39.78" N-Longitude 72°34'33.48"E.

The alignment is proposed on elevated viaduct and bridges, and also has 26.915 km of underground tunnels. There are a total of 8 tunnels with the longest tunnel of 20.375km under sea at the Thane Creek in Mumbai. The length of the bridges is 6.421km. The rest of alignment of 474.834 km is on viaduct.

The MAHSR alignment is shown in Exhibit 1.2.1, Exhibit 1.2.2 and Exhibit 1.2.3.

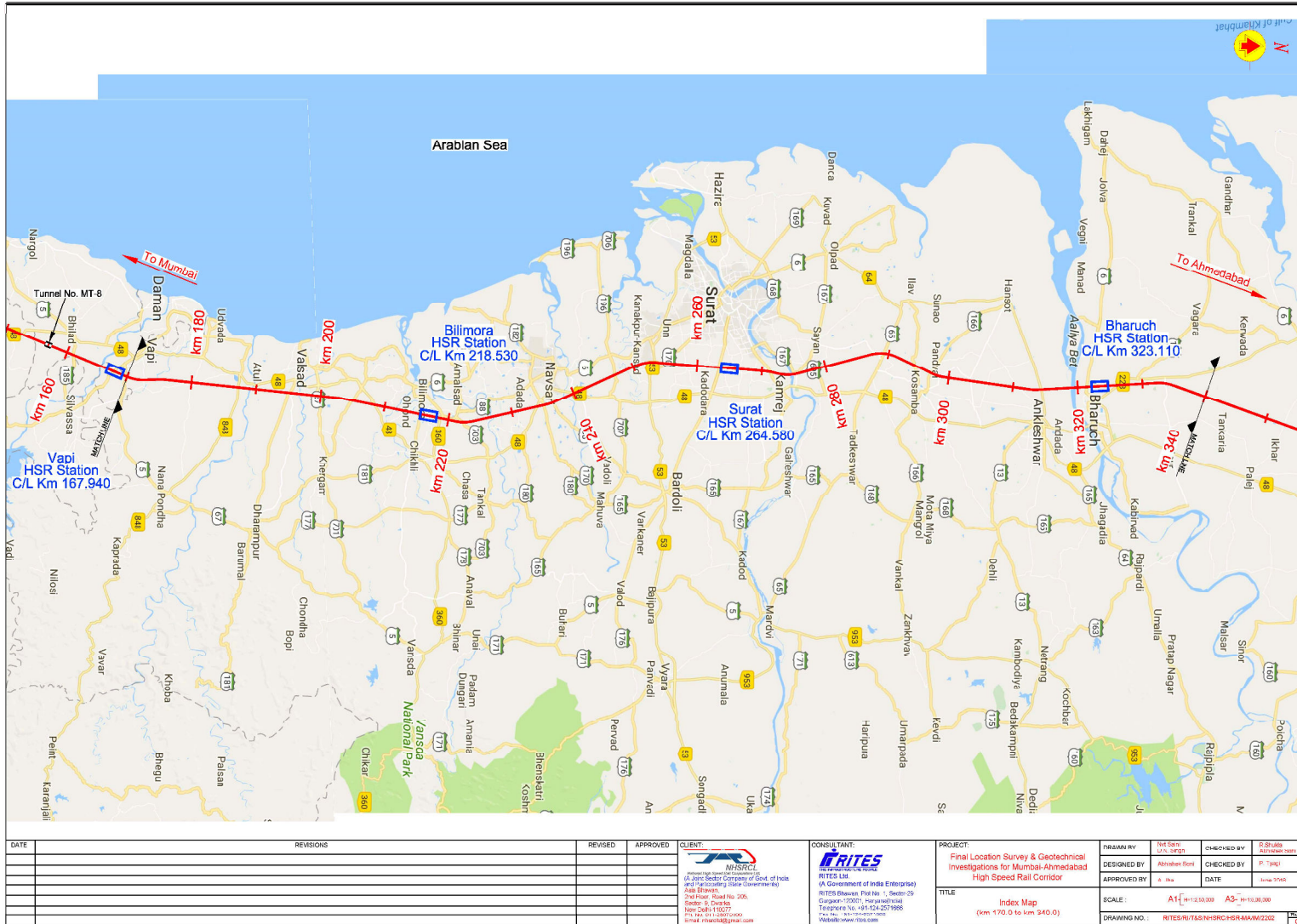
Exhibit 1.2.1: MAHSR Alignment with proposed Stations



DATE	REVISIONS	REVISED	APPROVED	CLIENT:	CONSULTANT:	PROJECT:	DESIGNED BY:	CHECKED BY:
				NHSRCL National High Speed Rail Corporation of India (A Joint Sector Company of Govt. of India and Participating State Governments)	RITES Rail Infrastructure and Transportation Services Ltd. (A Government of India Enterprise) RITES House Plot No. 1, Sector-29 Gurgaon-120017, Haryana (India) Telephone No. 011-261-2071998 Fax No. 011-261-2071999 Email: rites@rites.com	Final Location Survey & Geotechnical Investigations for Mumbai-Ahmedabad High Speed Rail Corridor	Abhishek Bora	P. 1940
						Index Map (km -0.255 to km 170.0)		
							SCALE: A11=1:250,000 A3=1:100,000	DATE: June 2016
							DRAWING NO.: RITES/RIT/TA/HSR/CHBR/MA/MA/201	

Source: NHSRCL

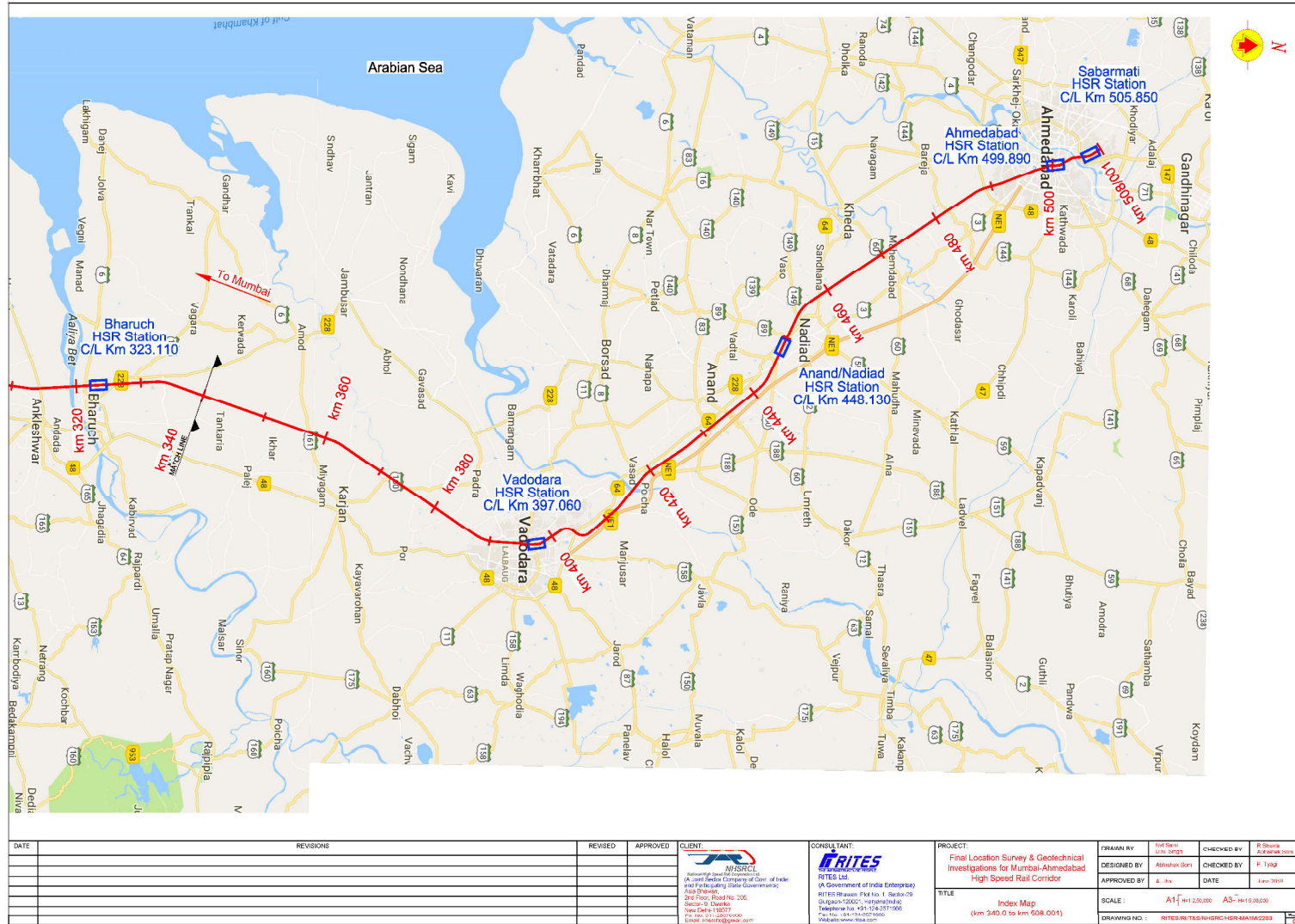
Exhibit 1.2.2: MAHSR Alignment with proposed Stations



DATE	REVISIONS	REVISED	APPROVED	CLIENT:	CONSULTANT:	PROJECT:	DESIGNED BY	CHECKED BY	DATE
				NHSRCL National High Speed Rail Corporation of India (A Government of India Enterprise) 2nd Floor, Road No. 206, Sector 5, Dwarka, New Delhi 110077 Tel: No. 011-26109000 Email: nhsrcl@gmail.com	IRITES (A Government of India Enterprise) IRITES House Plot No. 1, Sector-29 Gurgaon-120017, Haryana/India Telephone No. 011-224-207998 Fax No. 011-224-207999 Website: www.iritest.com	Final Location Survey & Geotechnical Investigations for Mumbai-Ahmedabad High Speed Rail Corridor	IRISH	IRISH	IRISH
			IRISH				IRISH	IRISH	
			IRISH				IRISH	IRISH	
			IRISH				IRISH	IRISH	
			IRISH				IRISH	IRISH	

Source: NHSRCL

Exhibit 1.2.3: MAHSR Alignment with proposed Stations



Source: NHSRCL

There are 12 stations along the corridors as provided in Table 1.2.1 below:

Table: 1.2.1: Proposed Stations along MAHSR

S.No	Station	Co-ordinates
1	BKC, Mumbai	19° 04'02.84"N, 72°51'54.10"E
2	Thane	19°11'43.87"N, 73°03'36.37"E
3	Virar	19°26'11.52"N, 72°50'18.43"E
4	Boisar	19°47'11.67"N, 72°46'32.10"E
5	Vapi	20°20'03.45"N, 72°56'55.84"E
6	Bilimora	20°45'57.63"N, 73° 00'25.74"E
7	Surat	21°10'31.81"N, 72°56'09.39"E
8	Bharuch	21°41'43.50"N, 72°57'06.43"E
9	Vadodara	22°18'39.61"N, 73°10'47.31"E
10	Anand	22°38'52.21"N, 72°53'26.40"E
11	Ahmedabad	23°01'37.22"N, 72°36'08.85"E
12	Sabarmati	23°04'29.12"N, 72°35'16.10"E

Source: Study Team¹

1.2.1 Project Commissioning Schedule

Based on the information disclosure of JICA and NHSRCL, the tendering process has been initiated and construction activities shall commence from third quarter of 2018 and expected to be completed by 2023. The first bullet train is expected to rollout in 2023. All the clearances required for the commencement of construction activities shall be secured before commencement of the construction activities.

Alignment overlaid on the Survey of India Topographic Sheet is provided in **Annexure 1.1, Vol-II** of the S-EIA Report.

¹ The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

1.3 PROJECT PROFILE

The proposed MAHSR alignment starts at the BKC, Mumbai, Maharashtra and ends at Sabarmati in Gujarat. The total proposed length is 508.17 km consisting of tunnels, viaducts and bridges. The pictures of the start and end points of the MAHSR alignment are shown in Exhibit 1.3.1. The details of different segments of the proposed MAHSR alignment are discussed in the following sections.

a) Right of Way (RoW)

The RoW considered for the entire stretch of the MAHSR alignment is to the extent of 17.5 m (except stations and yards). It also accommodates the space for the maintenance road.

Exhibit 1.3.1: Start and End point of MAHSR Alignment



Site for the proposed BKC Station-Start Point



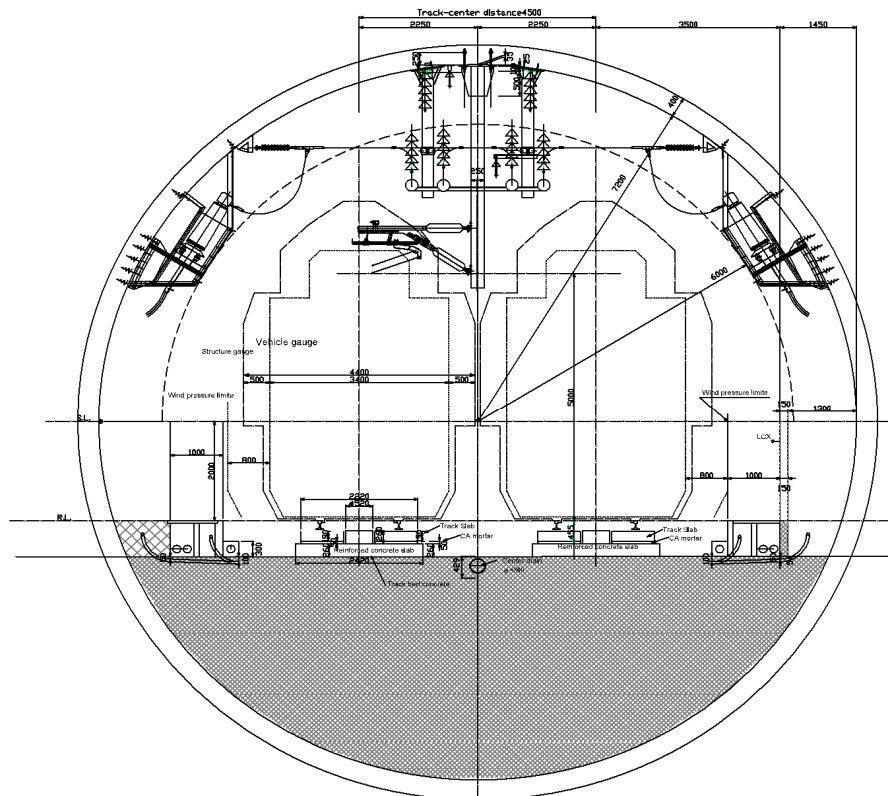
Proposed Site of Sabarmati Station-End Point

Source: Study Team

1.3.1 Tunnels

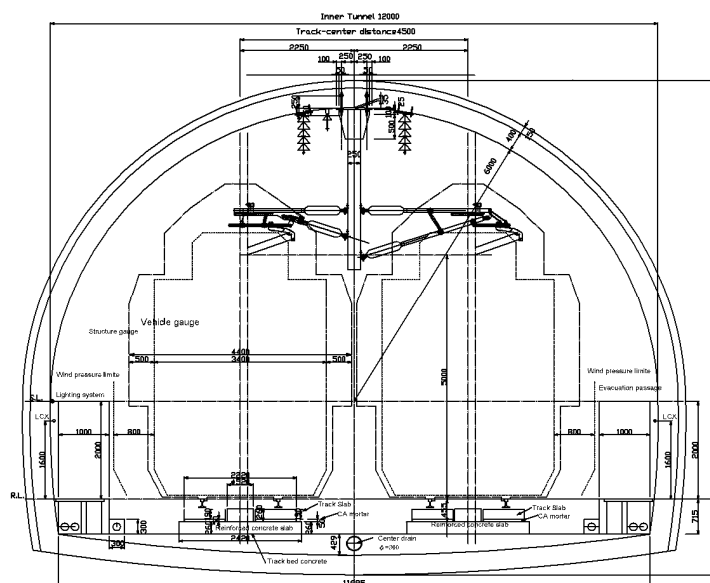
A total of 8 tunnels having total length of 26.203 km have been proposed in the MAHSR alignment. The tunnels shall be constructed with NATM and TBM Technology. The details of the Standard Design are shown in Exhibit 1.3.2 and 1.3.3

Exhibit 1.3.2: Standard Design of the Tunnel in TBM



Source: Study Team

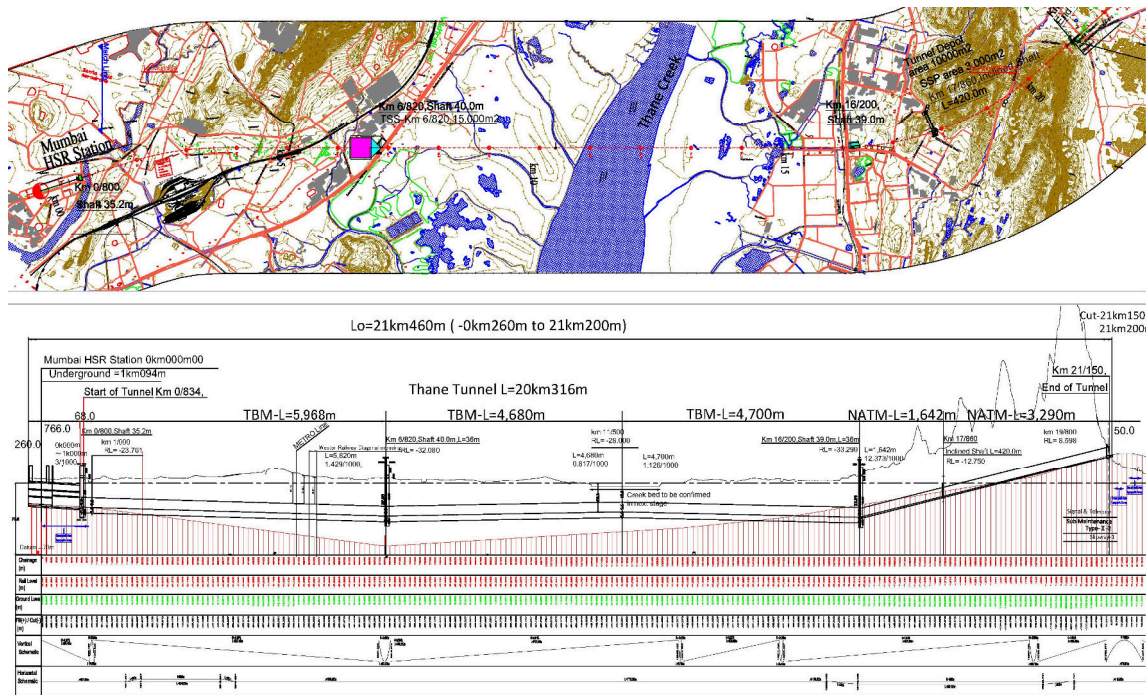
Exhibit 1.3.3: Standard Design of the Tunnel in NATM



Source: Study Team

Longest tunnel is 20.375 km long passing undersea across Thane Creek. Key Plan and L – Section of the undersea tunnel is shown in Exhibit 1.3.4.

Exhibit 1.3.4: Plan and Profile of the Thane Tunnel (TBM & NATM)

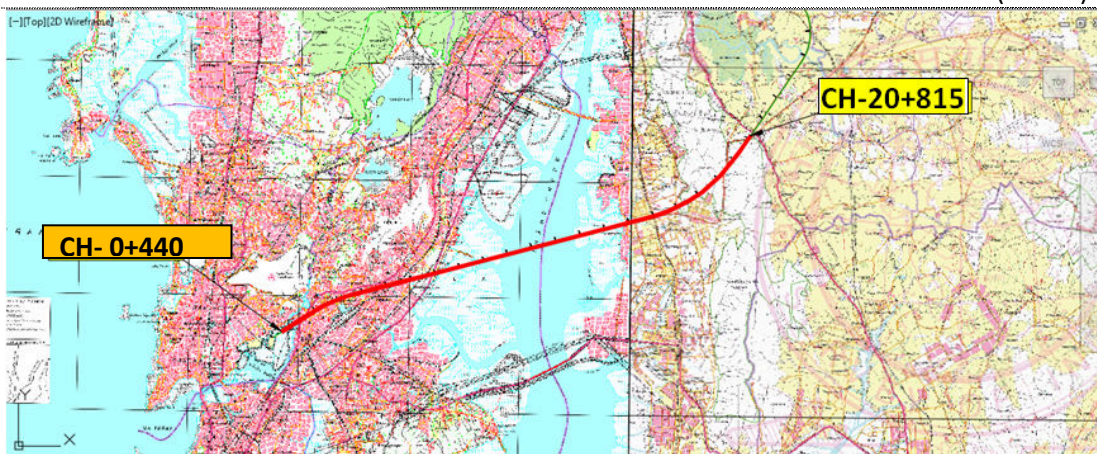


Source: Study Team

The details of the proposed tunnel section along with chainage and length is presented below in Table 1.3.1.

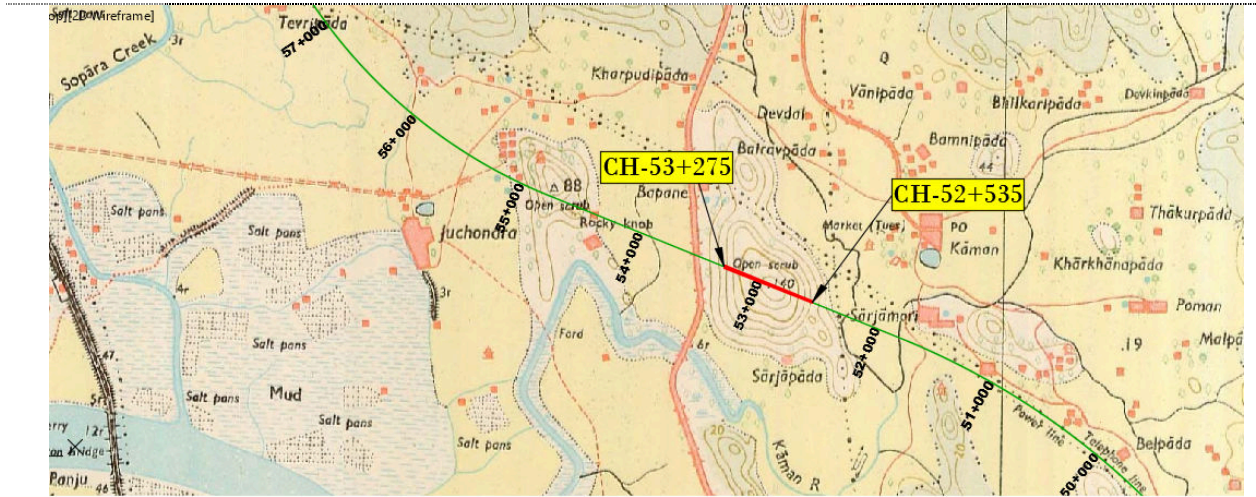
Table 1.3.1: Tunnels in the entire stretch of MAHSR

TUNNEL NO-1							
Start Chainage	End Chainage	Location Village, District, State	Length (Km)	Depth (m)	Diameter (m)	Gradient	Construction Methodology
0+440	20+815	Mumbai, Thane, Maharashtra	20.375	40	14.2	2/1000	Tunnel Boring Machine (TBM), New Austrian Tunneling Method (NATM)



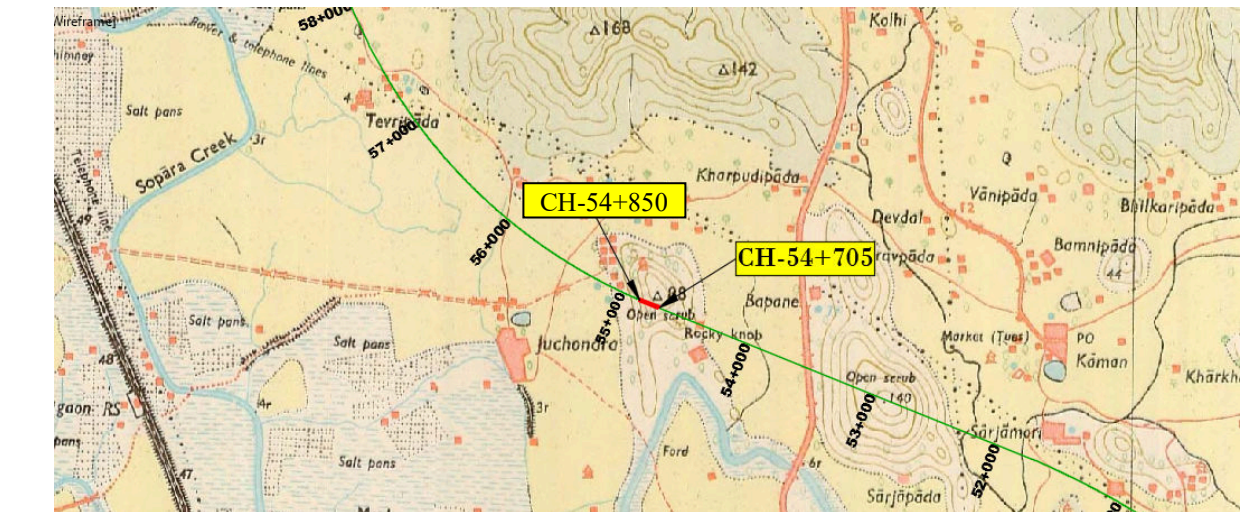
TUNNEL NO-2

Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
52+535	53+275	Mori,Thane, Maharashtra	740	26	14.2	NATM

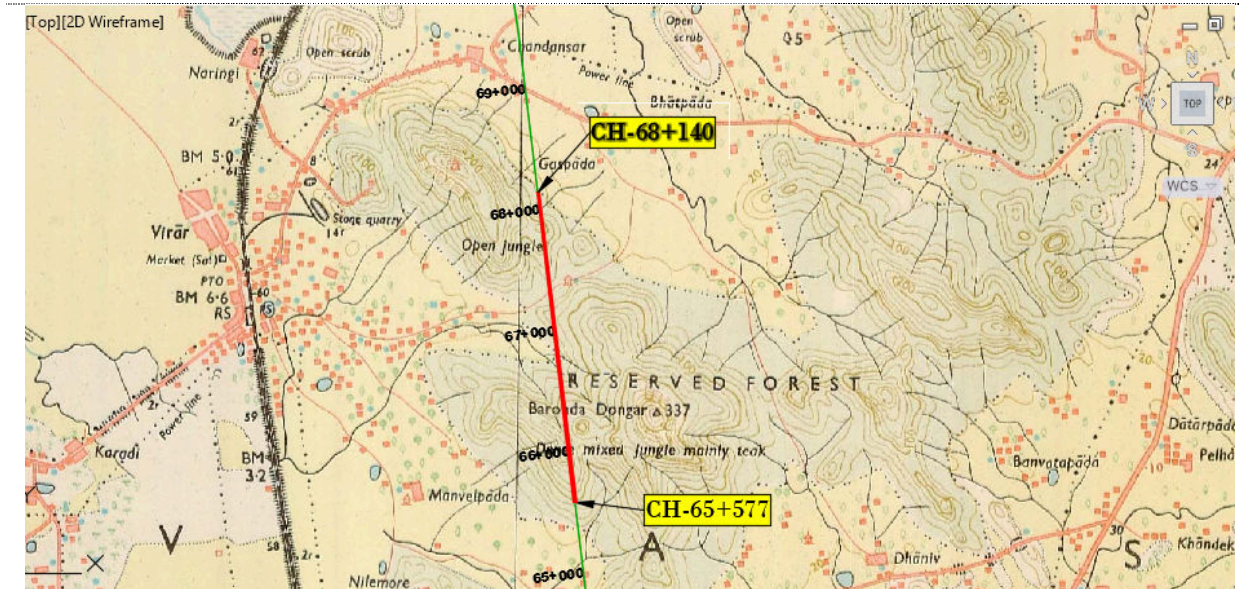


TUNNEL NO-3

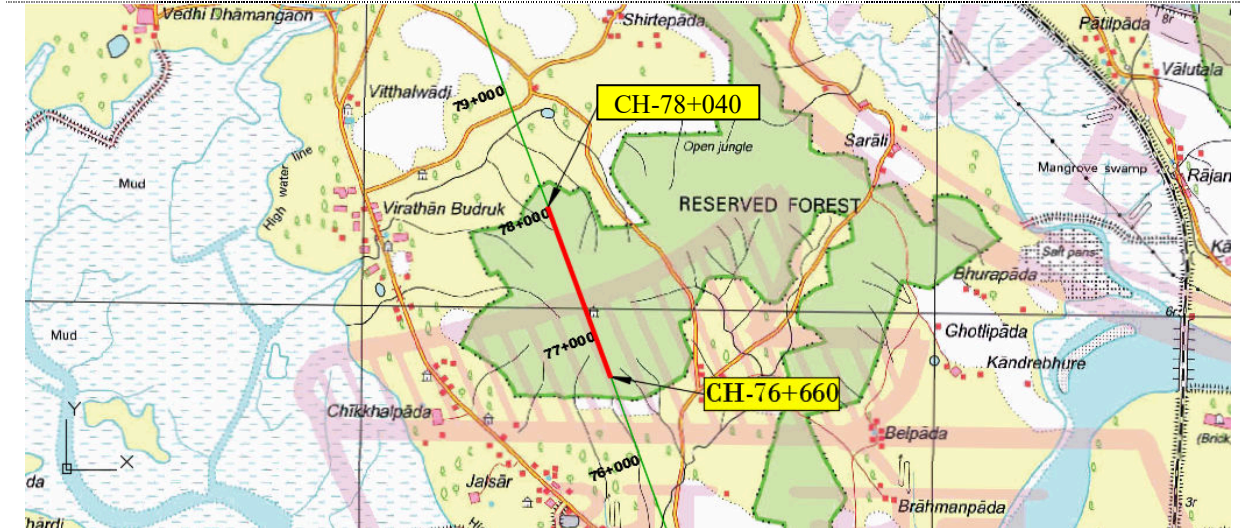
Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
54+705	54+850	Bapne,Palghar, Maharashtra	145	23	14.2	NATM



TUNNEL NO-4						
Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
65+577	68+140	Vakaipada, Palghar, Maharashtra	2563	46	14.2	NATM

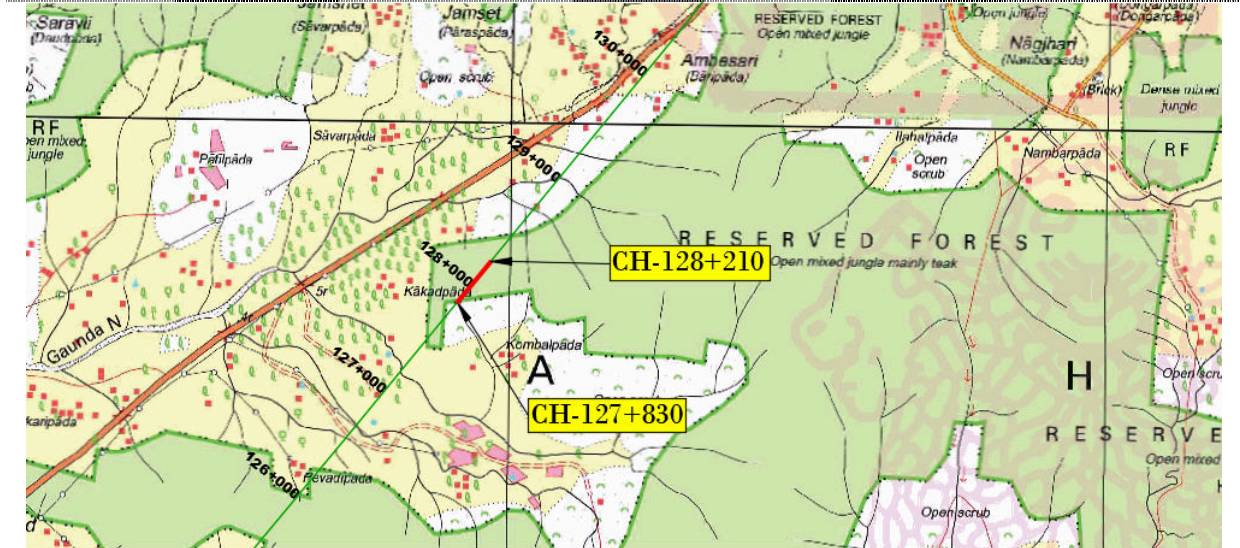


TUNNEL NO-5						
Start Chainage	End Chainage	Location- Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
76+660	78+040	Jivdani Temple, Palghar, Maharashtra	1380	46	14.2	NATM



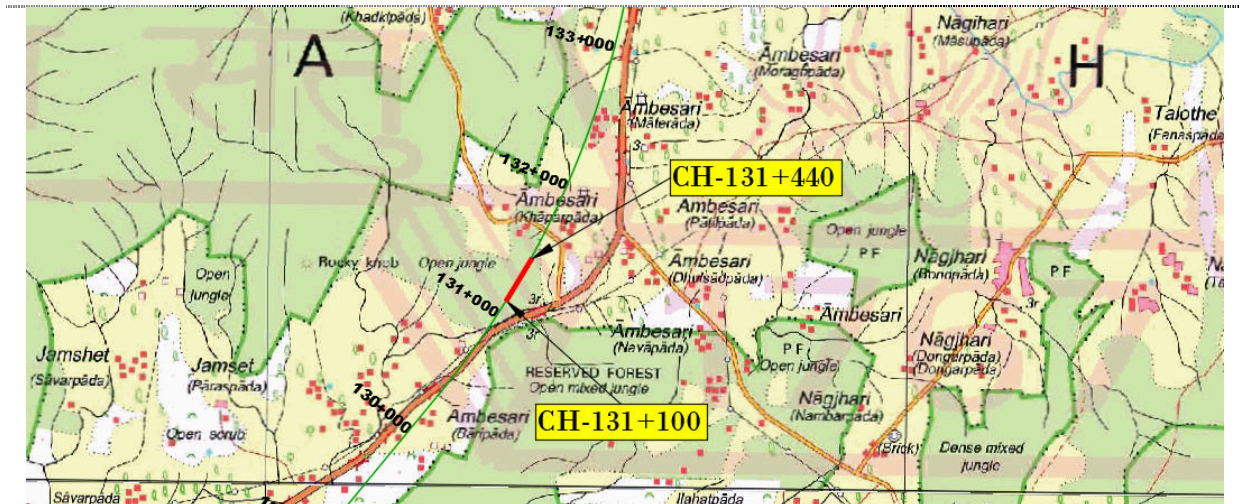
TUNNEL NO-6

Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
127+830	128+210	Kakadpada, Palghar, Maharashtra	380	55	14.2	NATM

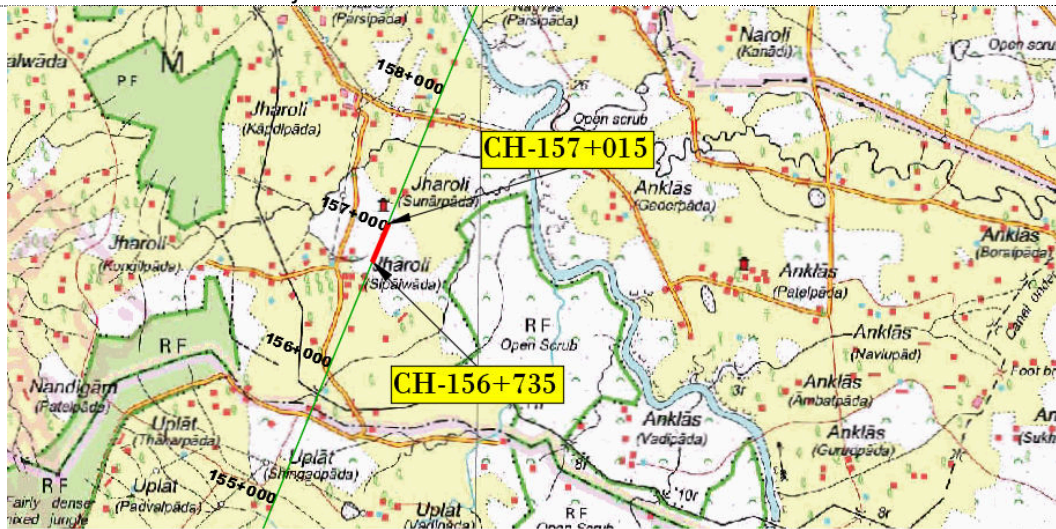


TUNNEL NO-7

Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
131+100	131+440	Ambesari, Palghar, Maharashtra	340	82	14.2	NATM



TUNNEL NO-8						
Start Chainage	End Chainage	Location-Village, District, State	Length (m)	Depth (m)	Diameter (m)	Construction Methodology
156+735	157+015	Zaroli, Valsad Gujarat	280	46	14.2	NATM



Source: Study Team

1.3.2 River Crossings

The MAHSR alignment passes through major rivers, estuaries and creeks at 23 locations and ponds at 32 locations on viaduct and bridges. The detail of the locations along with chainage is presented in Table 1.3.2 (a) and List of Pond in Table 1.3.2 (b) below:

Table 1.3.2(a): Locations of River/Estuaries/Creeks Crossings along the MAHSR alignment

Chainage		Length	Name	Location (Locality/Village, District, State)
Start	End			
28+600	29+000	400 m	Ulhas River	Thane, Maharashtra
38+350	38+430	80 m	Ulhas River	Kevani, Maharashtra
71+520	73+600	2080 m	Vaitarna River	Virar, Maharashtra
166+500	166+850	350 m	Daman Ganga River	Achchhar, Valsad, Gujarat
174+760	174+800	40 m	Kolak River	Rata, Valsad, Gujarat
175+020	175+070	50 m	Kolak River	Valsad, Gujarat
175+460	175+590	130 m	Kolak River	Valsad, Gujarat
190+060	190+300	240 m	Par River	Vapi, Gujarat
198+000	198+300	300 m	Auranga River	Vapi, Gujarat
212+500	212+600	100 m	Kaveri River	Valsad, Gujarat
214+370	214+460	90 m	Kaveri River	Navsari, Gujarat
228+500	228+640	140 m	Ambica River	Navsari, Gujarat
239+800	240+100	300 m	Purna River	Navsari, Gujarat
250+310	250+370	60 m	Mindhola River	Surat, Gujarat
276+060	276+550	490 m	Tapi River	Surat, Gujarat
293+270	293+310	40 m	Kim River	Surat, Gujarat
320+360	321+500	1140 m	Narmada River	Baruch, Gujarat
373+070	373+100	30 m	Dhadhar River	Vadodara, Gujarat
416+820	417+400	580 m	Mahi River	Anand, Gujarat
463+960	463+980	20 m	Mohut River	Kheda Gujarat
473+300	473+600	300 m	Vatrak River	Kheda Gujarat

Chainage		Length	Name	Location (Locality/Village, District, State)
Start	End			
476+590	476+700	110 m	Meshwa River	Kheda Gujarat
504+300	504+600	300 m	Sabarmati River	Ahmedabad Gujarat

Source: Study Team

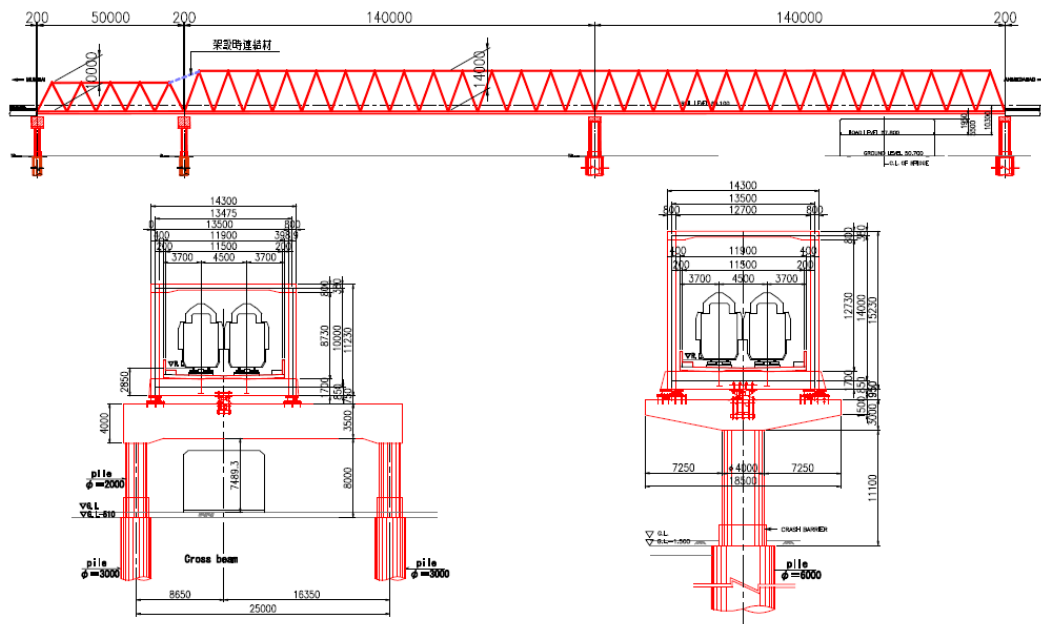
Details of construction and launching scheme are referred as **Annexure 1.2, Vol-II**. Indicative design for river crossing / Bridge is shown in Exhibit 1.3.5.

Table 1.3.2 (b): List of Ponds along the MAHSR alignment

S.No.	Chainage	Coordinate	Location	District / State
1.	22900	19° 9'18.12"N, 73° 3'14.92"E	Padle Gaon	Thane / Maharashtra
2.	24300	19° 9'56.16"N, 73° 3'41.35"E	Desai Village	Thane / Maharashtra
3.	27560	19°11'33.95"N, 73° 3'42.34"E	Mahatardi Village	Thane / Maharashtra
4.	33300	19°14'7.37"N, 73° 1'52.33"E	Anjurdive	Thane / Maharashtra
5.	35060	19°14'54.24"N, 73° 1'17.80"E	Kalher	Thane / Maharashtra
6.	36100	19°15'24.91"N, 73° 1'3.46"E	Kopar	Thane / Maharashtra
7.	39600	19°17'3.02"N, 73° 0'8.36"E	Kharbao	Thane / Maharashtra
8.	43000	19°18'1.16"N, 72°58'28.76"E	Bangalapada	Thane / Maharashtra
9.	49000	19°19'58.61"N, 72°55'49.88"E	Shilottar	Thane / Maharashtra
10.	54270	19°21'19.12"N, 72°53'13.00"E	Bapane	Thane / Maharashtra
11.	58700	19°22'56.82"N, 72°51'30.75"E	Rajivali Talav	Palghar / Maharashtra
12.	58800	19°23'0.14"N, 72°51'28.89"E	Rajavali	Palghar / Maharashtra
13.	58900	19°22'56.82"N, 72°51'30.75"E	Rajavali	Palghar / Maharashtra
14.	64300	19°25'46.72"N, 72°50'22.08"E	Nalasopara East	Palghar / Maharashtra
15.	64400	19°25'49.61"N, 72°50'21.53"E	Nalasopara East	Palghar / Maharashtra
16.	73700	19°30'41.60"N, 72°49'11.41"E	Tembhikhodave	Palghar / Maharashtra
17.	137000	20° 3'46.53"N, 72°51'26.30"E	Ghadane	Palghar / Maharashtra
18.	146100	20° 8'35.96"N, 72°52'29.16"E	Zari	Palghar / Maharashtra
19.	173800	20°22'40.43"N, 72°57'37.36"E	Rata	Valsad / Gujarat
20.	179600	20°25'51.60"N, 72°57'47.55"E	Rata	Valsad / Gujarat
21.	188600	20°30'42.57"N, 72°58'12.00"E	Balda	Valsad / Gujarat
22.	219000	20°47'0.64"N, 73° 0'42.16"E	Kesali	Navsari / Gujarat
23.	223000	20°49'7.77"N, 73° 0'58.63"E	Vadsangadh	Navsari / Gujarat
24.	232700	20°54'15.55"N, 72°59'43.73"E	Kachhol Village	Navsari / Gujarat
25.	250800	21° 3'18.13"N, 72°55'45.47"E	Navi Nagri	Surat / Gujarat
26.	254100	21° 5'3.83"N, 72°55'34.80"E	Hoziwala	Surat / Gujarat
27.	261800	21° 9'14.10"N, 72°55'50.69"E	Mohni	Surat / Gujarat
28.	292500	21°25'28.00"N, 72°55'0.01"E	Kimamli	Surat / Gujarat
29.	293000	21°25'43.43"N, 72°55'7.46"E	Kimamli	Surat / Gujarat
30.	295000	21°26'41.96"N, 72°55'36.43"E	Kuwarda Gram	Surat / Gujarat
31.	427100	22°31'24.14"N, 73° 1'44.51"E	Mogar	Anand / Gujarat
32.	483700	22°53'29.46"N, 72°39'52.86"E	Mahij	Kheda / Gujarat

Source: Study Team

Exhibit 1.3.5: Indicative Design of the River Crossing Bridge



Source: Study Team

1.3.3 State and National Highway

The MAHSR alignment crosses various Expressways, National Highways, State Highways, and other district roads, village roads, etc. at 21 locations. The details of the crossing points of MAHSR alignment are detailed in Table 1.3.3. The MAHSR alignment traverses through road network at these intersections *via* either bridges or viaduct as a dedicated line causing no interference in road traffic movement except during the construction phase.

Table 1.3.3: Locations of Road Crossings along MAHSR alignment

Road Crossing Chainage	Location (Name of Road)
21+340	Shilphata Thane (NH4)
33+000	Anjurdive, Thane (NH3)
35+500	Purna, Thane (SH35)
48+200	Chinchoti Anjurphata Rd-1
50+500	Chinchoti Anjurphata Rd-2
53+500	Bapne, Palghar (NH8-1)
61+350	Palghar Gokhivare Rd
116+270	Gowane, Palghar (SH74)
144+640	AwarpadaPalghar (SH29)
151+400	Amgoan, Palghar (NH8-2)
210+400	Panchali, Valsad (NH8-3)
216+840	Antalia, Navsari (NH360)
235+400	Wada, Navsari (NH8-4)
241+630	Amadpore, Navsari (NH8-5)
264+850	Haripura, Surat (NH6)
316+020	Taibah Nagar, Baruch (NH228)
405+150	Sursi, Vadodara (NH8-6)

Road Crossing Chainage	Location (Name of Road)
449+600	Kehda (NH8-7)
459+480	Anand (NH8-8)
494+750	Ahmedabad (NH8A)
505+170	Sabarmati, (NH228)

Source: Study Team

1.3.4 Railway Crossings

The MAHSR crosses the existing Indian Railway network and the upcoming Dedicated Freight Corridor at 25 locations. The detail of intersection points is presented in Table 1.3.4. The MAHSR traverses at these crossings via bridges as a dedicated line causing no interference in operation of Indian Railways except maybe during the construction phase.

Table 1.3.4: Details of Indian Railways Crossing along MAHSR Alignment

S.No.	Chainage of Crossing	Location	Geo-Coordinates
1	26+030	Agason, Thane, Maharashtra	19°10'48.23"N, 73° 4'1.39"E
2	28+100	Mhatardi Gaon, Thane, Maharashtra	19°11'49.77"N, 73° 3'32.85"E
3	46+570 (Proposed DFC)	Nagle, Thane, Maharashtra	19°18'57.52"N, 72°56'42.22"E
4	71+320	Kopri, Palghar, Maharashtra	19°29'31.13"N, 72°49'40.57"E
5	85+400 (Proposed DFC)	Mykhop, Palghar, Maharashtra	19°36'50.39"N, 72°47'37.62"E
6	221+140	Desad, Navsari, Gujarat	20°48'8.37"N, 73°0'55.44"E
7	262+700	Niyol, Surat Gujarat	21° 9'42.60"N, 72°55'51.65"E
8	285+950 (Proposed DFC)	Kudasad, Surat, Gujarat	21°22'3.58"N, 72°54'44.44"E
9	326+960	Tham, Bharuch, Gujarat	21°43'47.47"N, 72°56'57.44"E
10	394+080	Vadodara, Gujarat	22°17'2.55"N, 73°10'42.72"E
11	397+500	Vadodara, Gujarat	22°18'54.86"N, 73°10'46.48"E
12	400+900	Vadodara, Gujarat	22°20'26.80"N, 73° 9'46.08"E
13	401+700	Vadodara, Gujarat	22°20'48.05"N, 73° 9'30.60"E
14	402+930	Vadodara, Gujarat	22°21'26.65"N, 73° 9'20.40"E
15	434+760	Ismaile Nagar, Anand, Gujarat	22°34'37.29"N, 72°58'55.35"E
16	446+670	Uttarsand, Kheda, Gujarat	22°38'46.39"N, 72°53'46.90"E
17	455+200	Pij, Anand, Gujarat	22°40'47.77"N, 72°49'19.65"E
18	496+000	Ahmedabad, Gujarat	22°59'30.66"N, 72°36'52.46"E
19	499+200	Ahmedabad, Gujarat	23° 1'7.51"N, 72°36'10.58"E
20	499+650	Ahmedabad, Gujarat	23° 1'19.89"N, 72°36'8.93"E
21	500+600	Ahmedabad, Gujarat	23° 1'53.44"N, 72°36'7.57"E
22	62+800, Proposed DFC	Vasai, Palghar, Maharashtra	19°25'0.43"N, 72°50'32.41"E
23	317+380, Proposed DFC	Juna, Bharuch, Maharashtra	21°38'36.36"N, 72°57'19.96"E
24	333+450, Proposed DFC	Tralsi, Bharuch, Maharashtra	21°47'17.26"N, 72°56'45.89"E

Source: Study Team

1.3.5 Maintenance Depots

There are 8 maintenance depots proposed on the entire route of MAHSR. These locations are provided in Table 1.3.5.

Table 1.3.5: Location of Maintenance Depots

Geo-Coordinates	Location
19°48'1.20"N, 72°47'38.53"E	Warangade, Palghar, Maharashtra
20°19'8.02"N, 72°57'11.69"E	Vapi, Valsad, Gujarat
21° 9'42.33"N, 72°55'28.28"E	Niyol, Surat, Gujarat
21°42'11.18"N, 72°56'40.34"E	Dehgam, Baruch, Gujarat
22°20'11.90"N, 73° 9'58.61"E	Vadodara, Gujarat
22°38'33.62"N, 72°53'55.12"E	Bhumel, Anand, Gujarat

Source: Study Team

1.3.6 Electric and Signaling Associated Facilities

Electric and signaling associated facilities are provided in Table 1.3.6 and Table 1.3.7.

Table 1.3.6: List of SSP/SP/TSS

Station Name	TSS 180m×100m	SP 100m×60m	SSP 50m×45m	ATP	Chainage (km)
Mumbai					
				01	0.75
	01				6.82
		01			17.86
Thane					27.95
	Depo TSS1				30.50
	02				32.70
			01		47.40
		02			57.40
Virar					65.07
			02		69.80
	03				82.10
			03		94.80
Boisar					104.26
		03			107.30
			04		119.50
	04				130.40
			05		143.30
		04			155.30
			06		166.10
Vapi					167.94
	05				179.20
			07		192.50
		05			204.50
Bilimora					216.73
			08		217.10
	06				229.30
			09		241.80
		06			254.70
Surat					264.58

Station Name	TSS 180m×100m	SP 100m×60m	SSP 50m×45m	ATP	Chainage (km)
			10		266.40
	07				278.30
			11		290.50
		07			302.80
			12		316.00
Bharuch					323.11
	08				327.70
			13		340.40
		08			352.90
			14		365.00
	09				377.50
			15		390.50
Vadodara					397.06
		09			403.10
			16		414.00
	10				426.60
			17		439.50
Anand					448.13
		10			452.40
			18		461.40
Mahemdabad	11				472.70
		11			481.30
	12				489.10
Ahmedabad					500.18
			19		501.80
Sabarnati					505.88
	Depo TSS2				507.00

TSS: Traction Substation, SP: Sectioning Post, SSP: Sub Sectioning Post,
ATP: Auto Transformer Post

Source: Study Team

Table 1.3.7: List of DSS/SER

Distribution Substations

No.	Post Name	Type	Size of Land			Shape	Site Centre Chainage
			W(m)	D(m)	area(m ²)		
01	Mumbai/station	Station DSS (underground)	-	-	-		-
02	Thane creek/drainage post 1	Drainage DSS	50	35	1750	Rectangular	6km616m
03	Thane creek/drainage post 2	Drainage DSS	50	35	1750	Rectangular	16km143m
04	Thane/station	Station DSS	75	45	3375	Rectangular	27km642m
05	Thane/depot	Depot DSS & SER	95	65	6175	Rectangular	-
06	Virar/station	Station DSS & SER	93	45	4185	Rectangular	64km846m
07	Boisar/station	Station DSS & SER	93	45	4185	Rectangular	104km742m
08	Vapi/station	Station DSS & SER	93	45	4185	Rectangular	167km760m
09	Bilimora/station	Station DSS & SER	93	45	4185	Rectangular	218km381m
10	Surat/station	Station DSS	75	45	3375	Rectangular	264km344m
11	Bharuch/station	Station DSS & SER	93	45	4185	Rectangular	322km898m
12-1	Vadodara/station (HV)	Station DSS	55	35	1925	Rectangular	395km333m
12-2	Vadodara/station (LV)	Station DSS	57	34	1153	Triangle	397km253m
13	Anand/Nadiad/station	Station DSS	75	45	3375	Rectangular	447km929m
14	Ahmedabad/station	Station DSS & SER	132	57	3790	Complicated	499km600m
15	Sabarmati/station	Station DSS	85	45	3825	Rectangular	506km109m
16	Sabarmati/work shop	Depot DSS	80	65	5200	Rectangular	-

Intermediate Distribution Substations

01	Kaman	Intermediate SER & DSS	60	45	2700	Rectangular	49km900m
02	Kelva Road	Intermediate SER & DSS	60	45	2700	Rectangular	86km950m
03	Jamshet	Intermediate SER & DSS	60	45	2700	Rectangular	126km390m
04	Zari	Intermediate SER & DSS	60	45	2700	Rectangular	144km560m
05	Wadi Falia	Intermediate SER & DSS	60	45	2700	Rectangular	191km000m
06	Vijalpore	Intermediate SER & DSS	60	45	2700	Rectangular	243km600m

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07	Kharach	Intermediate SER & DSS	60	45	2700	Rectangular	293km800m
08	Dora	Intermediate SER & DSS	60	45	2700	Rectangular	347km623m
09	Husepura	Intermediate SER & DSS	60	45	2700	Rectangular	374km000m
09-2	Vadodara Maintenance Depot	Intermediate SER & DSS	65	25	1625	Rectangular	Approx. 384km
10	Adas	Intermediate SER & DSS	60	45	2700	Rectangular	421km550m
11	Vadadla	Intermediate SER & DSS	60	45	2700	Rectangular	474km200m

Depot SER

02	Thane Depot Sub SER1	Depot Sub SER	12	15	180	Rectangular	-
03	Thane Depot Sub SER2	Depot Sub SER	12	15	180	Rectangular	
04	Thane Depot Sub SER3	Depot Sub SER	12	15	180	Rectangular	
05	Thane Depot Sub SER4	Depot Sub SER	12	15	180	Rectangular	
06	Sabarmati Depot SER	Depot SER	60	45	2700	Rectangular	-
07	Sabarmati Depot Sub SER1	Depot Sub SER	12	15	180	Rectangular	
08	Sabarmati Depot Sub SER2	Depot Sub SER	12	15	180	Rectangular	
09	Sabarmati Depot Sub SER3	Depot Sub SER	12	15	180	Rectangular	

DSS: Distribution Substation

SER: Signaling and Telecommunication Equipment Room

Source: Study Team

1.3.7 Rolling Stock Depots

There are 2 rolling stock depots proposed at both end of the MAHSR alignment. The location of the depots is provided in Table 1.3.8.

Table 1.3.8: Location of Rolling Stock Depots

Name	Geo-Coordinates
Thane Depot	19°13'18.10"N, 73° 02'57.28"E
Sabarmati Depot	23° 06'02.73"N, 72°34'02.88"E

Source: Study Team

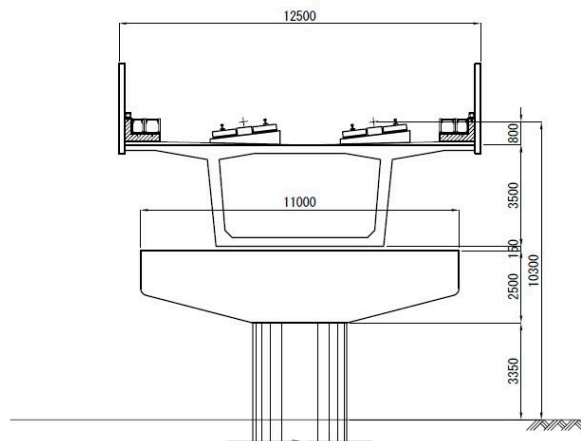
1.3.8 Construction Yards

Construction yards are proposed at every 25km along the alignment. The exact location of the yards will be decided by NHSRCL subject to criteria for selecting locations for yards. Details of the yard is discussed in **Annexure 1.3, Vol-II**.

1.3.9 Viaduct

The MAHSR runs on elevated viaduct in major portion of the alignment. The viaduct length is approximately 476.3 km. The ground elevation of the viaduct is 10-12m and the width is 12.5m for dual carriageway. The standard design of the viaduct for the corridor is depicted in Exhibit 1.3.6.

Exhibit 1.3.6: Standard Design of the Viaduct




Source: Study Team

1.4 ROLLING STOCKS

The MAHSR will employ the E5 series (E5) Shinkansen High Speed Train type. E5 is a Japanese Shinkansen high-speed train type operated by the East Japan Railway Company (JR East) on the Tohoku Shinkansen services since March 5, 2011, and on the Hokkaido Shinkansen services since March 26, 2016. The technical details of the E5 Series Shinkansen High Speed Train, are given in Table 1.4.1.

Table 1.4.1: Technical Specification E5 Series Shinkansen High Speed Train

E5 Series	
	
E5 Series Shinkansen on a <i>Hayabusa</i> service, March 2011	
Manufacturer	Hitachi, Kawasaki Heavy Industries
Capacity	731 (658 Standard, 55 Green, 18 Gran Class)
Operator(s)	JR East
Specifications	
Car body construction	Aluminium alloy
Train length	253 m (830 ft)
Car length	26,500 mm (86 ft 11 in)(end cars) 25,000 mm (82 ft 0 in) (intermediate cars)
Width	3,350 mm (11 ft 0 in)
Height	3,650 mm (12 ft 0 in)
Doors	E514: one per side plus one cab access door per side E515: one per side E523: two per side plus one cab access door per side Other intermediate cars: two per side
Maximum speed	320 km/h (200 mph)
Weight	453.5 t (446.3 long tons; 499.9 short tons)
Traction system	MT207 AC traction motors (300 kW)
Power output	9,600 kW (12,870 hp)
Acceleration	1.71 km/(h·s) (0.48 m/s/s)
Electric system(s)	25 kV AC, 50 Hz overhead catenary
Current collection method	Pantograph
Bogies	DT209 (motored), TR7008 (trailer)
Braking system(s)	Regenerative
Safety system(s)	DS-ATC
Track gauge	1,435 mm (4 ft 8 1/2 in)

Source:<http://www.railway-technology.com/projects/shinkansen-bullet-train-high-speed-japan/>

1.5 PROJECT FINANCIALS AND FINANCING

The revised estimated cost of the MAHSR is INR 1.08 Lakh Crores. As part of cooperation agreement between the Governments of India and Japan, the Government of Japan has agreed to provide a soft loan of 12 Billion USD at 0.1% interest to be repaid over 50 years and includes a 15 year grace period. The loan will be made available through Japan International Cooperation Agency (JICA).

The project is designed and conceptualized on Public Private Partnership (PPP) model. The project will generate revenues through non-subsidized ridership and commercial utilization of the stations.

1.6 OBJECTIVE OF THE EIA STUDY

1) Rationale

Schedule I of the Environmental Impact Assessment (EIA) Notification issued by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, New Delhi on 14th September, 2006, and subsequent amendment therein, under the Environment (Protection) Act, 1986, emphasizes on the requirement of prior Environmental Clearance. The Railway project is not included in the Schedule I of the EIA Notification, 2006. In view of this, prior Environmental Clearance is not required for the Mumbai-Ahmedabad High Speed Railway project.

Since the MAHSR project is being financed by the JICA, preparation of EIA report is mandatory as per the Environmental and Social Consideration Guidelines published by JICA in April 2010. In view of the above, the present S-EIA has been prepared.

During the F/S stage EIA Study was taken up as a prerequisite for the primary impact assessment of the project in consonance with the JICA's Environmental and Social Guidelines, April 2010. Now, as the project is sanctioned for implementation, to supplement the EIA Study of F/S stage, Supplemental EIA study has been carried out as a part of the Detailed Design Engineering. The output of the EIA Study is S-EIA Report which will form the basis for final approval of JICA.

The proposed MAHSR alignment passes through Coastal Regulation Zones in both the States of Maharashtra and Gujarat at seven locations, Environmental Impact Assessment (EIA) studies including preparation of an Environmental Management Plan (EMP) have been conducted in order to secure the necessary CRZ clearance from the MoEFCC, Government of India, under the CRZ Notification, 2011.

In order to identify the environmental impacts due to the construction and operation of the proposed MAHSR project and associated facilities (Depot, Railway Stations and Maintenance Depot etc.), an EIA study has been conducted by the Study Team. Based on the definition of "Associated Facilities" provided in the glossary of the terms included in IFC's Policy and Performance Standards on Social and Environmental Sustainability and IFC's Guidance Notes to the Performance Standards, only access roads and station plaza planned for the MAHSR project are part of the associated facilities.

The EIA Study has been conducted in accordance with the latest Guidelines of Ministry of Environment Forests and Climate Change (MoEFCC), Japan International Cooperation Agency (JICA) on Environmental and Social Considerations, 2010, the rules and regulations notified by the participating states-Maharashtra and Gujarat from time to time and the Terms of Reference issued by the JICA. The present S-EIA Report has been prepared based on the Terms of Reference discussed above and brief is presented below.

Study Objective

- Review of the existing EIA carried out in 2014-2015;
- Preparation of Inception Report and screening of Environmental Assessment;
- Supplemental studies (as outlined in this Scope);
- Public consultation;
- Preparation of documents for necessary clearances;
- Preparation of S-EIA report.

The Study consists of the primary data collection, intensive site visits and detailed assessment, consultations with stakeholders and the analysis of available secondary data.

The Study was carried out to achieve the following objectives:

- a) Execution of primary data collection/surveys to supplement the Joint F/S EIA to appropriately establish an environmental baseline in the Study area.
- b) Identification of significant environmental issues to inform decision-making for proposed works, including analysis of the various alternatives for design changes from the Joint F/S and more detailed project impact information during detailed design.
- c) Assessment of potential impacts to realize requisite avoidance, minimization, management/mitigation and compensation measures, as needed.
- d) Preparation of applications with necessary assessments and reference documents for expected clearances as well as to assist NHRCL to acquire final clearances/approvals.
- e) Planning and proposing of fund allocation to ensure the occupational health & safety of all contract and casual workers.
- f) Identification of existing occupational and safety hazards, such as the exposure levels of hazards and whether they are within Permissible Exposure Level (PEL). If these are not within the PEL, measures should be identified to keep them within the PEL so that health of the workers can be preserved.
- g) Development and preparation of appropriate mitigation measures and Environmental Management Plan (EMP), addressing implementation, monitoring and reporting requirements.
- h) Addressing identified environmental issues through appropriate planning and design of works and integration of EHS requirements into the bidding documents.

Overall, the objective of the study is to ensure that anticipated adverse impacts on natural, physical and social environment likely to be caused by the proposed project interventions, to assess the impacts adequately and to address through appropriate mitigation measures integrated into the design and execution of the works.

2) Changes From F/S stage EIA to S-EIA study of Detailed Design Stage

The change which has been effected from F/s stage EIA to Detailed Design Stage S-EIA is presented in Table 1.6.1.

Table 1.6.1: Change effected from F/s Stage EIA to Detailed Design Stage S-EIA

Environmental Attributes	F/s Stage EIA	Detailed Design Stage S-EIA
Period/Season	Post-Monsoon	Pre-monsoon
Noise	12 locations	31 locations
Vibration	12 locations	31 locations
Ecology	3 locations	17 locations
Clearances	Not Required	Required for CRZ, Wildlife and Forest
Water Quality	Only Surface Water	Both Surface and Ground Water
Public Consultation	Not Conducted	Conducted
Tree Counting	Not Carried out	To be carried out to secure Tree Felling Permission
HTL/LTL Demarcation	Not carried out	At seven locations
Bio-diversity Conservation Plan	Not carried out	It has been taken up (by Study team, ZSI & MSI)

Source: Study Team

The Findings of the EIA study carried out during the F/S stage and the Scope of Work (for S-EIA study in 2017) as detailed in the ToR; conclude that the project requires several clearances from different statutory bodies. The certain section of Mumbai-Ahmedabad High Speed Railway Project passes through CRZ area at six locations in Maharashtra region and one location in Gujarat; three ecologically sensitive areas of Protected Areas like Sanjay Gandhi National Park (SGNP), Tungareshwar Wildlife Sanctuary (TWLS), Thane Creek Flamingo Sanctuary (TCFS- through tunnel 30 m below the creek bed); one ecologically fragile area-Dahanu Taluka, and also involves the removal of mangrove patches at multiple locations.

Considering the requirement of various clearances, following studies have been carried out by the reputed organizations as detailed in the subsequent sections.

a) CSIR-National Institute of Oceanography (NIO), Goa through Regional Centre, Vishakhapatnam

Regional Centre, CSIR-NIO, Visakhapatnam has carried out the demarcation of HTL/LTL for the candidate CRZ area at seven locations-six in Maharashtra and one in Gujarat. The details are discussed in Chapter 3 of the S-EIA Report.

b) Zoological Survey of India (ZSI), Ministry of Environment, Forest and Climate Change (MoEFCC), Govt. of India, Kolkata

ZSI has carried out Study of Faunal Components and Preparation of Management and Conservation Plan for Flamingo Sanctuary at Thane Creek in Mumbai to assess the impact of the undersea tunnel and formulate management and conservation plan for the migratory bird Flamingo and other faunal species.

c) Mangrove Society of India (MSI), Goa

The MSI entrusted for Preparation of Integrated Conservation and Management Plan for the Mangrove to be affected by the MAHSR alignment. The study aims at assessing the number and area of mangrove to be felled and to delineate the compensatory mangrove afforestation plan at the identified locations in consultation with the Mangrove Cell, Thane, Maharashtra.

Apart from the above, some additional reports were prepared by the respective experts for the following:

Conservation and Management Plan for:

- Sanjay Gandhi National Park (SGNP), Borivali;
- Tungareshwar Wildlife Sanctuary (TWLS);

1.6.1 Study Area

The region targeted by the study is a corridor having a length of approximately 508.17 km that connects the city of Mumbai (Maharashtra State) and Ahmedabad (Gujarat State). The study area comprises of 500 m, considered as Zone of Influence (ZOI) along the proposed MAHSR alignment.

1.6.2 Structure of the S-EIA Report

The structure of the S-EIA Report adopted for the proposed MAHSR project is detailed below in Table 1.6.2, keeping in view the Scope of Work as detailed in the RFP document for Environmental Consultancy Services for Detailed Design of Mumbai-Ahmedabad High Speed Railway Project.

Table 1.6.2: Structure of the S-EIA Report

	Executive Summary	Brief summary of the S-EIA Report
Chapter 1	Description of the Project	Describes the technical description of the project, the financial status and Scope of the S-EIA Report
Chapter 2	Analysis of Alternatives, Impact Identification & Scoping Matrix	Justification of the selected alignment structure and advantage over other alignment structure, Technology, Stakeholders view, etc.
Chapter 3	Applicable Environmental Regulatory Framework and Lender’s Requirement	Describes the regulatory framework applicable to the proposed MAHSR project on Indian and International Context, JICA’s Guidelines on Environmental and Social Consideration, April 2010, Lender’s Requirement
Chapter 4	Existing Environmental Conditions of the Project Area	Describes the baseline condition of all environmental components and social conditions of the Zone of Influence (Zoi) with respect to MAHSR project.
Chapter 5	Potential Environmental Impacts and Mitigation Measures	Describes the qualitative and quantitative analysis of the impacts and also identifies the mitigation measures for each of the environmental attributes.
Chapter 6	Environmental Management Plan & Monitoring plan	This Chapter describes the Environmental Management Plan delineated and based on the outcome of the impacts predictions for implementation in construction phase as well as in operation phase of the project. An Environmental Monitoring Plan formulated for both construction and operation phases of the project, are presented in this chapter along with indicative budget layout
Chapter 7	Information Disclosure and Public Consultation	The information disclosure about the projects and S-EIA study to the stakeholders and outcome and suggestions of the Environmental Public Consultation has been discussed in this Chapter
References		Lists the sources of information and reference materials used in the preparation of this report
Annexures		Contains supporting data, analysis, maps, drawings etc. referenced in the main body of the report, is in Volume-II as Annexure of the S-EIA Report.
Photographs		Site photographs of important and sensitive man-made structures, natural scenery etc. have been incorporated in the respective sections of the chapters
Disclosure of the Consultants		Details of the EIA Consultants and the experts associated with the S-EIA Study as Appendix-1

Source: Study Team

Chapter 2
Analysis of Alternatives

Chapter 2 Analysis of Alternatives

2.0 ANALYSIS OF ALTERNATIVES

The primary purpose of an analysis of alternatives (AoA), is to identify alternate project options at a systemic (technology, route or alignment, etc.) as well as engineering (materials, construction methods, operating practices, etc.) levels.

An AoA, conducted early into the project design and planning stage, helps identify more cost-effective alternatives, reduce adverse impacts and risks, improve performance and validate the appropriateness of the selected option.

Infrastructure design is often a complex task due to the multidisciplinary aspects involved. Environmental aspects (together with the socioeconomic variables) assume considerable importance for rail design, and high-speed rail in particular. These aspects often influence multiple choices in the rail projects, such as route alignment, construction methods, rolling stock, traction technology, type of carriageway, materials and services, etc.

This chapter presents a comparative analysis between several alternatives considered to avoid or minimize environmental and social impacts. Along with technical aspects (based on design speed and geometrics), these alternatives were used to adopt the preferred options.

The Ministry of Railways (MoR), Government of India, released The Indian Railways' VISION 2020 which envisages a two-pronged approach to bring High Speed Rail (HSR) in the country. The first strategy involves using conventional technology to increase the existing speed from 80-100 kmph to 160-200 kmph on segregated passenger corridors on trunk routes. The second approach involves identifying viable intercity routes to build advanced high speed corridors for speeds up to 350 kmph. The proposed "Diamond Quadrilateral" HSR network will link the four major metro cities of India. These are mainly high-density corridors and range from 135-991 km in length. These plans target building four corridors of 2,000 km by 2020 and planning for eight other corridors. These interventions are expected to deliver significant economic, social and environmental benefits. In this report, the benefits for energy security and mitigation of CO₂ emissions are analyzed, thereby contributing to the understanding of the impacts of HSR.

An Expert Committee constituted on Modernization of Indian National Railway in 2012 submitted its recommendation in Section 8 under High Speed Passenger Train Corridors, *"Paragraph 8.1 - Construct a High Speed railway line between Mumbai and Ahmedabad with speed of 350 kmph. This would lead to increased connectivity, traffic and faster intercity travel."*

In furtherance of the plan, Ministry of Railway has decided to implement first High Speed Rail Corridor between Mumbai and Ahmedabad - named as Mumbai-Ahmedabad High Speed Railway (MAHSR) Project. The total length of the proposed MAHSR alignment works out to be 508.17 km. Out of this, 155.642 km falls in Maharashtra, 345.17 km in Gujarat and 7.358 km in Union Territory of Dadra and Nagar Haveli. The alignment starts from Bandra Kurla Complex (BKC) close to Mithi River in Mumbai and terminates at Sabarmati Railway Station in Ahmedabad. The MAHSR has been proposed with 12 Stations *i.e.* Bandra Kurla Complex (BKC)-Mumbai, Thane, Virar, Boisar, Vapi, Bilimora, Surat, Bharuch, Vadodara,

Anand, Ahmedabad and Sabarmati, all near major traffic points. Two maintenance depots are proposed on either ends of the corridor-one in Thane and another in Sabarmati.

In addition, to facilitate the Railway infrastructure, the Government of India, created National High Speed Rail Corporation Limited (NHSRCL) - a Joint Venture of Government of India and Participating State Governments for implementing all stages of project development from planning to execution, construction, operation and maintenance.

2.0.1 With or Without Project Scenario

The ‘with’ or ‘without’ project scenarios are analyzed with respect to the development of reliable quality infrastructure for sustained growth of economy and consequent welfare of its citizens.

Providing better and faster connectivity will ensure that goods and people from areas covered by the project can move in and out of the areas more efficiently. The project is expected to spin off increased trade and commerce activity. The project has been designed to connect the various urban economic growth centers.

Without this project, it is expected that there will be an increase in air pollution, due to slow moving traffic and congestion. Travel will take longer thus impacting productivity and reducing the economic growth of the area. Overloading of existing transport infrastructure will also affect safety and lead to loss of human life due to increase in accidents (Local rail transport in Mumbai, for instance, has been reported to result in about 3000 deaths annually, based on news agency reports). The proposed MAHSR project shall have an enclosed and dedicated corridor and also have automatic doors that remain closed during travel.

Benefits of HSR over other mode of transportation evaluated for parameters, such as land use, time of travel, greenhouse gas emission and fuel consumption, are presented in Table 2.1.1.

Table 2.1.1: Benefits of MAHSR over Other mode of Transport

Aspect	MAHSR	Other/Railway/Road/Air
Land Use	High speed rail is more efficient on land use – an average high-speed line uses 2.8 ha per km.	9.3 ha per km for an average motorway (UIC, 2012)
	Land impacts can be significantly reduced, if new high-speed railway lines are laid out parallel to existing motorway alignments. Minimal change in land use pattern is envisaged as the alignment shall be either elevated or under tunnel.	Changes in land use pattern at large scale
Travel Time	Time savings from high-speed rails are significant. Less than 2 hours after the commencement of high speed rail service between Mumbai-Ahmedabad.	More time due to slow speed 6 to 12 hours depending upon the speed of train. By air it takes 1 hour 15 minutes.
	As an alternative against air travel, MAHSR offers convenience through better connectivity to local transport infrastructure.	Access to the airport is not convenient in all the cities and not connected to local city transport.

Aspect	MAHSR	Other/Railway/Road/Air
GHG Emissions	Due to higher energy efficiency of the HSR operations, net GHG emissions are expected to be lower. A 10% reduction of emissions per annum over BAU. Annual average emissions reduction of about 81,040 tCO ₂ over a 15-year period.	By 2050 a six fold increase in the CO ₂ emission. With BAU- 1.4 MT CO ₂ per km.
Fuel Consumption	Significant reduction in fuel consumption due to expected modal shift in vehicles plying between Mumbai and Ahmedabad to MAHSR.	Higher fuel consumption due to increased number of private vehicles plying between Mumbai and Ahmedabad.

Source: Study Team¹

2.1 ALTERNATIVE SCENARIOS FOR MAHSR

This section deals with the rationales behind preferred choice of taking the Viaduct Route Vs the Embankment Route Vs the No-HSR/Business as Usual evaluation and comparison of impacts.

In continuation to the analysis presented at the feasibility stage for the selection of the alignment which is enclosed in **Annexure 2(a), Vol-II** of the S-EIA Report, the final proposed alignment option at the DPR Stage is named as Alternative 1, while the final alignment of the feasibility stage is named as Alternative 2, and the No-HSR / Business as Usual (BAU) (so called Zero option) is named as Alternative 3.

2.1.1 Alternative 1- HSR with Viaduct / Bridges and Tunnels

Alignment runs on viaduct/bridges/tunnels minimizing the footprint area and avoiding all the land related issues with minimal land acquisition for construction of pillars and tunnels in Maharashtra and Gujarat.

Alternative 1 (ALT1) with starting station proposed at Bandra Kurla Complex (BKC)/close to Mithi River, Mumbai, crossing Thane Creek by tunnel and ends up at Sabarmati, in Ahmedabad with new suburban stations in Surat, Bharuch, Anand, Virar, Thane, Bilimora and juxtaposed to existing stations at Vadodara and Ahmedabad. As mentioned earlier, it will be a dedicated corridor with total length of 508.17 km with 12 stations.

2.1.2 Alternative 2- HSR with Embankment and Bridges

This alternative is the alignment selected at Feasibility Stage. More than 90% of the alignment is on embankment and less than 10% of the alignment is on bridges and Tunnel. Hence the foot print area of the project is high due to embankment.

¹The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

Alternative 2 (ALT2) is totally dedicated route for which starting station is proposed at Bandra Kurla Complex (BKC), Mumbai, crossing Thane Creek by tunnel and ends up at Sabarmati, in Ahmedabad with new suburban stations in Surat, Bharuch, Anand, Bilimora, Virar, Thane and juxtaposed to existing stations at Vadodara and Ahmedabad. It will also be a dedicated corridor with total length of 508.17 km with 12 stations.

2.1.3 Alternative 3 – No-HSR - Business-as-Usual (BAU)

In the absence of HSR, the passenger travel choices will continue to operate on the existing modes including road, rail and air. The future modal share for this scenario is predicted to mimic the BAU scenario of *Dhar and Shukla* (2015), in terms of growth rates for road and air transport, with rail transport accounting as the residual. Despite the improvement in rail capacity, the percentage share of air is expected to increase due to rising incomes. In addition, growing ownership of private vehicles will result in significant number of trips being served by cars. Road are predicted to continue to dominate, especially short trips between intermediate cities along the MAHSR corridor. Thus, the modal shares of air and road transport (largely due to private vehicles) are expected to increase at the expense of public transport like Rail, which shall have serious effect on the GHG emissions.

2.2 COMPARISON OF ALTERNATIVES

It is evident from the above that all the three alternatives have some advantage and disadvantage in terms of cumulative impact-environmental, social etc. On assessment of the advantages and disadvantages of the three alternatives and certain limitation, it is considered that **Alternative 1** is the most preferred option. The comprehensive comparison of three alternatives is summarized and presented in Table 2.2.1.

Table 2.2.1: Comparison of Alternatives

		Alternative 1		Alternative 2		Alternative 3	
		(HSR with Viaduct / Bridges and Tunnels)		(HSR with Embankment/ Bridges and Tunnels)		(No-HSR – BAU)	
Route Overview	Length	508.17 km		508.17 km		538.0 km (Road)	
	Number of Station	12 nos.		12 nos.		Not applicable	
	Structural Feature	Embankment / At Grade : 0.0Km	A	Embankment / At Grade: 341 km	B	538 (distance on existing rail line)	C
		Viaduct/Bridge: 482.85km Tunnel / Underground : 26.203 km		Viaduct/Bridge: 140 km Tunnel / Underground: 27.5 km		No improvement	
	The entire section of the alignment shall be in viaduct / bridge structure except the tunnel sections.		Continuous elevated section: 123 km, River section: 13 km/37 number, RUB section: 4 km/121 number		No improvement		

	Alternative 1 (HSR with Viaduct / Bridges and Tunnels)	Alternative 2 (HSR with Embankment/ Bridges and Tunnels)	Alternative 3 (No-HSR – BAU)
	<p>Comparison between Embankment and Viaduct</p> <p>Width of Land for Each Structure</p> <p>12m × 126km = 1,510,592m²</p> <p>38m × 326km = 12,387,384m²</p>		
Time Required	<p>Super express (Stop at 3 stations): 2 hours 07 min.</p> <p>Local train (Stop at every station): 2 hours 58 min.</p>	<p>Super express (Stop at 3 stations): 2 hours 07 min.</p> <p>Local train (Stop at every station): 2 hours 58 min.</p>	<p>Non Stop travel taking 8 hours 52 minutes</p> <p>No improvement</p>
Transport Network	<p>A high speed operation is possible throughout the whole section.</p> <p>Thane/Vadodara/Ahmedabad/Sabarmati: connected to existing railway.</p>	<p>A high speed operation is possible throughout the whole section.</p> <p>Thane/Vadodara/Ahmedabad/Sabarmati: connected to existing railway.</p>	<p>Speed restrictions prevail on Road and existing Rail line due to crossings / intersections</p> <p>Thane/Vadodara/Ahmedabad/Sabarmati: connected to existing road and railway.</p>
Passenger Demand	<p>Boarding Passenger: 40 thousand PAX/day (2023), 202 thousand PAX/day (2053).</p> <p>Large demands on Mumbai, Ahmedabad and Vadodara stations are expected.</p>	<p>Boarding Passenger: 40 thousand PAX/day (2023), 202 thousand PAX/day (2053).</p> <p>Large demands on Mumbai, Ahmedabad and Vadodara stations are expected.</p>	<p>Boarding Passenger: 38 thousand PAX/day (2023), 165 thousand PAX/day (2023).</p> <p>No improvement</p>
Technical Side			

	Alternative 1 (HSR with Viaduct / Bridges and Tunnels)	Alternative 2 (HSR with Embankment/ Bridges and Tunnels)	Alternative 3 (No-HSR – BAU)
Technical issues related to operation	High speed operation is available due to the dedicated line. A	High speed operation is available due to the dedicated line. A	A High Speed Operation is not possible on these lines. The carrying capacity of the existing road and rail lines is lesser because multiple vehicles / trains are operated on same road / railway infrastructure. C
Safety	A high safety is kept because of full-dedicated railway line. A	A high safety is kept because of full-dedicated railway line. A	The safety performance is lower than dedicated railway line. B
Cost	INR 1,080,000 (million) C	INR 709,151 (million) B	NA A
Environmental and Social Considerations	Natural Conservation: Some forests and mangroves are affected but Thane Creek is not affected. A Land Requirement for the Construction on Viaduct and Road is 2.8 ha./km.	Natural Conservation: Some forests are affected but Thane Creek is not affected. B Land Requirement for the Construction on Embankment and Road is 3.2ha./km.	NA C 7.5 ha/km for conventional railway
Total Evaluation	The HSR system can be introduced throughout whole section. High safety and efficiency are kept. It is possible that the characteristic of HSR is exerted most. A High demand is expected because major stations are in the urban area and linked with the city transport service.	The HSR system can be introduced throughout whole section. High safety and efficiency are kept. It is possible that the characteristic of HSR is exerted most. B High demand is expected because major stations are in the urban area.	It is impossible that High Speed Rail is introduced in existing railway. C The demand is lower because there is competition with other modes. The high safety cannot be kept. High safety and efficiency cannot be kept.

Alternative 1	Alternative 2	Alternative 3
(HSR with Viaduct / Bridges and Tunnels)	(HSR with Embankment/ Bridges and Tunnels)	(No-HSR – BAU)
In Mumbai area, the impacts of resettlement and natural environment are less because MAHSR alignment is underground.	In Mumbai area, the impacts of resettlement and natural environment are less because MAHSR alignment is underground.	NA
The impact on the natural environment is the least because the number of bridges to be constructed is less among alternatives.	The impact to natural environment is the least because the number of bridges to be constructed is less among alternatives.	The time required is longer than ALT1 or ALT2.
This is the most desirable plan.	This plan is inferior to ALT1.	This plan is inferior to ALT1 and ALT2.

Source: Study Team

2.3 ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Based on JICA’s guidelines on Environmental and Social Considerations issued in April 2010 and the components of the MAHSR project along with the compliance is discussed in detail in Chapter 3. The envisaged impact matrix and quantification of impacts due to construction and operation of the proposed project is further discussed in length in Chapter 5, whereas the mitigation measures, Environmental Management Plan and Environmental Monitoring Programme (EMoP) is presented in Chapter 6 of the S-EIA Report.

Chapter 3
**Applicable Regulatory Framework
and Lender's Requirements**

Chapter 3

Applicable Regulatory Framework and Lender's Requirements

3.0 INTRODUCTION

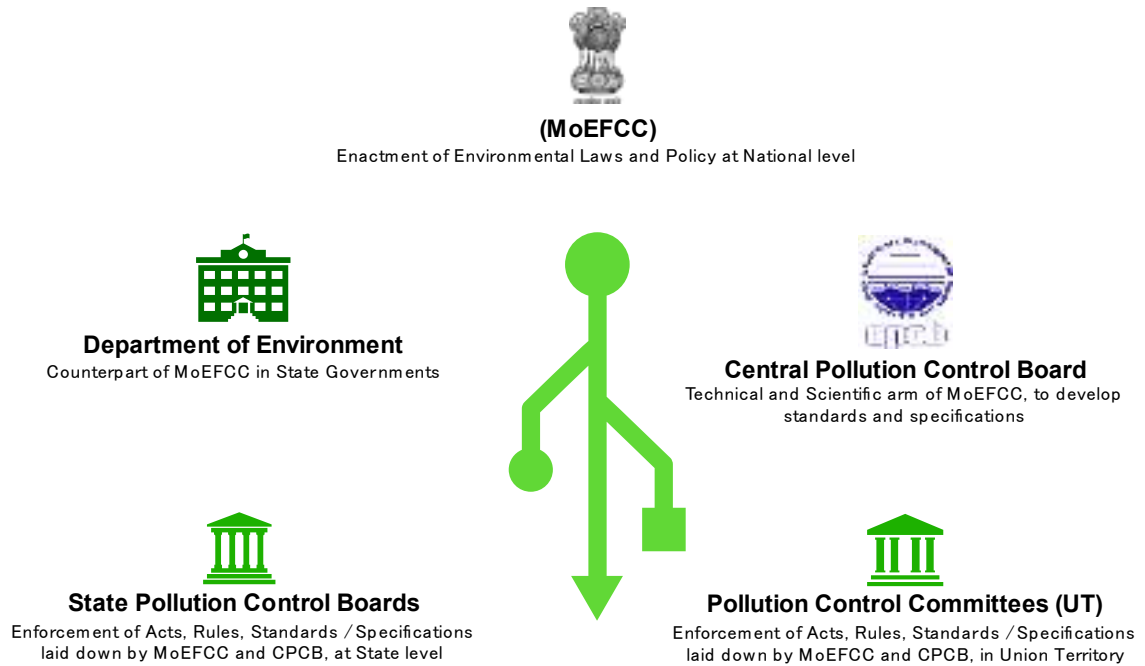
Environmental legislation has developed considerably in India since 1970's and plays an important role in ensuring that environment protection measures are incorporated in the plans, programs and projects advancing the socio-economic development of the nation, so that every project will become environmentally sound and people friendly.

The sincere implementation of these laws ensures that the development is sustainable as well as protects human health and property in the long term. The Ministry of Environment, Forest and Climate Change (MoEFCC), the Central and State Pollution Control Boards / UT Pollution Control Committees represent the principal administrative and regulatory bodies responsible for the preservation and conservation of the environment as the country undergoes massive social, economic and infrastructural transformation and thereby ensuring environmentally sustainable development in the country.

Acts are the legislations passed by the Parliament or the State Legislative Assembly (the "Legislature"). The Act usually provides and delegates powers for framing of the rules / regulations for effective implementation of the Act to the Government (the "Executive") but may require them to be placed before the enacting Legislature for approval and coming into force. The Government responsible for framing of the rules/regulations depends upon whether the Act is Parliamentary or State. In cases of State Acts, the rules are always framed by the respective State Government. In cases of Parliamentary Acts, depending upon the mandate and the provisions of the Act, it may either be the Central Government alone or each State Government to which the Act applies or both, the Central Government and the State Governments for different matters in the same Act. Notifications are official orders made under the Act by the Government and are usually declaratory in nature: allowing, regulating, restricting or prohibiting certain activities, practices *etc.* The rules / regulations / notifications made or issued under any Act must be in conformity with the mandate given under the provisions of the Act and such rules / regulations / notifications not in consonance are *ultra vires* to the Act and can be challenged in a Court of Law.

In India, various Environmental Acts, Rules and Notifications have been introduced to ensure that developmental projects are planned and executed on the principles of sustainable development. The objective of these regulations is that the project should not lead to major ecological or other losses while accruing project benefits. The applications of various regulations/law to the design (project preparation stage), construction (implementation stage) and post project stage (operational phase) of the project are described in detail, in this Chapter. The environmental regulatory framework in India is depicted in Exhibit 3.0.1.

Exhibit 3.0.1: Environmental Regulatory Framework in India



Source: Study Team¹

3.1 ROLE OF REGULATORY AUTHORITIES

3.1.1 Ministry of Environment, Forest and Climate Change (MoEFCC)

MoEFCC is the nodal agency in the administrative structure of the central government for planning, promotions, co-ordination and overseeing the implementation of India's environmental and forestry policies and programs. The major responsibilities of MoEFCC include:

- Environmental resource conservation and protection, including EIA, clearance of developmental projects;
- Co-ordination with the other ministries and agencies, voluntary organizations and professional bodies for environmental action plans;
- Promotion of research and development, manpower planning and training and creation of environmental awareness;
- Liaison and coordination with international agencies involved in environmental matters.

¹ The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

The proposed MAHSR project would require CRZ Clearance, Forest Clearance and Wildlife Clearance and these shall be approved by the MoEFCC as per regulatory procedures.

3.1.2 Central and State Pollution Control Boards (CPCB & SPCBs)

The Central and State Pollution Control Boards (CPCB and SPCBs) of India is a statutory organisation under the Ministry of Environment, Forest and Climate Change (MoEFCC). The Water Act 1974 was amended in 1988 and accordingly CPCB and SPCBs were formed after renaming the previously functioning Central/State Boards for the prevention and control of water pollution. The water and Air Acts, and other Acts related to environment from time to time are implemented through CPCB. The new boards in the centre and state were also entrusted to look after air pollution besides their work to safeguard water from pollution.

The functions of the SPCBs include:

- The planning of comprehensive state programs for the prevention and control of air and water pollution and to ensure the implementation thereof;
- Inspection of pollution control equipment/plants for monitoring of their efficiency.
- The SPCB in consultation with the CPCB may establish norms for air quality, gaseous emission and noise level, etc.

The project shall require obtaining consent from Maharashtra Pollution Control Board (MPCB) and Gujarat Pollution Control Board (GPCB) for 'Consent to Establish' and 'Consent to Operate' by submitting an online Common Application (as per Schedule-I), under Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and authorization under Hazardous Wastes (Management and Handling) Rules, 1989, as amended.

3.1.3 National Boards for Wildlife (NBWL) and State Boards for Wildlife (SBWL)

Wildlife Division in the Ministry of Environment, Forest and Climate Change (MoEFCC) is responsible for carrying out the activities relating to wildlife conservation in coordination with the State Governments through State Board of Wildlife (SBWL) and to provide financial and technical assistance to the states for scientific management of the wildlife resources in the country. It is also responsible for carrying out the activities related to wildlife research and training of personnel involved in wildlife management through the Wildlife Institute of India. Presently, the Wildlife Division is headed by the Additional Director General of Forests (Wildlife) who is also the Director, Wildlife Preservation and the Management Authority of Convention on International Trade in Endangered Species of Wild Fauna and Flora, or CITES.

As the proposed MAHSR alignment passes through the Eco-sensitive Zone of two protected areas namely Sanjay Gandhi National Park (SGNP), Tungreshwar Wildlife Sanctuary (TWLS) and core zone of Thane Creek Flamingo Sanctuary (TCFS), the permission is required from Standing Committee of NBWL for commencement of construction activities in these areas.

3.1.4 The Forest Department – Gujarat and Maharashtra

Both State Forest Departments are entrusted with the prime responsibility of protection, conservation and development of the forests and wildlife of the state.

- Protection, Conservation and development of forests and wild life, the adoption of measures of soil conservation, moisture conservation, and increasing soil fertility.
- The utilization of the forest so as to obtain the maximum yield consistent with their permanent maintenance and the supply of the needs of the people, agriculture, industry, and defence.
- To conduct research into civil culture, utilization, and other problems affecting the regeneration and development of the forests.
- To achieve the goals of National Forest Policy 1988 and to cover the maximum area under forests.
- To create awareness among the people about the forests and environment.
- To increase the active participation of the local people in protection and conservation of forest with special emphasis on tribal, poor and women.

Tree felling permission and diversion of forest land will be required before undertaking construction activities.

3.1.5 The Supreme Court of India

Since 1996, the Supreme Court of India, as the highest judicial authority in the country, is often assumed as a catalyst decision maker on issues relating to forests and wildlife. These judgements of the SC have largely been in response to litigations filed by citizens or civil society groups / environmental activists / NGOs.

The Supreme Court's intervention was initiated through the following cases:

- The T. N. Godavarman Thirumulkpad vs Union of India and others (WP No 202 of 1995) concerning the implementation of the Forest Conservation Act, 1980.
- The Centre for Environmental Law (CEL), WWF vs Union of India and others (WP No 337 of 1995) concerning the issue of settlement of Rights in National Parks and Sanctuaries and other issues under the Wildlife (Protection) Act, 1972.

These cases are being heard for the last nine years and are a part of what is termed as "continuing mandamus", whereby the Courts, rather than passing final judgments, keeps on passing orders and directions with a view to monitor the functioning of the executive. They have led fundamental changes in the pattern of forest governance and decision making. Some examples include:

By virtue of the Supreme Court's order dated 13.11.2000 in the CEL vs.WWF case (W.P. No. 337 of 1995), no forest, National Park or Sanctuary can be de-reserved without the approval of the Supreme Court.

No non-forest activity is permitted in any National Park or Sanctuary even if prior approval under the Forest (Conservation) Act, 1980 has been obtained. The interim order dated 14.2.2000 prohibited the removal of any dead or decaying trees, grasses, drift wood *etc.* from any area comprising a National Park or a Sanctuary notified under Section 18 or 35 of the Wildlife (Protection) Act, 1972.

It was also directed that if any order to the contrary has been passed by any State Government or other authorities the operation of the same shall be stayed. In order to advise the Supreme Court on the various issues concerning forest and wildlife conservation, the Central Empowered Committee (CEC) was set up as an authority under Section 3 (3) of the EPA, 1986 to adjudicate on forest and wildlife related issues. Despite its wide impact and implication on forest management and governance most environment, human rights and activists groups and also the Government are not generally aware of the current developments in the Courts. Existing methods of reporting of Court's orders and judgments are generally inadequate and do not reach the concerned the groups in time. An Information Dissemination Service is, therefore, been envisaged as a neutral body that will keep a watch on the happenings in the Supreme Court and disseminate information through electronic as well as other means to interested groups and individuals on all decisions concerning the above two cases.

3.1.6 Coastal Zone Management Authority (CZMA)

It was in the year 1998 that the MoEFCC (in compliance to orders of the Supreme Court of India in 1996) constituted the State Coastal Zone Management Authorities (SCZMAs) for each State having coastline and National Coastal Zone Management Authority (NCZMA) to ensure the implementation of CRZ Notification, 1991.

Maharashtra Coastal Zone Management Authority (MCZMA)

In exercise of the powers conferred by sub-sections (1) and (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) (hereinafter referred to as the said Act), and in supersession of the notification of the Government of India in the erstwhile Ministry of Environment and Forest number S.O 383(E) dated the 6th March, 2012, except as respects things done or omitted to be done before such suppression, the Central Government hereby constitutes an authority to be known as the Maharashtra Coastal Zone Management Authority (hereinafter referred to as the Authority) vide S.O. 1054(E) for a period of three years, with effect from the date of publication of this notification in the Official Gazette. Main functions of MCZMA are as follows:

- To take measures for protecting and improving the quality of the coastal environment Examination of proposals for changes or modification in classification of CRZ areas;
- Enquiry into cases of alleged violation of the provisions of the CRZ Notification, 2011 and take appropriate decision under Section-5, 10 & 19 of EPA, 1986;
- To examine all projects proposed in CRZ areas and give their recommendations
- To identify ecologically, economically and highly vulnerable areas of the coastal zone and formulate area specific management plans.

Gujarat Coastal Zone Management Authority (GCZMA)

In exercise of the powers conferred by sub-sections (1) and (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) (hereinafter referred to as the said Act), the Central Government hereby constitutes an Authority vide S.O. 2507 (E) to be known as the Gujarat Coastal Zone Management Authority (hereinafter referred to as the Authority), for a period of three years, with effect from the date of publication of this Order in the Official Gazette. The main functions of the GCZMA are as follows:

1. The Authority shall deal with environmental issues relating to Coastal Regulation Zone which may be referred to it by the State Government of Gujarat, the National Coastal Zone Management Authority or the Central Government, as the case may be.
2. The Authority shall identify ecologically sensitive areas in the Coastal Regulation Zone and formulate area-specific management plans for such identified areas.
3. Authority shall co-ordinate for implementing conservation projects or projects related to upliftment of coastal population protection, *etc.*
4. The Authority shall identify coastal areas highly vulnerable to erosion or degradation and formulates area-specific management plans for such identified areas and arrange for funding for the implementation of the same.

National Coastal Zone Management Authority (NCZMA)

In exercise of the powers conferred by Sub-sections (1) and (3) of Section 3 of the EPA, 1986 (29 of 1986) (hereinafter referred to as said Act) and in supersession- of the Order of the Government of India issued by MoEFCC vide OM NO. J-17011/18/96-IA-III dated 13th August, 1998, except as respects things done or omitted to be done before such supersession, the Central Government hereby constitutes an authority vide S.O.991 (E) to be known as the National Coastal Zone Management Authority (NCZMA)(hereinafter referred to as the Authority) for a period of two years, with effect from the date of publication of this Order in the Official Gazette, namely:

1. The Authority shall have the power to take the following measures for protecting and improving the quality of the coastal environment and preventing, abating and controlling environmental pollution in coastal areas, namely:-
 - Coordination of action by the SCZMA and the Union Territory CZMA under the said Act and the rules made there under, or under any other law which is relatable to the objects of the said Act.
 - Examination of the proposals for changes and modifications in classification of CRZ areas and in the CRZ Plans received from the SCZMA and the Union Territory CZMA and making specific recommendations to the Central Government.
 - (a) Review of cases involving violations of the previous of the said Act and the rules made there under, or under any other law which is relatable to the objects of the said Act and, if found necessary, issue directions under section 5 of the said Act.
 - (b) Review of cases under (iii) (a) either *suo motu*, or on the basis of complaint made by an individual or a representative body, or an organization functioning in the field of environment.
 - File complaints, under Section 19 of the said Act in cases of non-compliance of the directions issued by it under sub-paragraph (iii) (a) of paragraph II of the Order.
 - To take action under Section 10 of the said Act to verify the facts concerning the issues arising from sub-paragraphs (i), (iii) and (iii) of paragraph II of the Order.
 2. The Authority shall provide technical assistance and guidance to the concerned State Government, Union Territory Governments/Administrations, the SCZMA, the Union Territory CZMA, and other institutions/organization as may be found necessary, in matters relating to the protection and improvement of the coastal environment.
-

3. The authority shall examine and accord its approval to area specific management plans, integrated CZMA and Union Territory CZMA.
4. The Authority may advise the Central Government on policy, planning, research and development, setting up of Centre's of Excellence and funding, in matters relating to CRZ Management
5. The Authority shall deal with all environmental issues relating to CRZ, which may be referred to it by the Central Government.
6. The Authority shall furnish report of its activities and the activities of the SCZMA and Union Territory CZMA at least once in six months to the Central Government.
7. The foregoing powers and functions of the Authority shall be subject to the supervision and control of the Central Government.
8. The Authority shall have its headquarters at New Delhi.
9. Any matter specifically not falling within the scope and jurisdiction of the authority, so constituted, shall be dealt with by the statutory authorities concerned.

3.1.7 Dahanu Taluka Environment Protection Authority (DTEPA)

Dahanu Taluka of Palghar District was declared as an ecologically fragile area by the Ministry of Environment and Forest (now MoEFCC) vide clause (v) of Sub-section (2) of Section 3 of the Environment (Protection) Act, 1986 on 24th June 1991 and imposed restriction on setting up of industries which have detrimental effect on the environment.

The industries have been classified under Green, Orange and Red categories as per the notification while railway project is not included in any categories of the above mentioned notification of MoEFCC.

3.2 PROCESS FLOW CHART FOR VARIOUS CLEARANCES/APPROVALS

The flow charts for the various clearance processes are discussed in the following sections. The MAHSR requires clearances for diversion of Forest Land, Wild Life and Coastal Regulation Zone areas.

3.2.1 Forest Clearance

The small stretch of the MAHSR alignment passes through the forest area. MAHSR project will require forest clearances undertaking the construction activities on the forest land. In Maharashtra about 26.990 km of MAHSR alignment falls under the forest land while in Gujarat 3.706 km of MAHSR alignment are under the forest land. For the forest section, forest clearance shall be obtained as per the Forest Conservation Act, 1980.

Status of Clearance

- The application for Forest Clearance for Maharashtra State has been submitted on February 12, 2018 vide proposal No. FP/MH/RAIL/31785/2018 for a total of 132.2235 Ha including Mangrove forest area of 32.3902 Ha.
- The hard copies on the instruction of the Nodal Officer, have been submitted on 16th April 2018.

- The proposal for diversion of 6.1034 Ha of forest land in the Gujarat state has been submitted on May 10, 2018 vide proposal No. FP/GJ/RAIL/33381/2018.
- The hard copies have been submitted on 4th July, 2018 on receipt of instruction from Nodal Officer.
- Expected to secure the clearance within 3 to 6 months.

Status of Clearance (Mangroves Cutting)

- The application for mangrove cutting shall be submitted to Mangrove Cell, Thane and Mangrove Conservation Unit, Mumbai after finalisation of area statement by the Office of the Dy. Conservator of Forest-Thane and Dahanu.
- After recommendation from the Mangrove Cell, Thane the application shall be submitted to the Bombay High Court for final permission.
- Application is scheduled for submission to the Mangrove Cell, Thane and Mangrove Conservation Unit, Mumbai in the 2nd week of August, 2018.
- Expected to secure the final permission from Bombay High Court during September-October, 2018.

The forest clearance process consists of two stages. The flow chart for the Stage-I and Stage-II of the Forest Clearance is shown in Exhibit 3.2.1.

3.2.2 Wildlife Clearance

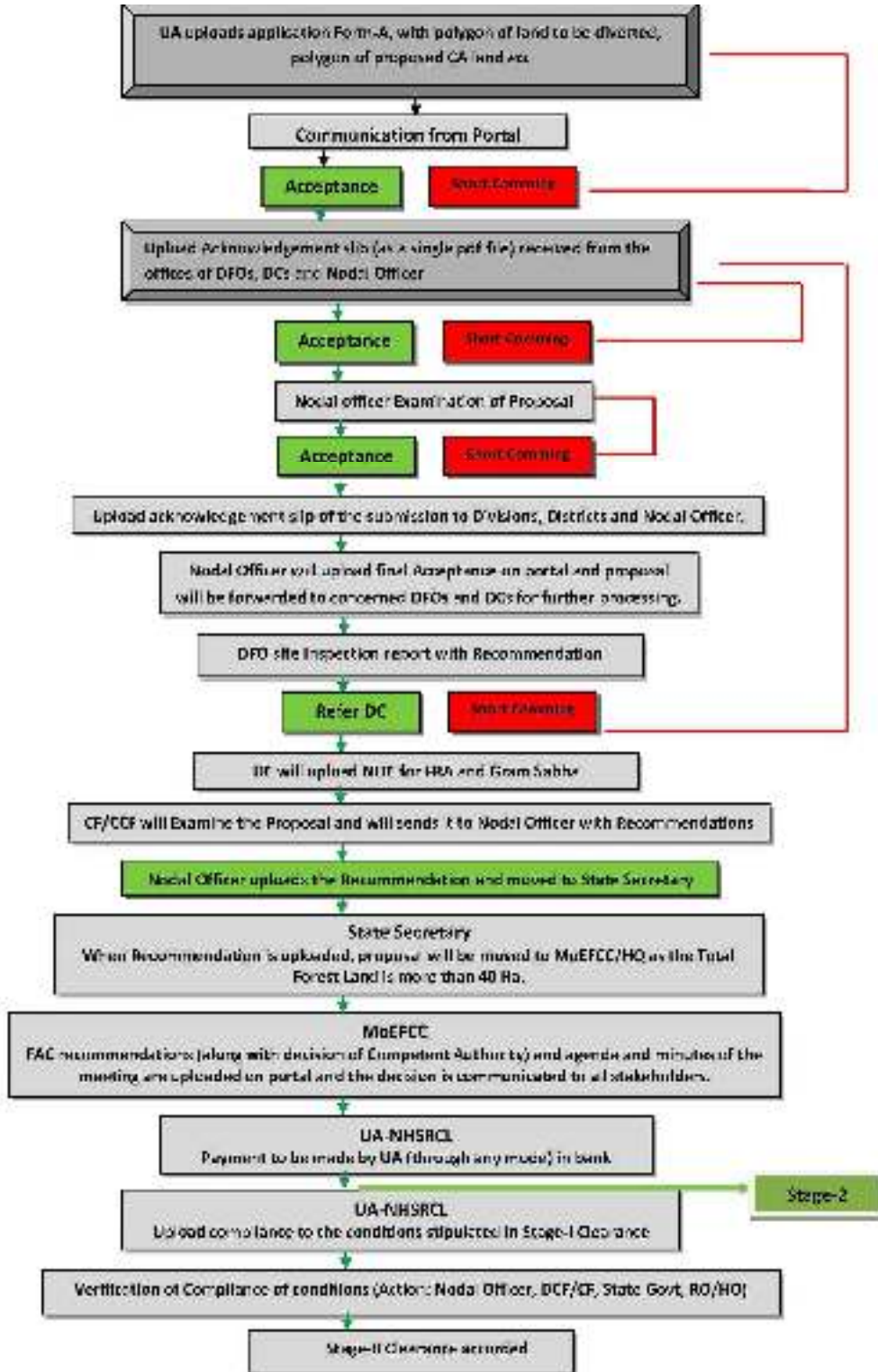
The proposed MAHSR alignment passes through the ESZ of SGNP, TWLS as viaduct and Core Zone and ESZ of TCFS through tunnel, 30 meter below the creek bed. For commencing any construction activity in these areas, wildlife clearance is required from Standing Committee of National Board of Wildlife (NBWL) and State Board of Wildlife (SBWL). In Maharashtra 15.174 km stretch of MAHSR alignment falls under the ESZ of SGNP, TWLS (viaduct) and 5.889 km under ESZ and Core Zone of TCFS (Tunnel).

Status of Clearance

- The application for the Wildlife Clearance from Standing Committee, MoEFCC has been submitted on 18-May-2018 vide proposal No. FP/MH/RAIL/31785/2018.
- The proposal after scrutiny has been accepted without any short comings.
- The hard copies have been submitted on 29th June, 2018 and 4th July 2018 to the concerned CCF/Wildlife.
- Expected to secure the clearance within 3 to 6 months.

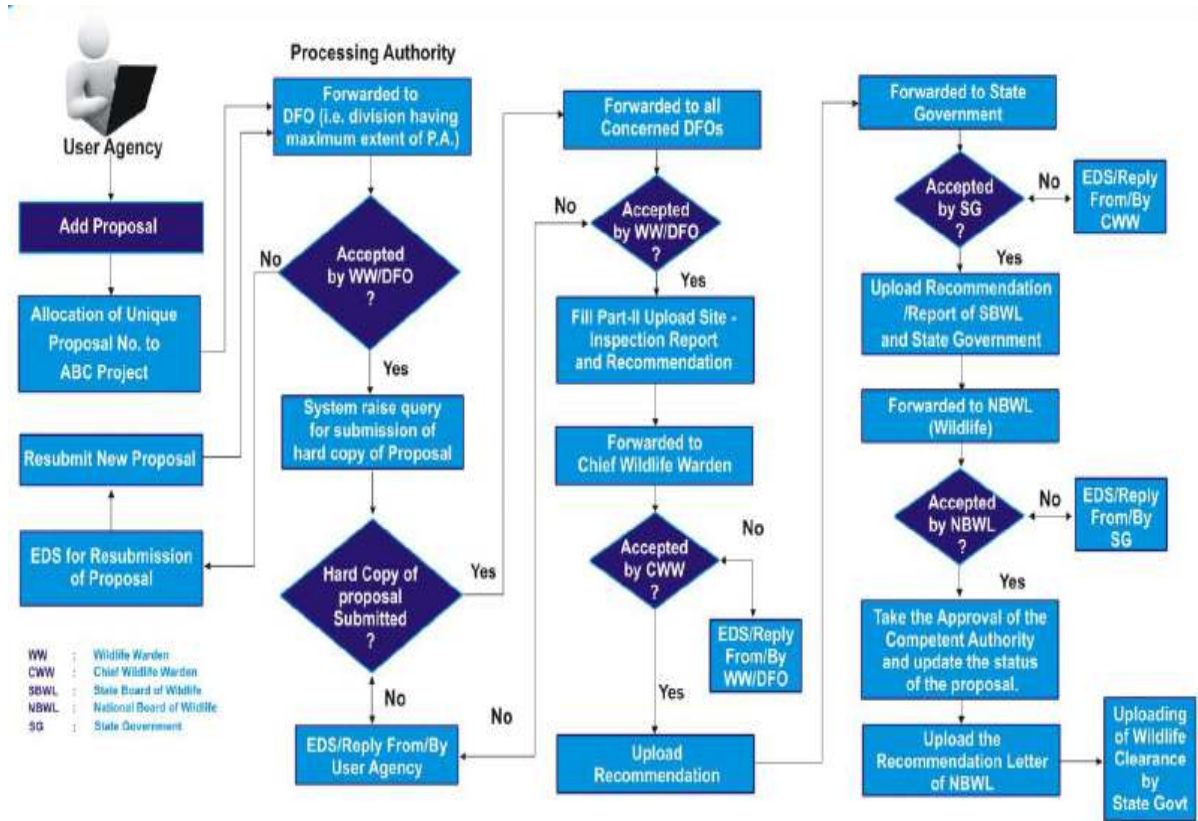
The flow chart for NBWL clearance is shown in Exhibit 3.2.2.

Exhibit 3.2.1: Process Flow Chart for Forest Clearance-Stage-I and Stage-II



Source: Based on the guidelines as illustrated on <http://efclearance.nic.in>

Exhibit 3.2.2: Process Flow Chart for Wildlife Clearance



Note : Automatic mailer notifications will be triggered for each and every transaction committed in the portal.

Source: Based on the guidelines as illustrated on <http://efclearance.nic.in>

3.2.3 CRZ Clearance

The proposed MAHSR alignment passes through CRZ areas at seven locations-

1. Mithi River- BKC, Mumbai, Maharashtra;
2. Thane Creek, Thane, Maharashtra;
3. Ulhas River-Bharodi Gaon, Thane, Maharashtra;
4. Ulhas River-Kevani, Bhiwandi, Thane Maharashtra;
5. Ulhas River- Brahmangaon, Thane, Maharashtra;
6. Vaitarna River- Virar, Palghar, Maharashtra; and
7. Narmada River- Bharuch, Gujarat

As per the CRZ Notification 2011, CRZ clearance is required to be obtained before commencement of construction activity in these stretches (seven stretches totaling approx. 10 km). The CRZ clearance shall be granted by the MoEFCC.

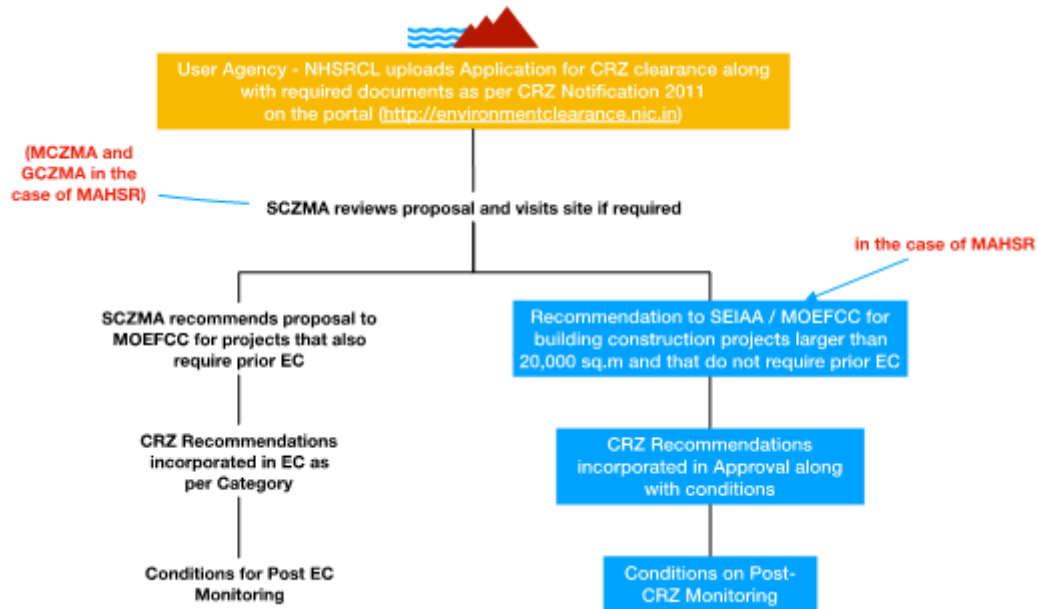
Status of Clearances

- The application for seeking recommendation of MCZMA has been submitted on 18th June 2018 along with all the required documents.

- Similarly application for seeking recommendation of GCZMA has been submitted on 19th June 2018 along with all the documents in line with the check list.
- GCZMA convened meeting on 6th August, 2018 for appraisal of the project for recommendation.
- Expected to secure the recommendation of MCZMA and GCZMA within two to three months.
- After getting recommendations from MCZMA and GCZMA, the application for CRZ clearance shall be submitted to MoEFCC.
- Expected to secure the CRZ clearance from MoEFCC within two to three months after getting recommendations from MCZMA and GCZMA.

The process flow chart for obtaining the CRZ clearance is depicted in Exhibit 3.2.3

Exhibit 3.2.3: Process Flow Chart for CRZ Clearance



Source: Based on the guidelines as illustrated on <http://efclearance.nic.in>

3.3 APPROVAL AND CLEARANCES REQUIRED FOR MAHSR

The proposed MAHSR project is being implemented by the National High Speed Rail Corporation Limited (NHSRCL), a Joint Venture of the Government of India and participating State Governments, a Special Purpose Vehicle (SPV) created by the Government of India.

It is clarified (vide a letter from Ministry of Railway, dated February 15, 2018) by NHSRCL as per its planned structure, that it qualifies to be designated as a ‘Non-Governmental Railway’ within the meaning of the Section 2(25) of the Railway Act, 1989 and the Managing Director, NHSRCL as ‘Railway Administration’ under Section 2(32) of the Railway Act, 1989. NHSRCL is accordingly planning to invoke the Section 11 of the Railway Act, 1989 for smooth and speedy implementation of the MAHSR project. The excerpts of Section 11 of the Railways Act, 1989 are reproduced here for reference.

Section 11 of the Railways Act, 1989

Notwithstanding anything contained in any other law for the time being in force, but subject to the provisions of this Act and the provisions of any law for the acquisition of land for a public purpose or for companies, and subject also, in the case of a non-Government railway, to the provisions of any contract between the non-Government railway and the Central Government, a railway administration may, for the purposes of constructing or maintaining a railway:

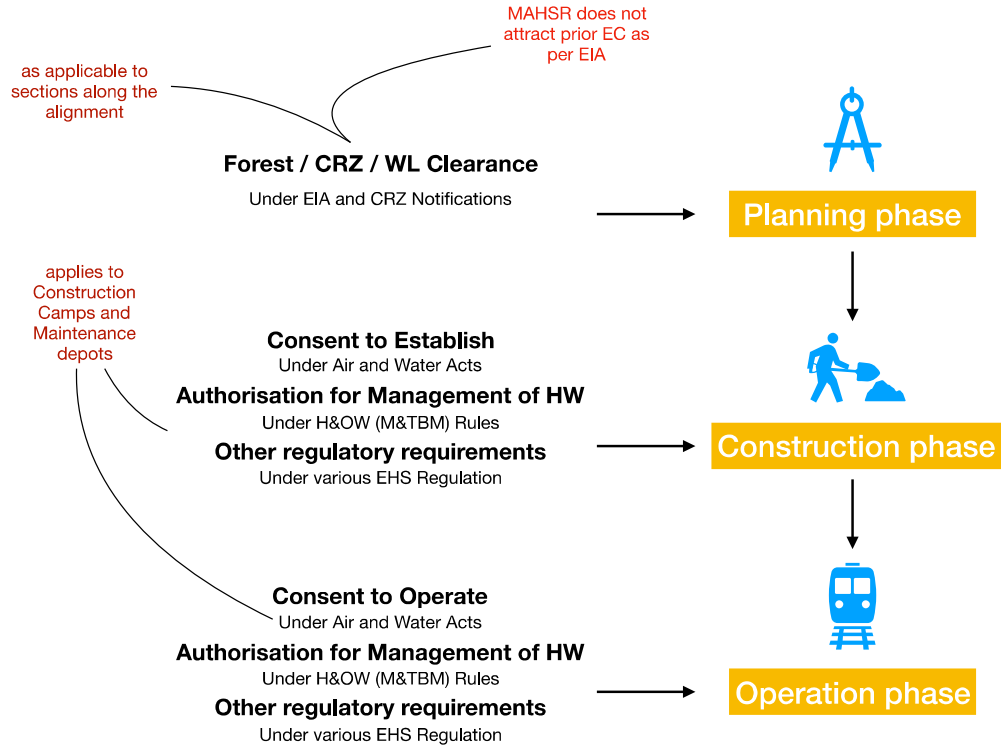
- (a) make or construct in or upon, across, under or over any lands, or any streets, hills, valleys, roads, railway, tramways, or any rivers, canals, brooks, streams or other waters, or any drains, water-pipes, gas-pipes, oil-pipes, sewers, electric supply lines, or telegraph lines, such temporary or permanent inclined-planes, bridges, tunnels, culverts, embankments, aqueducts, roads, lines of railways, passages, conduits, drains, piers, cuttings and fences, in-take wells, tube wells, dams, river training and protection works as it thinks proper;
- (b) alter the course of any rivers, brooks, streams or other water courses, for the purpose of constructing and maintaining tunnels, bridges, passages or other Works over or under them and divert or alter either temporarily or permanently, the course of any rivers, brooks, streams or other water courses or any roads, streets or ways or raise or sink the level thereof, in order to carry them more conveniently over or under or by the side of the railway;
- (c) make drains or conduits into, through or under any lands adjoining the railway for the purpose of conveying water from or to the railway;
- (d) erect and construct such houses, warehouses, offices and other buildings, and such yards, stations, wharves, engines, machinery apparatus and other works and conveniences as the railway administration thinks proper;
 - (da) developing any railway land for commercial use (*Inserted vide Railways Amendment Act, 2005*)
- (e) alter, repair or discontinue such buildings, works and conveniences as aforesaid or any of them and substitute others in their stead;
- (f) erect, operate, maintain or repair any telegraph and telephone lines in connection with the working of the railway;
- (g) erect, operate, maintain or repair any electric traction equipment, power supply and distribution installation in connection with the working of the railway; and
- (h) do all other acts necessary for making, maintaining, altering or repairing and using the railway.

Environmental Regulation

However other regulatory clearances related to diversion land or approvals for forest land, mangroves and wildlife (protected) areas, tree felling in various land types, coastal regulatory zone will be relevant as applicable to specific sections of the alignment passing through such areas.

Other requirements (Environmental, Occupational Health & Safety as well as Labour laws) based on various Central, State and Gram Panchayat level regulation will apply (as relevant) during the construction and operational phases.

The National, State and local approvals/permits as detailed in the Table 3.3.1 and shown in Exhibit 3.3.1 are required for the Project.



Sr. No.	Clearances	Acts	Approving Agency	Applicability to the Project	Estimated Time Frame ⁴	Responsibility	
						Execution	Supervision
PROJECT PREPARATION STAGE							
EC is exempted for the project.							
PRE CONSTRUCTION STAGE							
1	Diversion of forest Land for Non-forest use	Forest Conservation Act (1980) Forest Conservation Rules (2003) and Guidelines issued to date Government of Gujarat, Gazette dt 5 th July, 1973	MoEFCC	Applicable	9-12 months	NHSRCL	-
2	Permission for Mangrove Felling	Forest Conservation Act (1980)	Bombay High Court	Applicable	1-2 months	NHSRCL	-
3	CRZ Clearance for undertaking construction activities in coastal zone	CRZ Notification 2011	MoEFCC after recommendation from MCZMA & GCZMA	Applicable	3-6 months	NHSRCL	-

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Sr. No.	Clearances	Acts	Approving Agency	Applicability to the Project	Estimated Time Frame ⁴	Responsibility	
						Execution	Supervision
4	NBWL Clearance for undertaking construction activities in the Protected Areas or in the Eco-sensitive Zone	Wildlife (Protection) Act, 1972	Standing Committee of NBWL after recommendation from SBWL	Applicable	3-6 months	NHSRCL	-
5	NOC/Permission from DTEPA	Environment (Protection) Act, 1986	Dahanu Taluka Environment Protection Authority (DTEPA)	Applicable	2-3 months	NHSRCL	-
PROJECT IMPLEMENTATION STAGE							
6	No Objection Certificate(NOC)	Water(Prevention and Control of Pollution)Act 1974, Air (Prevention And Control of Pollution) Act 1981	Maharashtra and Gujarat Pollution Control Board	Applicable	3-6 months	NHSRCL	-
7	Permission for Removal of avenue Tree within the RoW	Forest Conservation Act (1980) Forest Conservation Rules (2003) and Guidelines Issued to date by the respective State Govts.	Tree Officer/Local Designated District Authority	Applicable	1-2 Months for each workout area	NHSRCL	-
8	NOC for undertaking construction activities within 200 m of the notified heritage site	The Ancient Monuments and Archaeological Sites and Remains Act, 1958	Expert Advisory Committee of ASI	Applicable	2-3 months	Contractor	Engineer
9	Permission for Withdrawal of Surface Water from Rivers, Nallah, Water harvesting structure/ Reservoirs/Ponds/ Irrigation canals	Gujarat Water Supply and Sewerage Board Act,1978	Maharashtra and Gujarat Water Supply and Sewerage Board	Applicable(If The contractor is extracting Surface water)	3 months	Contractor	Engineer
10	Permission for withdrawal of ground water and NOC for construction of tube well/bore well	Ground Water Regulation and Control of Development and Management Act, 2005	CGWA	Applicable (if contractor abstract ground water)	3 months	Contractor	Engineer
11	Permission for Sand Mining from Riverbed	Mines and Minerals (Development and Regulation) Act,1957	Dept. of Mines & Geology, Maharashtra & Gujarat	Applicable	2 months	Contractor	Engineer
12	Permission for Opening of New Quarry	Mines and Minerals (Development and Regulation) Act,1957	Dept. of Mines & Geology, Maharashtra & Gujarat	Applicable	2 months	Contractor	Engineer
13	Hotmix Plant, Crushers, Cement Batching Plant	Air(Prevention and Control of Pollution) Act.1981	Maharashtra &Gujarat Pollution Control Board	Applicable	3 months	Contractor	Engineer

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Sr. No.	Clearances	Acts	Approving Agency	Applicability to the Project	Estimated Time Frame ⁴	Responsibility	
						Execution	Supervision
14	Storage of Hazardous Chemicals	Hazardous Waste (Management and Handling) Rules 1989 And Manufacturing Storage and Import of Hazardous Chemicals Rules 1989	Maharashtra & Gujarat Pollution Control Board	Applicable	3 months	Contractor	Engineer
15	Disposal of Hazardous Waste	Hazardous Waste (Management and Handling) Rules 2016	MPCB & GPCB	Applicable	2 months	Contractor	Engineer
16	Disposal of Construction Waste And liquid effluent From Labour camps	Water (Prevention and Control of Pollution) Act 1974 Construction & Demolition Rules, 2016	MPCB & GPCB	Applicable	2 months	Contractor	Engineer
17	Pollution Under Control Certificate	Central Motor Vehicles Act 1988	Transport Department (GoG & GoM)	Applicable	1 month	Contractor	Engineer
18	Power Supply	Maharashtra Electricity Regulatory Commission (Electricity Supply Code and Other Conditions of Supply) Regulations, 2005 & Gujarat Electricity Regulatory Commission (Electricity Supply Code and Related Matters) Regulations, 2005	MMSEB & GSEB	Applicable	1-2 months	Contractor	Engineer
19	Employing Labour	Executing Agency of Building and other Construction Act, 1996	Labour & Employment Department, (GoG & GoM)	Applicable	1 Week	Contractor	Engineer
20	Registration of Workers	Labour Welfare Acts	Labour & Employment Department, (GoG & GoM)	Applicable	1 Month	Contractor	Engineer

Source: Study Team

3.4 REGULATORY FRAMEWORK WITH RESPECT TO MAHSR

The proposed MAHSR project passes through the States of Maharashtra, Gujarat and Union Territory, Dadra and Nagar Haveli, and thus laws enacted by the States (State laws) as well as Parliamentary laws along with the rules / regulations made under them are applicable to the project. Different set of laws are applicable at different stages of the MAHSR such as planning, site preparation, construction and operation. While some legislations and rules / regulations made there under are applicable during the planning and construction stages of the project (such as seeking clearances / permissions from the statutory authorities), others apply during construction of the project and later in the operational phase of the project.

As per the policy decision of the Government of India, the Central Pollution Control Board (CPCB) has delegated its powers and functions under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, with respect to Union Territories to respective local administrations, so that implementation of said laws are

responsibility of CPCB in Union Territory, Dadra and Nagar Haveli. As far as States of Maharashtra and Gujarat is concerned they have state level pollution control board offices and SPCB office will look after pollution related issue in their territory.

In addition to the Laws for Environmental Protection, laws related to labour employment and welfare, occupational health and safety, land acquisition, compensation and resettlement and laws for indigenous peoples/scheduled tribes/castes, Maharashtra Village Panchayats Extension to Village Areas (PESA) Rules 2014, Forest Rights Act (FRA), 2006 along with certain miscellaneous laws constitute the body of laws applicable to the development of the proposed MAHSR project. Each of these set of laws have been dealt with in separate sections of this chapter. The list of significant laws applicable to MAHSR project is presented in Table 3.4.1 below.

Table 3.4.1: Summary of Various Regulatory Requirements with respect to MAHSR Project

Environmental Laws	Labour Employment and Welfare Laws	Occupational Health and Safety Laws	Land Acquisition, Compensation & Resettlement Laws	Laws for Welfare of Indigenous Peoples/ Scheduled Tribes/Castes	Miscellaneous Laws
The Environmental (Protection) Act and Rules, 1986	The Factories Act, 1948	Explosives Act, 1984	Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013	The Scheduled Castes/Scheduled Tribes Prevention of Atrocities Act, 1989	Ancient Monuments and Archaeological Sites and Remains Act, 1958
The Air (Prevention and Control of Pollution) Act and Rules, 1981	The Workmen's Compensation Act, 1923 now known as The Employee's Compensation Act, 1923	Sexual Harassment of Women at Workplace (Prevention, Prohibition & Redressal) Act, 2013	The Railway Act, 1989	The Panchayats (Extension to the Scheduled Areas) Act, or PESA, 1996	The Trade Unions Act, 1926
The Water (Prevention and Control of Pollution) Act and Rules, 1974	The Industrial Disputes Act, 1947	The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996	-	Maharashtra Panchayats (Extension to Scheduled Areas) Rules, 2014	Public Liability Insurance Act, 1991
The Indian Forest Act, 1927	The Minimum Wages Act, 1948	-	-	Forest Rights Act 2006	-
The Forest (Conservation) Act, 1980	The Employees Provident Funds and Miscellaneous Provisions Act, 1952	-	-	-	-
The Wild Life (Protection) Act, 1972	The Employers Liability Act, 1938	-	-	-	-
Saurashtra Felling of Trees (Infliction	The Inter-State Migrant Workmen	-	-	-	-

Environmental Laws	Labour Employment and Welfare Laws	Occupational Health and Safety Laws	Land Acquisition, Compensation & Resettlement Laws	Laws for Welfare of Indigenous Peoples/ Scheduled Tribes/Castes	Miscellaneous Laws
of Punishment) Act, 1951	(Regulation of Employment and Conditions of Service) Act, 1979				
Maharashtra Felling of Trees (Regulation) Act, 1964	The Child and Adolescent Labour (Prohibition & Regulation) Act, 1986				
Maharashtra (Urban Areas) Protection and Preservation of Trees Act, 1975	The Contract Labour (Regulation & Abolition) Act, 1970				
-	The Payment of Wages Act, 1936 The Equal Remuneration Act, 1976				

Source: Study Team

3.4.1 Applicability of Environmental Laws to MAHSR

Government of India has prepared National Policies to address various issues relating to the use of natural resources and other environmental matters. There are multiple Environmental Legislations applicable to the MAHSR project. The complete list of applicable Environment and Pollution laws along with the rules framed and notifications issued there under are compiled in Table 3.4.2 and described in Table 3.4.3 of this section.

Table 3.4.2: Environment and Pollution Laws along with the Rules framed and Notifications

Sl. No.	Act	Rules / Regulations / Notification made under the Act	Parliamentary or State Law	Applicability to MAHSR Project
1	The Environmental (Protection) Act, 1986	<ol style="list-style-type: none"> 1. The Environment (Protection) Rules, 1986 2. Solid Waste (Handling and Management) Rules, 2016 3. The Construction and Demolition Waste Management Rules, 2016 4. The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 5. The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 6. The Noise Pollution (Regulation and Control) Rules, 2000 7. The Bio-medical Waste Management Rules, 2016 8. The Ozone Depleting Substances (Regulation and Control) Rules, 2000 9. Coastal Regulation Zone (CRZ) Notification, 2011 10. The Batteries (Management and Handling) Rules, 2001 11. The Wetlands (Conservation and Management) Rules, 2010 12. The E-Waste (Management) Rules 2016 13. The Plastic Waste Management Rules 2016 14. The Regulation of Lead Contents in Household and Decorative Paints Rules, 2016 15. Environment Impact Assessment Notification, 2006 and amendments thereof 16. Eco-Sensitive Area (ESA) Notifications 17. Fly Ash Utilization Notification, 1999 and subsequent Amendments 18. Central Ground Water Authority Notifications for Abstraction of Ground water 	Parliamentary	Gujarat and Maharashtra and Union Territory, Dadra and Nagar Haveli
2	The Air (Prevention and Control of Pollution) Act, 1981	The Air (Prevention and Control of Pollution) Rules, 1981	Parliamentary	Gujarat and Maharashtra and Union Territory, Dadra and Nagar Haveli
3	The Water (Prevention and Control of Pollution) Act, 1974	The Water (Prevention and Control of Pollution) Rules, 1975	Parliamentary	Gujarat and Maharashtra and Union Territory, Dadra and Nagar Haveli
5	The Indian Forest Act, 1927 along with Gujarat and Maharashtra State	Government of Gujarat, Gazette Notification, 15 th March, 1973	Parliamentary with State Legislature Amendments	Gujarat and Maharashtra and Union Territory, Dadra and Nagar Haveli

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Sl. No.	Act	Rules / Regulations / Notification made under the Act	Parliamentary or State Law	Applicability to MAHSR Project
	Amendments			
6	The Forest Conservation Act, 1980	The Forest Conservation Rules, 2003	Parliamentary	Gujarat and Maharashtra Both States and Union Territory, Dadra and Nagar Haveli
7	The Wild Life (Protection) Act, 1972	The Wildlife (Protection) Rules, 1995	Parliamentary	Gujarat and Maharashtra Both States and Union Territory, Dadra and Nagar Haveli
8.	Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951		State	Gujarat
9.	Maharashtra Felling of Trees (Regulation) Act, 1964	Maharashtra Felling of Trees (Regulation) Rules, 1967 as amended till 2005	State	Whole of Maharashtra except urban areas
10	Maharashtra (Urban Areas) Protection and Preservation of Trees Act, 1975	Maharashtra (Urban Areas) Protection and Preservation of Trees Rules, 2009	State	Urban areas of Maharashtra

Source: Study Team

Table 3.4.3: Environmental Legislation/Regulations applicable to MAHSR

Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
1.	The Environment (Protection) Act, 1986	The EPA is a general legislation for environmental protection and designed to cover up areas of environmental hazards not covered by specific environment laws, prescribe standards for discharging pollutants and handling of hazardous substances etc., strengthen control mechanisms and constitute a single authority for studying, planning, implementing and coordinating environment related activities of various regulatory agencies, Central and State. The EPA is essentially implemented through rules, regulations and notifications and many of them are applicable to the MAHSR.	The MAHSR being a mega project involving acquisition of agricultural, forest, Coastal land etc. and construction upon it there after and will involve handling, generating and discharging pollutants, debris, hazardous substances, generating noise etc.	MoEFCC through CPCB, Maharashtra Pollution Control Board (MPCB) & Gujarat Pollution Control Board (GPCB) are the nodal bodies and multiple other regulatory bodies as per the rules framed under the EPA and CPCB for Union Territory, Dadra and Nagar Haveli
1.1	The Environment (Protection) Rules, 1986	These rules prescribe the standards for emission or discharge of various pollutants from industries, operations or processes. By virtue of Rule 3A, the parameters and standards for emission and discharge of pollutants as applicable to MAHSR are prescribed in Schedule VI of the rules. Further, Schedule III provides Ambient Air Quality Standards with respect to Noise, Schedule IV provides standards for emission of smoke, vapor etc. from motor vehicles and Schedule VII provides National Ambient Air Quality Standards.	The rules will be applicable along the MAHSR alignment at the Construction sites/yards, project sites etc. and during the Operation phase at the stations and depots and along the entire corridor.	Maharashtra Pollution Control Board (MPCB) / Gujarat Pollution Control Board (GPCB) and CPCB for Union Territory, Dadra and Nagar Haveli
1.2	Solid Waste (Handling and Management) Rules, 2016	Lay down the procedure and norms for segregation, handling, storage and disposal of Municipal Solid Waste (MSW) generated.	The provisions will be applicable to the labour camps and construction yards / project offices that will be setup during the construction phase and later during the operation phase at the Stations, HSR Offices, Commercial areas etc. under the control of Project proponent. SWM practices prescribed in the Rules will need to be followed and MSW generated should be disposed through authorised collection / receiving centres as established and instructed by the regulatory authorities.	MPCB / GPCB and Urban Local Bodies (ULBs) and CPCB for Union Territory, Dadra and Nagar Haveli
1.3	Construction and Demolition (C&D) Waste Management Rules, 2016	Procedure for collection, segregation, storage and disposal of C&D waste comprising of building materials, debris and rubble resulting from construction, remodeling, repair and demolition of any civil structure.	C&D waste will be generated during the construction phase of the MAHSR project from debris from structures dismantled on RoW, excavations, waste concrete and spoil, pile head, etc.	SPCBs (MPCB and GPCB), Urban Local Bodies (ULBs) or any other local authority and CPCB for Union Territory, Dadra and Nagar Haveli

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
1.4	The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	These rules lay down the procedure and responsibility for management, storage, transport, treatment and disposal etc. of hazardous and other wastes and regulation of import / export of such waste.	The rules will be applicable as hazardous waste is expected to be generated during the demolition and construction including tunneling and operation phase from the industrial use of solvents, mineral or synthetic oil as lubricants in hydraulic systems, spent oil, High speed diesel, paints, pigments, lacquers, varnishes, adhesives and resins etc.	MPCB / GPCB and CPCB for Union Territory, Dadra and Nagar Haveli along with MoEFCC
1.5	The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989	These rules lay down the responsibility of the occupier of an industrial installation w.r.t. production, storage and import of hazardous chemicals as provided in its schedules and approval and notification of such sites, prepare safety reports and emergency plans, intimation in case of accident.	These rules will be applicable during the construction phase as it is expected that large quantities of flammable gases, flammable chemicals and explosives will be stored and used. Prior site approval and notification will be required from the concerned authorities before storing and using the hazardous chemicals under these rules.	MPCB / GPCB and CPCB for Union Territory, Dadra and Nagar Haveli
1.6	The Noise Pollution (Regulation and Control) Rules, 2000.	These rules prescribe the ambient noise standards for different areas and restrict / regulate the use of noise emanating objects and equipment at certain times. The rules are enforced by a local authority designated by the State Govt. which may either be the District Magistrate, Police Commissioner or any other officer not below the rank of Deputy Superintendent of Police.	These rules will be applicable during the Construction and Operation phase. During the Construction phase noise producing heavy construction equipment will be used and during the operation phase, the movement of the train and use of public address system at the stations shall produce noise.	Local authority designated by the State Govt. along with SPCB's and CPCB for Union Territory, Dadra and Nagar Haveli
1.7	The Bio-medical Waste Management Rules, 2016	These rules provide for categorization of biomedical waste, management and safe disposal of it to protect health and environment against adverse effects. The State Pollution Control Boards are entrusted with grant of authorization and monitoring of compliance of provisions of these rules.	These rules will be applicable to the construction sites and Labor camps where first aid/emergency medical help will be provided to the injured / sick workers. They will apply during the operation phase at the stations and in the trains where first aid/emergency medical help will be rendered to the staff and passengers.	

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
1.8	The Ozone Depleting Substances (Regulation and Control) Rules, 2000.	These rules categorize the Ozone Depleting Substances (ODS) into groups and further regulates, restricts and prohibits the manufacture, sale, use, import/export etc. of certain groups of ODS's.	These rules be complied with during the construction and operation phase to ensure that ODS's prohibited from use in construction and operation phases of MAHSR, are not used.	MoEFCC
1.9	The Batteries (Management and Handling) Rules, 2001	These rules regulate the manufacture, sale, stocking, disposal etc. of lead acid batteries by consumers, recyclers etc.	<p>The project is expected to be a "bulk consumer" of lead acid batteries during the construction phase for providing back up electricity at project sites/offices/ labor camps etc. and probably in the train components and at the stations and depots as well during the operation phase.</p> <p>The discarded batteries will need to be disposed off in consonance with the provisions of these rules through authorized vendors.</p>	MPCB/GPCB and CPCB for Union Territory, Dadra and Nagar Haveli
1.10	The E-Waste (Management) Rules, 2016	These rules apply to discarded e-waste /electrical/electronic equipment including their components and provide for safe and environment friendly disposal of them though a system of authorized collection centers and e-waste processors.	<p>The project is expected to be a "bulk consumer" of electrical and electronic products like computers, laptops, monitors, computer accessories, printers, copiers, phones, TV's etc. during construction as well as operational phase.</p> <p>The discarded products/components will need to be disposed off in consonance with the provisions of these rules through authorized e-waste collection centers and maintain record of e-waste generated and file annual return with the SPCB's.</p>	MPCB/GPCB and CPCB for Union Territory, Dadra and Nagar Haveli
1.11	The Plastic Waste Management Rules 2016	These rules provide for manufacturing standards, plastic waste management, responsibilities of local bodies/gram panchayats/waste generators etc. and provides for segregation of plastic waste at source for collection and disposal as per Solid Waste (Management and Handling) Rules, 2000.	The project is expected to be an "Institutional Waste Generator" as defined in the rules during the construction as well as operational phase at project sites, labor camps, depots, local/regional project offices, Stations and Trains.	MPCB/GPCB, ULBs/ other local bodies and CPCB for Union Territory, Dadra and Nagar Haveli

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
1.12	The Regulation of Lead Contents in Household and Decorative Paints Rules, 2016	The rules provide for prohibition of presence of lead metal in excess of 90ppm in paints including undercoating used for painting in interior and exterior of buildings, walls, civil structures etc. The rule allows a relaxation of 2 years for sale of existing stock till 1.11.2018.	<p>The project will involve construction of massive civil structures and require the use of paints at stations, depots, offices, pillars, viaduct etc.</p> <p>The developers should ensure that the paint purchased and used after 1.11.2018 does not contain lead in excess of prescribed concentration.</p>	CPCB/ MPCB/GPCB
1.13	The Wetlands (Conservation and Management) Rules, 2010	<p>These rules provide guidance for the conservation and management of Wetlands and prohibits certain activities while certain restricted activities within the wetlands, may be undertaken only with the prior permission of the State Government.</p> <p>The Central Wetlands Regulatory Authority (CWRA), State Government (SPCB) and the Central Government (in case of prohibited activities) are the nodal bodies.</p>	<p>The MAHSR has 21.00 Km undersea tunnel at the Thane Creek. It is expected to encounter wetland in this area in the form of marine park, mangroves, corals, wildlife habitats, inland waters like lagoon, creeks, estuaries etc.</p> <p>Any construction activity of permanent nature within the wetlands is prohibited and may be undertaken only with the prior permission of the Central Government on the recommendation of the CWRA.</p>	CWRA, GPCB/MPCB & Central Government/MoEFCC and CPCB/MoEFCC for Union Territory, Dadra and Nagar Haveli
1.14	Coastal Regulation Zone (CRZ) Notification, 2011	The CRZ Notification regulates all construction and developmental activities in the CRZ. The CRZ includes the land area from "High Tide Line" (HTL) to 500 m on the landward side, as well as the land area between HTL to 100 m or width of the creek, whichever is less, on the landward side along tidal influenced water bodies connected to the sea. The CRZ also includes, water area up to 12 nautical miles in the sea and the entire water area of a tidal water body such as creek, river, estuary, backwater etc.	<p>The proposed MAHSR passes through the CRZ at seven locations –</p> <ol style="list-style-type: none"> 1. Mithi River- BKC, Thane, Maharashtra 2. Thane Creek, Thane, Maharashtra 3. Ulhas River-BharodiGaon, Thane, Maharashtra 4. Ulhas River-Kwani, Bhiwandi, Thane Maharashtra 5. Ulhas River- Brahmangaon, Thane, Maharashtra 6. Vaitarna River- Virar, Palghar, Maharashtra 7. Narmada River- Bharuch, Gujarat <p>Necessary permissions would be required from the regulatory authorities before commencing the Construction activities. Application for getting</p>	Maharashtra Coastal Zone Management Authority (MCZMA), Gujarat Coastal Zone Management Authority (GCZMA) & MoEFCC

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
1.15	Environment Impact Assessment Notification, 2006 (14 th September 2006) with subsequent Amendments	Environmental Impact Assessment (EIA) Notification regulates all activities /projects listed in the Schedule 1 of the Notification. The activities listed in Schedule-1 shall require prior Environmental Clearance before commencement of project activities.	<p>recommendation from MCZMA and GCZMA has been submitted on 18/06/108 and 19/06/2018 respectively.</p> <p>The procedure for obtaining permissions is detailed later in this Chapter in the subsequent Section.</p> <p>Railway project is not included in Schedule I of the Notification. Hence, prior Environment Clearance is not required for MAHSR project (including all facilities and activities).</p> <p>The National Green Tribunal in 2016 made EIA and prior EC mandatory for Railway and metro projects under the EIA notification but the order of NGT has been stayed by the Supreme Court.</p>	Not Applicable.
1.16	Eco-Sensitive Zones Notifications	<p>These zones are areas around protected areas like Natural Parks, Wildlife sanctuaries <i>etc.</i> that act as shock absorbers to the protected areas by regulating/restricting the industrial and developmental activities in them. These zones are declared as ESA by MoEFCC on the basis of proposal sent by the State Governments.</p> <p>The Supreme Court in the case of Goa Foundation v/s. Uoi WP(C) 460 of 2004 "proposed" a distance of 10km from all protected areas as ESZ but did not pass any final order to that effect but ordered that projects within 10 km from the Protected areas requiring Environmental Clearance (EC) under the EIA Notification 2006 would also require a clearance from Select Committee of National Board for Wild Life (NBWL). The said proposal of the Apex Court was deemed and applied as a law and simultaneously the MoEFCC sped up the process of notifying ESZ's with marked boundaries but the distance from the protected area has been highly customized for each ESZ and is not uniform and varies from few hundreds of meters to few KM for each and every ESZ based upon the recommendations of the State Government. Currently, there are 13 notified ESA's in Gujarat and 17 in Maharashtra. With regards to ESZ's that have not been notified yet, the 10 km distance rule is applied.</p>	<p>The MAHSR passes through ESZ of two Protected Areas and Core Zone of 1 Protected Area-</p> <ol style="list-style-type: none"> (1)Thane Creek Flamingo Sanctuary, Thane, Maharashtra-Core Zone & ESZ (2) Sanjay Gandhi National Park, Mumbai, Maharashtra-ESZ Only (3) Tungareshwar Wildlife Sanctuary, Mumbai, Maharashtra-proposed ESZ <p>The SGNP has notified ESZ while TWLS & TCFS have proposed ESZ. The clearance is required to be obtained from the Standing Committee of NBWL.</p> <p>The application for Wlidlife Clearance from Standing Committee of NBWL has been submitted on 18/05/2018.</p>	National Board of Wildlife(NBWL),Regional Regulatory Authorities under Maharashtra Regional and Town Planning Act upon recommendation from the Monitoring Committee.

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
		<p>For the Notified ESZ's, with respect to projects falling under the ambit of EIA notification, prior clearance is required from MoEFCC and Standing Committee of National Board for Wild Life (NBWL) on recommendation of State Board for Wildlife (SBWL) after approval from the State Government on the recommendation of Chief Wildlife Warden.</p> <p>For the Notified ESZ's, with respect to projects out of the ambit of EIA notification, prior clearance is required from local regulatory authorities as per the regional development plan.</p>		
1.17	Fly Ash Utilization Notification, 1999 and its subsequent amendments	<p>The intent of the notification is to promote and achieve 100% utilisation of fly ash generated from coal or lignite based thermal power plants. The notification mandates that every construction agency in public and private sectors shall utilize fly ash based products within 300 Km of the thermal power plant.</p>	<p>There are many coal based thermal power plants within 300 km of the MAHSR alignment and thus the notification shall be applicable for the construction subjected to technical suitability and acceptability.</p>	<p>MPCB/GPCB, ULBs/ other local bodies and CPCB for Union Territory, Dadra and Nagar Haveli</p>
1.18	Central Ground Water Authority (CGWA): Guidelines / Criteria for Evaluation of Proposals/ Requests for Groundwater Abstraction, 2015	<p>CGWA has been constituted under Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources in India. CGWA has issued a list of notified and non-notified areas.</p> <p>Ground water abstraction in notified areas is permitted only for drinking water and domestic use purposes through the Authorized officer (Deputy Commissioner/District Magistrate/ District collector) of the revenue district in which the notified area falls.</p> <p>In the non-notified areas, NOC from CGWA is mandatory to industrial / infrastructural / mining projects for groundwater withdrawal as per the guidelines / Criteria for evaluation of proposals / requests for ground water abstraction.</p>	<p>Ground water would need to be abstracted along the ROW where municipal piped water supply is not available during the construction as well as operation phase.</p> <p>Multiple Blocks / Talukas / Mandals / areas in Gujarat and Maharashtra along the RoW are listed in the notified list and prior permission from CGWA would need to be obtained before abstracting ground water in these areas.</p>	<p>CGWA along with the Administrative In-charge of the Revenue District.</p>
2.	The Air (Prevention and Control of Pollution) Act, 1981	<p>The Act provides for preservation of air quality and control and abatement of air pollution, constitution of Boards, functions and powers of the boards, for setting of standards of air quality and standards for emissions of air pollutants into the atmosphere from industrial plants and automobiles, penalties for violation and process for appeals etc.</p> <p>It is mandatory to obtain prior consent of the State Pollution Control Board before establishing or operating any industrial plant in an Air Pollution Control Area. The entire States of</p>	<p>Air pollutants will be emitted during the construction and operation phase during activities like demolition of existing structures, excavation, operation of DG Sets, operation of heavy construction machinery, casting yards, maintenance depots etc.</p>	<p>The MPCB and GPCB are the nodal agencies for granting consent and ensuring compliance with the provisions of the Act and CPCB for Union Territory, Dadra and Nagar Haveli</p>

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
3.	<p>The Water (Prevention and Control of Pollution) Act, 1974</p> <p>and</p> <p>The Water (Prevention and Control of Pollution) Rules, 1975</p>	<p>Gujarat & Maharashtra have been notified by the respective State Governments as Air Pollution Control Areas. The air quality and air emission standards are provided in Annexure 4.10, Vol-II of the S-EIA Report.</p> <p>The Act provides for prevention and control of water pollution, maintaining or restoring the wholesomeness of water, constitution of Boards, functions and powers of the boards, for prescribing standards of water quality, effluent standards for the sewage and trade effluent and standards of treatment of sewage and trade effluent to be discharged into the streams, penalty for violation and process for appeals etc.</p> <p>The Act prohibits the discharge of poisonous, noxious or polluting matter into any stream, well or sewer or on land. It is mandatory to obtain prior consent of the SPCB before establishing any industry, operation or process or any treatment and disposal system which is likely to discharge sewage or trade effluent into a stream or well or on land in Water Pollution, Prevention and Control Area. The entire States of Gujarat & Maharashtra have been notified by the respective State Governments as Water Pollution, Prevention and Control Area. The Sewage and trade effluent treatment and discharge standards are provided in Table 4.13.5, Annexure 4.13, Vol-II of the S-EIA Report.</p>	<p>Sewage effluent will be generated during the Construction phase at the construction workers residential camps, site offices, construction yards, etc. and during the operation phase at the Stations, maintenance depots, at offices along the alignment etc.</p> <p>Trade effluent will be generated during the operational phase at the maintenance depots.</p> <p>The sewage effluent may be discharged into existing municipal sewage system with the prior permission of the Urban Local body and Sewage treatment plants of appropriate capacity and treatment standards will need to be established where ever such municipal system does not exist before discharging the sewage.</p> <p>STP's would need to be established at maintenance depots before discharging the trade effluents into the municipal sewage system or streams or on land.</p>	<p>MPCB and GPCB are the nodal agencies for granting permissions before establishing any project for CTE & CTO and CPCB for Union Territory, Dadra and Nagar Haveli</p>
4.	<p>The Water (Prevention and Control of Pollution) Cess Act, 1977</p> <p>And</p> <p>The Water (Prevention and Control of Pollution) Cess Rules, 1978</p>	<p>The Act provides for levying a cess on water consumed by every industry and local authority entrusted with the duty of supplying water with an object to fund the CPCB & SPCBs constituted under The Water (Prevention and Control of Pollution) Act, 1974. The cess chargeable varies according to the purpose for which water is consumed. The cess is collected by the State Governments and deposited with the Central Government which ultimately disburses it to the CPCB/SCPB's. The Act further provides for affixation of water meters, furnishing of monthly returns, assessment of cess, rebate for installing effluent treatment plants, manner and procedure for imposition of penalty for noncompliance with the Act, recovery of cess and</p>	<p>The MAHSR classifies as an industry under Section 2(j) of the Industrial Disputes Act, 1974. The MAHSR shall consume water during the construction and operational phase for various activities.</p> <p>NHSRCL will need to comply with the provision of the Act and pay the cess as prescribed.</p>	<p>Officer or Authority designated by the State Government along with Member Secretary of the MPCB & GPCB and CPCB for Union Territory, Dadra and Nagar Haveli</p>

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
		appeal.		
5.	The Indian Forest Act, 1927 along with Gujarat and Maharashtra State Amendments	The Act provides for consolidating the laws relating to forests, designation of forest land and waste land belonging to the State Government as reserved or protected forest or assigning them to village communities, panchayats or cooperative societies as village forest, determination of rights of locals in such forests, management and/or acquisition of private forest or waste land as reserved forest for public purposes, regulating/prohibiting activities within the reserved, protected or village forests like felling trees, clearing land, burning fire, mining or quarrying, collecting forest produce <i>etc.</i> , regulating the collection, storage, transit, imposition of duty on timber and other forest produce, penal and appeal provisions for contravention of the provisions of the Act.	The MAHSR alignment passes through forest land (RF, PF) over multiple stretches in Maharashtra and Gujarat States. The project involves diversion of 131.5416 ha. forest land in Maharashtra and 6.1034 ha. in Gujarat. The application for Forest Clearance under Section 2 of Forest (Conservation) Act, 1980 has been submitted.	MoEFCC
6.	The Forest Conservation Act, 1980 along with The Forest Conservation Rules, 2003	The Act prohibits the State Government or any other authority, without the prior approval of the Central Government, to de-reserve the Reserved Forests or permit use of any forest land or any portion thereof for non-forest purpose. It further prohibits without the prior approval of the Central Government, to assigned by lease or otherwise, any forest land or portion thereof to any private entity not owned, managed or controlled by the Government and further than no forest land or portion thereof may be cleared of naturally grown trees including for re-forestation.	The MAHSR alignment passes through forest land (RF, PF) over multiple stretches in Maharashtra and Gujarat States. The project involves diversion of 132.2235 ha. forest land in Maharashtra and 6.1034 ha. in Gujarat. The application for Forest Clearance under Section 2 of Forest (Conservation) Act, 1980 has been submitted. Forest Clearance from MoEFCC would need to be obtained as the total forest area to be diverted exceeds 40 ha. and compliance of all conditions contained therein would have to be done before initiating construction.	MoEFCC
7.	The Wildlife (Protection) Act, 1972	The Act provides for Preservation and Conservation of wildlife, birds, plants and environment in biodiversity rich areas by notifying them as Protected Areas (PA) either as Wildlife Sanctuaries (WLS) or National Parks (NP) or Conservation Reserves (CR) or Community Reserves (CoR). The State Government and the Central Government, both have the powers to notify WLS & NP. The Act provides for constitution of National and State Board of	The MAHSR passes through ESZ of two Protected Areas and Core Zone of 1 Protected Area- (1) Thane Creek Flamingo Sanctuary, Thane, Maharashtra-Core Zone & ESZ (2) Sanjay Gandhi National Park, Mumbai, Maharashtra-ESZ Only (3) Tungreshwar Wildlife Sanctuary,	<ol style="list-style-type: none"> 1. Chief Wildlife Warden Maharashtra State 2. Maharashtra State Board for Wild Life (SBWL). 3. Standing Committee of National Board for Wildlife (under delegation of power from NBWL) 4. MoEFCC

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
		Wildlife with the Prime Minister of India and Chief Ministers of States as their respective Chairpersons.	Mumbai, Maharashtra –proposed ESZ	5. Supreme Court of India.
		The Act prohibits hunting of Wild animals specified in schedules I-IV except without a permit from the Chief Wildlife Warden (CWLW) and for special purposes like education, scientific research, specimen collection etc.	The SGNP has notified ESZ while TWLS & TCFS have proposed ESZ.	
		The Act prohibits wilful picking, uprooting, damaging, destroying, acquiring or collection of any specified plant from any forest land and area specified by the central government and further prohibits the possession, selling or transfer of specified plants except for special purposes like education, scientific research, etc. with a permit from Chief Wild Life Warden.	The clearance for MAHSR will need to be obtained from the Standing Committee of NBWL. The application for Wildlife clearance has been submitted on 18-May-2018.	
		The Act provides process and procedure for notification of any area or territorial water by the State Government that is considers to be of adequate ecological, faunal, floral, geomorphological, natural or zoological significance for protecting, propagating or developing wild life or its environments, as a Wild Life Sanctuary or a National Park and matters incidental and connected therewith like adjudication of rights of affected persons, acquisition of rights, acquisition proceeding etc. before notifying the WLS or the NP.		
		The Act prohibits alteration of the boundaries of a WLS or NP by the State Government except on a recommendation of the NBWL.		
		The Act restricts entry / residing in a WLS or NP except with a permit from the CWLW which is granted only for limited purposes like Tourism, photography, scientific research etc.		
		The Act prohibits destroying, exploiting or removing any wild animal or forest produce from a WLS or NP or destroy or damage or divert the habitat of any wild life by any act whatsoever or divert or change the flow of water except in accordance with a permit from CWLW, granted after approval from State Government in consultation with SBWL (in case of WLS) or NBWL (in case of NP) that such removal of Wild Life or the change in the flow of water is necessary for the		

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
		<p>improvement and better management of wild life therein. It is significant to mention here that on strict reading of Section 29 (for WLS) & Section 35(6) (for NP), it is evident that though the sections prohibit host of activities within the WLS or NP, the permit from CWLW as mentioned above can be obtained only for removal of wild life or change in flow of water, that too if such removal or change is for improvement and better management of wild life therein. Thus, non-forest use or diversion of land of WLS or NP for non-forest use whatsoever is not permissible under the Act.</p> <p>The Act further prohibits, carrying firearms or using any hazardous chemicals, explosives etc. within the WLS or NP without a permit from the CWLW and prohibits kindling any fire, teasing of wildlife and littering in the Protected Areas. The provisions of the Act apply to a Conservation Reserve as they apply to a WLS.</p> <p>That despite the non-forest use or diversion of Protected Areas for non-forest use being impermissible under the Wildlife Act, the MoEFCC has issued guidelines for seeking recommendation of Standing Committee of NBWL (under power delegated to it by NBWL) for activities in protected areas and Online Integration of Wildlife Clearance with Environmental and forest clearance through letter bearing reference No. F.No.6-74/2012 WL(pt) dated 10.04.2015. It describes the process of obtaining recommendation of Select Committee of NBWL for non-forest use or diversion/denotification of Protected Areas.</p> <p>For non-forest activities within the WLS, permission from CWLW upon approval from State Government (in consultation with SBWL) is required under S-29. Further, in light of Supreme Court order dated 09.05.2002 in Center for Environment Law, WWF-1 v. Union of India, WP(C) 337/1995, approval from the Supreme Court itself is required after obtaining the recommendation of the select Committee of NBWL.</p> <p>For non-forest activities within an NP, permission from CWLW upon approval from State Government (in consultation with NBWL) is required Section 35(6). Further, in light of Supreme Court order dated 09.05.2002 in Center for Environment Law,</p>		

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
		<p>WWF-1 v. Union of India, WP(C) 337/1995, approval from the Supreme Court itself is required after obtaining the recommendation of the select Committee of NBWL.</p> <p>For activities within an Conservation reserve, a recommendation from the Standing Committee of NBWL would be required after obtaining the permission from the CWLW with the approval of the State Government (in consultation with SBWL). The Supreme Court vide order dated 13.11.2000 in Center for Environment Law, WWF-1 v. Union of India, WP(C) 337/1995 has prohibited the de-reservation/de-notification of WLS & NP without the approval of the Supreme Court.</p>		
8.	Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951	<p>The Act applies to entire Gujarat and provides that in the land falling under the Bombay Land Revenue Code, 1879, it is prohibited to fell, appropriate or damage any tree without the prior written permission of concerned Authority.</p> <p>The regulations/notifications issued under the Act classify trees growing on private, non-forest land into exempt, reserved and unreserved category and compensatory afforestation has to be done accordingly.</p> <p>86 trees species growing on non-forest/private land are exempted from felling and transit regulation except for 5 species (<i>Limbo, Desi Baval, Kanji, Ambo and Ambli</i>) growing in specific areas, for which felling and transit permission is required from the concerned DFO's.</p> <p>5 Tree species (<i>Sag, Sisam, Khair, Chandan and Mahudo</i>) growing on non-forest / private land are classified as reserved and felling permission is required from Concerned DFO's.</p> <p>17 Tree species on non-forest / private land are classified as unreserved/restricted and felling permission is required from concerned revenue/urban authorities and transit permission from the concerned forester.</p>	<p>The MAHSR alignment shall require felling/transportation of large number of trees of different species along the RoW in Gujarat. Prior felling and transit permission from concerned authorities would need to be obtained before felling of trees.</p> <p>Compensatory afforestation would have to be done in accordance with the directions issued by the concerned Authority.</p>	The concerned authorities vary according to the geographical location, tree species and nature of permit required.
9.	Maharashtra Felling of Trees (Regulation) Act, 1964 along with Maharashtra Felling of Trees (Regulation)	The Act provides for regulating in non-urban areas the felling of certain tree species for the purpose of their preservation and protection of soil from erosion. The Act prohibits the felling of trees (currently 16 species) specified in the Schedule to the Act without the prior permission of the Tree Officer and provides for	The MAHSR alignment shall require felling of large number of trees of different species along the RoW in non-urban Maharashtra and prior felling permission from Tree officer would need	Tree Officer (Forest Officer not below the rank of Range Forest Officer duly empowered by the State Government)

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Sr. No.	Title of Act and Rules / Notifications	Objective / Intent of the Regulation	Relevance / Applicability to MAHSR	Responsible Regulatory Authority
	Rules, 1967 as amended till 2005	penalty and procedure for penalty along with conditions of artificial plantation.	to be obtained before undertaking the exercise. Artificial plantation and maintenance of such trees would have to be done in accordance with the directions issued by the Tree Officer	
10.	Maharashtra (Urban Areas) Protection and Preservation of Trees Act, 1975 along with Maharashtra (Urban Areas) Protection and Preservation of Trees Rules, 2009	<p>The Act provides for protection and preservation of trees in urban areas, by regulating felling of trees and through planting of adequate number of new trees. It is applicable to any urban area or part thereof as specified by the State Government in the Official Gazette.</p> <p>The Act prohibits felling of any tree except with the prior permission of the Tree Officer after applying in writing to the Tree Authority and the authority may impose conditions with regards to compensatory plantation. There may also be a Tree Cess levied by the urban local authorities in some of the urban areas.</p>	<p>The MAHSR alignment shall require felling of large number of trees of different species along the ROW in urban area of Maharashtra and prior felling permission from Tree officer/Authority would need to be obtained before undertaking the exercise.</p> <p>Artificial plantation and maintenance of such trees would have to be done in accordance with the directions issued by the Tree Officer/Authority.</p>	Tree Authority/ Tree Officer constituted by the concerned Urban Local Authority.
11.	Regulation Governing Vibration	<p>There are no prevailing regulations/standards in India governing train induced ground vibrations. However, Director General of Mines and Safety DGMS) has prescribed permissible limit for ground vibration for different structures like domestic buildings, historical and sensitive monuments <i>etc.</i></p> <p>Vibration Regulation Law in Japan issued by the Ministry of the Environment, Government of Japan, stipulates to preserve the living environment and contribute to the protection of people's health by regulating vibration.</p> <p>As per USA, Federal Transit Administration (FTA), the criteria for environment impact from ground-borne vibration are based on the maximum root-mean-square vibration level for repeated events from the same source.</p> <p>In the present scenario of MAHSR project, the standard stipulated by the Japan and Guidelines for Noise & Vibrations for metro Systems in India stipulated by Research Design and Standards Organisation, (RDSO), Ministry of Railway shall be adhered to during the operation phase of the MAHSR project.</p>	The MAHSR project shall comply with the permissible vibration limit stipulated by the DGMS and RDSO.	CPCB and MPCB/GPCB and CPCB for Union Territory, Dadra and Nagar Haveli

Source: Government of India, MoEFCC, Govt. of Maharashtra, Government of Gujarat

3.5 APPLICABILITY OF LABOUR LAWS TO MAHSR PROJECT

Implementation on legislation on related to labour standards is the primary responsibility of the Ministry of Labour and other State Labour Departments. The National Human Rights Commission of India is an autonomous public body constituted on 12 October 1993 under the Protection of Human Rights Ordinance of 28 September 1993. It was given a statutory basis by the Protection of Human Rights Act, 1993. The applicable labour laws with respect to MAHSR project is detailed in Table 3.5.1.

Table 3.5.1: Applicability and Responsibility of Labour Laws to MAHSR

Law	Objective/Intent of the Regulations	Relevance/Applicability to MAHSR	Responsible Regulatory Authority
Minimum Wages Act, 1948	As per this act, the employer is supposed to pay not less than the minimum wages fixed by appropriate Government. There are stipulations for working hours, overtime and contract inclusions. Minimum wage requirements vary within each state.	<p>A large number of workforce shall be employed at the project site during the construction phase of the project, it shall be the responsibility of NHSRCL to strictly adhere to the stipulations made in the act. The contractors engaged for the project shall be made responsible to comply with the provisions of the act.</p> <p>During the operation phase of the project large number of workforce shall be deployed by the outsourced agencies. NHSRCL being the principal employer, it shall be the responsibility of the NHSRCL that the workforce gets the wages as per the provision of the act.</p>	Ministry of Labour through Chief Labour Commissioners of the respective States and UT
The Payment of Wages Act, 1936	The Payment of Wages Act, 1936 was enacted with a view to ensuring that wages payable to employed persons covered by the Act were disbursed by the employers within the prescribed time limit and that no deductions other than those authorised by law were made by them.	As the large number of workforce shall be employed at the project site during the construction and operational phase of the project, it shall be the responsibility of NHSRCL to strictly adhere to the stipulations made in the act. The contractors engaged for the project shall be made responsible to comply with the provisions of the act and it shall be ensured that the wages are paid within the stipulated time limit.	Ministry of Labour through Chief Labour Commissioners of the respective States.
Equal Remuneration Act, 1976	This act entitles for payment of equal remuneration to men and women workers and for the prevention of discrimination, on the ground of sex, against women in the matter of employment and for matters connected. It stipulates employer to pay equal remuneration to men and women who has same nature and amount of work.	It shall be the responsibility of the NHSRCL that the workforce employed by the contractors gets the remuneration as per the provision of the Act without any discrimination of gender.	Ministry of Labour through Chief Labour Commissioners of the respective States.
Child Labour (Prohibition and Regulation) Act, 1986, (major revisions were enacted under	The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes.	It shall be the responsibility of the NHSRCL that no Child Labour are deployed in any kind of project activities by the engaged contractors.	Ministry of Labour through Chief Labour Commissioners of the respective States.

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Law	Objective/Intent of the Regulations	Relevance/Applicability to MAHSR	Responsible Regulatory Authority
The Child Labour (Prohibition and Regulation) Amendment Bill, 2012)			
The Labour Act, 1988	The act provides the health and safety of workers employed in construction work etc.	It shall be the primary responsibility of the contractors to take care of health and safety of the workers at the work site.	Ministry of Ministry of Labour through Chief Labour Commissioners of the respective States.
The Industrial Employment (Standing Orders) Act 1946	It applies to every industrial establishment wherein 100 or more workmen are employed. This Act mandates employers to define the conditions of employment under them and to make the said conditions known to workmen employed by them.	The MAHSR project envisages establishing two maintenance depot-one at Sabarmati and another at Thane. It shall be responsibility of NHSRCL to adhere to the provisions of the act.	Respective Factory Inspector, Ministry of Ministry of Labour through Chief Labour Commissioners of the respective States.
The Trade Unions Act, 1926	Article 19 of the Constitution of India gives the right to individuals to form associations and unions and this is implemented through the Trade Unions Act, 1926.	The NHSRCL management cannot deny the formation of Trade Union and it is the primary responsibility of the NHSRCL to recognise such trade unions which is the fundamental right of the workers.	Ministry of Ministry of Labour through Chief Labour Commissioners of the respective States.
Workmen's Compensation Act, 1923	This act provides for compensation in case of injury by accidents arising out of and during employment.	During construction and operation phases of the MAHSR project, it shall be responsibility of the Contractors and NHSRCL to comply with the provisions of the act.	Ministry of Ministry of Labour through Chief Labour Commissioners of the respective States.
Contract Labour (Regulation and Abolition) Act, 1970	This act provides for certain welfare measures to be provided by the contractor to contract labour.	NHSRCL being principal employer, it shall be its responsibility to ensure that the contract labour deployed by the contractors is looked after in accordance with the provisions of the act.	Ministry of Ministry of Labour through Chief Labour Commissioners of the respective States.

Source: Government of India, Ministry of Labour, Govt. of Maharashtra, Government of Gujarat

3.6 REGULATORY FRAMEWORK FOR OCCUPATIONAL HEALTH & SAFETY, LABOUR AND WORKING CONDITIONS

Constitutional provisions form the basis of workplace health and safety (H&S) laws in India by imposing a duty on the State to implement policies that promote the H&S of workers at workplaces. In addition, H&S statutes for regulating occupational health and safety (OHS) of persons at work exist in different sectors, namely manufacturing, mining, ports, and **construction**. The regulations in place in these four sectors include the Factories Act, 1948 as amended in 1987; the Dock Workers (Safety, Health and Welfare) Act, 1986; the Building and other Construction Workers (Regulation and the Employment and Conditions of Service) Act, 1996; the Child Labour (Prohibition and Regulation) Act 1986; the Mines Act 1952, as amended in 1957 and the Mines Rules 1957. In addition, there are also other specific regulations on hazards or focused on particular sectors and territories. OHS in India is the primary responsibility of the Ministry of Labour and the state labour departments. The Ministry of Labour has also issued a National Policy on Safety, Health and Environment at the Workplace.

The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 applies to the MAHSR project during the construction phase(all the establishments who carry on any building or other construction work employs 10 or more workers are covered under this Act; the employer of the establishment is required to provide safety measures at the construction work site and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace etc.)

3.7 REGULATORY FRAMEWORK FOR LAND ACQUISITION, COMPENSATION AND RESETTLEMENT

The Land Acquisition Plan (LAP) has been finalized and the Rehabilitation Action Plan (RAP) has been prepared and documented in the form of RAP Report. According to the LAP, 1415.75 ha. of land shall be acquired for the MAHSR project. The Stake Holders Meeting (SHM) was organized at taluka/Tehsil and District level.

3.7.1 Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (30 of 2013)

The act was enacted to ensure, in consultation with institution of local self-government and Gram Sabhas established under the Constitution, a humane, participative, informed and transparent process for land acquisition for industrialisation, development of essential infrastructural facilities and urbanisation with the least disturbance to the owners of the land and other affected families whose land has been acquired or proposed to be acquired or are affected by such acquisition and make adequate provisions for such affected persons for their rehabilitation and resettlement and for ensuring that the cumulative outcome of compulsory acquisition should be that affected persons become partners in development leading to an improvement in their post-acquisition social and economic status and for matters connected therewith or incidental thereto.

3.8 REGULATORY FRAMEWORK FOR INDIGENOUS PEOPLES / SCHEDULED TRIBES / CASTES

Indigenous People (IP) is referred to as a population with social, cultural, economic, and political traditions and institutions distinct from the mainstream or dominant society and culture. IP with

similar cultural characteristics are known as *Adivasi* in Hindi and are recognized as Scheduled Tribes (STs) as per the Indian Constitution.

The National Commission for Scheduled Tribes has been formed through bifurcation of the National Commission for Scheduled Castes and Scheduled Tribes which is under the 89th Amendment Act of the Constitution. Although, the National Commission for Scheduled Tribes has been created in August 2003, little measures in terms of adequate budgetary and staff allocations have been made to make the Commission function effectively. One of the duties assigned to the National Commission for Scheduled Tribes and Scheduled Castes is to submit reports to the President annually or at such other time as the Commission may deem fit, upon the working of the safeguards.

As per international definitions, the term Indigenous People is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees: (i) self-identification as members of a distinct indigenous cultural group and recognition of its identity by others; (ii) collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories; (iii) customary cultural, economic, social or political institutions that are separate from those of the dominant society and culture; and (iv) a distinct language, often different from the official language of the country or the region. Essentially, indigenous people have a social and cultural identity distinct from the mainstream society that makes them vulnerable to being overlooked in development processes.

The laws on scheduled tribes/castes and its applicability to MAHSR project are detailed in Table 3.8.1.

Table 3.8.1: Applicability and Responsibility of Laws on Scheduled Tribes/Castes

Law	Objective/Intent of the Regulations	Relevance/ Applicability to MAHSR	Responsible Regulatory Authority
The Scheduled Castes/Scheduled Tribes Prevention of Atrocities Act, 1989	This is the main Act to deal with atrocities against members of Scheduled Castes and Scheduled Tribes. Some states like Maharashtra and Gujarat have setup exclusive Special Courts for cases to be heard under this Act. Other States and Union Territories have notified the existing Courts of Sessions as Special Courts for the trial of offences under the Act.	The proposed MAHSR alignment passes through the villages having tribal and scheduled caste populations. Some of the villages have been notified as tribal village especially in the Maharashtra. In view of the above, NHSRCL shall have to comply with the provisions of the act.	National Commission for Scheduled Tribes.
The Panchayats(Extension to the Scheduled Areas) Act, or PESA, 1996	The Parliament of India has passed the Provisions of the PESA, to extend the provisions of the 73rd Constitutional Amendment to the Schedule V Areas of the country. This Act accords statutory status to the Gram Sabhas in Schedule V areas with wide-ranging powers and authority. This aspect was missing from the provisions of the 73rd Constitutional Amendment. This Act recognizes the prevailing traditional practices and customary laws besides providing the management and control of all the natural resources-land, water and forest in the hands of people living in the Schedule Areas. The Act empowers people in the tribal areas through self-governance. One of the important provisions of this act states “the Gram Sabha or the Panchayats at the appropriate level shall be consulted before making the acquisition of land in the Scheduled Areas for development projects and before re-settling or rehabilitating persons affected by such projects in the Scheduled Areas.	This act shall be applicable to NHSRCL as the MAHSR alignment passes through the Scheduled areas. Gram Sabha shall be organised before land acquisition in the Scheduled Area.	Concerned District Collector
The Scheduled Tribes and Other Traditional Forest Dwellers Act 2006	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act2006, recognizes and vests the forest rights and occupation in forest land to Scheduled Tribes and other traditional forest dwellers who have been residing in such forests for generations but whose rights are not recorded. This law provides for recognition of forest rights to Scheduled Tribes in occupation of the forest land prior	At one of the location, the proposed MAHSR alignment passes through the forest land which is the source of sustenance of the scheduled tribes. In view of this, the NHSRCL shall have to comply with the provision of the act.	Concerned District Collector and DCF/DFO.

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Law	Objective/Intent of the Regulations	Relevance/ Applicability to MAHSR	Responsible Regulatory Authority
	to 13.12.2005 and to other traditional forest dwellers who are in occupation of the forest land for at least 3 generations <i>i.e.</i> 75 years, up to maximum of 4 hectares. These rights are heritable but not alienable or transferable.		
The National Policy on Tribals, 2006	As per Dr. Freddie D’Souza in article, “Women Tribal Domestic Workers in Delhi”, the success of the National Policy on Tribals of the Government of India to a large extent will depend on strengthening of the National Commission for Scheduled Tribes, implementation of the Civil Rights Act and the Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989 and making necessary budgetary allocations.	NHSRCL shall have to comply with the provision of the act, in the event of tribal women are engaged in the project activity.	Concerned District Collector.

Source: Study Team

3.9 INTERNATIONAL TREATIES, AGREEMENTS AND CONVENTION

India is also a signatory to a number of international treaties agreements and conventions (refer Table 3.9.1) and those which are applicable to the Project are mainly related to environmental and social protection, and labour welfare as well.

Table 3.9.1: Applicable International Agreements and Conventions

Agreement/Convention	Objective/Intent	Applicability to MAHSR
International Labour Organisation (ILO) Conventions	The ILO is a United Nations agency dealing with labour issues, particularly international labour standards, social protection, and work opportunities for all. ILO's core labour standards of which India has ratified include four (4) of the eight (8) core conventions, which cover forced labour and discrimination. These conventions are, C029: Forced Labour Convention, 1930; C105: Abolition of Forced Labour Convention, 1957; C100: Equal Remuneration Convention, 1951; and, C111: Discrimination (Employment and Occupation) Convention, 1958. India has not ratified the ILO conventions on Freedom of Association and the Right to Organise Collective Bargaining (<i>i.e.</i> C087 and C098). However, Article 19 of the Constitution of India gives the right to individuals to form associations and unions and this is implemented through the Trade Unions Act, 1926.	MAHSR project shall employ large workforce during the construction and operation phases of the project. The obligations under these conventions have been translated into municipal laws through Parliamentary enactments. Though compliance with the domestic laws, the obligations under the ILO Convention shall be met.
International Covenant on Economic, Cultural and Social Rights (ICESCR)	ICESCR is a multilateral treaty adopted by the United Nations General Assembly on 16 December 1966, and in force from January 03, 1976. It mandates to work toward the granting of economic, social, and cultural rights (ESCR) to the Non-Self-Governing and Trust Territories and individuals, including labour rights and the right to health, the right to education, and the right to an adequate standard of living. India ratified the ICESCR in 1979 India interprets the right of self-determination as applying "only to the peoples under foreign domination" and not to apply to peoples within sovereign nation-states. It also interprets the limitation of rights clause and the rights of equal opportunity in the workplace within the context of its constitution.	The people from different social and cultural groups shall be deployed during the construction and operation phases of the MHASR project. The obligations under these conventions have been translated into municipal laws through Parliamentary enactments. Though compliance with the domestic laws, the obligations under the ICESCR shall be met.
The Kyoto Protocol, the Doha Amendment and the Paris Agreement	The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits State Parties to reduce greenhouse gas emissions. India signed and ratified the Protocol in August 2002. The first commitment period of the Kyoto Protocol was 2005 - 2012. India was exempted from the framework of the treaty, and was expected to gain from the protocol in	The obligations under these Protocols and Agreements have been translated into municipal laws through Parliamentary enactments or rules/regulations made under them. Though compliance with the domestic laws, the obligations under these Protocols and Agreements shall be met.

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Agreement/Convention	Objective/Intent	Applicability to MAHSR
	<p>terms of transfer of technology and related foreign investments. On 24 January 2017, India ratified the second commitment period of the Kyoto Protocol starting 2013 to 2020. Under the agreement developing countries are not required to curb emissions.</p> <p>In April 2016, India became signatory to the Paris Agreement, which comes into force in 2020, when the Kyoto Protocol comes to an end. The Paris Agreement mandates all countries to act to minimize the impact of climate change as per their voluntary commitments and individual capacity.</p>	
<p>The Vienna Convention for the Protection of the Ozone Layer (1988); the Montreal Protocol on Substances that Deplete the Ozone Layer (1987), and, The Kigali Agreement amendment (2016)</p>	<p>India became Party to the Vienna Convention and the Montreal Protocol on 18 March 1991 and 19 June 1992, respectively. The Montreal Protocol is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. It was agreed on 16 September 1987, and entered into force on 1 January 1989. The treaty is structured around several groups of halogenated hydrocarbons that deplete stratospheric ozone. All the ozone depleting substances controlled by the Montreal Protocol contain either chlorine or bromine and include Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs). Hydrofluorocarbons (HFCs) replaced CFCs and HCFCs. HFCs pose no harm to the ozone layer because, unlike CFCs and HCFCs, they do not contain chlorine. They are however greenhouse gases, with a high global warming potential (GWP), comparable to that of CFCs and HCFCs. In October 2016, India signed the Kigali Agreement, which is an amendment to the Montreal Protocol. Under this agreement, starting from 2028, India has agreed to reduce HFCs by 85% of their values in 2024-26 by the year 2047.</p>	<p>During the operation of the MAHSR project, no significant impact on the ozone layer is envisaged.</p> <p>In view of the above, the convention is not applicable to MAHSR project.</p>

Source: Study Team

3.10 JICA GUIDELINES FOR ENVIRONMENTAL & SOCIAL CONSIDERATIONS, APRIL 2010

JICA enforced the new guidelines on environmental and social considerations in April 2010. As per this guideline, JICA supports the recipient governments by offering cooperation projects into which JICA incorporates appropriate environmental and social considerations so as to avoid or minimize development projects’ adverse impacts on the environment and local communities. JICA thus promotes sustainable development in developing countries. JICA recognizes the following seven principles to be very important under environmental and social considerations of a project.

- Coverage of a wide range of environmental and social impacts to be addressed.
- Implementation of measures for environmental and social considerations at an early stage in a project cycle based on analysis of alternatives.
- JICA makes serious attempts at promptness.
- Paying attention to accountability and transparency when implementing cooperation projects.
- Ensuring the meaningful participation of stakeholders in order to take consideration of environmental and social factors and to reach consensus accordingly.
- Disclosing information on environmental and social considerations in order to ensure accountability and to promote participation of various stakeholders.
- Capacity building of organizations to consider environmental and social factors appropriately and effectively at all times.

JICA classifies projects under four categories (A, B, C, and F1) according to the extent of environmental and social impacts similar to the funding agencies categorization like World Bank (WB), Asian Development Bank (ADB) and Japan Bank for International Cooperation (JBIC). The categories as classified by JICA based on the extent of environmental impacts are given in Table 3.10.1.

Table 3.10.1: Categorisation of the Project as per JICA

Category	Description
A	Project that is likely to have significant adverse impacts on environment and society. For example, a large-scale project in a sector that requires special attention such as energy development and infrastructure development, or a project in a sensitive area such as a nature reserve or a living sphere of indigenous people.
B	Project whose impacts on the environment and society are less adverse than that of category A.
C	Project that has a minimal or virtually no impact on the environment and society.
F1	Project in which JICA funds the financial intermediary or executing agency that selects its sub-projects after JICA’s approval of the funding, and therefore JICA cannot assess the ESC of each sub-project prior to its approval. Such projects are classified as FI if the sub-projects are likely to have a considerable impact on the environment and society.

Source: JICA Guidelines for Environmental and Social Consideration, 2010

As per the above categorization, the proposed MAHSR project is classified under **Category-A** considering the magnitude and scale of impact and size of the project.

In line with JICA’s Guidelines for E&S Considerations, the following international requirements have also been followed, as relevant to the project:

- World Bank E&S Safeguards
- International Finance Corporation's (IFC) Performance Standards, 2012
- EHS Sector Guidelines of IFC, 2007 (for Railways)
- General EHS Guidelines of IFC, 2007

JICA takes into account the importance of good governance surrounding projects so that measures for appropriate environmental and social considerations are implemented. JICA respects the principles of internationally established human rights standards like the International Convention on Human Rights, and gives special attention to the human rights of vulnerable social groups—including women, indigenous peoples, persons with disabilities, and minorities-when implementing cooperation projects. JICA obtains country reports and information issued by related institutions about human rights, and JICA understands local human rights situations by disclosing information about cooperation projects. JICA discloses the information after making inquiries to the recipient governments and related organizations.

The compliance of the key issues of JICA's guidelines are given in Table 3.10.2

Table 3.10.2: Compliance to the Stipulated JICA’S Guidelines 2010

Sl. No.	Issues	Compliance Status
Basic Principles		
1	Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined.	The alternative analysis to minimise the impacts has been taken up during the finalization of the alignment at the feasibility stage of the project and updated in the S-EIA stage as relevant.
2	Examinations include an analysis of environmental and social costs and benefits in the quantitative terms and qualitative analysis.	Conducted during the feasibility stage of the project and updated in the present version.
3	EIA reports must be produced for projects with large environmental impacts (Category A).	The EIA Report prepared at the FS stage and present Supplementary EIA Report has been prepared at the detailed design stage.
4	For projects with high potential for adverse impacts, a committee of experts may be formed.	The S- EIA report prepared has been examined by a group of experts appointed by JICC. Additionally the observations and comments received from JICA form its own expert committee have been complied with to complete the review process.
Impacts to be assessed and addressed		
5	Pollution	Air quality, Water quality, Waste, Soil contamination, Noise and vibration, subsidence, odour and sediment
6	Natural Environment	Protected areas, Ecosystem, Fauna and flora including endangered species
7	Social Environment	Resettlement, Living and livelihood, Heritage, Landscape, Ethnic minorities, Indigenous peoples, and occupational safety
8	“In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent.”	Addressed in the present version of the S-EIA Report. Possible cumulative impacts caused by the project, such as noise, vibration and dust, have been considered in the S-EIA. Cumulative impacts by undetermined plans of other sectors are not included in the S-EIA Report.
Compliance with Laws, Standards, and Plans		
9	Projects must comply with the laws, ordinances, and standards established by the governments	The MAHSR project shall comply with all the existing laws, ordinance, and regulation issued from time to time by the Government authorities.
10	Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage.	Every care has been taken while finalising the alignment. However, due to design constraint of high speed rail, the proposed MAHSR alignment passes through eco-sensitive zones (buffer zones outside the core zone of protected areas) of two protected areas on viaduct and Core Zone and ESZ of one PA through tunnel.
Social Acceptability		
11	Projects must be adequately coordinated so that they are accepted in a	SIA has been taken up and submitted for review.

Supplemental EIA Report for Mumbai-Ahmedabad High Speed Railway Project

Sl. No.	Issues	Compliance Status
	manner that is socially appropriate to the country and locality.	
12	Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.	Addressed in the present version of the SIA Report
Ecosystems and Biota		
13	Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	The project does not involve any conversion or degradation of critical natural habitats / forests
14	Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging.	Proposal for diversion of forest land has been initiated with the Central and State Governments and shall be secured before commencement of construction activities in the forest land. Additionally, the EMP and terms of reference of Contractors clearly prohibit any forest logging near construction / labour camps for any purpose
Involuntary Resettlement		
15	Avoid and minimize the impacts on Involuntary resettlement and loss of means of livelihood	Addressed in the Resettlement Action Plan (RAP)
16	Prior compensation, at full replacement cost	Shall be complied with while finalising the compensation and within the existing laws, as applicable.
17	To Improve or at least to restore standard of living, income opportunities, and production levels, to pre-project levels	Addressed in the RAP as per SIA and prevailing legal requirements.
18	Grievance mechanisms must be established	This requirement has been addressed in Chapter 7 of the S-EIA Report and a grievance redress mechanism will be established at NHSRCL as well as Contractor level.
19	Resettlement Action Plan (RAP) must be prepared and disclosed in host country before JICA environmental review	RAP has been finalised and being reviewed by JICA.
20	RAP needs to include the elements stated in the World Bank's Safeguard Policy, Operational Policy (OP) 4.12, Annex A.	These elements have been addressed in the RAP document
Indigenous Peoples		
21	Avoid and minimize the impacts on Indigenous People	Please refer to the RAP document for details on this aspect
22	Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.	Please refer to the RAP document for details on this aspect
23	Indigenous Peoples Plan (IPP) must be prepared and disclosed in host country before JICA environmental review	Indigenous Peoples Plan (IPP) has been prepared and has been disclosed during Stakeholders Meetings.
24	IPP needs to include the elements stated in the World Bank's Safeguard Policy, OP 4.10, Annex B.	Have been addressed in the IPP Report.
Monitoring		
25	Project proponents monitor whether any unforeseeable situations occur and whether the	An Environmental Monitoring Programme for the Construction and Operation phases of the project has been formulated and shall be

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Sl. No.	Issues	Compliance Status
	performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.	implemented as detailed in Chapter 6 of the S-EIA Report.
26	Project proponents should make efforts to make the results of the monitoring process available to local project stakeholders.	The finding of the monitoring shall be made available to the project stakeholders.
Environmental Impact Assessment (EIA)		
27	EIA must be prepared and disclosed in host country before JICA environmental review.	The FS Stage EIA has been disclosed to community and stakeholders, and their comments have been incorporated. The S-EIA Report was also disclosed to local community and stakeholders during the course of Public Consultation.
28	EIA needs to include the elements stated in the World Bank's Safeguard Policy, OP 4.01, Annex B.	The S-EIA addresses the recommended requirements.

Source: Study team

Chapter 4

Existing Environment of the Project Area

Chapter 4

Existing Environment of the Project Area

4.0 INTRODUCTION

This chapter presents information on the existing status of the environmental attributes in the project area spanning from Mumbai to Ahmedabad covering 508.17 km of length. For the present S-EIA study, 250 meter either side of the proposed centre line of the alignment of Mumbai-Ahmedabad High Speed Railway (MAHSR) Project has been considered as the Zone of Influence (ZOI) and study area as per the standard Terms of Reference (TOR) issued by the Ministry of Environment, Forest and Climate Change (MoEFCC) for linear projects.

Collection of baseline information on bio-physical, socio-economic aspects of the project area is a very important initial step for environmental assessment studies. The description of environmental settings includes the characteristic of area in which the activity of project corridor would take place and cover area anticipated to be affected by the project activities. For environmental assessment along the project corridor, information and data have been obtained by intensive site visits, primary data collection, secondary data from published sources, e-source and various government agencies. All ecosystem components have been systematically analysed and presented in this chapter.

The project study area encompasses the geographic area potentially affected by the project. For most of the issues involving physical impacts, this could be considered as the project “footprint,” or the area that would be directly used for the proposed MAHSR alignment and associated project facilities like construction yard, stations, maintenance depots, tunnel inspection shafts, power sub-stations, various locations proposed for traction power facilities and power connections *etc.*

The MAHSR alignment starts at Bandra Kurla Complex (BKC) in Mumbai Suburban, crosses Thane and Palghar districts of Maharashtra to enter Gujarat in Valsad district, runs a short course of 7.358 km through the UT of Dadra and Nagar Haveli and re-enters Gujarat and runs through Navsari, Surat, Bharuch, Vadodara, Anand, and Ahmedabad districts of Gujarat before terminating at Sabarmati Station. The planned route lies between Latitude 19°03'58.52"N - Longitude 72°05'47.48"E and Latitude 23°05'39.78"N - Longitude 72°34'33.48"E.

4.1 TOPOGRAPHY, PHYSIOGRAPHY AND DRAINAGE PATTERN

1) Topography

The topography of the entire study area along the proposed alignment can be bifurcated into two different regions. The first part towards Mumbai in Maharashtra region having undulated and coastal area while the second one, falling in the Gujarat region, having plain terrain with minor undulation. The major portion of the MAHSR alignment runs almost through coastal undulating areas (cross slopes less than 10%) and rolling terrain (cross slopes 10-25%) for a small stretch which is parallel to the Arabian Sea. Each of these landscapes, generally vary in width and lies more or less parallel to the Arabian Sea. The main rivers in the region cross the corridor, flowing generally east to west from the inland mountains to the sea; their tributaries flow generally north or south.

a) Coastal Plain Region

The Coastal Plain Region, adjacent to the sea, is flat and is, therefore, subject to flooding and periodic inundation both by the sea and the rivers. It is characterized by mud flats, rice paddies, and generally land unsuitable for laying the track. In this region, the rivers form marshy estuaries in the broad tidal flats. In some locations, the marshes support mangrove vegetation. These estuaries and tidal marshes provide fishing grounds, as well as feeding and breeding areas for a wide variety of aquatic plant and animal life.

The alignment passes through Coastal Regulatory Zones (CRZ) at Thane Creek, Ulhas River, Mithi River, Vaitarna River in Maharashtra and Narmada River at Bharuch in Gujarat.

b) Rolling Terrain Region

The Rolling Terrain Region is characterized by landscape and soils with good constructability. Cross slopes of the land range between 10 and 25%. The project alignment in Thane and Palghar is passing through rolling terrain.

2) Drainage Pattern

Maharashtra

Geographically, Mumbai is an island outside the mainland of Konkan separated from it by narrow Thane Creek and a somewhat wider Harbor Bay. At present, it covers the original island group of Mumbai and most of the islands of Salsette with the former Trombay island appended to it in its Southeast.

The drainage of Thane is controlled by two river streams: Ulhas and Vaitrana, both draining the rainy western slopes of Sahyadri. There is much similarity in their courses, dashing over the black scarp of the Sahyadri ranges.

Gujarat

All rivers of the state except Tapi, Narmada and Mahi originate in the eastern hilly tract. The rivers flow with highly meandering courses in westerly direction and cut across the alluvial plains. The flow directions of the rivers are dominated by tectonic activities *e.g.* Rivers like Narmada and Tapi flows through rift valleys along the Vindhyan and Satpura range in a westerly direction. There are many other small and medium streams cutting across the site of proposed alignment.

To maintain the natural drainage, bridges have been provided across all the rivers, estuaries, canals and *nallahs* as mentioned in Chapter 1 of the S-EIA Report. Maps and further details are provided in **Annexure 4.1, Vol-II**.

4.2 LANDSCAPE

A landscape is the visible feature of an area of land, its landforms and how they integrate with natural or man-made features. Landscape of the project region can be bifurcated into two areas a) the area falling in the Maharashtra State and b) the area falling in the Gujarat State. The landscape of Maharashtra region of the study area is having undulated land with many hillocks with rich vegetation, forests and coastal plains while the landscape of the area

falling in Gujarat shows plain agricultural land with minor undulation. The area falling in the UT of Dadra & Nagar Haveli shows the similar landscape as Gujarat. Maps and further details are provided in **Annexure 4.2, Vol-II**.

4.3 GEOLOGY & SEISMICITY

1) Geology

Geologically, the MAHSR alignment can be divided into two segments - Alluvial plains in Gujarat, UT of Dadra & Nagar Haveli and Paleogene sedimentary rocks in Maharashtra, Vindhyan formation.

Project area is a part of Gondwanaland. The rock formations of the area comprises of metamorphosed quartzite, slates and lime stones.

Thane and Palghar regions are underlain by basaltic rocks. Basalt flow forms the predominant formation capped at a few places by laterite at higher levels. A number of hot springs occur in Palghar district which have positive relation with the geology of the area. The hill ranges in the area are predominantly aligned north-south and have more or less escarpments. Basalt flows, popularly known as Deccan traps, forms the predominant formation. It is capped by laterite on a few high plateaus and covered by shore sands along the coast.

2) Seismicity

On perusal of Seismic Zoning Map of India, 2002, entire MAHSR alignment falls in the intensity Zone-III as per IS 1893:2002. Zone -III represents area of moderate risk zone. However, all the structures like station building, bridges, depots, tunnel, yards and the viaduct shall be designed with a safety margin, taking care of the seismic intensity, as applicable.

Detailed description of the geology of the MAHSR project area along with supporting Tables, Exhibits, Maps and explanations are provided in **Annexure 4.3, Vol-II**.

4.4 SOIL QUALITY

The entire alignment can be divided into two parts on the basis of the soil characteristics- the alignment falling in Maharashtra *i.e.* Mumbai Suburban, Thane & Palghar and Gujarat.

The project area has four types of soils ranging from moderately well drained to poorly drain, acidic to slightly alkaline and medium to high textured. The soils are primarily belonging to deep black soil, coastal alluvial, medium black soil and grey brown soil. Alluvial soil is found along riverbed, which is used for agriculture. Sandy soil is also found in the riverbeds. The coastal plain of project area is composed of alluvial clays with a layer of black soil on the surface.

Dadra and Nagar Haveli are underlain by hard rock strata particularly by Deccan Basaltic flows [81% of the total area] with localized occurrences of sedimentary and alluvial formations. Detailed Description of the soil quality with Exhibits and explanations are discussed in **Annexure 4.4, Vol-II**.

4.5 GROUND SUBSIDENCE

According to the analysis of the specimen collected during geotechnical investigation in the Feasibility Study Stage, for sample Nos. 10, 32, 33, 34 and 38, the value of Free Swelling Index (FSI) exceeds 35, a yardstick value to indicate high “expansibility”. The FSI of specimen Nos. 33 and 34 exceed 50 suggesting extremely high expansibility. To suppress the swelling effects of the black cotton soil in the surface layer it is important to prevent invasion of water including rainwater from outside. As current surveys don’t provide the definite scope of distribution of black cotton soil, the study team¹ estimated the ratios of its distribution between stations based on literature (soil maps).

The sub-grade strength required for railways is N-value of 4 or above. Sub-grades for which the N-value is lower than 4 require soil improvement work. During the geotechnical investigation conducted during the F/S stage, no layers having an N-value less than 8 were found. Accordingly, the study team assumes in this report that there are no sections where countermeasures against soft grounds are required.

Most of the alignment passes through the basaltic rock or black cotton soil. The abstraction of ground water is also minimal in the surrounding where the stations are planned. Measurement by boring surveys indicate the underground water level is lower than 8 m, with only small water content existing in and around the surface layer.

Concern of ground subsidence is present in the stretch of Konkan belt, where historically there have been several instances of rock sliding causing disruption in train services. The possibility of subsidence exists also in the proposed tunnels in the Mumbai region, which will be intersecting the basaltic rock formation. If a void space is created during the construction, it may result in ground subsidence. Proper measures shall be taken during tunnelling.

In Gujarat, implementing effective water management will help to mitigate potential ground subsidence. Integration of hydrological data like well locations, exploitation rates and lithostratigraphic maps of subsurface sequence in areas affected by ground subsidence will provide better understanding of the relation between surface displacements and the lowering of the groundwater level.

Precaution is the best way of approaching the problem. By constant monitoring, precautions can be taken at the right time to avoid any type of future problems. Prevention starts where precaution ends. Certain regulations have to be implemented to prevent any untoward happenings in future and this will be the preventive measure.

4.6 LAND USE

Land use as a function of land cover distribution in the study area has been assessed and provided below. The land use pattern indicates that 76.94 % of the Zone of Influence (ZOI) is agricultural land followed by built-up area of 15.71% (refer Table 4.6.1).

¹ The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

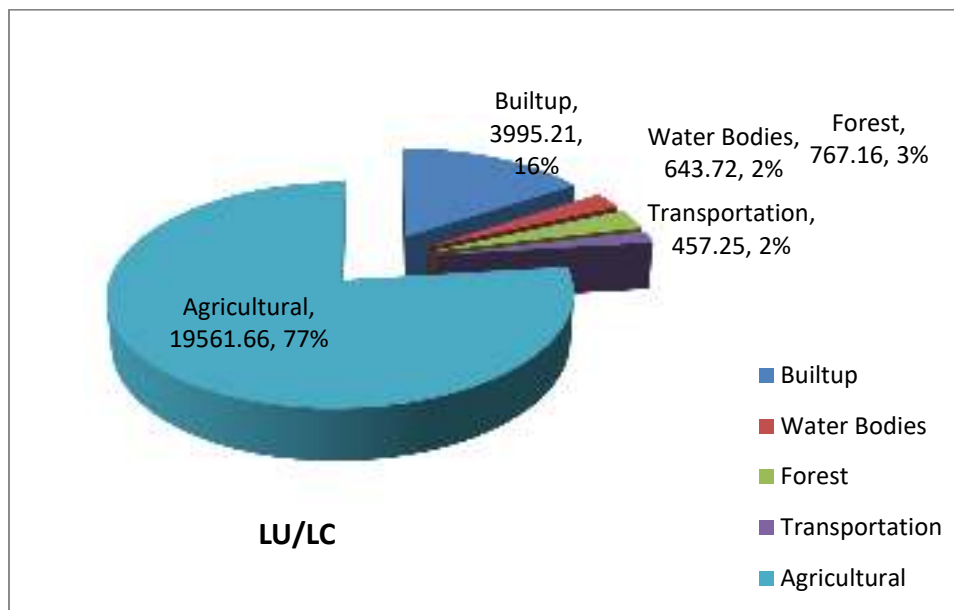
Table 4.6.1: Land Use/Land Cover of the Study Area

Land Use Class	Area in Ha	%
Built-up	3995.21	15.71
Agriculture	19561.66	76.94
Forest/Vegetation	767.16	3.02
Water bodies	643.72	2.53
Transportation	457.25	1.80
Total	25408.70	100%

Source: Study Team

The area under different land use is shown in Exhibit 4.6.1.

Exhibit 4.6.1: Land Use/Land Classification of the ZOI



Source: Study Team

4.7 WATER USE

In the study area, the water is primarily used for irrigation, domestic purposes, commercial, industries and livestock. The study area comprises of Urban and Rural area along the alignment. The urban areas in Gujarat include major Industrial towns as Ahmedabad, Anand, Baruch, Surat, Vapi, etc., having substantial domestic and industrial water demand. The water demand is met from rivers as Narmada, Sabarmati, Mahi, Tapi, Daman Ganga etc. and ground water.

Similarly, water demand in urban and rural areas in Maharashtra is met from rivers, ground water, confined water bodies, ponds, lakes such as Tulsi, Tansa, Modak Sagar (or Lower Vaitarna), Upper Vaitarna, Vihar and Bhatsa.

The water is supplied in urban areas through piped water supply network from the local bodies, whereas, rural area demand is met through multiple sources like dug wells, tube wells, bore wells, hand pumps and rivers with their tributaries. In some villages where surface water is not available, the supply is being met through existing ponds or lakes.

4.8 CLIMATOLOGY AND METEOROLOGY

1) Rationale

The weather of a place represents the state of the atmospheric environment over a brief period of time. Meteorological factors play an important role in dispersion of air pollution. This information is useful to assess the capacity of dispersion and diffusion of pollutants during the construction and operation phases of the project. The climate of the area is tropical wet and dry.

As per Koppens classification, climate of Gujarat and Dadra & Nagar Haveli is semi-arid steppe (hot) type and that of Maharashtra as Tropical Wet-Dry or Savanna type. The climatic parameters have been discussed individually further.

The climatic conditions of the study area are strongly influenced by its geographical setting. The MAHSR alignment almost runs parallel to the Arabian Sea particularly in Maharashtra and short stretch of Gujarat. The study area can be divided into two parts - (i) the alignment in the State of Maharashtra and (ii) the alignment in the State of Gujarat. The area falling in the mainland of Gujarat has different weather condition compared to the area of Deccan Trap of Maharashtra and coastal region in the vicinity of Mumbai and Thane. As per the Indian Meteorological Department, a year has been divided into following seasons in the Indian sub-continent:

Summer (Pre-monsoon)	:	March-to-May
Monsoon Season	:	June-to-September
Post-monsoon Season	:	October-November
Winter Season	:	December-to- February

2) Micro-Meteorology

The micro-meteorological conditions at the project alignment sites regulate the transport and diffusion of air pollutants released into the atmosphere. The principal meteorological variables are horizontal convective transport (average wind speed and direction), vertical convective transport (atmospheric stability, mixing height) and topography of the area. The data on surface meteorological parameters (wind speed and direction, ambient temperature, relative humidity, atmospheric pressure, solar radiation, rainfall *etc.*) in the study area were collected using automatic weather monitoring station. In this report the on-site meteorological data generated from 01-May-2017 to 31-May-2017 has been incorporated and subjected to statistical analysis.

For other cities like- Bharuch, Navsari and Vadodara, the AWS data from nearest India Meteorological Department (IMD) observatory was procured and has been presented in the report after statistical analysis.

Table 4.8.1: On-Site Meteorological Data (May 2017)

Station	Temp. (°C)		Relative Humidity (%)		Rainfall (mm)	Mean Wind Speed	Atmospheric Pressure (hPa)	
	Min.	Max.	Min	Max			Min	Max
Ahmedabad	29.7	42.8	8	74	0.0	3.2 m/s	991.6	997.6
Navsari	27.8	38.5	10	77	0.0	2.2 m/s	996.9	998.1
Bharuch	27.4	39.5	9	76	0.0	2.0 m/s	995.2	997.3
Vadodara	27.7	42.5	13	75	0.0	0.8 m/s	1001.1	1006.2
Mumbai	25.6	36.5	65	79	0.0	3.3 m/s	1007.4	1009.2

Source: Study Team and IMD Observatory

3) Discussion

On perusal of Table 4.8.1 it can be inferred that the temperature during the month of May 2017 varied from 25.6°C (Mumbai) to 42.8°C (Ahmedabad). The relative humidity was on higher side in Mumbai-79 per cent followed by Navsari-77 per cent and lowest at Vadodara-75 per cent. Mumbai being coastal city, the wind speed was observed to be higher (3.3 m/s) followed by Ahmedabad at 3.2 m/s. It is evident from the wind rose diagram that the prevalent wind direction is from west most of the time followed by southwest and south. No rain was observed during the month of May 2017 in the study area. For further details, refer **Annexure 4.8, Vol-II**.

4.9 CLIMATE CHANGE

1) UNFCC-Fifth Assessment Report

The UNFCC report provides a comprehensive assessment of sea level rise and its causes, over the past few decades. It also estimates cumulative CO₂ emissions since pre-industrial times and provides a CO₂ budget for future emissions to limit warming to less than 2°C. About half of this maximum amount was already emitted by 2011.

From 1880 to 2005, the average global temperature increased by 0.85 °C. Oceans have warmed, the amounts of snow and ice have diminished and the sea level has risen. From 1901 to 2010, the global average sea level rose by 19 cm as oceans expanded due to warming and ice melted. The sea ice extent in the Arctic has shrunk in every successive decade since 1979, with 1.07×10^6 km² of ice loss per decade.

Given current concentrations and ongoing emissions of greenhouse gases, it is likely that the end of this century will see a 1–2° C increase in global mean temperature above the 1990 level (about 1.5–2.5° C above the pre-industrial level). The world's oceans will warm and ice melt will continue. Average sea level rise is predicted to be 24–30 cm by 2065 and 40–63 cm by 2100 relative to the reference period of 1986–2005. Most aspects of climate change will persist for many centuries, even if emissions are stopped.

There is alarming evidence that important tipping points, leading to irreversible changes in major ecosystems and the planetary climate system, may already have been reached or passed. Ecosystems as diverse as the Amazon rainforest and the Arctic Tundra, may be approaching thresholds of dramatic change through warming and drying. Mountain glaciers are in alarming retreat and the downstream effects of reduced water supply in the driest months will have repercussions that transcend generations.

MAHSR project life cycle of 100 years will see the rise in ocean level along the Indian coastal line and hence the impact on the project will also be felt in the areas of Mumbai and Thane, specially the entry to the underground facilities have to be insured for such eventuality by building them above the anticipated rise in sea levels. Due to rise in sea levels during the operation stage, MAHSR alignment will be affected at the locations where it is closer to the CRZ boundary. Particularly, the proposed starting station close to Mithi River, shall have to consider the rise in sea level and the design engineering team should consider this factor.

Exhibits, Maps and further explanations on this topic are covered in **Annexure 4.9, Vol-II**.

4.10 AMBIENT AIR QUALITY

Anthropogenic activities are rapidly altering the proportion of gases in the atmosphere and causing unprecedented climate change, having serious repercussions for life on Earth.

Air pollutants degrade the atmosphere by reducing visibility, damaging property, combining to form smog, agricultural yield, deleteriously affecting human / animal health, altering ecosystems *etc.* Air quality in the India is governed by the National Ambient Air Quality Standards (NAAQS) formulated under the Air (Prevention and Control of Pollution) Act, 1981 by Central Pollution Control Board (CPCB). Pollutants that have established national standards are referred to as "criteria pollutants." Pollutants considered for the proposed MAHSR project are Particulate Matter (PM₁₀ & PM_{2.5}), Carbon Monoxide (CO), Oxides of Nitrogen (NO_x) and Sulfur Dioxide (SO₂).

The major sources of anthropogenic air pollution in a region are vehicular traffic, industrial emissions, domestic fuel burning, construction and demolition activities *etc.* A baseline study was conducted by the study team to establish the existing air quality and to compare with the NAAQS.

The prime objective of the baseline air quality monitoring is to establish the existing representative ambient air quality along the project corridor. This will also be useful for assessing the incremental impact and conformity to standards of the ambient air quality specified by CPCB due to the construction and operation of the MAHSR project. The ambient air quality monitoring was conducted in May 2017 (pre-monsoon season) at 12 locations during baseline survey to assess the ambient air quality status in the study area (250 m both side of the centre line of the proposed alignment). This is a follow up of ambient air quality monitoring carried out in October- 2014 (post-monsoon season) during the F/S Stage of EIA study. At all the monitoring stations PM_{2.5}, PM₁₀, SO₂, NO_x and CO were monitored on 24-hourly basis with frequency of twice a week. The data collected was subjected to statistical analysis to arrive at maximum, minimum and average value. The results were compared with NAAQS and are presented in **Annexure 4.10, Vol-II**.

Study Conclusion

The data demonstrates that the concentration of the measured pollutants was higher than prescribed NAAQS standards at few locations in the study area and the situation in the rural area is quite satisfactory and the air quality was well within the NAAQS standards.

PM₁₀ and PM_{2.5}: The measured value at Ahmedabad, Valsad and Sabarmati were found to be the highest among all locations and crossed the threshold limits of NAAQS standards. The PM₁₀ and PM_{2.5} though are less than NAAQS standards at other locations but quite close to it.

SO₂ and NO_x: The measured value at all the locations were found to be lower than NAAQS standards.

CO: The measured value was found to be higher than NAAQS standards at multiple locations including BKC, Surat, Bharuch, Vadodara and Anand. It is pertinent to mention that these locations are industrial belts/urban areas.

Comparison of the Two Seasons Results

On perusal of the results of the monitoring of two seasons *i.e.* post-monsoon season (undertaken in October 2014 during Feasibility Study Stage EIA Study) and pre-monsoon season (May 2017-EIA study being undertaken at detailed design engineering stage), following conclusions can be drawn-

- The concentration of pollutants particulate matter and gaseous except CO are on higher side in the pre-monsoon season (May 2017) which is due to the wash out of the pollutants on account of rain during monsoon season which lasted till the end of the September in 2014.
- The concentration of CO was on higher side in post-monsoon season (October 2014) due to vehicular emission and decrease in the mixing height due to low temperature.

Effects/sources of different pollutants, descriptive methodology of study, monitoring locations and detailed analysis of measured air pollutants at each location are described in **Annexure 4.10, Vol-II**.

4.11 AMBIENT NOISE

Ambient noise refers to the sound energy content of the natural system including any sound produced due to anthropogenic activities. Noise from an HSR system is expressed in terms of a “source-path-receiver” framework. The “source” generates noise levels that depend on the type of source (e.g., a high-speed rail) and its operating characteristics (e.g., speed). The “receiver” is the noise-sensitive land use (e.g., residence, hospital, or school) exposed to noise from the source. In between the source and the receiver is the “path,” where the noise is reduced by distance, intervening buildings, and topography. Noise criteria are established for the various types of receivers because not all receivers have the same noise sensitivity.

During assessment S-EIA study, preliminary survey was undertaken to identify the major noise generating sources in the area. The noise levels at different noise generating sources has been measured based on the commercial and residential activities, traffic and noise at sensitive areas. Ambient noise measurement was conducted in May 2017 to establish baseline ambient noise along the MAHSR alignment and to identify areas with existing high noise levels and areas that are susceptible to experience higher noise levels on account of construction and operation of the MAHSR. The information will be assisting in designing appropriate and adequate mitigation measures and allocate resources judiciously.

For the study, 31 locations were selected along the entire MAHSR alignment comprising residential, commercial, industrial and sensitive zones. Of the 31 locations, 24 locations were in Gujarat and 7 in Maharashtra. Continuously 24 hours data was recorded at each location for sound level indicators such as L_{max}, L₁₀, L₅₀, L₉₀, L_{eq}, L_{Day} and L_{Night}. The L_{Day} and L_{Night} levels were compared with the prescribed Ambient Air Quality Standards for Noise.

The results were converted into a color coded scale for each location that categorizes the

difference between the measured value and the prescribed standard value into very unsafe ($< -5\text{dBA}$), unsafe (< 0 and $> -5\text{dBA}$), safe (≥ 0 and $< 5\text{dBA}$) and very safe ($> +5\text{dBA}$).

Perusal of the measured values shows that the overall L_{eq} value varied between 43.4 dB(A) to 80.1 dB(A) among all locations. L_{Day} and L_{Night} value varied between 44.1 dB(A) to 81.2 dB(A) and 32.2 dB(A) to 65.3 dB(A) respectively. The highest L_{eq} value 80.1 dB(A) was recorded at Bandra Kurla Complex (BKC) due to proximity of plying vehicles and running of various equipment while the lowest L_{eq} 43.4 dB(A) was recorded at Kholvad in Surat, a slum area. The highest L_{Day} 81.2 dB(A) was recorded again at Bandra Kurla Complex (BKC) and lowest value of L_{Day} 44.1 dB(A) at Kholvad. The existing ambient noise was higher than prescribed standards at multiple locations in Maharashtra and Gujarat especially in urban areas, during both day and night.

The detailed methodology, locations and data recorded along with the results and analysis, exhibits are provided in **Annexure 4.11, Vol-II**.

4.12 VIBRATION

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. Ambient vibration or environmental vibration seldom have such magnitude to be perceptible or cause audible ground borne noise unless there are specific vibration sources close by. Such sources may be external such as railway line, road traffic *etc.* or internal such as air conditioning and ventilation systems, generator sets *etc.* Therefore, assessment of existing vibration levels is essential at certain susceptible receptors like archeological and heritage sites and monuments, which are prone to an increase in vibration levels or which are located in close proximity to existing vibration sources such as railway line, road traffic *etc.*

All structures close to MAHSR are vulnerable to vibrations during construction as well as operation phase, but those having vibration sensitive manufacturing, research or laboratory activities, old and weak buildings, houses *etc.* are especially vulnerable. Careful assessment of pre-existing vibration provides valuable information on real sensitivity of the receptor to external vibration and provides reference points. Similarly, old, historic or archeological sites are particularly vulnerable to vibration and hence, their real sensitivity shall be assessed. Vibration assessment is also important at locations where there is an existing source of vibration.

In order to assess the likely vibration impact due to construction and operation of MAHSR, vibration study has been conducted along the entire MAHSR alignment at 42 selected locations. Of the 42 locations 10 locations are in Maharashtra and 32 in Gujarat. Ground vibrations from passing of Superfast trains and passenger/local trains were also measured.

The detail of the selected vibration measurement locations and outcome of the measurement is given in **Annexure 4.12, Vol-II**.

Interpretation of Results

On perusal and statistical analysis of the data, the existing ground borne vibration at all locations ranged between zero to 0.230 mm/sec. The maximum vibration level was recorded at Ahmedabad, a commercial shop near the existing Railway track at 0.230 mm/sec during the passing of Rajdhani Express. It was pertinent to mention that at location NV108 in Vadodara city, which is in close proximity to the railway track and superfast trains regularly

pass, cracks were noticed in the walls of the first row of the houses. The residents confirmed that the crack was due to the effect of ground borne vibration of the passing trains.

4.13 WATER QUALITY

Surface water resources of the area are derived from annual rainfall in the area. Numbers of water resources were identified along the proposed alignment of MAHSR. These water resources can be broadly classified in flowing water resources (rivers, estuaries, reeks, nallahs) and stagnant water resources (pond, lakes).

The project area falls largely in the region of alluvial plains and traverse across several river basins. The rivers intersecting the proposed alignment are Narmada, Tapi, Ambica, Purna, Par, Damanganga, Mindhol, Ghadvi, Mahi, Vanki, Kolak, Vaitarni, Ulhas, Mithi, Sabarmati. The chainage wise details of the rivers, estuaries, canal, nallahs intersecting the proposed alignment of MAHSR has been discussed in Chapter 1 of the S-EIA report.

Water samples (surface and ground) were collected during the baseline survey in May 2017 and analyzed for physico-chemical and biological parameters on-site and in laboratory as per Standard Methods for the Examination of Drinking and Waste Water (CPCB, APHA, AWWA and WPCF). Surface water from 13 locations (2 in Maharashtra & 11 in Gujarat) and ground water from 5 locations (1 in Maharashtra & 4 in Gujarat) were collected and analysed.

4.13.1 Result and Discussions

1) Surface Water

a) River Water: (11 Locations)

(i) Physical Parameters

For surface water the values of physical parameters viz. pH, temperature, turbidity, TSS and TDS were found in the range as follows:

Parameter	Observed Values
• pH	= 6.84-8.32
• Temperature	= 29 -37°C
• TSS	= 7-42 mg/l
• TDS	= 158-3430 mg/l

(ii) Inorganic Parameters

The Inorganic parameters viz. total alkalinity, total hardness, chlorides, sulphate, sodium and potassium were found in the range as follows:

Parameter	Observed Values
• Total alkalinity	= 92-280 mg/l
• Total hardness	= 80-1042 mg/l
• Chlorides	= 36-2560 mg/l
• Sulphate	= 5.9-228 mg/l
• Potassium	= 5.5-28.6 mg/l

(iii) Nutrient Parameters

The nutrient and demand parameters viz. nitrate, total phosphate, dissolved oxygen, chemical oxygen demand and biochemical oxygen demand were in the range as follows:

Parameter	Observed Values
• Nitrate	= 0.12-23.5 mg/l
• Dissolved Oxygen	= 4.8-6.4 mg/l
• Chemical Oxygen Demand	= 36-124 mg/l
• Biochemical Oxygen Demand	= 9-22 mg/l

(iv) Trace Element

The trace elements were below the permissible limit of IS: 2296 in the river water.

(v) Bacteriological Characteristics

The total coliform density in river water was observed to be in the range of 170-5004 CFU/100 ml.

b) Estuarine Water: (3 Locations)

(i) Physical Parameter

The physical parameters in estuarine water sample were observed to be in the following range

Parameter	Observed Values
pH	7.34-7.85
Temperature	28°C -35°C
Turbidity	11.0-35.0 NTU
Total Suspended Solids (TSS)	24-59 mg/l
Total Dissolved Solids (TDS)	177-23038 mg/l

(ii) Inorganic Parameters

The inorganic parameters in estuarine water sample were observed to be in the following range:

Parameter	Observed Values
Total Alkalinity	150-187 mg/l
Chloride	250-2450 mg/l
Sulphate	42- 210 mg/l
Salinity	4-32%

(iii) Nutrient Parameters

The nutrient parameters in estuarine water sample were observed to be in the following range:

Parameter	Observed Values
Nitrate	0.24-32.6 mg/l
Dissolved Oxygen (DO)	1.1 – 5.3 mg/l
Biochemical Oxygen Demand (BOD)	20-172 mg/l
Chemical Oxygen Demand (COD)	72-544 mg/l

(iv) Trace Elements

The trace elements were below the permissible limit of IS: 2296 in the river water.

(v) Bacteriological Characteristics

The total coliform density in the estuarine water was observed to be in the range of 6600-240000 CFU/100 ml.

2) Ground Water Quality (5 Locations)

On perusal of the results presented in the Table 4.13.3 (i) and Table 4.13.3(ii) of **Annexure 4.13, Vol-II**, it may be inferred that the Total Dissolved Solids and Chlorides in ground water are little higher than the permissible limits in GW5 sample from Vasai in Thane District of Maharashtra. All other parameters were found within the permissible limit of the Indian Standard for the Drinking Water Quality- IS: 10500-2012. Some of the vital parameters are above permissible / desirable limits. Detailed methodology, sample locations, laboratory testing results with analysis, Exhibits and explanations are provided in **Annexure 4.13, Vol-II**.

a) Depth to Ground Water Table

The ground water table along the project corridor ranges from 0.50 mbgl (Thane) to around 58.30 mbgl (Gandhinagar). It shows that lower part (southern part of the alignment) is relatively less water stressed than as one move northward. This coincides with the rainfall amount also that reduces as one moves north ward in the project area. However, yield is higher in the unconsolidated formation *i.e.* 25 to 40 l/sec in Surat, Bharuch and Vadodara. The hilly region in Palghar gets a yield of 1 l/sec. The stage of ground water development is high in Gujarat *i.e.* 76% while that in Palghar is around 48%. Hence, though the yield is higher in the Gujarat portion of project area, due to exploitation the water table has gone down. So water extraction for construction purpose has to be done with utmost care that the confined aquifer does not get over exploited.

Table 4.13.1: Depth to Ground Water Table in the Project Area

Sl. No.	Location	Depth to Ground Water Table (in m)
1	Dadar Nagar Haveli	2.5 -7.30
2	Mumbai	3.0 -13.75
3	Thane	0.50-5.0
4	Dahanu	4.40-4.60
5	Palghar	5.0-10.0
6	Vadodara	1.20-29.51
7	Navsari	2.18-27.13
8	Vapi	3.40-10.15
9	Bharuch	0.96-18.14
10	Nadiad	1.25-34.80
11	Surat	1.0-21.67
12	Ahmedabad	0.85-24.77
13	Anand	1.65-24.26
14	Gandhinagar	11.99-58.30
15	Valsad	2.53-13.53

Source: Central Ground Water Year Book, Gujarat (2015-2016) & Maharashtra (2015)

4.14 BOTTOM SEDIMENT

Sediments form a natural buffer and filter system and often play an important role in the storage and release of nutrients in the aquatic ecosystems. During the last two centuries, heavy metals released by human activities have superimposed new pattern of metal distribution on those which are naturally occurring. A number of processes influence the sedimentary content and quality of estuary/river water. Sediments have an important role in the nutrient cycle of aquatic environment. Sediment analysis is increasingly important in evaluating qualities of the total ecosystem of a water body, in addition to the water sample analysis practiced for years. (O. K. Adeyemo *et al.* 2008).

In rivers the predominant source of bottom sediments is land runoff. Impoundments and estuaries are often characterized by heavy siltation from tributary streams. In fertile lakes and swamps, the sediment may be largely composed of decaying vegetation, *i.e.*, humus.

There are two major river basins in the study area - Narmada and Tapi Basins and both lie in Gujarat. Most of the nallahs and rivers that intersect the alignment are the tributaries of Narmada and Tapi basins except a few.

The water bodies along the proposed alignment were identified and can be broadly classified into flowing water resources (rivers, estuaries, creeks, *nallahs etc.*) and stagnant water resources (pond, lakes *etc.*).

It is necessary to know the existing geochemical characteristics of the bottom sediment of the surface water bodies as during the construction phase, foundation of the piers/well shall be constructed in the crossing rivers/estuaries which may cause some disturbance.

4.14.1 Sampling and Analysis

Bottom sediment samples were collected in zip-lock polythene bags from 13 locations (ten samples from each site) during May 2017 (pre-monsoon season). The samples were analyzed for physico-chemical and nutrient parameters and heavy metal concentration *viz*; Lead (Pb), Nickel (Ni), Copper (Cu) and Zinc (Zn) .

Results and Discussion

- The mean values of organic carbon content in the sediments varied between 0.245% at SW7 to 2.172% at SW1.
- The highest value of % organic matter was recorded as 1.025% at SW 1, whereas the lowest value of 0.543% was recorded at SW7
- pH did not show any significant variation and ranged between 6.91 at SW6 to 8.34 at SW8
- The concentration of total nitrogen varied from 0.160 mg/g (SW8) to 0.784 mg/g (SW2)
- The available phosphate content varied between 0.030 mg/g to 0.246 mg/g.
- The potassium content was minimum at SW1 *i.e.* 20.10 mg/g and maximum at SW10 *i.e.* 42.53 mg/g
- The concentration of chloride was the highest at SW3-Damanganga
- The concentration of Copper ranged between 4.6-178.2 mg/kg. The highest concentration of Cu was recorded at SW10-Tapi River
- Nickel ranged between 0.01-245.1 mg/kg

- Zinc concentration ranged from 9.8- 240.1 mg/kg. The highest value of Zn concentration was recorded at Narmada estuary near Bharuch.
- The concentration of lead was found in the range of 2.5 -156.2 mg/kg. The maximum concentration observed was 156.2 mg/kg at SW10 while the lowest concentration observed was 2.5 mg/kg at SW4 Kolak River

Since the concentration of some of the parameters is high, care shall be taken by the contractors while handling the soil near the natural water course.

The details of the locations, laboratory testing results with analysis, Exhibits and explanations are provided in **Annexure 4.14, Vol-II**.

4.15 ECOSYSTEM

4.15.1 Terrestrial Ecosystem

In this study out of 10 bio geographic zones, two viz., Semi-arid in Gujarat and Deccan Peninsula are prominently evident. Following Roy *et al* (2006), Tropical Moist Forest, Tropical Dry Forest and Tropical Thorn Woodland biomes are also evident in the area. According to the MoEFCC, the study area belongs to the 4B Semi-arid and 6A Deccan Peninsular – Central Highlands. According to Champion and Seth (1968), the area has broadly the following major groups and sub- groups of forests:

1. Moist Tropical Forest:

a) Group Tropical Semi- evergreen Forest

Sub-group C2- West Coast semi-evergreen forest-*Terminalia paniculata*;

b) Tropical Moist Deciduous Forest:

Sub-group:

i) 3B - South Indian Moist Deciduous Forest

ii) C₁ Moist Teak bearing Forest

iii) E5 *Butea* Forest – *Butea monosperma*,

iv) 8a-*Phoenix savanna* – *Phoenix sylvertris*.

c) Tropical Thorn Forest

6.7 General edaphic, degraded and seral types of moist deciduous forest.

In regard to grassland / grazing lands, the area includes tropical *Sehima* – *Dichanthium* cover and too sub-tropical covers, viz., *Dichanthium* – *Cenchrus* – *Lasiurus* and *Phragmites* – *Saccharum* – *Imparata*. Due to local variations in microclimate, topography, soil and biotic pressure a myriad and distinct or transitional communities occur within the potential area of each of these major types.

1) Flora

The flora consists of orchids of mango, amla and cashew nut. In addition of the orchids there are various kinds of non-fruit trees, bushes and grasses. Different types of trees were observed along the alignment during the field visit. These trees mainly consists of *Agle marmelos* (Bel), *Mangifera indica* (Amba), *Spondias pinnata* (Ambadi), *Emblica officinalis* (Amla), *Bridellia retusa* (Asan), *Himenodictyon obovatum* (Bhorsal), *Bauhinia lawii* (Chamel), *Anogissus latifolia* (Dhamoda), *Randia Uliainosa* (Gogda), *Anacardium occidentale* (Kaju),

Garuga pinnats (Kakad), *Madhuca indica* (Mahudo), *Ficus rumphii* (Payar), *Casuarina equisetifolia* (Saru), *Oroxylum indicum* (Tetu) and *ficus bengalensis* (Vad). The list of common Flora recorded in the project area is given in Table 4.15.12 in **Annexure 4.15, Vol-II**.

a) Sabarmati Depot

The proposed Sabarmati Depot shall be located just after the proposed Sabarmati HSR station. 90% of the area of the proposed depot shall be accommodated in the railway dump yard and 10 % on the barren land (refer Exhibit 4.15.1, google image).

Under the Koppen climate classification, the region has a hot semi-arid climate with marginally less rain than required for a tropical savanna climate. Generally, climate of this city is dry. Environmental temperature ranges from 20°C (mid Nov - end Jan) to 45°C (end May-end June), with relative humidity from 30% to 60% (except rainy season). The region receives most of its rainfall mainly from the southwest monsoon. 60.0 % of the annual rainfall occurs during the months of July and August. The average annual rainfall for the period has been 732 mm.

The site falls under Zone-4, the Semi-arid (Biotic province-4B) of bio-geographical zone of India. Main forest type is dry deciduous forests of Teak, *Anogeissus*, *Butea* and Bamboo. There are hardly any wood or forest patches within the territory of the region. The present forest wealth is restricted to roadside plantation and the plantation along the canal banks. Most of the forests are of inferior dry scrub and are not very productive. The plains are mostly devoid of forest cover.

The tree species have been identified by using The Flora of Gujarat State (Shah, 1978), The Flora of Presidency of Bombay (Cooke, 1958) and other standard books. Species were arranged as per Bentham and Hooker (1862-83) with minor modifications in conformity with Hutchison (1959) including scientific name, local name and families. The isolated scrub includes *Ziziphus*, *Pithecelobium*, *Acacia*, *Parkinsonia* and other *Xerophytic* plants. The sandy plains have a few scattered trees of *Acacia* and *Prosopis*.

The proposed Sabarmati Depot shall be established on the Railway land which is presently part of Sabarmati sock yard with redundant machineries. The proposed area is devoid of natural vegetation. However, massive plantation has been carried out by the Railways in its premises. The details of floral species reported in the railway premises and is listed in Table 4.15.1. The dominant species are *Azadirachta indica*, *Eucalyptus* and *Ficus religiosa*. On the roadside of the barren land *Xerophytic* species- *Capparis aphylla* were dominant shrubs.

No faunal species were reported in the area as it is surrounded by housing societies

Table 4.15.1: Floral Species in the Proposed Sabarmati Depot

Botanical Name	Common Name
<i>Azadirachta indica</i>	Neem (medicinal plant)
<i>Mangifera indica</i>	Mango (fruit bearing plant)
<i>Ficus religiosa</i>	Peepal (religious plant)
<i>Saraca asoca</i>	Ashoka (ornamental plant)
<i>Ficus benghalensis</i>	Bargad (religious)
<i>Eucalyptus</i>	Nilgiri (Timber value)
<i>Vachellia nilotica</i>	Babool (Thorny tree)

Botanical Name	Common Name
<i>Pongamia pinnata</i>	Karanj

Source: Study Team

Exhibit 4.15.1: Bird's Eye View of Sabarmati Depot



Source: Google Image accessed on 21/06/2018

b) Thane Depot

The proposed Thane Depot shall be established on the waste land just after Ulhas River (chainage 30+100 Km (refer Exhibit 4.15.2, google image). It shall be established on 96.296 ha. of land out of which 48.148 ha. of land has been kept for the future expansion.

area falls under-

- 3B/C1 Southern moist teak bearing forest;
- 3B/C2 Southern moist mixed deciduous forests;
- 8A/C2 Western sub-tropical hill forests.

The proposed area of Thane Depot is devoid of natural vegetation. Only some of the trees were recorded on the boundary of the land plot and mined out area. During the field visit, it was recorded that earlier mining was being done and the void created is filled up with rain water. The area has rocky strata and not suitable for the plantation. On the boundary of the plots following tree species were reported- *Pongamia pinnata* (Karanj), and very few *Azadirachta indica* (Neem).

No faunal species were reported in the area as it is surrounded by habitations.

Exhibit 4.15.2: Bird's Eye View of Thane Depot



Source: Google Image accessed on 21/06/2018

2) Mangrove

The MAHSR alignment passes through a number of mangrove patches in the urban and sub-urban area of Mumbai, Thane and Palghar in Maharashtra (refer Table 4.15.2).

Table 4.15.2: Affected Mangrove Area

Sl. No.	Chainage Start (Km)	Chainage End (Km)	Length (m)	Location	Area Affected (Ha.)	Degree of Impact	Structure
1	7245	9800	2555	Thane Creek	7.9921	None	Tunnel
2	12750	14791	2041	Kopar Khairane / Thane		None	Tunnel
3	25000	36700	11700	Mahatardi, Bharodi, Dive, Kasheli, Kalher, Kopar, Thane	17.7079	Severe	Viaduct
5	36700	41600	4900	Kewani, Kharbhav, Thane	1.6611	Severe	Viaduct
6	41600	46600	5000	Malodi, Payegaon, Paye, Thane	4.1436	Severe	Viaduct
7	71000	71900	900	Shirgaon, Ghaskopari,	0.8852	Severe	Viaduct

Sl. No.	Chainage Start (Km)	Chainage End (Km)	Length (m)	Location	Area Affected (Ha.)	Degree of Impact	Structure
				Palghar			
Total Area					32.3902		

Source: Study Team

Mangrove Society of India (MSI), Goa has been entrusted for conducting a “Study of Mangrove Ecosystem and Preparation of Management and Conservation Plan for Mangrove” with the following objectives:

- i) To carry out a detailed survey of on the mangrove density and diversity at these patches.
- ii) Management and Conservation Plan for Flamingo Sanctuary at Thane Creek in Mumbai.

The field survey was undertaken in May 2017 by the group of scientists lead by Dr A G Untawale.

The detailed report ‘Integrated Mangrove Conservation and Management Plan’ is incorporated in the **Annexure-4.15 (a), Vol-II** of the S-EIA Report. However, the excerpts and key findings of the study is described in the subsequent sections.

a) Key Findings

i) Site I–Kopar Khairane (Thane Creek)

The area has well developed mangroves representing number of unique species (Plate – I). The dominant species of this site was *Avicennia marina var. acutissima* and *A. marina var. marina*. The trees were well developed with thick girth indicating well matured trees.

The dense mangroves stretch between Kopar Khairane and Ghansoli along Thane-Vashi creek is under threat from dumping of debris, discharge of sediments and solid wastes into the creek from drains and construction activities. This has resulted into decrease in current velocity and depth in coastal waters of Thane creek and Ulhas estuary. The proposed MAHSR alignment runs through tunnel below 30 m of the bed of the creek and mangrove forest by the side of Bhagwan Parshuram Ghat Lake.

ii) Diva (Near Diva Railway Track)

The stretch had around 700 acres of verdant mangroves but half of it has been destroyed and slum colonies sprung up (Plate–II). Besides this, concrete debris has been dumped to pave way for new residential buildings. Ulhas River is more dynamic and fluvio-estuarine in nature. The surrounding is best suitable for proliferation of mangroves because of the salinity of water and tidal impact. Ulhas Estuary comprises a network of channels of various depths, mud flats, tidal marshes and isles.

Sonneratia apetala was found to be most dominant followed by *Avicennia* spp. and *Acanthus ilicifolius* that showed moderate presence. *Excoecaria agalocha* and *Aegiceras coenoculata* were poorly represented. At this site, the MAHSR alignment will cross Ulhas river on viaduct. About 116398 sq. m of mangrove area shall be cleared. Therefore, about 101266 mangrove trees shall require to be cleared with density of 87/100 m².

iii) Near Anjurphata, Kharbav, Kewani

Comparatively well-developed mangroves were seen at side of the Ulhas creek. The total length of the mangrove patch at this site is around 750 m. *Sonneratia apetala* was found to be most dominant species followed by moderate representation by *Avicennia* spp. and *Acanthus ilicifolius*. The trees were fruiting and large number of fruits was seen spread all over the places.

The area falling within the ROW of 17.5 i.e. 8.75 m each side of the center line of the alignment would be cleared all along the viaduct. About 968 m of MAHSR alignment passes through the patch of mangrove at this location. Therefore, the total mangrove area to be cleared will be 13070 sq. m. and around 7449 nos. of mangrove trees required to be cleared.

iv) Brahmangaon (Bhiwandi)

At this site there is a well-developed mangrove patch bordering the creek. *Sonneratia apetala* was found to be most dominant followed by *Avicennia marina*. The trees were quite tall and densely populated. *Sonneratia – Avicennia* association was seen at most of the places with height ranging from 10 to 15 m.

The MHASR alignment passes through the mangrove area on viaduct. The total length of the mangrove stretch at this site is 2381 m and the total area required to be cleared would be 44190 sq. m. Therefore, total mangrove trees to be cleared will be around 31375 nos. of trees.

v) Saphale, Tembhikhadave (Vairana River)

Saphale is a village in Palghar Taluka of Thane District in Maharashtra State. It belongs to Konkan region. It is located 44 km towards North from District headquarters Thane and 73 km from State capital Mumbai. The area is surrounded by industries and several power stations. The Saphale-Palghar belt also has many salt works.

The total length of mangrove patch measures around 1004 m long. In the middle of the creek there is a small semicircular island. The island has small mangrove patch towards the periphery. *Avicennia marina var marina* and *Avicennia marina var acutissima* and *Sonneratia apetala* were abundantly found at this site. *Avicennia officinalis* was found to be moderately present. The average height of the mangrove trees is 4 to 5 m. Some well grown and tall mangrove trees were seen in the middle and towards land ward side of the island. The proposed MAHSR alignment will run on viaduct and bridge across mangrove patch for which around 10662 nos. of mangrove trees will be cleared.

b) Mangrove Associates

Mangroves forest provides both hard and soft bottom habitats for variety of invertebrate life such as worms, clams, crustaceans, crabs, bivalves, sponges, juvenile fish and other tiny organisms that live in the bottom sediments. The extensive mangrove root systems, muddy bottoms and open waters are all favorable habitats to invertebrates that are well adapted to the temperature and salinity variations as well as tidal influences to mangroves. Benthic organisms play an important role in regulating and maintaining the detritus food chain of estuarine ecosystem.

i) Floral Association

Other associate mangrove species recorded from the study area were *Salvadora persica*, *Derris heterophylla*, *Sesuvium portulacastrum* etc. They were present towards the landward side. Some of these species such as *Derris heterophylla* was growing as epiphytes on the *Sonneatia apetala* and *Avicennia* spp. sometimes covering entire canopy of the plant.

The number of macrophyte (seaweed) species grows on mangrove tree trunks, pneumatophores, stilt and prop roots at water level and at the level on the trunk where moisture is available. These seaweeds form microhabitats for number of invertebrate species such as polychaete worms, amphipods, isopods, barnacles, snails, gastropods etc. who feed and breed and take shelter from predators.

ii) Faunal Association

Mangroves forest provides both hard and soft bottom habitats for variety of invertebrate life such as worms, clams, crustaceans, crabs, bivalves, sponges, juvenile fish and other tiny organisms that live in the bottom sediments. The extensive mangrove root systems, muddy bottoms and open waters are all favourable habitats to invertebrates that are well adapted to the temperature and salinity variations as well as tidal influences to mangroves. Benthic organisms play an important role in regulating and maintaining the detritus food chain of estuarine ecosystem.

iii) Wildlife

Birds are prominent part of most mangrove forests and they are often present in large numbers. The shallow waters and exposed mudflats of the mangroves offer rich feeding grounds for many of the large and more spectacular species of birds. These forests make an excellent habitat for number of bird species, from the smallest Kingfisher and Plovers to the large Heron. About 177 species of resident and migratory birds have been reported from the mangrove forests.

A large population of otters has also been reported from mangroves feeding on fishes, crabs, oysters etc. Apart from this, animals such as wild boar, monkeys, flying fox, fishing cats, civets, mongooses, monkeys (rarely), wild cats etc. frequently enter the mangroves for feeding and shelter.

3) Fauna

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

The terrestrial fauna including domestic animals is based on the field investigation and literature review. The domestic animals reported in the study area are mainly mammals and listed in **Table 4.15.13 (Refer Annexure 4.15, Vol-II)**. In absence of natural forest (National Parks and Sanctuary other than SGNP, TWLS, TCFS), there is a dearth of wild animals in the study area. A list of avifauna, reptiles, amphibians and rodents based on information

gathered from local enquiries and State Forest Department is presented in the **Table 4.15.14 of Annexure 4.15, Vol-II.**

4) Thane Creek Flamingo Sanctuary

a) Background of Thane Creek Flamingo Sanctuary

By reason of its adequate ecological, faunal, floral, geomorphological, natural and zoological significance for the purpose of protection, propagating and developing wildlife therein and its environment, the Government of Maharashtra, in exercise of the powers conferred by sub-section (1) and (2) of Section 18 and Section 18B of the Wild Life (Protection) Act, 1972 (53 of 1972), declared the northern area of Thane creek as Flamingo Bird Sanctuary in August, 2015 (No. WLP-0315/CR-76/F-1, 6th August 2015, Govt. of Maharashtra). The area also includes 896 ha of mangroves and 794 ha of adjacent water body (see Exhibit 4.15.3). The figure shows boundaries and eco sensitive zone, mangrove cover and mudflat (Adopted from Wildlife Institute of India document; Integrated Management of the Thane Creek Flamingo Sanctuary, 2016-25). The Thane Creek Flamingo Sanctuary spreads from Thane city East coastal area to Mulund East, Bhandup East, Kanjurmarg and Vikhroli East, adjacent to Deonar Dumping Ground with a small flowing river connecting this creek, Ramabai Nagar, Mandala with Jeejabai Bhosle Road Connecting the main road of Sion-Panvel Expressway (Airoli-Vashi bridge) that goes from borders of Yogayatan Port towards other side of creek which is Navi Mumbai, Vashi.

The Thane Creek attracts flamingos in large numbers every year mainly from October-November. Over 30,000 flamingos occupy the mudflats and the bordering mangroves. After May, most of them migrate to Bhuj in Gujarat for breeding, leaving a small resident population. Besides supporting a large congregation of flamingos, the area is a refuge for 200 species, many resident and migratory birds. The Thane Creek also inhabits a large diversity of avifauna as over 205 species of birds are reported from Thane Creek. The mudflats on both banks of the creek exposed during the low tide, are used as the foraging grounds by a variety of Waders. Birds like clamorous reed warbler, white-eared *Bulbul* and Little Heron are mostly seen in and around mangrove creeks and White-spotted Fantail, Greater Coucal, Cattle Egret, Little Egret, Pond Heron and Little Cormorant are commonly seen bird species in the Creek. The area is known to be important habitat for Lesser Flamingo *Phoenicopterus minor* and Greater Flamingo *Phoenicopterus roseus*. The mudflats also inhibit several other species such as Greater Spotted Eagle (*Aquila heliaca*) and Black-headed Ibis (*Threskiornis melanocephalus*). The area is heavily polluted with wastes, both the creek through several inlets. Both banks of Thane Creek supports mangrove vegetations with dominant species *Avicennia marina*, *Avicennia officinalis*, *Sonneratia apetala*, *Sonneratia alba*, *Bruguiera cylindrica*, *Aegeiceras corniculatum*, *Aleuropus lagopoides* *Excoecaria agallocha* and associate mangrove species such as *Acanthus illicifolius*, *Salvadora persica*, *Derris trifoliata* and *Sesuvium portulacastrum*.

Exhibit 4.15.3: Thane Creek Flamingo Sanctuary



Source: Courtesy Mangrove Cell, Thane

b) Key Findings

The field study commenced from June 2017 and continued till February 2018. In this section the key finding of the field study undertaken during June 2017 to February 2018 has been incorporated. The detailed report 'Study on The Faunal Components and Preparation of Management and Conservation Plan for Thane Creek Flamingo Sanctuary at Thane, Mumbai' is incorporated in the **Annexure-4.15 (b), Vol-II** of the S-EIA Report. However, the excerpts and key findings of the study is described in the subsequent sections.

The sampling covered mainly mangrove areas in Thane creeks and surrounding terrestrial areas in the suburban of thane creek. The major faunal groups focused were Protozoa, Diptera, Lepidoptera and Hymenoptera. Apart from these groups, specimens were also collected/photographed for the other fauna such as molluscs, arthropods, birds, reptiles etc. About, 36 soil and water samples were collected from mangrove and terrestrial areas to be analyzed for the presence of protozoans. In Diptera, 218 specimens were collected. In Lepidoptera, 62 specimens were collected. A total of 325 hymenopteran specimens were collected. Other faunal collections include 309 specimens which has been distributed to their respective sections for identification. Overall, 914 specimens were collected during the survey.

i) Methodology

During the present study, bird count was done using point count method using binoculars (Nikkon 10x). Bird species observed in the field were identified using standard field guides (Kazmierczak 2000; Grimmet 2013). Photographs were obtained using camera (Canon SX50/Nikkon SLR D7000) whenever and wherever possible. Due influence of monsoon, bad weather condition and poor visibility, some bird counts were not possible and therefore, only their presence were confirmed from the Thane Creek.

The near threatened species namely Painted Stork, Lesser Flamingo, Black-headed Ibis (IUCN 2015) was observed during the study period from June-July to September at Thane Creek. Of these, flamingos were counted systematically. On sighting a flamingo flock, photographs were taken using a hand-held digital camera (Nikon DX-D7000) and the flock's position was recorded using a GPS (GARMIN-GPS 72H). Where the flock was too large to be captured on one photograph, a sequence of overlapping photographs were taken to record the flock entirely for details of taking and recording total count photographs. Wherever flocks were small and possible to count, photographs were taken for evidence along with direct counts were made. The number of individuals per photograph/exposure and direct counts made in the field were added up to determine the total population of flamingos in the surveyed area.

ii) Mammals

Mammals like the Jungle Cat *Felis chaus*, Golden Jackal *Canis aureus* and Common Mongoose *Herpestes edwardsi* reported to inhabit the area (Deshmukh 1990, Kulkarni 2000). A total of 05 species of mammals belonging to 05 genera, 04 families and 02 order have so far been reported from in and around Thane Creek Flamingo Sanctuary. Of the different species of mammals reported from the area, the sighting of Golden Jackal *Canis aureus* and Common Mongoose *Herpestes edwardsi* were frequent during the field study, in all the grids.

iii) Herpetofauna

A total 42 herpetofauna have been known from in and around Thane creek and among those, 50% are common, 36% are uncommon and 14% are rare (Walmiki et al. 2012) which include threatened species like Python *molurus molurus* and *Varanus bengalensis* recorded also. During the field survey, common lizard in the shrubs and skippering frog were commonly sighted in the pond and smaller water pools. Among the geckos *Hemidactylus brooki* and *Hemidactylus flaviviridis* were commonly observed. However, except for the common species of lizards, skinks, gecko and toad, no rare species of reptiles recorded in the study area which suggest that due to urbanization and anthropogenic activities, reptilian biodiversity was low.

iv) Avifauna

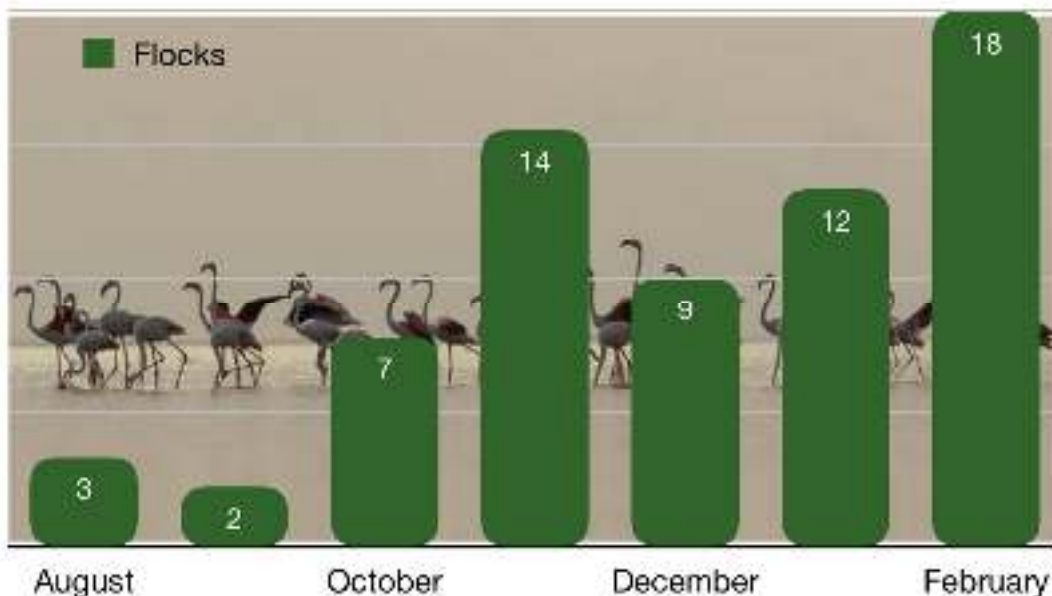
In total 125 species of birds were recorded from Thane Creek during June 2017 to February 2018, against the earlier published record of 95 species (Chaudhari-Pachpande Pejaver, 2016). The bird species were further classified as resident, migratory, and resident migratory bird species. The vegetation of the mangrove ecosystem at Thane Creek supported the population of both waders and terrestrial bird species also. A maximum diversity of bird species was reported at Bhandup (Grid-B3) as it provides a mixed habitat that includes Saltpans, grasslands, planted trees, and mangrove vegetation. Among the bird species observed, 43% of birds were observed on mudflats and 43% birds in mangrove

vegetation. This suggested that 86% of birds are dependent on mangroves and mudflats. The vegetation of mangrove ecosystem and mudflats of Thane Creek are used by waders as shelter belt, foraging, roosting and other purposes during spring migration.

Nevertheless, majority of bird species dominated in the area are flamingos with 90 per cent of the population consists of Lesser Flamingos (*Phoenicopterus minor*) and the remaining 10 per cent are Greater Flamingo (*Phoenicopterus roseus*). Other than the flamingos, the mangrove ecosystem of Thane Creek invariable supporting good population of Waders and terrestrial bird species observed all along the intertidal area. Therefore, the population estimation of Lesser Flamingos and Waders were carried out systematically, during the field visits.

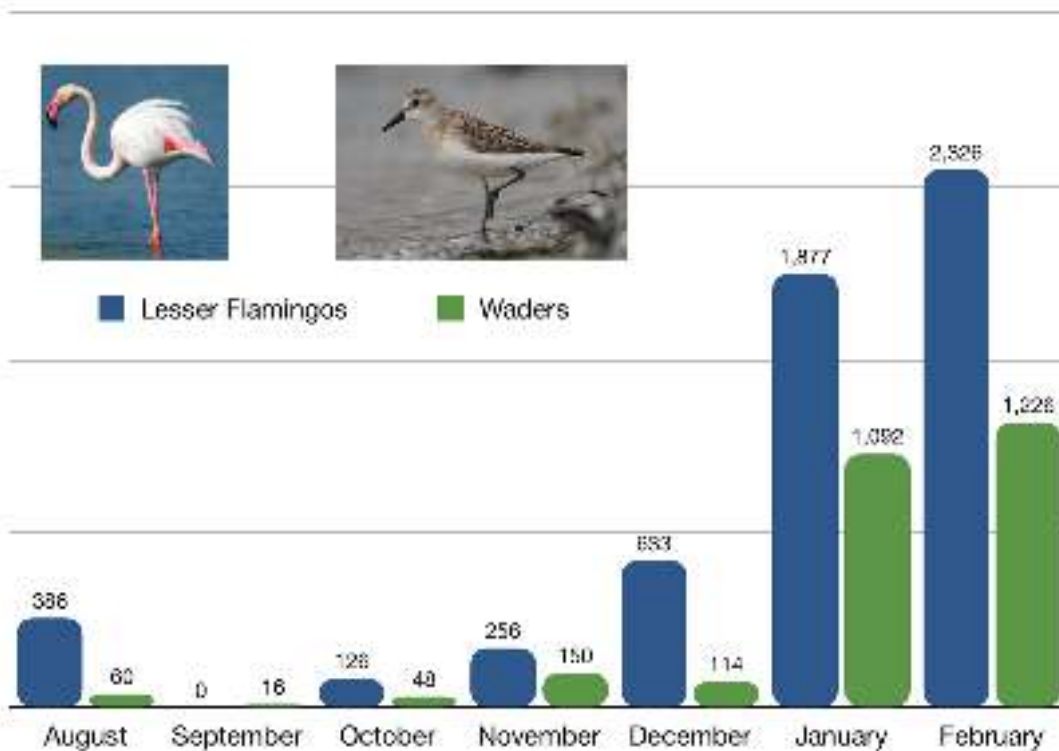
From photographs taken from the fixed geo-coordinate points along the western banks and eastern banks of Thane Creek, ~5500 Lesser Flamingos were counted and from direct counts of 65 flocks, with average of ~ 290 individuals were recorded/flock. Therefore the total population of Lesser Flamingos from aerial photographs and direct counts between June 2018 and February 2018 estimated to be around ~ 18,000 individuals in the stretch of 9 km intertidal mudflat of Thane creek. Distribution pattern Most of the Lesser Flamingos counted were concentrated in the northern and north-western parts of the Creek. Small numbers of individuals were counted in the southern and south eastern part also. The flamingos and waders were equally in large number during January and February 2018 [refer Exhibit 4.15.4 (a) and Exhibit 4.15.4 (b)].

Exhibit 4.15.4 (a): Result of Flamingo Flock Counting



* Count for Flamingo average of whole month observation and exclude juveniles
Survey period: August 2017- February 2018

Exhibit 4.15.4 (b): Result of Flamingo & Wader Counting



* Count for Flamingo average of whole month observation and exclude juveniles
Survey Period: August 2017- February 2018

During the survey in and around the Thane creek, the maximum diversity of bird was reported from Bhandup Pumping Station, probably due to existing of saltpan, grassland, smaller water pools and mangroves which are ideal sites for feeding and rooting of birds. Bird species viz. Eurasean Collared Dove, Red-headed Bunting, White Stork were also reported from Bhandup. The near threatened species namely Painted Stork and Black-headed Ibis were observed during the survey in more than one grids, which suggests the area to be good feeding and roosting ground for migratory and resident birds.

v) Conservation and Management Plan for Thane Creek Flamingo Sanctuary

Keeping in view the magnitude and intensity of anticipated impacts due to construction and operation of Mumbai-Ahmedabad High Speed Railway Project, the specific conservation plan is presented below.

- Monitoring on flamingos and other migratory birds of Thane Creek should be given top priority; especially ecological aspects such as habitat requirement, habitat suitability, migratory corridors, feeding and breeding behaviours etc. and for this, funding should be available.
- Dedicated administrative and scientific staff required for monitoring as well as associating with scientific research and monitoring of specific taxon, events and status by professional scientific agencies.
- Regarding public awareness, there is already exist one Coastal and Marine Biodiversity Centre by the Mangrove Cell of Maharashtra Forest Department, Govt. of India. Such interpretation facilities should be utilized for outreach materials and regular awareness programme, for habitants of nearby Thane Creek resident.

- The management plan for Thane Creek Flamingo Sanctuary need to be reviewed at a time interval of every five years through a review committee, for further suggestions and improvement for better conservation and management.

4.15.2 Forest Land Diversion

Based on the Land Acquisition Plan (LAP), about 1415.75 ha. of land shall be acquired for the project. Out of this, 132.2235 ha. of forest land comprising Protected Forest, Reserved Forest and un-scheduled forest, shall be diverted including the mangrove forest (Reserved Forest) of 32.3902 ha. in the state of Maharashtra. The forest land of Maharashtra falls in Thane, Dahanu Division and Mangrove Cell, Thane under Thane Forest Circle. The proposal for forest clearance has been submitted as the Proposal No. FP/MH/RAIL/31785/2018 for the forest land falling in Maharashtra. The forest proposal for the diversion of forest land of 6.1034 ha. has been submitted vide proposal No. FP/GJ/RAIL/33381/2018.

4.15.3 Aquatic Ecology

There are a number of rivers/nallahs/estuaries; small *nallahs* (rivulets) and ponds which cross the MAHSR alignment and represent the natural water aquatic ecosystems in the study area. Aquatic ecosystems provide home to many species including phyto-planktons, zooplanktons, aquatic plants, insects, molluscs, etc. They are organized at many levels from smallest building blocks of life to complete ecosystems, encompassing communities, populations, species and genetic levels. All aquatic ecosystems are generally colonized by the representatives of Arthropoda and Mollusca. Benthic invertebrates occupy the bottom of the water body. The functional role of benthic communities in the trophic dynamics of river ecosystem is well-acknowledged. The composition and distribution of benthic organisms over a period of time provide index of health of an ecosystem.

The finding of the study on phytoplanktons, macrophytes, itchthyofauna, microbenthos etc. has been discussed in detail in **Annexure 4.15 (c), Vol-II**.

Conclusions

- In general, the area around the proposed alignment in the Mumbai region harbours moderate diversity of marine organisms including the Phyto and zooplankton, algae, higher plants, mangroves and faunal groups such as benthic organisms, macrofaunal with the avian richness.
- The water is mesotrophic and shows signs of pollution especially in the Ulhas river.
- The fish catch is low near the shore, which increases towards mouth of the sea with increase in depth.
- In the Gujarat mainland region, the water seems to be free from pollution except the river Sabarmati in Ahmedabad and Ghadvi.

4.16 PROTECTED AREAS

The MAHSR alignment can be divided into two segments in accordance with the ecological characteristics of the region. The first stretch falling in Maharashtra shows rich diversity comprising of Sanjay Gandhi National Park (SGNP), Dahanu Taluka-Ecologically Fragile Area (DTEFA), Tungareshwar Wildlife Sanctuary (TWLS), Thane Creek Flamingo Sanctuary (TCFS), forests, creek, mangroves whereas, the stretch falling in Gujarat region comprises of mainly agricultural land with flat topography.

Most of the land in the study area (Zone of Influence) is used for agriculture and horticultural practices. The MAHSR alignment in Maharashtra passes through ESA's of (i) SGNP, Borivalli, Mumbai, (ii) TWLS, Thane, and core zone of (iii) Thane Creek Flamingo Sanctuary, Thane. The MAHSR alignment also passes through the ecologically fragile area of Dahanu Taluka. The details of the legislation and its applicability to MHSR project is described in the subsequent section. The map showing the MAHSR alignment and the notified eco-sensitive area are shown in Exhibit 4.16.1 of **Annexure 4.16, Vol-II** and the list along with chainage is presented in Table 4.16.1.

Table 4.16.1: Details of the Protected Areas falling under MAHSR Alignment

Segment No.	Chainage -Start	Chainage -End	Length (Km)	Location	Viaduct /Tunnel
1	0+000	32+200	32.200	ESZ-TCFS	Tunnel
2	9+428	11+750	2.322	Thane Creek Flamingo Sanctuary-Core Zone- Thane Creek, Maharashtra	Tunnel
3	49+106	51+764	2.658	SGNP-ESZ, Borivalli, Naigaon East, Thane	Viaduct
4	31+781	74+891	43.110	Tungareshwar Wildlife Sanctuary-ESZ	Viaduct
Total Length			80.290		

Source: Study Team

Proposal for securing Wildlife Clearance from the Standing Committee of National Board of Wildlife has been submitted vide proposal No. FP/MH/RAIL/31785/2018. The proposal has been scrutinized and accepted by the MoEFCC. The hard copies have been submitted on 29th June, 2018 and 4th July, 2018.

The SGNP and TWLS are located side by side and in some stretch there is common ESZ boundary. Both SGNP and TWLS are under the jurisdiction of CCF (Director), SGNP, Borivalli. The conservation plan for both SGNP and TWLS are common and discussed in subsequent section. More detailed discussion has been presented in **Annexure 4.16, Vol-II** along with maps and exhibits.

4.16.1 Dahanu Taluka Ecologically Fragile Area

Dahanu Taluka of Palghar District was declared as an ecologically fragile area by the Ministry of Environment and Forest (now MoEFCC) vide clause (v) of Sub-section (2) of Section 3 of the Environment (Protection) Act, 1986 on 24th June 1991 and imposed restriction on setting up of industries which have detrimental effect on the environment.

The industries have been classified under Green, Orange and Red categories as per the notification while railway project is not included in any categories of the above mentioned notification of MoEFCC. In exercise of the powers conferred by sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government constituted an authority known as the Dahanu Taluka Protection Authority (DTEPA), in the District of Thane (now part of Palghar District) vide its Gazette Notification No. S.O. 884 (E) dated 19th December, 1996.

No endangered species in the project corridor over Dahanu Taluka was reported during the study period.

4.17 SENSITIVE LOCATIONS

Apart from the protected areas, the MAHSR alignment also intersects number of sensitive locations like temples, mosque, Eidgah, churches, educational institutions, hospitals *etc.* During the construction phase care shall be taken to avoid any damage to these structures. The pier locations shall be judiciously shifted, if warranted. A comprehensive list of the sensitive locations has been prepared and presented in Table 4.17.1 of **Annexure 4.17, Vol-II**.

4.18 PROTECTED MONUMENTS/SITES

There are no archaeologically / historically important monuments or sites within the RoW of the MAHSR alignment. During field survey and on perusal of records of Archaeological Survey of India, it has been observed that eight heritage sites fall within 500 m of the MAHSR alignment. Out of these, two sites-Sidi Bashir Mosque - (Jhulta Minar) Nr. Kalupur Railway Station Road, Sakar Bazar, Kalupur, Sakar Bazaar, Kalupur, Ahmedabad about 138 m on the LHS of MAHSR alignment and another Historic Site S. No. 431,435 near Natraj township, Vadodara about 125 m on the RHS of MAHSR alignment are within the zone of influence. Necessary permission shall be obtained before commencement of construction activities at these locations from Archaeological Survey of India as per the provisions of Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Rules, 1959.

4.19 CHILD'S RIGHT

1) Introduction

The Indian constitution accords special status to children as citizens of the country, and in keeping with their special status the legislature has enacted special laws. The Directive Principles of State Policy articulate social and economic rights that have been declared to be "fundamental in the governance of the country and the duty of the state to apply in making laws" (Article 37).

Under the Indian Majority Act, 1875 the age of majority is 18 years and in case of a minor where a guardian is appointed the age of majority is 21 years. Under the Child Labour (Prohibition and Regulations) Act, 1986, child means a person who has not completed his fourteenth year of age. Under the Child Marriage Restraint Act, 1926, child means a person who, if a male, has not completed 21 years of age and, if a female, has not completed 18 years of age. Indian Contracts Act, 1872 prohibits entering into a contract with a minor.

Constitutional Guarantees that are meant specifically for children include:

- Right to free and compulsory elementary education for all children in the 6-14 year age group (Article 21 A);
- Right to be protected from any hazardous employment till the age of 14 years (Article 24);
- Right to be protected from being abused and forced by economic necessity to enter occupations unsuited to their age or strength [Article 39(e)];

- Right to equal opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and guaranteed protection of childhood and youth against exploitation and against moral and material abandonment [Article 39 (f)].
- Right to early childhood care and education to all children until they complete the age of six years (Article 45)

Table 4.19.1 lists key Acts for the welfare and protection of Children

Table 4.19.1: Special Acts for Children

Sl.No.	Act
1	The Child Labour (Prohibition and Regulation), 1986
2	The Protection of Children from Sexual Offences Act, 2012
3	The Right of Children to Free and Compulsory Education Act, 2009
4	The Juvenile Justice (Care and Protection of Children) Act, 2015
5	The Commission for Protection of Child Right Act 2005.
6	The Prohibition of Child Marriage Act, 2006
7	The Child Marriage Restraint Act,1929
8	The Orphanages and Other Charitable Homes (Supervision and Control) Act, 1960
9	The Immoral Traffic Prevention Act, 1956

Source: Study Team

The Parliament has enacted The Commissions for Protection of Child Rights Act, 2005 whereby a National Commission and State Commissions have been set up, with powers to inquire into alleged violations of child rights and recommend initiation of proceedings. The States of Gujarat and Maharashtra have established said Commissions.

2) Applicability to the MAHSR Project

1. **Child Labour** – NHRCL shall ensure that no Child Labour is engaged during the construction as well as operation stage of the project. While awarding the contract for construction, a special condition shall be stipulated and undertaking shall be obtained from the contractors regarding non-deployment of child labour.
2. **Protection from Sexual offences, neglect and abuse:** NHRCL and the Contractor shall be responsible for ensuring that the children of construction workers and employees are provided a safe environment at project sites to protect from abuse, neglect and sexual predators.
3. **Child Marriage:** It is quite common in lower socio-economic strata. NHRCL and the Contractor shall be responsible for promptly notifying the Police and the district administration upon receipt of any information, knowledge or suspicion of any child marriage at the project sites.
4. **Child Trafficking:** NHRCL and the Contractor shall be responsible for promptly notifying the Police and the district administration upon receipt of any information, knowledge or suspicion of any child trafficking activity at the project sites.

4.20 INDIGENOUS PEOPLE/ETHNIC COMMUNITY

Table 4.20.2 of **Annexure 4.20, Vol-II** provides the list of Scheduled Castes and Scheduled Tribes present in the Study Area as per the Census 2011.

The total Schedule Caste (SC) population in the study area is 3,129,030 (5.98% of the total population of the study area) comprising 1,620,602 males and 1,508,428 females. The highest SC population was recorded as 645,107 in Thane urban area followed by 640,981 in Ahmedabad urban area as per the Census 2011. The lowest SC population is 17,348 in Navsari rural area

The Schedule Tribes (ST) comprises 12.58% (6,585,506) of the total population of the study area with 3,326,853 males and 3,258,653 females. The highest ST population is in Thane Rural area at 1,265,162 followed by 1,040,599 in Vadodara rural area. The ST population is lowest in Anand urban area at 9,884. The ST population is higher in the rural areas as compared to urban.

The MAHSR alignment passes through several tribal villages in Palghar, Thane and Valsad districts. Land acquisition may adversely affect their domestic and agricultural land holding. Special attention is required to be paid during the land acquisition.

4.21 SOCIO-ECONOMIC PROFILE OF THE STUDY AREA (ZONE OF INFLUENCE)

This section presents the socio-economic profile of the study area with respect to indicators like - population trends, sex ratio, occupational pattern *etc.*, The socio-economic data used in the section are derived from various sources, including the published data of Census of India, District Census Handbook, electronic media and published reports/journals.

The analysis includes a review of the Feasibility Report of the proposed MAHSR, which included early community involvement in the project (including outreach to minority and low-income populations), station design workshops, and the maintained connectivity of pedestrian, bicycle, and vehicle crossings of the rail corridor to maintain neighbourhood and community integrity.

A detailed socio-economic survey and analysis of the project affected areas has been carried out and addressed in the RAP document prepared by NHRCL.

1) Study Area

For population and household characteristics, including minority populations, census data was analysed for the study area. Because of the sparse population in rural areas, especially in Gujarat, some villages encompass very large areas of land that often extend for miles beyond the study area. This was done by reviewing Google Earth imagery and respective Toposheets of Survey of India to determine the presence of habitations within the study area followed by site visits during September 2014-November 2014 at the F/S Stage and again from May 2017 onwards during the Detailed Design Stage of the project. There are twelve proposed stations in the entire alignment of MAHSR. The most of the stations are located in the outskirts of the urban conglomerate. The list of the villages and cities falling in the Zone of Influence is enumerated in Table 4.21.1 of **Annexure 4.21, Vol-II**.

2) Population

As per Census 2011, the total population of the districts in ZOI stood at 45,131,455. The population growth shows downward trend during 2001-2011 as compared to 1991-2001. The population growth in the Mumbai district stood at 5.14% during 1991-2001 at 5.75% during 2001-2011. The population growth in Mumbai city has decreased from 27.9% during 1991-2001 to 8.01% during 2001-2011.

3) Gender

The sex ratio in general shows positive trend except Surat. As per Census 2001, it stood at 810 females per 1000 males which reduced to 788 in 2011. Mumbai has recorded growth in sex ratio from 822 in 2001 to 857 in 2011 representing 4.26% increase in the sex ratio.

4) Population Density

Table 4.21.2 of **Annexure 4.21, Vol-II** provides that there has been phenomenal growth in the population and its density. The highest population density is in Mumbai suburban area at 20,925 per sq. km. (Census 2011) increasing from 19,373.1 per sq. km in 2001. However, the rural area of Mumbai district shows downward trend with 20038 per sq. km. in 2011, compared to 21261.3 per sq. km in 2001. The trend is reflective of migration to the cities from rural areas. The lowest population density was recorded in Bharuch district of Gujarat at 238 per sq. km (Census 2011) as compared to 210 per sq. km. (Census 2001).

5) Occupational Pattern of the Study Area

Table 4.21.3 of **Annexure 4.21, Vol-II** shows the status of occupational pattern of people in the ZOI based on the Census 2011. The population of main workers in the ZOI stands at 18,465,302 (35.29 per cent of the total population) comprising of male – 15,024,665 and female – 3,440,637 respectively. The population of main workers is highest in Mumbai suburban at 93,515,922 followed by Thane urban at 3,045,058. The lowest population of main workers is seen at Navsari -144,902.

The population of marginal workers (which work for 3 to 6 months in a year) stood at 2,412,238 (4.61% of the total population). The highest population is seen at Panch Mahals at 379,808 (0.73% of the total population). This is because of the rural character of the district.

The population of non-workers in the study area stands at 31,140,831 (59.50% of the total population) comprising male – 11,595,194 and female – 19,545,637. The number of female non workers being higher indicates that most are assigned to household duties. It is surprising to note that the population of non-workers in Mumbai suburban is highest at 5,621,941 (10.74% of the total population) comprising male – 2,087,001 and female- 3,534,940 followed by Thane at 5,191,640 (9.92% of the total population) comprising male – 1,931,237 and female – 3,260,403. During the construction of the MAHSR the non workers can be engaged suitably.

4.22 HEALTH CARE FACILITIES

1) Importance of Health

Health is defined by the World Health Organization (WHO) as "a state of complete physical, mental, social and spiritual well-being and not merely absence of disease or infirmity." This declaration gave the call of "Health for All by 2000 AD" and accepted that primary health

care was the key to attaining this goal. Health is a fundamental right under Article 21 of the Indian Constitution and under Article 47 the State is committed to raise the level of nutrition and the standard of living and to improve public health as the Directive Principle of State policy.

2) Maharashtra

Maharashtra has a three-tier public health system, providing Primary care through Primary Health Centres (PHCs), sub-centres (SCs) and Rural hospitals/ Cottage hospitals, Secondary care through Sub District hospitals & District hospitals and tertiary care through multi-speciality hospitals and medical colleges located in urban areas. A broad overview of the public healthcare delivery system is given in the following section with a focus on time trends as well as regional inequities.

Despite its impressive overall health infrastructure as shown in the Table 4.22.1, rural – urban disparities as shown in Exhibit 4.22.2 impacts access to healthcare. Most public as well as private hospitals are in the cities and while the urban hospitals are also used in significant numbers by those living in villages, various adversities that they face in accessing these healthcare facilities cannot be ignored. The graph shows that in 1991 urban areas had 8 times more hospitals and 13 times more beds than rural areas but in 2005 this disparity worsened to 13 and 19 times, respectively (SATHI 2008).

Table 4.22.1: Public health services provided by the State Government (2010)

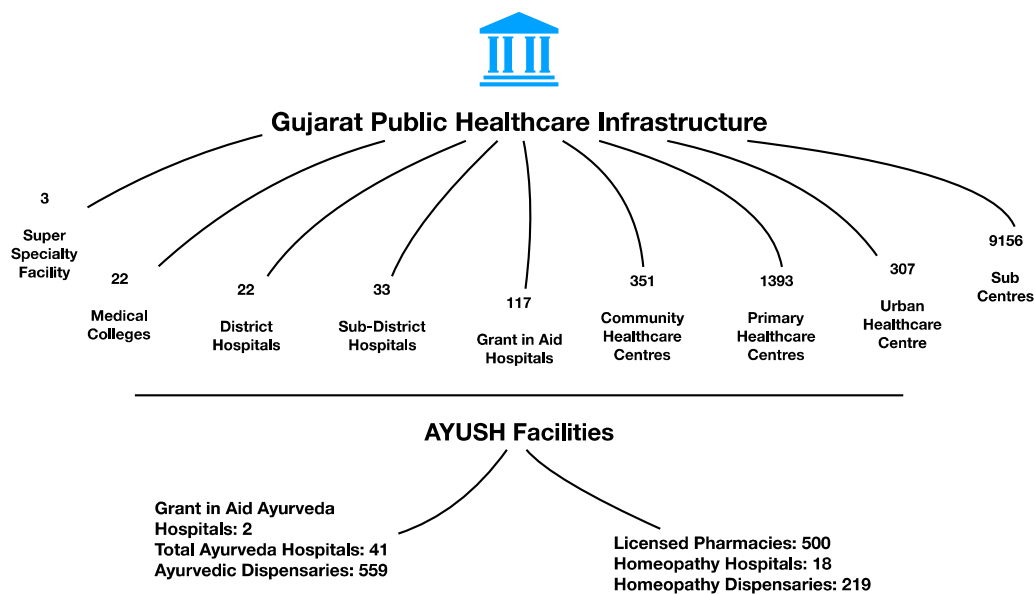
Type of institution	No. from ESM
State level Hospitals	498
District Hospitals	23
Sub District Hospitals with capacity of	
a) 50 beds	56
b) 100 beds	23
c) 200 beds	3
Community Health Centres	458
Rural Hospitals /Cottage Hospitals	386
Primary Health Centres	1816
Sub Centres	10580
Primary Health Units	172
Mobile Health Units	61
Women Hospitals	8
Mental Hospitals	4
Dental Hospitals	3
TB Hospitals	5

Source: Directorate of Health Services cited in ESM 2010-11

3) Gujarat

The public health infrastructure of Gujarat is shown in exhibit 4.22.1

Exhibit 4.22.1: Public Health Infrastructure in Gujarat



istics.

Table 4.22.2: Health Indicators of Gujarat

Indicators	2001	Current Level
Maternal Mortality Ratio(MMR) (Per lakh live births)	202 (SRS:1991-01)	112 (SRS:2011-13)
Infant Mortality Rate (IMR) (Per '000 live births)	60	35 (SRS:2014)
Under 5 Years -Mortality Rate (Per 1000 live births)	79	45 (SRS:2013)
Crude Birth Rate (CBR) (Per 1000 population)	24.9	20.6 (SRS:2014)
Crude Death Rate (CDR) (Per 1000 population)	7.8	6.2 (SRS:2014)
Total Fertility Rate (TFR)	2.9	2.3 (SRS:2013)
Life Expectancy at Birth (%)		
	Male 62.3 (1997-01)	66 (2009-13)
	Female 64.2(1997-01)	70.5 (2009-13)

Source: <https://vibrantgujarat.com/writereaddata/images/pdf/healthcare-sector.pdf>

4) Conclusion

During the construction phase, a large workforce will be deployed along the alignment. The construction period is assumed to be 4 years. A construction camp/housing camp for the workers is tentatively planned at every 25 km along the alignment. There will be necessity of providing health care facilities to the workforce including emergency care. Regular health checkup of the deployed workforce shall be undertaken to see any degradation in health. This facility can be provided through the construction contractors.

During the operation phase, the stations, trains and the maintenance depots shall be equipped with health care facility of appropriate level.

4.23 EDUCATION AND LITERACY

1) Maharashtra

The districts of Maharashtra through which MAHSR alignment passes (Mumbai Sub-urban, Thane & Palghar) have well developed educational infrastructure (Ref. Table 4.23.1 in *Annexure-4.23, Vol-II*).

Maharashtra has 24 universities with a turnout of 1,60,000 Graduates every year. The University of Mumbai is the largest university in the world in terms of the number of graduates and has 141 affiliated colleges.

2) Gujarat

Gujarat ranks 9th on the Education Development Index (EDI), it points to a compelling need for making intensive efforts to bring about a change in the status of education in the state.

The districts of Gujarat through which MAHSR alignment passes have well developed educational infrastructure (Ref. Table 4.23.2 in *Annexure 4.23, Vol-II*).

3) Literacy Rate in the Zone of Influence (ZOI)

Table 4.23.3 in *Annexure 4.23, Vol-II* shows the status of literacy rate in the ZOI. It is evident from the table that there has been phenomenal growth in the literacy rate both in urban and rural areas of the ZOI during the last decade 2001-2011.

In the Maharashtra region, the highest literacy rate was recorded in Mumbai suburban areas as 90.9 % as per the Census 2011 compared to 86.89 % as per the Census 2001. The male literacy rate was highest in Mumbai, at 94.28% in 2011 against 91.56% in 2001. Amongst the females, the highest literacy rate was recorded in Mumbai suburban at 86.93% in 2011 against 81.12% in 2001. It can be concluded that the literacy rate in the study area is excellent in the urban areas whereas same in rural area is moderate. However, trend in literacy rate shows upward surge over the decade.

In Gujarat region, the highest literacy rate is seen in Ahmedabad and Surat (86.65 %) in 2011 followed by Anand (85.79 %). The male literacy rate was the highest in Kheda (93.40 %) followed by Anand (93.23 %), whereas the literacy rate amongst female was highest in Surat (81.02 %) followed by Ahmedabad (80.29 %).

4.24 HUMAN IMMUNODEFICIENCY VIRUS (HIV)/ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS)

1) Current Status of HIV / AIDS in Maharashtra & Gujarat

The current status of HIV epidemic based upon the NACO HIV Estimation 2015 report for the States of Gujarat and Maharashtra is summarized in Table 4.24.1.

Table 4.24.1: Status of HIV/AIDS Epidemics in Maharashtra and Gujarat

	Adult HIV Prevalence (National Average- 0.26%)	People Living With HIV (PLHIV)	Annual New HIV Infections
Maharashtra	>0.26%	3.01 Lakh	3000-4000
Gujarat	0.42%	1.66 Lakh	>7500

Source: NACO HIV Estimation 2015

- I. Gujarat has one of the highest Adult HIV prevalence rate in India at 0.42%. It means that 0.42% of the population in the age group of 15-49 years is HIV positive. The HIV estimation report 2015 does not provide exact adult prevalence rate for the State of Maharashtra but only that it is higher than the national average of 0.26%. The adult HIV prevalence rate is showing a declining trend in Maharashtra and is stable in Gujarat.
- II. Both the States have heavy presence of PLHIV's. Of the total number of 21.1 Lakh PLHIV's in India, Gujarat has 1.66 lakh and Maharashtra has 3.01 Lakh PLHIV's. Together they constitute 22.1% of total PLHIV's in India.
- III. The State of Gujarat is one of the 4 States currently having highest new infection rates. The number of new annual infections is in excess of 7500 while the corresponding number for Maharashtra stands at 3000-4000.

2) Conclusions

The proposed MAHSR project shall attract large number of people during the construction and operation phase. The highest risk of HIV transmission is apprehended during the construction phase. The construction phase is expected to bring groups with high prevalence of HIV infection *e.g.* Long route truck drivers, commercial sex workers *etc.* in direct contact with groups at high risk of vulnerability of HIV infection *e.g.* single migrant male. Injectable drug users and Men who have sex with Men (MSM) are also expected to be present in large numbers.

The project developers are advised to make provisions for the prevention of HIV transmission amongst the workers and for treatment to PLHIV's. A few of the recommendations are:

- Easy availability of Personal protection devices like condoms and diaphragms;
- Sustained ICE activities and counseling mechanism;
- Regular home visit holidays;
- Collaboration with local police to curb the sale and use of Narcotics.

The project developers are also advised to act in consonance with the new HIV / AIDS Prevention and Control) Act, 2014 with regards to employment, termination of employment, access to health care, housing, access to other facilities *etc.*

4.25 WASTE GENERATION AND MANAGEMENT

1) Construction Waste

Construction and operation of the MAHSR project would involve the use, storage, generation and disposal of hazardous materials and wastes in the study area. The construction waste expected to be generated includes asphalt or concrete chunks, surplus soil, construction

scrap materials and others. Although the amount and percent composition of construction waste is not clear at this stage, surplus soil is planned to be reused as much as possible in construction of the MAHSR embankment and maintenance road. In addition, all other construction waste is also planned to comply with relevant Centre or State laws pertaining to the waste management.

According to JICA's Guideline and NHRCL's Environmental Policy, concept of waste utilization will be promoted by encouraging recycling and reuse. The project, therefore, will inbuilt such measures to reduce overall volume of waste generated. In principle, most of metal scrap and other saleable wastes are received by authorized dealers. However, concrete and masonry wastes which constitute a major part of construction wastes are currently not recycled.

The contractors shall comply with the guidelines issued by the NHRCL as a part of the contract for safe handling and management of waste. All the construction and demolition waste shall be handled as per the provision of the Construction and Demolition Waste Rules, 2016.

MAHSR Study team recommended a tunnel inner void space of 80 m² including a margin. The longest tunnel in the MAHSR is from BKC to Shilphata with a length of about 20.375 km. Based on the geological formation of the region, the area is underlain by basaltic rocks. Therefore, during the construction of the tunnel, the waste shall be generated in the form of rocks only. These rocks shall be used in the construction after crushing to the desired size. The rocks of the tunnel shall be stored at designated location with easy access as per the authority approval. The soil/debris generated during the cutting, shall be used for maintenance road along the MAHSR alignment. NHRCL is also looking for other avenues of reuse of the construction waste like DFC, road construction (NHAI) and other agencies.

2) Municipal Waste

The proposed Stations and Maintenance Depots shall be located in the cities and in some cases on the outskirts of the cities. The municipal waste generated shall be handled as per the Solid Wastes Management Rules, 2016.

3) Existing Land Fill Site

During the field survey existing land fill site were recorded or information collected from the local authorities. The list of land fill site in the vicinity of the corridor or in the project district/towns are presented in Table 4.25.7 and shown in Exhibit 4.25.1 (refer **Annexure 4.25, Vol-II**).

4.26 OFFENSIVE ODOUR

An odour is perceived when chemicals in gaseous form stimulate the human olfactory system present in the nose. The human nose has hundreds of receptors, each coded by for by unique DNA to detect different odors, and therefore, accounting for why different people have different sensitivity and reactions to smell. Reactions to odors can be very subjective thus making objective assessment of odour difficult.

In other words it can further be defined as the "perception of smell" or in scientific terms as "a sensation resulting from the reception of stimulus by the olfactory sensory

system". Whether pleasant or unpleasant, odour is induced by inhaling air-borne volatile organic or inorganic chemicals.

With growing population, industrialization and urbanization, the odour problem has been assuming objectionable proportion. Urbanization without proper sanitation facilities is a major cause of odour problem. Rapidly growing industrialization has aggravated the problem through odorous industrial operations. Odour contributes to air quality concerns and affects human lifestyle. Odour is undoubtedly the most complex of all the air pollution problems.

During field survey of environmental attributes, offensive odour problem was not encountered at any location along the proposed MAHSR alignment. The existing dumping sites/land fill sites located in the nearby urban areas are far off from the proposed alignment. The solid waste disposal sites/landfills, which are the major source of offensive odour, are not located in the ZOI of the proposed MAHSR alignment. Cleanliness shall be maintained at construction sites during the construction phase and at the proposed stations, maintenance depots during the operation phase to avoid any foul odour.

The common effects of odour, odorous industrial compounds, sources of odour, odour index of common odorous compounds are provided in **Annexure 4.26, Vol-II**.

4.27 OCCURRENCE OF ACCIDENTS

Most train accidents in India are due to unmanned level crossing, derailments and human error in train operations. Traffic accident mortality rate in India is 10.9 per 100,000 populations and is relatively high compared to developed countries. In 2014-15, about 40% of the accidents occurred at Unmanned Level Crossing (UMLC) and 28% in 2015-16. In 2013-14, 4624 people were killed in train accidents. The number of rail accidents has declined from 325 in 2003-04 to 106 in 2015-16. In 2015-16, 60% of the accidents were caused by derailments and 33% by accidents at level crossings.

Since independence, the railways' route kilometres have increased by 23% while the passenger and freight traffic has increased by 1,344% and 1,642% respectively suggesting severe congestion.

1) High Speed Train Accidents Worldwide

High-speed rail is one of the safest modes of transportation. Notable major accidents involving high-speed trains include the following.

a) The 1998 Eschede Accident

In 1998, after over thirty years of high-speed rail operations worldwide without fatal accidents, the Eschede accident occurred in Germany: a poorly designed ICE 1 wheel broke at 200 km/h (124 mph) near Eschede, resulting in the derailment and destruction of almost the entire full set of 16 cars and the subsequent death toll of 101 people.

b) The 2011 Wenzhou Accident

On 23 July 2011, a Chinese CRH2 traveling at 100 km/h (62 mph) collided with a CRH1 which was stopped on a viaduct in the suburbs of Wenzhou, Zhejiang province, China. The two

trains derailed, and four cars fell off the viaduct. 40 people were killed, at least 192 were injured, 12 of which were severe injuries.

The disaster led to a number of changes in management and exploitation of high-speed rail in China. Despite the fact that high speed was not a factor in the accident, one of the major changes was the lowering by 50 km/h (31 mph) of all maximum speeds in China HST, 350 km/h (217 mph) becoming 300, 250 km/h (155 mph) becoming 200, and 200 km/h (124 mph) becoming 160.

c) The 2013 Santiago de Compostable accident

On 23 July 2011, two high-speed trains travelling on the Yongtaiwen railway line collided on a viaduct in the suburbs of Wenzhou, Zhejiang province, China. The two trains derailed each other, and four cars fell off the viaduct. 40 people were killed, at least 192 were injured, 12 of which were severe injuries. Officials responded to the accident by hastily concluding rescue operations and ordering the burial of the derailed cars. These actions elicited strong criticism from Chinese media and online communities. In response, the government issued directives to restrict media coverage, which was met with limited compliance, even on state-owned networks.

2) Causes of train accidents on High Speed Lines

- Aerodynamic fairing lost due to incorrect maintenance that broke a window and injured a passenger;
- Strikes of animals on the track;
- Fires in compartments or power units;
- Passengers may open the door at cruising speed;
- Instance of concrete placed on the track.

3) Proposed MAHSR

The MAHSR project which employ the Shinkansen E5 Series with a proven safety track record on the operational route in Japan. No accident has been reported from the Shinkansen E5 Series since its inception.

Chapter 5
**Anticipated Environmental Impacts
and Mitigation Measures**

Anticipated Environmental Impacts and Mitigation Measures

5.0 INTRODUCTION

As described in the previous chapters, the alignment of the MAHSR project is passing through various types of land-use such as forest, protected areas, coastal areas, agricultural areas and human settlements (urban – commercial / residential). Therefore, it is expected that the proposed project will have certain adverse impacts across these sensitive receptors.

This chapter presents the outcome of the assessment of potential impacts of the proposed project on the natural environment in the corridor of influence, due to the design, construction and operation of the MAHSR project. The environmental impacts have been evaluated on severity, scale, reversibility and temporal basis. Accordingly, mitigation measures have been identified to avoid, minimize, control and manage the key environmental impacts.

While most impacts (related to construction phase) are common in and around the project area and easily and commonly mitigated, some impacts are expected to be irreversible and long term and some of them are unprecedented in India. Such impacts required a careful examination and separate studies to understand their full impact. Since the project alignment is passing through Forest, Wildlife, ecologically fragile and CRZ areas, which are home to a variety of flora and fauna, impacts relating to biodiversity are also significant and hence have been carefully assessed.

A number of families and institutions (schools, temples and mosques, etc.) will also have to be displaced and rehabilitated where the alignment is passing through or over part of their properties. The social impacts have been assessed in detail by specific locations and mitigation measures have been identified in the separate Rehabilitation Action Plan (RAP) and Social Impact Assessment (SIA) reports.

The proposed project is also expected to influence major positive impacts and benefits such as technology transfer, safe, fast as well as energy efficient transport connectivity between Mumbai and Ahmedabad, improvement in productivity, generation of employment and promote a modal shift from private vehicles to high speed rail (resulting in relative reduction in air pollutants and greenhouse gas emissions).

The subsequent sections in this chapter deal with the assessment and prediction of impacts due to the project on the natural and biological environment and socio and cultural environment as well as recommend mitigation measures and interventions in the pre-construction, the construction stages and the operation stages. The next Chapter 6 assimilates the various mitigation interventions in to a management plan.

The environment in the vicinity of the proposed Project (within 500 m zone of influence), is expected to be affected by:

- i) The activities pertaining to site preparation and construction of the proposed MAHSR railway line and ancillary component works;
- ii) The operation and maintenance of the high-speed railway system; and
- iii) Growth of population and economic activity in the surrounding areas due to the project, in due course of time.

Evaluation and prediction of impacts is the most important step of an environmental impact assessment. Superimposing predicted impacts over baseline environmental scenario provides an understanding of the resulting environmental impact scenarios. In the present study baseline environmental scenario was established through baseline data generated over the period from May 2017 to February 2018. Information and data from previous EIA (FS Stage) was also used for generic data attributes that have not changed over time or influenced due to changes in project features.

Quantification of impact assessment in terms of measurable units would be the ideal case. However, due to lack of information/data, uncertainties involved and complex inter-relationships between various attributes of the environment, it is not always practically possible to do so. In such cases, only qualitative predictions have been made based on rationale, experience elsewhere and reasonable judgment.

Adequacy of proposed mitigation measures suggested in environmental management plan has been evaluated against predicted environmental impacts and various standards notified by MoEFCC under the Environment Protection Act, 1986 and other relevant standards/criteria published by Bureau of Indian Standards as well as other National and International agencies.

As a first step, the entire MAHSR project has been divided into a number of smaller sub-activities by linear segments, for construction and operation phases. The probable potential impacts of each of these activities on various sectors of environment (such as air, water, noise and vibration, soil, biota, socio-economic, topography, geology, climate change, ecology etc.) have been identified and listed. Table 5.0.0 (a) lists various activities of construction phase and their probable impacts on various components of environment. The impacts further have been classified as long-term impacts and short-term impacts. Most of these impacts are envisaged to be short term impacts, confined to the construction period only. Mitigation measures for significant impacts are discussed in respective sections.

Table 5.0.0 (a): Identification of Construction Activities and Probable Impacts

Construction Activities	Environmental Attributes	Potential Impacts
A) Long Term Impacts		
Land	Topography	<ul style="list-style-type: none"> • Permanent change in the local topography of the area
	Landscape	<ul style="list-style-type: none"> • New landscape will be created due to viaduct from Mumbai to Ahmedabad and bridges across the intersecting rivers • Permanent land use change and ancillary development in the vicinity of the proposed stations
Tunnel	Geology & Hydrology	<ul style="list-style-type: none"> • Void shall be created due to construction of tunnel • Excavated soil/basaltic rocks debris from the tunnel will need to be disposed • The ground water aquifer shall be affected as the tunnel may intersect the aquifer in some areas
B) Short Term Impacts		
Site clearing and Leveling (cutting, stripping, earth excavation, compaction)	Air	<ul style="list-style-type: none"> • Fugitive Dust (PM₁₀ and PM_{2.5}) Emissions causing health concerns to local community and workers • Air Emissions from construction equipment & machinery and backup power generation, causing health concerns to local community and workers

Construction Activities	Environmental Attributes	Potential Impacts
	Water	<ul style="list-style-type: none"> Run-off from vegetation stripped area and erosion Domestic effluent discharge from the labour camp and construction camp proposed to be constructed at every 25 km along the alignment There may be change in the natural drainage pattern
	Groundwater	<ul style="list-style-type: none"> Seepage of wastewater from the project site into the groundwater table, where groundwater level is shallow.
	Soil	<ul style="list-style-type: none"> Loss of fertile top soil Temporary loss of agricultural produce High concentration of heavy metals in some areas
	Ecology	<ul style="list-style-type: none"> Loss of vegetation cover/ habitat Topographic Transformations Migration of wildlife
	Noise & Vibration	<ul style="list-style-type: none"> Increase in noise levels due to running of heavy construction equipment Frequent vibration impact due to demolition (existing pavement, road surfaces, etc.), underground tunneling and compaction work for viaduct Noise propagation due to plying of heavy construction vehicles at the sites
	Climate Change	<ul style="list-style-type: none"> Due to loss of vegetation cover (tree felling and mangrove cutting) there may be a temporary / short term rise in the local ambient temperature
Transportation and Storage of Construction Material/ Equipment	Air	<ul style="list-style-type: none"> Gaseous emissions from construction vehicles particularly on unpaved access roads Fugitive Dust Emissions due to Traffic Movement especially in the Gujarat region where the alignment runs through the agricultural field Fugitive emissions arising out of construction materials (cement, paints and varnishes)
	Water	<ul style="list-style-type: none"> Spillage of construction material and flow into streams particularly during the monsoon months Run-off from Storage areas of Construction Material
	Soil	<ul style="list-style-type: none"> Deposition of spilled construction material on soil
	Public Utilities	<ul style="list-style-type: none"> Increased traffic volume and density Congestion on roads
	Climate Change	<ul style="list-style-type: none"> Due to excessive emission from the construction vehicle, there may be increase in the concentration of CO and CO₂ (GHGs) however it is not expected to impact local climate significantly
Civil Construction Activities	Air	<ul style="list-style-type: none"> Gaseous Emissions from Construction Machinery Fugitive Dust (PM₁₀ and PM_{2.5}) Emissions due to Movement of Traffic on the unpaved way Fugitive dust (PM₁₀ and PM_{2.5}) emission from the batching, mixing and concreting plant
	Water	<ul style="list-style-type: none"> Run-off from Construction Areas during curing and also from the storage area of the construction materials
	Groundwater	<ul style="list-style-type: none"> Seepage of wastewater from the project site into the groundwater table, where groundwater level is shallow.
	Noise	<ul style="list-style-type: none"> High noise emitting from the construction equipment Noise generated from the running of heavy vehicles deployed in the construction activities

Construction Activities	Environmental Attributes	Potential Impacts
	Vibration	<ul style="list-style-type: none"> • Vibration in the nearby area due to piling • Blasting operation may lead to temporary ground borne vibration • Running of heavy construction equipment
Mechanical and Electrical Works	Air	<ul style="list-style-type: none"> • Air emissions from running of construction machineries due to fuel
	Water	<ul style="list-style-type: none"> • Run-off from erection areas containing spent oils, Paints
	Vibration	<ul style="list-style-type: none"> • Induced vibration may be experienced due to erection activities • Running of heavy mechanical and electrical equipment
Influx of Labour & Construction of Temporary Houses/Camps	Socio-economic	<ul style="list-style-type: none"> • Stress on infrastructure • Stress on social relations • Social conflict due to inflow of workforce
	Land	<ul style="list-style-type: none"> • Change in land use pattern of the area due to coming up of labour camps
	Water	<ul style="list-style-type: none"> • Sanitary effluents from labour colonies/camps
Transportation and Disposal of Construction & Demolition Waste	Air	<ul style="list-style-type: none"> • Noise and Air Emissions from Transport Vehicles • Fugitive Dust Emissions due to Movement of Traffic on the unpaved access roads • Spillage and fugitive emissions during handling of C&D waste • Fugitive emission from the pile of C&D waste
	Water	<ul style="list-style-type: none"> • Spillage/ spread of debris material and flow into streams • Run-off from Disposal Areas • Leaching effect from the debris disposal area
	Soil	<ul style="list-style-type: none"> • Spillage/ spread/ deposition of debris • Conversion of land into waste land

Source: Study Team¹

Table 5.0.0 (b) lists various activities of operation and maintenance phase and their probable impacts on various components of environment. Most of these impacts are long term impacts. However, the significance of most of these impacts is envisaged to be moderate, as discussed in the following sections.

Table 5.0.0 (b): Identification of Operation and Maintenance Activities and Potential Impacts

Operation and Maintenance Activities	Sector	Potential Impacts
Running of High Speed Train	Air	<ul style="list-style-type: none"> • Corridor effect on air movement along the MAHSR alignment due to high speed movement (although this is not expected to create any adverse effects).

¹ The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

Operation and Maintenance Activities	Sector	Potential Impacts
	Water	<ul style="list-style-type: none"> Discharge of untreated sanitary effluents from the station into local sewers Spillage of spent oils from the workshops and depot Increased water demand Scarcity of water to the competing and downstream users
	Public Utilities	<ul style="list-style-type: none"> Increased traffic volume and density Additional load on the public storm water drain network
	Noise & Vibration	<ul style="list-style-type: none"> Generation of high level noise along the proposed MAHSR alignment Generation of vibration due to high speed running train (300-350 kmph) in certain sections along the alignment Potential damage to old structures (that are already in a dilapidated condition) located close to MAHSR alignment
	Ecosystem	<ul style="list-style-type: none"> Potential Bird hits (impact on avian fauna) as the high-speed train shall be running on the viaduct of 12 to 21 metre height at a speed of 325-350 km/h Wildlife habitat may get disturbed due to noise and vibration
	Climate Change	<ul style="list-style-type: none"> Green House Gas (GHG) emission from the air conditioning system in the rolling stock and also from the station The outside temperature around the stations and maintenance depots
	HIV/AIDS	<ul style="list-style-type: none"> There may be rise in the number of HIV/AIDS infected people due to influx of large number of visitors
Drawal of Water	Water	<ul style="list-style-type: none"> Reduced availability to downstream users Reduced flow in downstream direction/ change in regime in case of drawal of surface water Ground water depletion nearby the station and maintenance depot areas
	Ecology	<ul style="list-style-type: none"> Entrapment/ Impingement of Organisms
Maintenance (Cleaning, Overhaul, Oil Change, Lubrication etc.)	Water	<ul style="list-style-type: none"> Generation of effluents containing oil/ chemicals from the Workshop and Maintenance Depot
	Hazardous Waste	<ul style="list-style-type: none"> Generation of hazardous waste from the maintenance depot
Domestic Use of Water at Stations and Maintenance Depot	Water	<ul style="list-style-type: none"> Generation of sewage

Source: Study Team

5.1 PHYSICAL CHANGE

5.1.1 Impacts- Construction Phase

This impact is unavoidable as the strip of land on which the proposed MAHSR alignment of 508.17 km long will be constructed, has to be cleared off all vegetation but damage to land adjoining it due to dumping of spoils from cuts and excavation of borrow pits can be

minimised. A project of this nature, where large quantum of construction is involved, both by excavation, cutting in the hilly area in Maharashtra region and for construction of embankments of approach *etc.* will causes damage to the slopes below the alignment and water bodies on the toes thereof. In this case, however, there is hardly any damage on the down-hill slope as MAHSR alignment shall pass through the hilly area from tunnels.

During the construction period, the project envisages requirement of about 200 hectares of additional land for use as labour campsites, storage yards, access roads *etc.* These will be returned to the civil authorities after their temporary use, nevertheless, the area will be completely denuded of vegetative cover and the top soil may also get damaged. Such lands will need to be rehabilitated post-construction phase.

Twelve stations, eight sub-maintenance depots and two rolling stock maintenance depots have been proposed in the entire route of MAHSR. The locations where the stations and maintenance depots shall be constructed will bring permanent change in the physiographic and land use of the area.

5.1.2 Mitigation Measures

- Before start of construction activities, all suitable disposal sites should be identified for solid waste and any other form of waste likely to be generated from the construction activities.
- A designated solid waste disposal site should be secured away from human settlements. In addition, a disposal site should be away from water streams and any archaeological and historical monuments. Generally barren lands are preferable for this purpose.
- No dumping should be carried out on private property without written consent of the owner.
- No dumping should be allowed on wetlands, forest areas, and other ecologically sensitive areas.
- Prepare and implement a hazardous waste management plan for the disposal of waste oil, batteries and other hazardous materials.
- All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids should have a dense base and be surrounded by a bund to contain any spillage. These areas should be covered by a roof structure to minimize the potential for infiltration and contamination of rainwater.
- Areas designed for the storage of hazardous materials are to be clearly designated and storage of such materials outside these areas strictly prohibited.
- Chip and mulch vegetation cleared and reuse it as an organic base for re-vegetation; ensuring that materials, which may cause land/water contamination or create odor problems, are not disposed of on the site.
- Ensure that there is the adequate provision of correctly marked waste containers made available at convenient locations for the disposal of wastes.

5.2 NOISE

5.2.1 Impacts – Construction Phase

Noise and vibration assessments are key elements of the environmental impact assessment process for high speed railway project. Experience has shown that noise and vibration are among the major concerns with regard to the effects of a high-speed railway project on the surrounding community. A railway system is of necessity place to connect the various

population centers and often causes significant noise and vibration at nearby residences and other sensitive types of land use.

During the environmental baseline data generation, the noise and vibration have been measured while the existing activities were in operation. Hence, the measured values reflect the noise and vibration level of the existing sources.

Moreover, the vibration level of the existing train, fastest in the Indian Railway network, Rajdhani Express, while passing, was measured at two locations one at Vashi bridge and another at Sabarmati bridge and detailed in the Table 4.12.2, **Annexure 4.12, Vol-II** of the S-EIA Report.

Deployment of large and heavy construction machinery and use of explosives *etc.* in the area during the construction phase of the MAHSR project will adversely affect the noise level of the surrounding for quite some time. The excessive noise levels may adversely affect the habitat of the wildlife especially in the SGNP and TWLS areas at least during the construction phase of the project.

1. Construction Noise

Table 5.2.1 shows the Federal Transit Administration (FTA) noise assessment criteria for construction. The last column applies to construction activities that extend over 30 days near any given receiver. Day-night sound level, L_{dn} , is used to assess impacts in residential areas and 24-hr L_{eq} is used in commercial and industrial areas. The 8-hr L_{eq} and the 30-day average L_{dn} noise exposure from construction noise calculations use the noise emission levels of the construction equipment, their location, and operating hours. The construction noise limits are normally assessed at the noise-sensitive receiver property line edge.

Table 5.2.1: Construction Noise Assessment Criteria

Land Use	8-Hour L_{eq} dBA		Noise Exposure, L_{dn} dBA
	Day	Night	30-day Average
Residential	80	70	75*
Commercial	85	85	80**
Industrial	90	90	85**

Source: FTA (2006)

*In urban areas with very high ambient noise levels (L_{dn} greater than 65 dB), L_{dn} from construction operations should not exceed existing ambient noise levels + 10 dB.

**Twenty-four-hour L_{eq} , not L_{dn} .

2. Construction Equipment Noise

By using the FTA criteria provided in Table 5.2.1 and the noise projections in Table 5.2.2, prepared by the Federal Railroad Administration (FRA), and assuming that construction noise reduces by 6 dB(A) for each doubling of distance from the center of the site, it is possible to estimate the screening distances for potential construction noise impact.

Table 5.2.2: Typical Equipment Noise for Rail Construction

Equipment Item	Typical Maximum Sound Level at 50 Feet dB(A)	Equipment Utilization Factor (%)	Leq dB(A)
Air Compressor	81	50	78

Equipment Item	Typical Maximum Sound Level at 50 Feet dB(A)	Equipment Utilization Factor (%)	Leq dB(A)
Backhoe	80	40	76
Crane, Derrick	88	10	78
Bulldozer	85	40	81
Generator	81	80	80
Loader	85	40	81
Jackhammer	88	4	74
Shovel	82	40	78
Dump Truck	88	16	80
Total Workday Leq at 50 feet (8-hour workday)			89

Source: (FRA 2012)

3. Noise Caused by TBM

Tunnel Boring Machine (TBM) shall be used for construction of tunnel under the Thane Creek. Actual noise level caused by TBM is not significant in Japan and no complaint is raised. Therefore, impact of noise caused by TBM is not considered in this report.

There is no quantitative study available for the TBM borne noise in Japan, since the noise level generated by TBM is believed negligible. In the present project, TBM will be deployed for tunneling under Thane Creek 30 m below the bed of the creek. Therefore, TBM borne noise cannot be experienced at the surface of the creek during TBM operation. According to the several studies Japan on impact to raptors (hawks and eagles) during tunnel construction by blasting, those reports conclude that the impact is negligible after the animals get used to the environment. Therefore, the impact to the human being is also considered negligible.

Since the speed of the HST at tunnel section between BKC station and Thane creek is considered low during operation phase, because the location is close to the station and curve sections at Km 16+000 and Km 25+000 major impact to human being living in the above ground of the tunnel and bird species at Thane Creek is not anticipated. Monitoring program, however, will be conducted to confirm those.

4. Blasting Noise

Noise level was predicted using following equation.

$$L_A = A + 16 \log W - 16 \log D - 20 \log R + \Delta L$$

where:

L_A : Noise level (dB)

W: Explosive volume (kg)

D: Distance inside of pit

R: Distance outside of pit

A: in case of DS detonation cap: 130

In case of Ms detonation cap: 136

ΔL : Correction value (dB) for directivity, noise barrier, obstacles

The prediction was carried out with two (2) sound proof doors (at 30m and 50m from the blasting point) and several explosive volumes. The result is presented in Table 5.2.3.

Table 5.2.3: Prediction Result on Blasting in Main Tunnel

Advance Length	m	IN-1	IN-2	II	III	IV	Note
Tunnel Charge Quantity	Kg	30.5	30.3	43.5	66.9	79.4	
Noise		dB	dB	dB	dB	dB	
Blast point of Tunnel (m)	21km085	110	110	113	116	116	
	1.0m						
	10.0m	94	94	97	100	100	
	20.0m	89	90	92	95	05	
	30.0m	86	87	89	92	93	No1 door
	31.0m	68	69	71	74	74	
	40.0m	66	67	69	72	73	
	50.0m	64	65	68	71	71	No2 door
	51.0m	52	53	56	59	59	

Source: Study Team

The summary of the result is as follows:

- From the blasting point to the first sound proof door (30m from the blast point), the sound level exceeds the noise standard value even with the minimum explosive volume. Therefore, explosive cannot be used until the first door is installed.
- Between the first sound proof door and the second door (50m from the blasting point), the sound level occasionally exceeds with larger explosive volume. However, explosive cannot be used during night time.
- After the second sound proof door is installed, explosive can be used.

5.2.2 Mitigation Measures

- Notify the local people prior to undertake the construction activities associating with higher noise level such as blasting operations.
- Locate the quarry sites away from the residential areas and sensitive receptors.
- Machinery and vehicles should be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.
- The construction yards should be located away from the settlement areas. Where a construction yard is unavoidably located at the residential areas and sensitive receptors, the time of the construction activities should be limited.
- Protection devices (ear plugs or ear muffs) should be provided to the workers operating in the vicinity of high noise generating machines.
- Expanding the right of way (buffer zone) is recommended method of reducing the noise impact. A vegetative barrier in the buffer zone will be suitable.
- Noise barriers should be erected at appropriate locations such as residential areas and sensitive receptors which are adjacent to the corridor.
- Avoid nighttime construction in residential neighborhoods.
- Locate stationary construction equipment as far as possible from noise-sensitive sites.
- Re-route construction-related truck traffic along roadways that will cause the least disturbance to residents.
- During nighttime work, use smart back-up alarms, which automatically adjust the alarm level based on the background noise level, or switch off back-up alarms and replace with spotters.
- Use low-noise designed equipment.
- Implement noise-deadening measures for truck loading and operations.
- Monitor and maintain equipment to meet noise limits.
- Line or cover storage bins, conveyors, and chutes with sound-deadening material.

- Use acoustic enclosures, shields, or shrouds for equipment and facilities.
- Use high-grade engine exhaust silencers and engine-casing sound insulation.
- Prohibit aboveground jack hammering and impact pile driving during nighttime hours near residential areas.
- Minimize the use of generators for power equipment.
- Limit use of public address systems (PAS).
- Grade surface irregularities on construction sites.
- Use moveable sound barriers at the source of the construction activity.
- Limit or avoid certain noisy activities during nighttime hours.
- When blasting is planned for tunneling, double sound proof doors must be installed. And until installation of the first door is completed, explosive cannot be used and only machinery excavation shall be carried out.
- After install of the first door is completed, the limited blasting can be carried out until install of the second door is completed.

5.2.3 Operational Noise

Railways are a solution to traffic congestion and pollution; however, one drawback is the problem of noise and vibration. Much energy has been exerted into the goal of reducing vibrations in the vehicle itself while, at the same time, improving passenger comfort. These vibration levels are merely a function of the forces generated by the train vehicle. Therefore, when attempting to predict and understand railway vibration, it is imperative that the vehicle characteristics are modeled correctly.

Historically, railway lines have been a popular mode of transport for both passengers and goods. Despite this, in recent years there has been increased deployment of new tracks due to the increased competitiveness in comparison to alternative forms of transport. In particular, there has been a surge in high-speed rail.

The frequent train movements would generate a certain level of noise as it is designed to accommodate trains traveling at around 330-350 km/h. Since the proposed MAHSR alignment will pass through several semi urban - urban areas, the generated noise may cause sleep disturbance and mental instabilities of the residents living adjacent to the proposed alignment. In addition, careful attentions should be paid on noise impacts on sensitive receptors (SRs) located near the proposed alignment such as educational institution, wildlife habitats, hospitals and religious institutions.

The main impacts in terms of higher noise levels are expected during the operation phase and it is predicted that noise levels may exceed the target standards.

In absence of the Indian Guidelines for assessment of impacts of Noise and Vibration due to running of High Speed Train, the available guidance manual of Federal Transit Administration (FTA) and Federal Railroad Administration (FRA) on noise and vibration has been used for the assessment of impacts of noise and vibration due to operation of HSR.

1. Proposed Provisional Target Level for Railway Noise Control

Provisional noise target levels on HSR to be documented were proposed because the existing noise standards in India are not considered to be the ones set specifically for railway noise and environmental or regulatory standards on HSR noise have not been established yet.

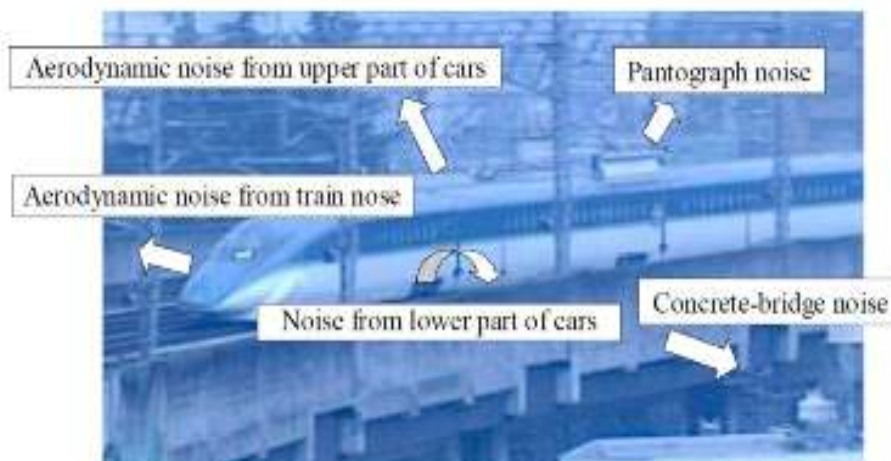
When providing target level, the corresponding technical capability should be considered to define the railway noise level through surveys about residents' opinions on noise or by referring to the experiences in other countries [refer to **Annexure 5(a), Vol-II**]. The standard environment values (the strictest value) as equivalent noise level on scale A which is relatable to human hearing- L_{Aeq} in various countries are around L_{Aeq} 60–65 dB during daytime and L_{Aeq} 50-55 dB during night time. In Japan, the equivalent noise level value is set at L_{Aeq} 60 dB during daytime and L_{Aeq} 55 dB at nighttime as the guideline value when a new railway or large-scale improvement for existing railways are constructed. Considering the noise standard values for the proposed HSR, the equivalent noise level values of L_{Aeq} 60 dB (6:00–21:00 HRS) and L_{Aeq} 50 dB (21:00–6:00 HRS), which are being adopted as railway noise standards or guidelines in many countries, are tentatively considered as target levels for the control of railway noise for the proposed HSR due to no legal standards for HSR in India.

The height of the evaluation point is proposed at 1.2 m from the ground level and outdoor where it easily affects humans. However, for elevated structures, where there is a possibility of the trains running near high rise buildings in urban areas, 10.0 m above the ground level is also proposed as a supplemental evaluation point.

2. Overview of Shinkansen Noise

Normally train noises are considered to come from the lower part of cars caused by motor sounds and friction between wheels and rails and from radiated sounds under concrete bridges, but additionally for this project due to trains operating at high speeds, aerodynamic noises from car bodies and pantographs will also be generated. Main noise sources and their locations are shown in the Exhibit 5.2.1.

Exhibit 5.2.1: Main Noise Sources and their Locations



Source: *Development of External-Noise Reduction Technologies for Shinkansen High-Speed Trains*

a) Annoyance due to Onset of HSR Pass-by

There is considerable evidence that increased annoyance is likely to occur for train noise events with rapid onset rates. Because of this, the relationship of speed and distance was used to define locations where the onset rate for HST operations may cause surprise according to the FRA guidance manual (FRA 2006). The potential for increased annoyance for the most part is confined to an area very close to the tracks. In the MAHSR project, the

maximum train speeds would be 320 kmph. At this speed, the distance from the tracks within which surprise can occur would be 25 m, which is approximately close to right of way of MAHSR alignment.

b) Noise Effects on Wildlife and Domestic Animals

FRA also addresses impacts on wildlife (mammals and birds) and domestic animals (livestock and poultry). Noise exposure limits for each are an SEL of 100 dB (A) from passing trains. The SEL represents a receiver’s cumulative noise exposure from an event and represents the total A-weighted sound during the event normalized to a 1-second interval. To provide a conservative estimate, in each case the HST maximum operating speed of 320kmph was used, and no shielding from intervening structures or terrain was assumed.

According to the screening distance information provided in Table 5.2.4, wildlife and domestic animals will not be within the screening distance for elevated structure and in tunnels majority of alignment lies in Elevated Track or in Tunnels. The primary location where this could be an issue is where wildlife migration routes cross the HST right-of-way along at-grade locations.

Table 5.2.4: Screening Distances for Effects on Wildlife and Domestic Animals

Track Location	Speed (kmph)	SEL dB(A)	Distance from Centerline (metre) – Ballast and Tie Track
HSR-at grade	320	100	30.48
HST-60-foot-high elevated structure	320	100	4.572

Source: FRA (2012)

3. Actual Noise Levels in Shinkansen Operation in Japan

a) Methodology

Desktop study, using available reports regarding Shinkansen, was carried out to understand the actual noise levels on operation of high speed railway.

b) Desktop Study

i) Items of Desktop Study

Following items were studied, reviewing available reports in Japan regarding Shinkansen.

- Actual level of noise on operation of E5 type Shinkansen
- Measures to noise in Japan
- Advantage of measures

ii) Results of The Desktop Study

In total 6 reports, prepared by 6 prefectures where Shinkansen passes, were reviewed to understand the actual noise levels.

The measurement point of noise in the reports is uniformly set as 25m horizontally from the center of rail way and 1.2m vertically above ground. Since planned operation speed in India is 320 kmph, the results of noise measurement at passing speed over 300 kmph were chosen. And the results of E5 type or E5+E6 type were selected, as same type (E5) in India. The number of data is 203.

Clear relationship between maximum noise level, passing speed and track type was not seen, while negative relationship between maximum noise level and distance from receiving point to the tip of sound barrier was seen with slab track, although data variation is great. It is considered that those are because some kind of mitigation to reduce the noise level have been undertaken in some monitoring points.

Therefore, it was concluded that the results of actual measurement are only used to understand the present situation of the operation of Shinkansen, and another approach to assess the impact of high speed railway would be necessary. Thus, the study of prediction was carried out.

5.2.4 Prediction of Operational Noise

Since any this kind of study regarding Shinkansen has ever conducted in India, this study was conducted in Japan.

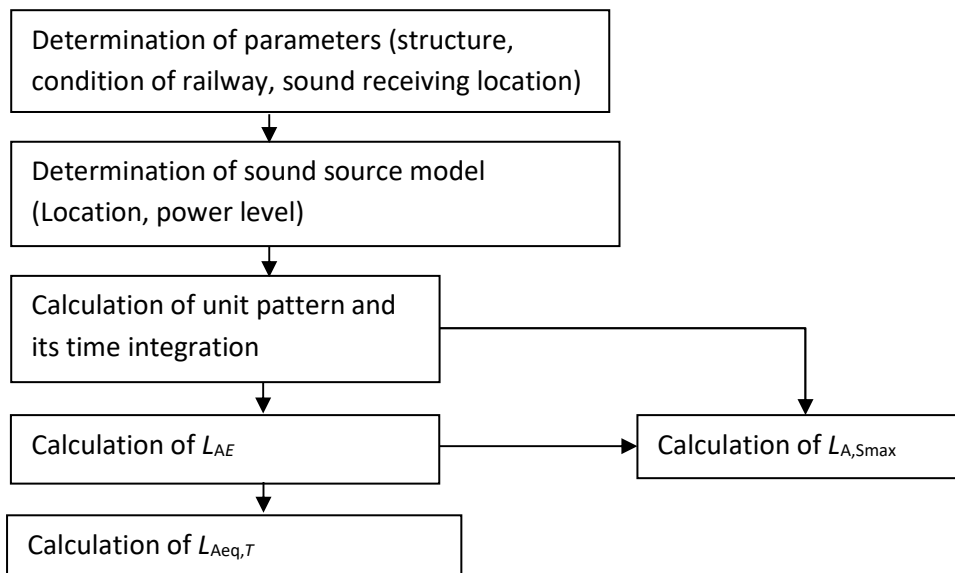
Based on the desktop study, noise level alongside the high-speed rail alignment was predicted, using the method on prediction of noise levels along the Shinkansen railway line in Japan² (hereinafter referred to as “the Method”)

Details of the study, such as detailed equation, determination of parameters, detailed results are presented as **Annexure 5(b), Vol-II**.

a) Prediction Procedure

The prediction procedure is shown in Exhibit 5.2.2.

Exhibit 5.2.2: Prediction Procedure



Source: Study Team

L_{AE} : Weighted equivalent continuous perceived noise level

$L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure level

$L_{A,Smax}$: Maximum A-weighted sound pressure level with time-weight feature

b) Noise Prediction Scenario and Condition

i) Prediction Scenario

Noise levels from high speed railway were predicted with the 48 scenarios as shown in Table 5.2.5. The target year of the prediction is 2023 (start of operation) and 2053 (operation peak). And the train speed is 320km/h and 350km/h respectively. The latest type of viaduct without any anti-noise measures, such as vibration absorption slab, was selected as an elevated structure. As for the sound barrier, general linear wall type with four (4) different heights was used for the prediction.

Table 5.2.5: Prediction Scenarios

Category	Target year	No. of cars	Train Speed	Viaduct structure	Height to the Rail level above ground	Sound barrier height from railway level [m]			
						2.0	2.5	3.0	3.5
A-1	Initial phase in 2023	10cars	320 kmph	Concrete	10m	○	○	○	○
A-2					15m	○	○	○	○
A-3					20m	○	○	○	○
B-1	62 trains at day time	253m Length	350 kmph		10m	○	○	○	○
B-2					15m	○	○	○	○
B-3					20m	○	○	○	○
C-1	Peak number train period in 2053	16cars	320 kmph	Concrete	10m	○	○	○	○
C-2					15m	○	○	○	○
C-3					20m	○	○	○	○
D-1	192 trains at day time	403m Length	350 kmph		10m	○	○	○	○
D-2					15m	○	○	○	○
D-3					20m	○	○	○	○
	18 trains at night time								

Source: Study Team

ii) Benchmark Standard Value for the Impact Assessment

In this study, benchmark standard values to assess the impact cause by noise generation from the proposed HSR are set as 60dB for day time and 50dB for night time respectively, which are stricter railway standards in the world and L_{Aeq} 10dB higher than the values of “Silence Zone” of the ambient noise standard in India.

c) Result of The Prediction

i) Maximum Noise Level ($L_{A, Smax}$)

Prediction result of Maximum A-weighted sound pressure level with time-weight feature S ($L_{A,Smax}$) on train passing is shown in **Annexure 5 (b), Vol-II**.

The predicted values for standard railway level of 15m with 2.0m noise barrier vary between 73dB and 75dB, showing the same level of actual measurement in Japan.

ii) Equivalent Sound Level (L_{Aeq})

Results of prediction of equivalent continuous A-weighted sound pressure level (L_{Aeq}) during day time and the one during night time is shown in **Annexure 5 (b), Vol-II**.

The sound levels during day time in year 2023 (start of operation) for standard railway level of 15m with 2.0m noise barrier is 51dB, which are less than the benchmark standard value 60dB for day time. The sound levels during night time in year 2023 (start of operation) for standard railway level of 15m with 2.0m noise barrier varies is 45dB, which are less than the benchmark standard value 50dB for night time. The sound level in the operation peak (year 2053) during day time would be 59dB for the speed of 320km and 60dB for the speed of 350km/h respectively, which are less than the benchmark standard value 60dB for day time. The sound level in the operation peak (year 2053) during night time would be 52dB for the speed of 320km and 52dB for the speed of 350km/h respectively, which are 2dB higher than the benchmark standard value 50dB for night time.

d) Study on Extent of The Impact

Based on the determination of the benchmark standard value (see Section 5.2.4, a) the extent of noise level exceedance beyond the benchmark standard value (Day time: 60dB, Night time: 50dB) for the Silence Zone is shown in Table 5.2.6. There is no exceedance for the Residential area.

Although the excess area of the benchmark noise level does not exist at the time of the start of operation (year 2023), there would be some noise excess area in the case of lower viaduct height and less than 3.0m sound barrier height at the peak operation (year 2043). The maximum distance of the noise excess area based on the benchmark standard level (60dB) for day time is 47m for viaduct height of 10m with noise barrier 2.0m in 2043. The maximum distance of the noise excess area based on the benchmark standard level for night time is 86m for viaduct height of 10m with noise barrier 2.0m in 2043.

Table 5.2.6 (1): Extent of Noise Level Exceedance for the Silence Zone (Day time)

Case	Target year	No. of cars	Train Speed	Viaduct structure	Height from the ground to the rail level	The farthest distance from the railroad track [m]			
						2.0	2.5	3.0	3.5
A-1	Initial phase in 2023	10cars	320 kmph	Concrete	10m	—	—	—	—
A-2					15m	—	—	—	—
A-3					20m	—	—	—	—
B-1	62 trains at day time	253m Length	350 kmph	Concrete	10m	—	—	—	—
B-2					15m	—	—	—	—
B-3					20m	—	—	—	—
C-1	Peak number	16cars	320	Concrete	10m	35	14	—	—

Case	Target year	No. of cars	Train Speed	Viaduct structure	Height from the ground to the rail level	The farthest distance from the railroad track [m]			
						2.0	2.5	3.0	3.5
C-2	train period in 2053	403m Length	kmph		15m	—	—	—	—
C-3					20m	—	—	—	—
D-1	192 trains at day time	403m Length	350 kmph		10m	47	36	16	—
D-2	18 trains at night time				15m	—	—	—	—
D-3					20m	—	—	—	—

Source: Study Team

Note: “-” means that the extent of impact does not reach beyond 25m from the centre of the track.

Table 5.2.6 (2): Extent of Noise Level Exceedance for the Silence Zone (Night time)

Case	Target Year	No. of Cars	Train Speed	Viaduct Structure	Height from the ground to the rail level	The farthest distance from the railroad track [m]			
						2.0	2.5	3.0	3.5
A-1	Initial phase in 2023	10cars	320 kmph	Concrete	10m	—	—	—	—
A-2					15m	—	—	—	—
A-3					20m	—	—	—	—
B-1	62 trains at day time 8 trains at night time	253m Length	350 kmph	Concrete	10m	—	—	—	—
B-2					15m	—	—	—	—
B-3					20m	—	—	—	—
C-1	Peak number train period in 2053	16cars	320 kmph	Concrete	10m	71	57	45	30
C-2					15m	60	46	24	16
C-3					20m	46	—	—	—
D-1	192 trains at day time 18 trains at night time	403m Length	350 kmph	Concrete	10m	86	71	58	43
D-2					15m	76	61	42	27
D-3					20m	66	35	18	—

Source: Study Team

5.2.5 Conclusion and Recommendation

Based on the results discussed above, it is considered that the impact of noise caused by the operation of high speed railway is limited and small, since the extent of impact, exceeding the threshold value, is not considered at the start of operation (year 2023) and is limited even in the peak operation (year 2053) [refer Section 5.2.4, (2), (d)].

Special measures, other than the linear wall sound barrier at the railway track, is not considered necessary during the start of operation, since the number of train is small. However, maximum sound level might exceed 75dB with the low height sound barrier, and, therefore, it is recommended to use higher sound barrier (refer Table 5.2.6).

For the consideration to silence zone, in which lower noise standard value is applied, either installment of acoustic insulation facility, such as double wall grass windows with air conditioning or sound barrier outside of the building might be prioritized, since the noise extent higher than the ambient noise standard level exist till 50m to 100m horizontally from the railway center line, according to the predicted results. And eventually, relocation of the building might be considered along with the modification of city plan.

Physical measures which is considered and included in designing of the rolling stocks and facilities are introduced, provided in **Annexure 5(c), Vol-II**.

5.3 VIBRATION

5.3.1 Construction Vibration

Guidelines in the FTA guidance manual (FTA 2006) provide the basis for the construction vibration assessment. FTA provides construction vibration criteria designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period. FTA recommends using the long-term operational vibration criteria provided below in the Vibration Criteria – HSR Operations section. Table 5.3.1 shows the FTA building damage criteria for construction activity; the table lists PPV limits for four building categories. These limits are used to estimate potential problems that should be addressed during final design.

The proposed MAHSR would generate a certain level of vibration as it is designed to accommodate trains travelling at 330-350 kmph. Although perceptible ground borne vibration is generally limited to the areas within few hundred feet of the railway system, the following mitigation measures are proposed since higher level of vibration has some possibilities to cause sleep disturbance and mental instability to the residents living adjacent to the proposed corridor.

Table 5.3.1: Construction Vibration Damage Criteria

Building Category	PPV (inch/sec)	Approximate L _v ^a
Reinforced concrete, steel, or timber (no plaster)	0.5	102
Engineered concrete and masonry (no plaster)	0.3	98
Non-engineered timber and masonry buildings	0.2	94
Buildings extremely susceptible to vibration damage	0.12	90

Source: FTA (2006)

^a:An RMS vibration velocity level in VdB relative to 1 micro-inch/second.

1. Common Construction Vibration Impacts

During construction, some equipment may cause ground-borne vibration, most notably pile-driving equipment. Tunnel has been proposed under sea in the Thane Creek area with length of 20.375 km. The tunnel shall be about 25-30 m below the sea bed. For construction of tunnel it is proposed to use Tunnel Boring Machine (TBM) having diameter of 14.2 m. During the geological exploration it has been confirmed that the area is endowed with basaltic rock with considerable compactness. The working of TBM may cause some vibration in the seabed consisting of mud flats, which provides resting and roosting ground to the Flamingo and other avifauna. Construction equipment can produce vibration levels at 25 feet (7.62 m) that range from 58 VdB for a small bulldozer to 112 VdB for a pile driver. Table 5.3.2 provides the approximate distances within which receivers could experience construction-related vibration effects.

Table 5.3.2: Approximate Distances to Vibration Criterion – Level Contours

Land Use Category	Vibration Criterion Level (VdB)	Approximate Vibration Contour Distance (feet)
Tracts of land where silence is an essential element. This category includes lands set aside for serenity and silence, such as outdoor amphitheaters, concert pavilions, and National Historic Landmarks with significant outdoor use.	65	175 (53.35 m)
Residences and buildings where people normally sleep. This category includes homes and hospitals, where nighttime sensitivity to noise is of utmost importance.	72	130 (39.624 m)
Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and religious, where it is important to avoid interference with such activities as speech, meditation, and concentration. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.	75	70 (21.336 m)

Source: FTA (2006)

a) Vibration from TBM

Tunnel Boring Machine (TBM) shall be used for construction of tunnel under the Thane Creek. JICC has studied on prediction of vibration caused by TBM. In the study, the vibration level was predicted based on the actual level measured in Japan.

As an actual vibration level of TBM (diameter 5 m, while it is 13 m for India HSR), 60dB with earth cover 25 m was observed. This value is 5dB higher than the level, which human starts detecting the vibration.

While some complaints such as annoyance were raised, since the drilling speed of the TBM is 10 m/day, there was no impact after 4 days (40m apart), and no damage of the houses were confirmed.

The following equation was used for the prediction, comparing the compression strength between TBM in Japan (diameter 5m) and TBM in Spain (Diameter 10m, 15m).

$$VAL = 10 \log_{10} (Ve/SV)^2$$

where:

VAL: Vibration level (dB)

Ve: Expected vibration level (m/s²)

SV: Standard level (1 x 10⁻⁵ m/s²)

According to the study result, the maximum level with full operation of the TBM was estimated as 66dB with 25m earth covering. Since it is said the almost residents feel vibration and hanging lights slightly swing at level of 65dB, several mitigation measures would be necessary.

b) Vibration by blasting

In certain section of the alignment (Navi Mumbai), blasting shall be done for tunneling. JICC has conducted a study on planning of blasting to control the vibration level caused by blasting.

The target vibration value was set as 60dB, based on the recommendation value of the Ministry of Environment, Japan for sensing limit of vibration in a house.

Following equation was used to determine the appropriate volume of explosive to control the vibration limit.

$$V = K * W^m * D^{-n}$$

Where:

V: Vibration velocity

K, m, n: Blasting coefficient

W: Volume of explosive (kg)

D: Distance (m)

After appropriate volume of explosive is determined, it is planned to conduct test blasting at the target area to measure the actual vibration level and to optimize the explosive volume to control the vibration level.

The study concludes that the vibration level is theoretically controlled, and significant impact is not envisaged.

2. Mitigation Measures

Building damage from construction vibration is only anticipated from pile driving at very close distances to buildings. If piling is more than 7.62 m to 15.24 m from buildings, or if alternative methods such as push piling or augur piling can be used, damage from construction vibration is not expected to occur. Other sources of construction vibration do not generate high enough vibration levels for damage to occur. When a construction scenario has been established, preconstruction surveys will be conducted at locations within 15.24 m of piling to document the existing condition of buildings in case damage is reported during or after construction. Damaged buildings would be repaired, or compensation paid to the owners.

- Notify the local people prior to undertake the construction activities associating with higher vibration level such as activities using vibrating rollers.
- The vibrations should be reduced considerably by ensuring and keeping correct track geometry by advanced measurement.
- Expanding the right of way (buffer zone) is sometimes the easiest method of reducing the vibration impact.

The details of the mitigation measures as being adopted in Shinkansen have been explained in **Annexure 5(d), Vol-II.**

For the vibration caused by TBM and blasting, following mitigation measures are considered.

- To reduce the vibration level caused by TBM, the drilling speed shall be reduced.
- The operation time shall be limited between 7:00 to 21:00, and operation during night time shall be stopped where earth cover is shallow.
- Although the vibration level caused by blasting is theoretically controlled within the threshold value, continuous monitoring is necessary during the construction for both TBM and blasting.
- Before commencement of the construction, operation details shall be well explained to the affected residents.

5.3.2 Operation Phase Vibration

Ground-borne vibration impacts from HSR operations inside vibration-sensitive buildings are defined by the vibration velocity level, expressed in terms of VdB, and the number of vibration events per day of the same kind of source. Table 5.3.2 summarizes vibration-sensitivity in terms of the three land use categories and the criteria for acceptable ground-borne vibrations and acceptable ground-borne noise. Ground-borne noise is a low-frequency rumbling sound inside buildings, caused by vibrations of floors, walls, and ceilings. Ground-borne noise is generally not a problem for buildings near railroad tracks at- or above-grade, because the airborne noise from trains typically overshadows effects of ground-borne noise. Ground-borne noise becomes an issue in cases where airborne noise cannot be heard, such as for buildings near tunnels.

1. Overview of Shinkansen Vibration

Vibration occurs when wheels roll over rails. Consequently, it can be assumed that when the car weight and train speed increases, vibration will also increase. Conversely, when the rigidity of a structural element propagating vibration increases, as a consequence vibration will decrease. However, vibration propagation will change according to geological conditions, making accurate predictions difficult.

2. Actual Vibration on Shinkansen Operation in Japan

a) Methodology

Desktop study, using available reports regarding Shinkansen, was carried out to understand the actual vibration levels on operation of high speed railway.

b) Desktop Study

i) Items of Desktop Study

Following items were studied, reviewed available reports in Japan regarding Shinkansen.

- Actual level of vibration on operation of E5 type Shinkansen;
- Measures to vibration in Japan;
- Advantage of measures.

ii) Results of The Desktop Study

In total 4 reports, prepared by 4 prefectures where Shinkansen passes, were reviewed to understand the actual vibration levels.

The measurement point of vibration in the reports is uniformly set on the ground surface at 12.5m or 25m horizontally from the center of rail way. Since planned operation speed in India is 320 km/h, the results of vibration measurement at passing speed over 300 km/h were chosen. The number of data is 14.

The vibration levels vary between 52 and 58dB at 12.5m and 45 and 62dB at 25m. The clear relationship between train speed and vibration level was not seen.

5.3.3 Vibration Prediction

a) Methodology

Vibration level was qualitatively predicted at ground surface along the railway, based on the results of the desktop study.

Since ambient vibration standard for train is not available in India and world organization such as WHO, the result was compared with a guideline value² in Japan. The guideline value, 70dB, was set as a threshold to avoid the unacceptable impact and this value does not secure an ideal living environment.

b) Result of The Prediction

Actual vibration level when Shinkansen passes with the speed over 300km/h varies between 52dB and 58dB at 12.5m from the center of railway track and varies between 45dB and 62dB at 25m from the center of railway track. The guideline value (see above section) in Japan is 70dB, and the actual vibration values were all less than the guideline value.

Therefore, if the same construction technique and measures are introduced to the planning of the high-speed railway in India, the impact caused by vibration is not considered. However, the guideline value is set as a threshold to avoid the unacceptable impact and this value does not secure an ideal living environment.

5.3.4 Conclusion and Recommendation

The actual vibration levels when Shinkansen passes with the speed over 300km/h do not exceed the guideline value in Japan.

Therefore, if the same construction technique and measures are introduced to the planning of the high-speed railway in India, the impact caused by vibration is not considered.

On mainline, the specification of track and structure will be same as used in Japan. However, in depot area for a short stretch, ballast in conformation to the Indian specification will be used. In the depot area, the train speed is very low. In fact, the noise generated in depot area is insignificant compared to the noise of Indian railway existing network. Therefore, the impact would be negligible.

Since the guideline value set as a threshold to avoid the unacceptable impact and this value does not secure an ideal living environment, continuous monitoring of vibration level along the railway is necessary.

² Guideline for Vibration of Shinkansen Railway, 1976, Ministry of Environment, Japan

5.4 TUNNEL BOOM

Nowadays, more and more tunnels are constructed for the reason that efficient transport strongly relies on road and railway tunnel, both in long-distance traffic and in metropolitan areas. When a tunnel is constructed, the ground moves towards the excavation face. This results in relaxation ahead and around the tunnel, which propagates towards the surface. A shallow depression or 'trough' results, following the tunnel alignment.

The movements start some distance ahead of the tunnel face and continue for some time after excavation. The vast majority of these types of movement occur within a few days of the tunnel face passing.

5.4.1 Impact

When a train enters into a tunnel, compressed air is transmitted in the tunnel at the speed of sound and compression noise (aerodynamic vibration) is generated at the opposite end of the tunnel, which causes trembling of windows and doors of residences adjacent to the tunnel exit. This is often referred to as the 'Tunnel Boom'.

The details regarding the impact and mitigation measures as being adopted in Shinkansen have been explained in **Annexure 5(e), Vol-II**.

5.4.2 Mitigation Measures

- 1) On the side of structure
 - Tunnel entrance hood
- 2) On the side of cars
 - Long nose design at the head portion

5.5 IMPACTS OF CO₂ (GREEN HOUSE GAS) EMISSION

This section focuses on evaluating the impacts during the operation phase of MAHSR project on energy consumption and CO₂ emission. This is based on the study carried out by the Tata Energy and Research Institute (TERI)³ titled "Estimating the impacts on energy consumption and emissions due to High Speed Rail operations along the Mumbai-Ahmedabad Corridor". Over and above, the introduction of high speed rail would also result in a lot of travel demand shifting from modes such as automobiles, airlines, buses and conventional trains to high speed trains. This would result in completely changing the energy demand for transport along this corridor. This study examines the impacts on the energy use and consequent carbon emission resulting from this change in the mode shift in traffic.

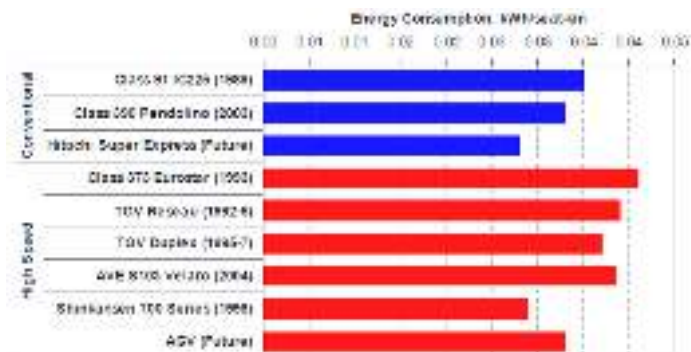
1) HSR Efficiency

Various studies have been undertaken to estimate the efficiencies of the different kinds of HSR operating across the world. A comparative set of figures for different HSR across the world is shown in Exhibit 5.5.1. The Shinkansen E 5 series come out as one of the most energy efficient HSR train-sets in the world.

³ TERI Study on Mumbai –Ahmedabad High Speed Railway predicted a reduction in CO₂ emissions over BAU scenario. Source: www.teri.co.in

While the efficiency range of HSR train-sets seem to be in the range of 0.029kwh/seat-km to 0.041 kwh/seat-km, the energy efficiencies seem to vary across different HSR lines based on a host of different parameters, such as route distances, number of stops, train-set seat capacities, high-speeds, etc.

Exhibit 5.5.1: Relative Energy Efficiencies of HSR across the world (kwh/seat-km)



Source: (Network Rail)

For the present study, the train characterization of the Shinkansen E5 series train has been used as per the following specification:

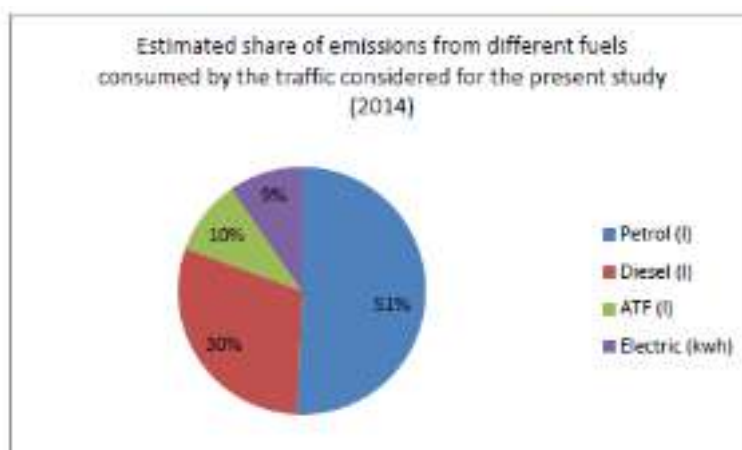
Train	Shinkansen E5 Series (1998)
Speed (km/h)	320
Seating capacity	731
Length (m)	253
Width (mm)	3350
Car per unit	10
Tare mass (tonnes)	454
Mass per train metre(tonnes)	1.59
Mass per seat(tonnes)	0.62
Energy consumption (kWh/seat `km)	0.029
Total distance (km)	508.17
Total energy consumption for a 750 seating capacity round trip between Mumbai and Ahmedabad	20,488
Occupancy (%)	70%
Energy consumption (kWh/100seatkm) for the round trip @70% occupancy	4.14

2) Current Levels of CO₂Emissions from Traffic considered for the Study

As of today, cars are estimated to be generating the largest volumes of CO₂ emissions (69%) followed by buses (11% share) and aviation and railways both with 10% of the shares.

What is interesting to note that in 2014, railways, with about 13% of the share in traffic and consuming only 3% of the energy, is estimated to be generating about 10% of the total CO₂ emissions. This is largely because of the fact that the electricity used by railways is generated from coal fired thermal power, which has high GHG emissions. Buses, which are the least emissions intensive, have only 3% of the CO₂ emissions share.

Exhibit 5.5.2: Estimated share of emissions from different fuels consumed by the traffic considered for the present study



Source: “Estimating the impacts on energy consumption and emissions due to High Speed Rail operations along the Ahmedabad-Mumbai Corridor” by TERI

Petrol has the largest share of emissions (51%) followed by diesel (30%) and ATF (10%). The share of emissions generated from electricity forms only 9% (only emissions from railways) of the total emissions generated by the traffic considered for the study.

5.5.1 Impacts on Fuel and Energy Consumption with the Introduction of HSR

a) Growth Rates in Fuel Consumption

In the scenario without MAHSR, the demand for petroleum products used for driving mobility is estimated to keep growing continuously at about 7 per cent annually (CAGR) between 2014 and 2053. Of all the fuels, growth in diesel consumption is estimated to be fastest at about 8% CAGR between 2014 and 2053, followed by ATF at 7% and petrol at 6% in the same period of time. Electricity consumption is expected to increase only by about 3% in the scenario without MAHSR.

In the scenario with the introduction of MAHSR, there is a marginal decline in the growth rates of petroleum products, which are expectedly substituted by electricity consumption by HSR. The growth rate of petrol and diesel goes down to 5.5% and 7.5% respectively followed by ATF the growth rate of which falls to 4.7% (CAGR between 2014 and 2053). There is substantial substitution of petroleum products with electricity due to the introduction of MAHSR. The rate of electricity consumption increases to almost 8% between 2014 and 2053 in the scenario with HSR, as compared to 3% in the scenario without HSR.

b) Fuel Savings

The introduction of MAHSR has a large number of impacts on the fuel and energy consumption for the traffic reduction (due to estimated transport modal shift) considered for this study. The largest impact in terms of the petroleum fuel reduction due to the introduction of MAHSR is expected to be for Aviation Turbine Fuel (ATF). The ATF consumption levels of 2053 are estimated to be reduced by 246 ML in the scenario with MAHSR as compared to the scenario without MAHSR.

MAHSR operations would also result in reduced consumption of petrol and diesel for vehicular transport. A total of about 4,983 ML of petrol and diesel is also estimated to be saved through the period 2023 to 2053 due to the operations of MAHSR along the corridor.

The reduction in petroleum products would however be substituted by increased consumption of electricity. From just 79 GWh in 2014, the electricity consumption goes up to 238 GWh, in the scenario without MAHSR and to 1,545 GWh in the scenario with MAHSR by 2053. Since most of the electricity generation in India in the Western region is based on coal fired thermal power plants, this electricity consumption can be converted to equivalent coal consumption and CO₂ generation, using suitable emission factors (as explained later).

c) Energy Saving

There is a net savings in energy seen due to the introduction of MAHSR. A total cumulative savings of 317,608 TJ is estimated between 2023, the start year of MAHSR operations, and 2053, the end horizon of the analysis due to the reduction in the consumption of petroleum fuels. Of this, the largest energy reduction is from air (45%) followed by cars (43%) and then buses (10%). The reduction of energy consumption due to reduced conventional rail travel is estimated to be only 1%.

d) Impacts on CO₂ Emissions with the introduction of MAHSR

The CO₂ emission in the scenario with and without HSR operations for the traffic under study is a function of the volumes of fuels used and their types along with their CO₂ emissions intensities.

e) CO₂ Emissions without MAHSR

As explained in the previous section, as of 2014, petrol is estimated to be the single largest source of energy to drive the traffic considered for the present study. It is also responsible for the largest volumes of emissions generated for driving this traffic with 51% (341 thousand tons of CO₂) of the emissions share, followed by diesel (202 thousand tones of CO₂) and ATF (66 thousand tones of CO₂) and electricity (65 thousand tones of CO₂, *i.e.* 9%).

The CO₂ emissions from cars are estimated to dominate by 2053, with over 79% of the share of total emissions from the traffic under consideration. This is followed by CO₂ emissions generated by airlines (13%), bus (6%) and rail (2%) shares in 2053.

The CO₂ emission for the total traffic under study is estimated to increase by over 12 times between 2014 and 2053. In terms of absolute volumes, it increases from 673 thousand tones of CO₂ in 2014 to 8,120 thousand tones of CO₂ in 2053 in the scenario without HSR.

f) CO₂ Emissions with MAHSR

In terms of fuels used the share of CO₂ emissions generated by petroleum products declines with the introduction of HSR. Between 2014 and 2053, it is estimated that there will be a decline in the share of CO₂ emissions from ATF (from 10% in 2014 to 5% in 2053) and petrol consumption (51% in 2014 and 35% in 2053). These declining shares CO₂ emissions is compensated by increasing shares of CO₂ emissions due to diesel consumption from 30 to 44% in the same period of time.

Increased electricity consumption due to MAHSR operations lead to increase in the shares of CO₂ emissions from electricity between 2014 and 2053. In terms of volumes, the total CO₂

emissions generated due to the consumption of electricity increases from 65 thousand tons of CO₂ in 2014 to 1,267 thousand tones of CO₂ emissions by 2053 due to use by conventional railways and MAHSR.

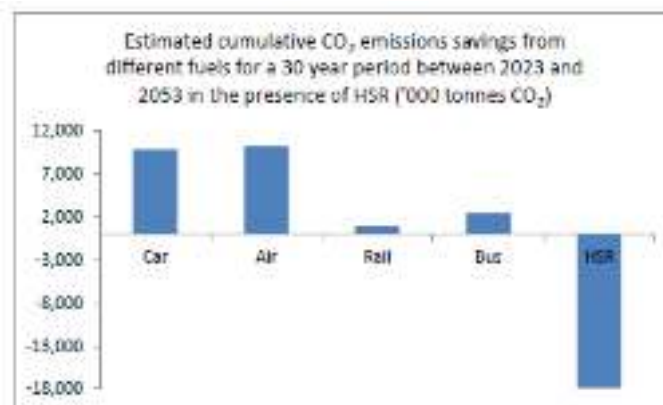
g) Impact of emissions with MAHSR

The relative impact on the CO₂ emissions generated due to the operations of MAHSR is marginal compared to the benefit due to energy savings. While there is a reduction in the total energy consumed by the traffic considered for transport along this corridor, there is little impact on the CO₂ consumptions.

In 2023, the start year of MAHSR, the total emissions due to the traffic considered for this study under the scenario with MAHSR is estimated to be 1,315 thousand tones of CO₂. This is marginally lower than the emissions generated in the scenario without MAHSR in the same year (1,363 thousand tones of CO₂) due to cumulative effect. As a result, there is a slight decline in the overall CO₂ emissions from the traffic even in the starting year of MAHSR operations (reduction of 48 thousand tones of CO₂).

It is, therefore, evident from this study that there are both energy and CO₂ emissions savings potentials from the operations of HSR along the proposed Mumbai-Ahmedabad High Speed Railway Project corridor.

Exhibit 5.5.3: Estimated cumulative CO₂ Emissions savings from different fuels for 30 years period between 2023 and 2053 in the presence of MAHSR (000 tonnes CO₂)



Source: "Estimating the impacts on energy consumption and emissions due to High Speed Rail operations along the Ahmedabad-Mumbai Corridor" by TERI

5.6 MICROCLIMATE CHANGES

The removal of trees on both private and public lands and those in forest reserves may result in changes in micro-climatic effects for the local communities; barring which no other significant adverse climate change impacts are anticipated during construction and operational phases of the project. The construction and operation of the proposed project is not expected to lead to any changes in the precipitation (rainfall) over the region.

5.6.1 Construction Phase

1) Impact

In the construction phase, the impact on local micro-climate is envisaged from the following activities:

- May be temporarily cause warming of local temperature due to operation of large number of heavy construction machineries;
- Continuous running of power back up DG set at the construction camp;
- Clearing of vegetative cover may also lead to rise in the local temperatures over long term.

5.6.2 Operation Phase

As discussed above, there is a net savings in energy due to the introduction of MAHSR. A total cumulative savings of 317,608 TJ is estimated between 2023, the start year of MAHSR operations, and 2053, the end horizon of the analysis due to the reduction in the consumption of petroleum fuels. Of this, the largest energy reduction is from air (45%) followed by cars (43%) and then buses (10%). The reduction of energy consumption due to reduced conventional rail travel is estimated to be only 1%. Further, this would not have meaningful impact on the climate change.

However, following activities can contribute to climate change due to cumulative effect-

- From station area there would be greenhouse gas emission due to running of air conditioning system and DG set
- Increased electricity demand would lead to increase in the CO₂ emission as the power shall be supplied from the coal based thermal power plant
- The temperature in the surrounding area of maintenance depot, which has proposed at Thane and Sabarmati may increase leading to climate change.

1) Mitigation Measures

- Solar PV cell shall be installed on roof top of all the buildings like station, maintenance depot to harness the solar energy;
- To design the building in compliance to the Energy Conservation Building Code 2017 to reduce the power requirement;
- Minimal use of air conditioning system in the station and maintenance depots.

5.7 IMPACTS ON EXISTING WATER SOURCES (QUANTITY) AND QUALITY

5.7.1 Water Demand for Construction

The project corridor is crossing many small rivers, natural stream, *nallahs* along its way. Access to water from these surface water sources may create problems for the local community and downstream users for their consumption.

In case of groundwater sources, there is likelihood that access to the wells could create competition with the existing local community who has priority rights on the local water sources. Therefore, adequate safe distance (this varies from place to place) from the existing ground water sources (borewell/open wells). The ground water table must be observed in order to avoid the well interference and drying up.

1) Project Water Demand

A Project of such magnitude requires large quantity of water both during construction and operation phase. Water demand for project has to be calculated with precision to mitigate any adverse impact on the existing system with timely remedial actions.

Total water demand shall be 24.8 MLD during construction phase for the entire stretch of the project. About 40 numbers of construction yard shall be established during the construction phase. Hence, practically only 0.62 MLD water shall be required at each construction yard, which is marginal and can be met through the existing water source. However, the quantity of water from each source can be ascertained once the location of the construction yard is finalised.

It is estimated that approximately 20,000 workers will be involved in the construction phase for 4 years. MAHSR will be catering to 70,000 passengers per day, 35,000 in each direction at 100% occupancy.

Water demand has been calculated separately for the two phases. Phase – 1: Construction and Phase – 2: Operation. In the Phase – 1 approximately **24.8 MLD** and in Phase – 2 approximately **4.11 MLD** water demand is envisaged. The demand will be distributed along the corridors on the stations, casting yards, maintenance yards, rolling stock etc.

a) Water Demand-Phase-1

The Construction period is assumed to be 4 years (1460 days) and the water requirement will be met from the existing water supply system or nearby water bodies.

(1) Domestic Use: CPHEEO Manual estimates 135 Litre Per Capita Per Day (LPCD) for personal use. With estimated 20,000 workers and average family size of 4 for a total of 80,000 persons, the requirement comes to **10.8 MLD (A)**. This translates to 0.9 MLD per station (approximately 1MLD / Station).

(2) Civil Works: Calculations are presented in Table 5.7.1 to Table 5.7.3 below. Calculating ballpark estimate of water demand during construction:

Total Length of the MAHSR alignment	=	508.50 km
Length in tunnel	=	26.203 km
Viaduct Section	=	482.85 km
Pier dimension	=	3.5*3.5*12 meters (including Pier Cap)
Piles dimension	=	1 m diameter, 20 m depth
No. of piles per pier	=	6
Tunnel diameter	=	14.2 m (outer) & 12.6 m (inner)
Average Span	=	30m

Table 5.7.1: Approximate Quantity of Concrete Used

	Description	Sectional / Length (m)	Breadth / Depth (m)	Ht (m)	Length (m)/No @ 30m per Span	Quantity of Concrete (m ³)
A	Super Structure	@16.03 m ³ /m			482,850	7,740,085
B	Pier (@ Average 30m Span)	4.0	3.5	12	16,095	2,703,960
C	Pile Cap	10.5	10.5	4	16,095	7,097,895
D	Piles @ 1.5 m Dia	@ 10.60 (m ²)		18	16,095	3,070,202
E	Miscellaneous	@ 10 %				2,061,214

	Description	Sectional / Length (m)	Breadth / Depth (m)	Ht (m)	Length (m)/No @ 30m per Span	Quantity of Concrete (m ³)
	Length (Viaduct)	482,850				
	Length (Tunnel)	26,203				
	Total	508,500			Net (A+B+C+D+E)	22,673,356
F	Tunnel		Thickness (m)	Area (sqm)	Length (m)	(m ³)
1	TBM			49.13	15456	759353
2	NATM			25.41	4919	124991
3	Cut and Cover					315461
4	3 Shafts + Audit Tunnel + Eq. Rooms etc.					100051
	Total Quantity					1299857
	Miscellaneous	@ 10 %				129986
					TOTAL (A to F)	24,103,199

Source: Study Team

Table 5.7.2: Water requirement for Viaduct Concrete during Construction

A. Viaduct Water Demand (22,673,356 concrete) in (KL)			
Mix @ 0.170 KL/Cu.m	3854471 KL		
Curing @ 0.300 KL/Cu.m	6802007 KL		
TOTAL	10656478 KL		
Add 20% for Transmission, Leakage, Evaporation losses	2131296 KL		
Total Water	12787773 KL		
Million Litre	12,787		
Say	12,787		
Assuming 1000 days (@2.8 years) of Viaduct Construction (B)	13 MLD	0.026923	MLD/Km

Source: Study Team

Table 5.7.3: Water requirement for Tunnel Concrete

B. Tunneling Water Demand (1429843m ³ concrete) in KL	
Mix @ 0.170 KL/Cu.m	243073 KL
Curing @ 0.300 KL/Cu.m	428953 KL
Total	672026 KL
Add 20% for Transmission, Leakage, Evaporation losses	134405 KL
Total Water in KL	806431 KL
Million Litre (ML)	806
Say	806
Assuming 1000 days of Concreting (C)	1 MLD
Daily Water requirement for Civil Works (B+C)	14 MLD
Daily Water requirement during Construction Phase (A+B+C)	24.8 MLD

Source: Study Team

b) Water Demand: Phase-2

i) Essential Services at Stations

Washroom, Water Fountains, Cleaning and Washing, Kitchen, cafeterias, Restaurants, landscaping etc **(Per Station per day)**

a) Drinking Water	=	6,000 Litre
b) Cleaning and Washing Water	=	17,000 Litre
Total	=	23,000 Litre

Total Water Demand for 12 stations = 253 KLD or **0.253MLD – (A)**

Source:DMRC Kalindi Kunj Corridor, EIA Study.

ii) Maintenance Depot: Washing, Cleaning and Sanitization

Washing of the Rolling Stock at the two maintenance depots -Thane and Sabarmati with assumed frequency of 35 trains per day per direction.

Assuming trains operate between 6am to 9pm (15 hours), 2 round trips are possible by each Train (assuming 2.5 hrs end to end travel time & 0.5 hrs of turning and inspection time). A total of 18 Trains + 1 additional =19 Trains will be required for daily operations. Train capacity is assumed to be 1000 seats in 10 Cars.

1) Washing: @ 1000 Litre/Car = 10,000 Litre per train per day
@19 Train = 190,000 Litre per day or 190 KL or **0.19 MLD**

This requirement will be split equally between the 2 depots, thus 0.095 MLD per depot.

2) Washroom demand @ 10,000 litre per depot = 20,000 L or **0.02 MLD**

Total water demand at depots is estimated to be **0.21 MLD– (B)**

iii) Passenger usage at Stations & onboard Train

The passengers will spend approximately 3.5 hrs on Station & the Train (wait and journey time). Assuming 35 litre of water usage per passenger for drinking and utilities, @70,000 passengers per day = 2,450,000 LPD or **2.45 MLD - (C)**

iv) Miscellaneous

Water would be required for ancillary activities like Landscaping, restaurants, cafeterias at the Stations etc. Assuming 100 KLD per station @12 stations = 1200 KLD or **1.2MLD - (D)**

Total Water Demand for Operation & Maintenance (A+B+C+D) = **4.11 MLD**

5.7.2 Construction Phase

The impact on the surface and ground water quality during the construction phase of the project may be expected from the following activities as detailed below:

- Effluent discharge from the construction camp;
- Sludge from the construction activities;
- Breeding of mosquitoes due to stagnant pool of water;
- Surface runoff from the unpaved road;
- Soil compaction as a result of construction activities;
- Discharge of untreated sewage from camp office, labour camps;
- Increase of sediment load in the runoff from construction sites would increase in turbidity in receiving streams/water bodies;
- Slight change in hydrology and geomorphology of the stretch of water course directly affected by the temporary works at the site;

- Water quality of nearby water bodies due to spillage and uncontrolled release of construction and toxic materials such as cement, concrete, oil, fuel and paints;
- Run-off of silt and spilled materials into the river water may arise from earth works, exposed ground, water collecting in excavations, stockpiled materials and site roads *etc.*

5.7.3 Operation Phase

During operation phase, maintenance gangways from sub-depots at intervals along the MAHSR alignment will maintain and repair track, catenary and other elements. This work could pollute river water with residual oil, grease, iron fillings *etc.* Besides this, some other impacts on the surface water environment would occur as a result of the following:

- Increase in the volume of surface water run-off caused by an increase in impermeable surface associated with the new bridge/crossing;
- Impacts associated with maintenance and repair of bridge which may include sediment aggravation and works on the watercourse banks;
- Increase in the possibility of flood risk.

a) Mitigation Measures (for both Construction and Operational Phases)

- Identification of water sources should include a quick assessment to identify capacities to maintain water requirement of competing users;
- All necessary statutory approvals should be secured from local authorities (Irrigation department for rivers / lakes and Gram Panchayats for wells);
- All applicable water quality standards should be complied with, at all construction sites along the proposed alignment route during the entire period of construction activity;
- It should be ensured that no liquid is discharged from any construction site/activity without treatment;
- Site drainage should be retained in purpose-built lagoons for enough time to allow most sediment to settle out before discharge to natural or urban drains;
- Stockpiled soil and other loose material should be covered with secure tarpaulins and drainage should be passes from stockpile areas into settlement lagoons;
- Since most of the important rivers intersecting the MAHSR alignment already have high turbidity levels, construction work when conducted in such rivers/streams should adopt suitable precautions to minimize and contain sediment disturbance;
- In order to prevent materials leaking from static plant, such as pumps and generators, contaminating the ground and being washed into the drainage system, static plant should be placed on drip trays;
- All parking, repair and fuel storage areas should be located more than 100 m away water body;
- Lagoons or other silt retention measures should be provided at the base of embankments built near water bodies *i.e. near Vaitarna River*;
- Effective storm water drainage system should be provided in every bridge to eliminate / reduce the chance of discharge of untreated storm water directly into the river;
- Measures should be adopted to avoid contact between water and machinery when construction work is conducted in rivers, streams and canals;
- All hazardous materials on-site should be stored in areas with concrete floors enclosed by concrete bunds;
- Oil catch pit/ oil trap may be erected along drain channel from construction site to prevent oily water to flow into any water body;
- As temporary/emergency mitigation, a floating oil boom should be placed on the water surface near construction site to prevent discharge of any trace oil or fuel that may have

entered the drainage system. This would serve as a contingency measure for the surface water body;

- Used oil may be sold to CPCB/ SPCB approved authorized recycler/ re-processor;
- Waste oil should be collected and stored in sealed damage-proof containers and disposed-off at legally approved common landfill site, which can be approached for disposal of waste oil according to local laws;
- To avoid disturbance to natural water course;
- A floating oil boom would be placed on the surface water near the construction sites to prevent discharge of any trace of oil and fuel that may have entered into the drainage system;
- Greening of the excavated area to prevent erosion of soil is one of the mitigation measures on the content;
- All hazardous chemicals would be stored in areas with concrete floors enclosed by concrete bunds;
- Silt fencing may be provided near water bodies;
- Proper sanitation facilities as per PHED norms shall be provided at the construction site to prevent health related problems due to water contamination.

5.7.4 Impacts on Water Use

2) Source of Water Supply

a) Construction Phase

- (i) Since the construction activities will be taken up in various sections along the alignment of the project, the domestic water demand shall be met through piped water supply from local bodies where ever available and in the absence of a piped supply, brought by water tankers or treated local water sources in the vicinity including groundwater. The respective contractors working in each of the sections will be tasked with this responsibility.
- (ii) The water demand for the construction activities shall be met through piped water supply wherever available and in the absence of piped supply, surface water in the vicinity or ground water as available will be used. Considering massive water requirement for civil works, constant supervision would be required on part of the Contractor to prevent over exploitation of surface water sources and adequate water is available for use by local communities.

b) Operation Phase

The demand at stations shall be met through piped water supply since the stations are in the urban or sub-urban area. For maintenance depots through piped water supply as well as the raw water sources like ground water developed during construction phase.

It is advisable to inform the local water supplying agencies of high requirement and apply for sanction of supply for the project life cycle at the earliest to enable them to take necessary action to ensure continuous and uninterrupted supply to the project.

3) Water Use

a) Construction Phase

(i) Impacts

Substantial quantity of water shall be required during the construction phase. The priority shall be given to use surface water wherever surface water source is available. In the absence of assured surface water supply, ground water shall be abstracted which will lead to increasing the depth to water table. It will pose severe water scarcity among the local habitants.

In some places, ground water level is shallow and, therefore, water use from natural resource must be done carefully and shall be assured that the resource is not contaminated.

In case of scarcity of water arises during the construction, the contractor shall explore alternative source of water and shall secure permission, if required. In the General Specification of bidding documents, a consideration/mitigation/securing permission in case of water exploring is specified as a responsibility of the contractor.

(ii) Mitigation Measures

- River water may be used only after obtaining necessary permissions from the respective Government authorities.
- Where there is no possibility for getting surface water for the construction, the ground water will be tapped after obtaining necessary permission from the authorities concerned such as Central Ground Water Authority (CGWA).
- The water course should not be blocked while constructing the corridor, but suitable culverts and drains should be provided for the free flow of water.
- Implement suitable measures to minimize usage of water as well as reduce wastage of the existing water resource to avoid possible impacts on the local population's water supply.

b) Operation Phase

(i) Impacts

- Twelve stations and two maintenance depots have been proposed for the MAHSR project. Total water demand for the stations has been envisaged to the tune of 10.62 MLD.
- Additional load on the local municipal authority may pose water scarcity to the competing users in the surrounding of the stations.
- Substantial water shall be required for the proposed maintenance depots. This may lead to additional load on the municipal authorities of Sabarmati and Thane.

(ii) Mitigation Measures

- To reduce the fresh water demand, recycle mechanism shall be adopted.
- Nowadays "Zero Discharge" concept is being preferred by the SPCBs. Every effort shall be made to achieve "Zero Discharge".

The concept of zero discharge effluent aims to eliminate discharges to the aquatic environment, recycle and reuse all possible liquid process wastes, to the lowest possible quantity and toxicity.

For all practical purposes, the concept of zero discharge necessarily means the following:

- 1) recovery of reusable water/other materials from waste water;
- 2) no discharge of polluting substances into the environment away from the waste water treatment facility

- For washing and cleaning of the floors of the workshops, maintenance depot and stations only recycled water shall be used.

5.8 IMPACTS ON AIR QUALITY

5.8.1 Construction Phase

1) Impacts

During the construction phase, the impact on ambient air quality is envisaged due to fugitive dust emission coming out of the construction site. However, this impact would be of temporary nature and will be localized.

- The earthmoving and construction activities are likely to generate dust.
- In the majority of cases, dust generation would only be a temporary impact. In the event that dust from the construction activities is being deposited on the nearby settlement then the mitigation measures are to be adopted as early as possible.
- Emissions from vehicles and machinery could also impact quality of air in and around construction sites.
- There are some locations, which fall within MAHSR project area such as Dombivali in Thane, Vapi and Ankaleshwar in Gujarat, which are also identified as critically polluted areas by the Central Pollution Control Board based on Comprehensive Environmental Pollution Index (CEPI).
- Fugitive dust emission from the plying of construction equipment and vehicles on the unpaved way particularly in Gujarat state where the proposed alignment of MAHSR passes through the barren and agricultural field. However, this impact would be minimal in the Maharashtra, as the alignment passes through the rocky area and the majority of stretch is covered with black soil.
- Continuous gaseous emission from the running of DG sets at the construction camp.

2) Mitigation Measures

- Consult the local pollution authorities, comply with relevant air quality laws and obtain necessary permissions at least for critically polluted areas before start of any construction related activities.
- Maintain all construction vehicles to minimize vehicle emissions.
- Payload area of the trucks or dumpers should be covered by tarpaulin when transporting soil and crush in order to prevent fall out of fines and emissions of dust. The material carrying trucks or dumpers will carry on the haulage corridors provided for the transport.
- Spray water on the stones while unloading from the truck/dumper, at the primary crusher feeder chute and the transfer points from one belt conveyor to another, etc.
- Facility for regular cleaning and wetting of the unpaved roads and exposed soil on construction sites should be provided in dry weather.
- Trees should be planted to develop a green belt within and along the boundary of the yards and corridor. Vegetation may improve air quality by providing a cooling effect through transpiration (water loss) from their leaves and by filtering atmospheric pollutants through their leaves. By decreasing both the temperature and the amount of pollutants in the atmosphere, trees can have a positive effect in improving air quality.
- Concrete batching plant and other machinery liable to generate dust should be kept away at safer distance from residential areas and should not be in predominant upwind direction of these areas.

- Ensure that all major construction machineries including batching plant placed on construction sites are inbuilt with appropriate dust reduction measures.
- The water sprinkling on the roads used by the trucks, as construction vehicles, should be properly and regularly undertaken, so that dust deposition problem on vegetation is minimized.
- The haul freight corridors inside the quarry should be properly watered to arrest the dust arising out of it.
- Periodic monitoring of ambient air quality should be conducted as per NAAQS, 2009 and submit reports to local State Pollution Control Boards as required in the CTE for the project.

5.8.2 Operation Phase

No major adverse impact on air quality is envisaged in the operation phase as the entire MAHSR alignment will be either on viaduct or in a tunnel. The only adverse impact on air quality is envisaged from the station and maintenance depots in the form of gaseous and particulate emission from DG set.

The only mitigation measure required is to provide adequate height of the stack of DG set to have wider dispersion of the gaseous emission and also to attain the mixing height.

5.9 IMPACTS ON SOIL QUALITY

Existing soil quality could be adversely impacted in the following manner:

- Contamination of land / soil due to concrete slurries, sewage wastewater from labour camps;
- Excavation of contaminated soil debris (from tunneling) and disposal in adjoining areas;
- Spills of materials and construction waste during hauling, storage or transport from site;
- Pollution / contamination at construction camps, electric substations and maintenance yards.

5.9.1 Construction Phase

1) Impacts-Soil Contamination

- The soil contamination may take place near the construction camp site due to untreated discharge of sewerage, spillage from the material storage area, surface run off in the monsoon months from the construction sites.
- Soil contamination is also expected from the leachate phenomena at the C&D dump sites.
- Soil contamination is likely to take place due to leakage of asphalt emulsifier at pavement of road.
- Soil contamination may also take place during filling of oil in vehicles or leakage from vehicles. For this, asphalt emulsifier will be handled with caution and any leakage detected should be immediately rectified.

2) Mitigation Measures

- Mulching should be anchored to the ground to hold the mulch in place, where the land has steep slopes. Mulch is required for seeded and planted areas where slopes are steeper than 2:1. (*Source: EPA, Chapter 3 – Sediment and Erosion Control*).
- Mulching technology should be adopted for soil stabilisation.

- The excavated earth should be covered.
- A stilt fence should be used to detain sediments from a small drainage area.
- Staging should be done to separate undisturbed land from land disturbed by construction activity and material storage.
- Spill prevention and control plans should be made, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills.
- Vegetation may, therefore, be used for modifying the microclimate by obstructing, guiding, deflecting or filtering wind current.

5.9.2 Operation Phase

Where can we anticipate contamination of soil: Exhibit 5.9.2 shows the probable area of soil contamination.

a) Station Areas

- Service areas (tanking, maintenance *etc.*)
- Where locomotives stop
- Accidents
- Exhaust gasses
- Soil disposal

Exhibit 5.9.2: Probable Areas of Soil Contamination



b) Outside Station Areas

- Contaminated soil is rare
- Disposed soil from station areas

5.10 IMPACTS OF WASTE GENERATION

5.10.1 Construction Phase

1) Impacts

The significant quantities of solid waste would be generated by the project, especially during the construction, including gravel; concrete; miscellaneous structures such as culverts, pile head, poles and cables, steel, and organic material such as cleared vegetation, timber; and unused/additional/excavated soil. In addition, there will be spent oils, fuel, grease and chemicals from construction equipment and vehicle servicing. Any hazardous materials that are used will also need to be stored and handled correctly to prevent spills and pollution.

There are multiple waste disposal facilities in the vicinity (Refer Chapter 4, Section-Waste) and disposal shall adhere to the Central Public Health and Environmental Engineering Organization (CPHEEO) Standards of Ministry of Urban Affairs, Government of India, including the usage of such facilities. Recently after notification of the Construction and Demolition Rules 2016, the various municipal authorities have formulated the guidelines for management of C&D waste. Ahmedabad Municipal Authority has published a guideline for management and handling of C&D Waste. It has also identified and demarcated the site for C&D waste.

During the construction of tunnel in Thane creek, huge amount of soil and basaltic rock would be excavated. This soil/basaltic rock must be disposed without damaging the

surrounding environment. It is expected that approximately 35,00,000 m³ (350 hectare-m) soil/basaltic rock would be excavated. Therefore, a considerable area would be required for its safe disposal. Depending upon the quality of the released soil/basaltic rocks can be used for construction purposes.

A study has been conducted for identification of safe disposal site in and around the Thane creek and Mumbai Sub-urban region. The candidate sites are depicted in Exhibits 5.10.1, 5.10.2 and 5.10.3. The locations have been identified within the reasonable range of the different tunnel shaft locations. Therefore, construction of any additional approach road to transport the excavated surplus from work site to disposal area is not required.

Exhibit 5.10.1: Candidate Disposal Site near Location of Shaft 1 (near BKC)



Source: Study Team

Exhibit 5.10.2: Candidate Disposal Site near Durgawadi, Thane



Source: Study Team

Exhibit 5.10.3: Candidate Disposal Site near Thane



Source: Study Team

Table 5.10.1 shows the different candidate locations identified during the reconnaissance survey.

Table 5.10.1: Identified Candidate site in Thane, Mumbai Sub-urban area

Shaft No.	Location	Distance from Shaft	Area (sqm)	Remarks
1	Near Kanjullman Masjid	3.5 km from Shaft No. 1	38165	<ul style="list-style-type: none"> • Huge area, Close to BKS-CST link road, • Easy movement of vehicles
	Near Edelweiss Tokyo Life Insurance Company	3.2 km (from Shaft No. 1)	16445	<ul style="list-style-type: none"> • Close to Lal Bahadur Shastri Road • Big horizontal area • Easy to deal with nearby BMC offices
	Near Napha Bus Stop	1.8 km (From Shaft No.1)	16157	<ul style="list-style-type: none"> • Very close to BKC
2	Deonar Dumping Ground	13.5 km (from Shaft No.2)	623895	<ul style="list-style-type: none"> • Very close to Eastern Express Highway • Huge area for disposal
	Near Railway Police Colony	19.7 km (from Shaft No.2)	15559	<ul style="list-style-type: none"> • Very close to Eastern Express Highway
	Near Ali Yavar Jung	22.3 km (from Shaft No.2)	4936	<ul style="list-style-type: none"> • Very close to Ghansoli flyover
	Near Adinatha Mandir, Mulund (W)	11.8 km (from Shaft No.2)	11678	
3	Near Helen Keller Institute of Deaf & Blind	100 m (from Shaft No. 3)	232542	Huge area and very close to shaft

Source: Study Team

Since surplus soils are generally almost reused, hence it will not have bearing on the existing capacity of the disposal site.

For the Thane creek section, the estimated surplus soil/muck is 3500000 m³ and it will be within the capacity of existing disposal site, Thane, Taloja with design life period of 25 years having capacity of 22812500 metric tonnes.

Effort shall be made to re-use to the extent possible like use it in concrete, as blanketing material in railway projects, as filling material for service road, use as fill material for other local construction projects. The precise end use will be decided based on contents and quality of the muck generated.

In the viaduct section of about 487 km, about 40,26,000 m³ surplus soil shall be generated. Out of this 2700000 m³ shall be used in the construction of maintenance road and the remaining 13,26,000 m³ shall be disposed off at the identified disposal site which comes to about 0.1 million m³ per district, negligible amount in comparison to the capacity of the existing land fill sites.

2) Mitigation Measures

- Comply with relevant laws pertaining to the management and disposal of solid waste and hazardous waste.
- Comply with the C&D Rules 2016.
- Before start of construction activities, all suitable disposal measures should be identified for solid waste and any other form of waste likely to be generated from the construction activities.
- A designated solid waste disposal site should be secured away from human settlements. In addition, a disposal site should be away from water streams and any archaeological and historical monuments. Generally barren lands are preferable for this purpose.
- No dumping should be carried out on private property without written consent of the owner.
- No dumping should be allowed on wetlands, forest areas, and other ecologically sensitive areas.
- All the workers at the disposal yard should be provided with safety attire.
- Prepare and implement a hazardous waste management plan for the disposal of waste oil, batteries and other hazardous materials.
- All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids should have a dense base and be surrounded by a bund to contain any spillage. These areas should be covered by a roof structure to minimize the potential for infiltration and contamination of rainwater.
- Areas designed for the storage of hazardous materials are to be clearly designated and storage of such materials outside these areas strictly prohibited.
- Chip and mulch vegetation cleared and reuse it as an organic base for plantation; ensure that materials, which may cause land/water contamination or create odour problems, are not disposed of on the site.
- Ensure that there is the adequate provision of correctly marked waste containers made available at convenient locations for the disposal of wastes.

5.11 IMPACTS ON FLORA

The major impact in this project on flora involves the removal of trees (on both private and public lands) to permit construction and to provide clear zone for safety of the users. Trees

growing within the ROW need to be removed for efficient construction workmanship and more importantly to prevent collision with the trees, in case of accident.

5.11.1 Construction Phase

1) Impacts

- Trees, herbs and shrubs in the ROW will be felled along the alignment route in both the forest and non-forest areas which could adversely affect vegetation cover and local landscape and may lead to habitat fragmentation and loss. There are some scheduled and non-scheduled trees, which will be cut and may impact the conservation and preservation planning and status of the local State Forest Department.
- Diversion of forest area will be 138.3269 ha.
- Diversion of mangrove area will be about 24.3981 ha.
- Loss of vegetation and tree cover (approximately, 60000 trees are expected to be cut, including Government and private lands on the ROW).
- There are several private orchard farms in Gujarat area, which will be affected by the project, which will impact the landscape, local conservation and soil erosion prevention status in this area as well as economic loss to the local people.
- Increased earth and rock extractions during the construction phase may affect or remove root structures and disrupt ecosystems.
- Construction workers demand for food and recreational hunting and fishing primarily impacts fauna but may have subsequent impacts on seed dispersal and overall ecosystem integrity.
- Use of local timber for small scale temporary housing, firewood and other small uses by the construction workers may have negative impacts on natural processes of biological regeneration.
- Deposition of fugitive dust on pubescent leaves of nearby vegetation may lead to temporary reduction of photosynthesis. Such impacts will be more pronounced in the immediate vicinity of the construction area.
- Substantial area (24.3981 ha) of mangrove shall be cleared in Thane district-along the bank of Ulhas River, Vaitarna River as they fall in the RoW of the proposed MAHSR alignment.
- The chainage from Km 43.535 to Km 45.916 involves the alignment passing south of a thickly vegetated and healthy mangrove patch. The construction of a service / access road during the construction phase is expected to cut off the northern area of the mangroves completely from tidal exchange and threatens the long-term survival of the mangroves.

2) Mitigation Measures

- Joint field verification should be conducted with the respective State Forest Department to agree and mark trees to be cut. This will avoid uncontrolled and indiscriminate tree felling.
- Appropriate compensatory plantation using suitable native species or pollution tolerant species should be initiated as per the applicable state level tree felling and preservation acts to compensate for the vegetation loss due to felling of trees during site clearing. The rate of replacement shall be decided by the State Forest Department and informed to the NHSRCL through tree felling permissions for non-forest areas and forest clearance under the FCA for forest areas. If adequate space for compensatory plantation is not available along the MAHSR alignment, compensation plan should be provided by including trees in the design of yards, depots, stations, etc. or in degraded forest lands.

- Adequate discussions should be held with the local Forest Department or any leading NGO or academic/research institutions to avoid introduction of any alien or non-native or invasive species, weeds in the project area.
- For trees to be felled in private land, compensation for trees based on fruit yield value, timber value and other economic value should be given to the owners.
- The need for wood as building materials for workers' temporary housing should be replaced with alternative eco-friendly building materials but if unavoidable, should only be bought from the sustainable source or authorized selling depots in the project area.
- Workers' labour contracts should specify no use of local timber or firewood as term/condition. They should be provided with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract.
- All equipment and plants should be cleaned to the satisfaction of the project engineer prior to their relocation to project sites.
- During site clearing activity, care should be taken to ensure that the vegetation areas affected are to be minimised.
- Minimising clearing to only necessary amount of vegetation from the forest area.
- For mangrove felling, permission from the Mumbai High Court shall be secured. Mangrove Conservation and Management Plan shall be formulated in consultation with Mangrove Cell, Thane and implemented.
- Compensatory mangrove plantation shall be taken up at the identified location in consultation with the Mangrove Cell, Thane in the area of 94.68 ha (with ratio of 1:5).
- Balancing culvert should be provided between chainage Km 43.535 and Km 45.916 for uninterrupted flow of intertidal water for survival of mangrove.
- Mangrove Conservation and Management Plan is discussed in detail in the report submitted by Mangrove Society of India (Refer *Annexure 6.9 (a), Volume II*).

5.11.2 Operation Phase

1) Impacts

Improper post-plantation care/maintenance as well as illegal felling of plantation along MAHSR track will offset all positive efforts by the project.

2) Mitigation Measures

Plantation along the ROW should be maintained properly (in terms of proper inspection / pruning, water and nutrition requirements) as well as protected from illegal felling.

5.12 IMPACTS ON FAUNA

5.12.1 Construction Phase

1) Impacts

- Terrestrial, aquatic and avifauna may be affected in the construction phase by noise and vibration due to running of construction equipment and machinery as well as movement of construction bound vehicles.
- Fauna may be impacted by destruction of their habitats such as bird nests, breeding sites *etc.* due to removal of trees along the proposed MAHSR alignment route.
- Construction workers having greater accessibility to the forest could lead to poaching activity in the forest areas along the corridor.

- Increased sediment loads into major water bodies during bridge construction work may impact aquatic fauna due to temporary loss of habitat and reduced water quality and flow.
- There will be loss of habitat as the MAHSR alignment passes through the ESZ of two PAs and Core Zone of one PA.

2) Mitigation Measures

- Noise and vibration at the construction site should be minimized (as described in previous section) so as to avoid impact on local fauna. All major noise producing construction equipment/machineries should be fitted with acoustic control measures.
- No construction yard should be set up in the forest areas.
- Honking should be strictly prohibited in the forest area by the trucks and dumper used for the construction activity.
- Heavy construction equipment/machineries should be kept away from the forest areas to minimize impact on local fauna. Construction schedule should be timely spaced so that the use of heavy construction equipment/machinery could be avoided near forest areas during the winter season when the migratory birds inhabit the area.
- Soil compaction for embankment work should be done immediately to avoid erosion and consequently increase in sediment loads to the water bodies. Such work should be avoided during the monsoon season.
- Major earth work during construction of important bridges should be done during the dry period.
- The coffer dams used for the construction of bridge piers may lead to increase of turbidity in the river water

5.12.2 Operation Phase

1) Impacts

- Division of habitats due to MAHSR line could affect faunal population range and distribution, ability to mate, connectivity between populations.
- Impact on aquatic fauna in case of accidental oil spill and toxic chemicals release find its way into the water bodies.
- The noise and vibration generated by the MAHSR project may disturb the wildlife especially in the night time.

2) Mitigation Measures

- Immediate actions should be taken for speedy cleaning up of oil spills, fuel and toxic chemicals in the event of accidents.
- Crossing structures should be put in place where the MAHSR line passes through the forest patches. The proposals should be discussed with the local Forest Department or local NGO or academic/research institutions to determine the location, frequency, basic design and number of crossing structures.

5.13 IMPACTS ON PROTECTED AREAS

5.13.1 Construction Phase

1) Impacts

- Mangrove area with dominant species of *Avicennia spp.* and *Salvadorapersica* having conservation concern in the Maharashtra State, will be affected by construction of MAHSR project.
- Some endangered species of trees such as *Sterculiaurens* in the RoW near SGNP and TWLS will be felled along the alignment route which could adversely affect conservation status and may lead to habitat fragmentation and loss.
- Fauna may be impacted by destruction of water holes and habitats such as bird nest and breeding sites along the new alignment route near protected area.
- The Thane Creek Flamingo Sanctuary where undersea tunnel has been proposed may have adverse impact on the flamingo as the mud flats may get disturbed during the construction of undersea tunnel.
- Due to running of TBM undersea, may cause vibration and due to continuous shaking of the mud flat, which is resting ground for the flamingo, may get compacted. It will result in the loss of resting ground for flamingo.
- **Annexure 5 (f), Vol-II** presents a discussion on potential impacts due to noise and vibration (during the construction and operational phases) on the Flamingo population in the TCFS.
 - In the discussion, it is concluded that while the overall impact on the avian fauna in Thane creek due to noise and vibration is expected to be low / insignificant, the precise nature and extent of the impact is still unknown due to lack of adequate information and past studies in the region. It is, therefore, recommended (and discussed in the EMP – Chapter 6) to adopt the following measures:
 1. Design and Engineering to adopt preventive mitigation measures in tunneling technology
 2. Contractor to implement measures as outlined in the EMP to reduce impact of noise and vibrations
 3. NHRCL to implement a comprehensive ecological monitoring plan in the Thane creek area, to continuously monitor impacts on avian fauna during operational phase of the MAHSR

2) Mitigation Measures

- The loss of mangrove vegetation due to MAHSR project should be compensated by replanting at with ratio of 1:5 at other identified sites so that there is no net overall loss of this important habitat. NHRCL should held discussions with the Mangrove Cell, Thane and pay legally required compensation so that they can integrate it in their overall mangrove afforestation plan at the State Level.
- Appropriate compensatory plantation should be initiated for endangered species in degraded forest land within SGNP as per the guidelines of the State Forest Department.
- Water holes at strategic sites should be developed in consultation with the SGNP authority. This should be developed inside the forest areas to encourage movement inside and minimum distraction outside.
- No earthen material or water from the springs present in the protected area should be used for the construction activity.
- A comprehensive Management and Conservation Plan for the Thane Creek Flamingo Sanctuary has been formulated [refer **Annexure- 4.15 (b), Vol-II** of the S-EIA Report], and its recommendation should be implemented.

5.13.2 Operation Phase

1) Impacts

- There is a potential of direct impact of MAHSR trains hitting wildlife (particularly avifauna) near protected area since MAHSR trains will be running at a speed of 320-350 km/h on viaduct at a height of 10 m-15 m.
- Due to aerodynamics and eddy current form by the shape of the running high speed train shall have adverse impact on the wildlife.

2) Mitigation Measures

- Incorporate into the design underpasses, pipe culverts and/or other structures as needed to allow wildlife to cross line safely.
- Viaduct structure has been planned for the MAHSR alignment in the ESZ of SGNP and TWLS to facilitate free movement of wildlife.

5.14 IMPACTS ON HYDROLOGY

5.14.1 Construction Phase

The hydrological analysis of the river intersecting the MAHSR alignment is presented in Table 5.14.1.

Table 5.14.1: Hydrological Analysis of River Crossings

S. No.	Chainage (m)	Name of River/Nallahs/ Stream/ Water Body	Discharge (cumecs)	Bed Level (m)	Water Level at the Time of Survey (m)	HFL (Designed /Local inquiry) (m)	Dry/ Waterbody
1.	28800	Ulhas River	10898	-17	-1.420	5.50	Waterbody
2.	38380	Ulhas River	1294	-5.15	1.136	4.00	Waterbody
3.	51830	River	605	0.635	1.824	3.568	Waterbody
4.	72600	Vaitarna River	14703	-8.879	0.947	4.00	Waterbody
5.	166700	Daman Ganga River	22045	12.193	14.437	26.50	Waterbody
6.	174780	River	1036	10.05	12.55	15.874	Waterbody
7.	175039	River	1038	9.723	12.123	15.847	Waterbody
8.	175526	Kolak River	2917	7.806	11.296	21.02	Waterbody
9.	187275	River	448.441	18.01	18.51	21.413	Waterbody
10.	190095	Par River	6991	6.288	8.488	19.34	Waterbody
11.	195490	River	189.923	16.11	Dry during survey	18.338	DRY
12.	196334	River	297	16.18	16.845	18.040	Waterbody
13.	198200	Auranga River	3510	4.003	6.667	16.00	Waterbody
14.	212550	Kaveri River (S)	2973	3.338	5.212	13.00	Waterbody
15.	214400	Kaveri River (N)	2907	0.276	2.776	12.50	Waterbody
16.	228550	Ambika River	4519	0.150	1.521	16.00	Waterbody
17.	240000	Purna River	10140	-1.880	1.293	13.75	Waterbody
18.	250335	Mindhola River	6546	-0.352	1.958	12.50	Waterbody
19.	276300	Tapi River	41000	-0.737	4.486	21.00	Waterbody
20.	293285	Kim River	1659	3.305	4.872	13.80	Waterbody
21.	320951	Narmada River	79650	-2.537	1.357	14.55	Waterbody
22.	373093	Dhadhar River	1659	8.249	8.607	21.75	Waterbody
23.	376810	Vishwamitri River	2275	7.989	9.478	18.125	Waterbody
24.	380315	Vishwamitri	2237	10.19	13.37	17.479	Waterbody

S. No.	Chainage (m)	Name of River/Nallahs/ Stream/ Water Body	Discharge (cumecs)	Bed Level (m)	Water Level at the Time of Survey (m)	HFL (Designed /Local inquiry) (m)	Dry/ Waterbody
		River					
25.	380580	Vishwamitri River	2208	9.826	10.744	17.795	Waterbody
26.	386015	Vishwamitri River	1370	13.91	15.328	25.495	Waterbody
27.	387270	Vishwamitri River	No need	15.67	16.904	25.825	Waterbody
28.	388057	Vishwamitri River	No need	16.93	18.075	25.891	Waterbody
29.	388225	Vishwamitri River	No need	16.45	17.636	25.824	Waterbody
30.	388380	Vishwamitri River	No need	16.34	17.819	26.041	Waterbody
31.	395000	Vishwamitri River	1219	22.26	22.343	33.407	Waterbody
32.	412360	Meni River	2081	20.82	22.021	29.458	Waterbody
33.	417120	Mahi River	41081	6.132	9.090	31.00	Waterbody
34.	463950	Mohar (Shedhi)River	2058	19.51	20.011	29.450	Waterbody
35.	473500	Vatrak River	6602	22.46	Dry during survey	32.50	DRY
36.	476600	Meshwa River	2228	24.7	Dry during survey	33.200	DRY
37.	488000	Khari River	1226	33.55	Dry during survey	37.169	DRY
38.	504455	Sabarmati River	15834	35.844	40.992	47.60	Waterbody

Source: Study Team

1) Impacts

- The MAHSR line intersects both perennial and non-perennial drainage system at several places which has the potential to directly affect the drainage conditions of the area. Moreover, construction sites and surrounding land may become flooded if drainage channels are blocked and if site drainage is not removed effectively.
- Increased incidence and duration of floods due to obstruction of natural drainage courses by the embankment.
- While crossing the water body, the location of piers and length of span shall be adjusted to avoid any obstruction to flow of the river. It will be ensured that the waterway available on these rivers through existing road or rail bridges in the vicinity will not be further constricted. It is anticipated that there would not be any adverse impact on the hydrology of the river.

2) Mitigation Measures

- No material should be dumped into natural drains or block, impede or alter drainage channels.
- Adequate cross drainage channels (longitudinal and median drains) should be provided along MAHSR route at suitable locations for the smooth passage of the surface run-off to prevent flooding.
- Capacity of existing drainage works, cross drainage structures in the parallel section should be duly augmented, wherever necessary or river channel should be realigned.

- Suitable drainage at construction site and camp should be provided to avoid formation of stagnant pool of water that lead to soil erosion, water logging and breeding of mosquitoes.

5.14.2 Operation Phase

1) Impacts

- No significant impact is anticipated during the operation of the MAHSR project.

2) Mitigation Measures

- Longitudinal drains of sufficient capacity should be provided on both sides of the maintenance road to accommodate increased run-off. The outfall of these drains should be in the nearby culverts/bridges on *nallahs* (canals)/rivers/drains.

5.15 IMPACTS ON TOPOGRAPHY AND GEOLOGY

5.15.1 Construction Phase

1) Impacts

- The MAHSR alignment which passes through plain, rolling and hilly terrain could impact the overall relief of the region.
- The possibility of weak zones such as faults, joints, and shear zones could enhance the rock-joint rupture hazard during deep cutting and rock excavation work in hilly area of Mumbai and Thane.
- Disfiguring of topography due to indiscriminate digging of borrow pits.

2) Mitigation Measures

- The necessary details should be studied for rock-rupture hazards and bed rock geology along with characterization of weak zones in Vasai detour before construction work.
- Only identified borrow pits and quarry sites should be used to avoid any disfiguring of topography.
- Construction materials should be procured from the approved and licensed quarry sites only.

5.16 IMPACTS ON SOIL AND SLOPE STABILITY

5.16.1 Construction Phase

1) Impacts

- During construction, loose soil could result in silt run-off if exposed to wind or rain and appropriate compaction or stabilization measures are not adopted immediately.
- Loss of productive soil may result from uncontrolled opening up of borrow pits.
- Loosening of top soil and loss of vegetative cover from the RoW section due to excavation, land cut and back filling could lead to soil erosion.

2) Mitigation Measures

- Embankment slopes made from earthen material as well as exposed surfaces of hills should be protected from low cost bio-engineering products for preventing soil erosion in areas which have high soil erodibility or high intensity rainfall.
- As far as practicable, top soil removed from the construction sites should be used for construction of embankment to enhance growth of vegetation on the embankment surface and its consolidation.
- Adequate temporary or permanent drainage should be provided before slope construction begins with lagoons to allow silt to settle out.
- Top soils of the borrow pit sites should be conserved and restored after excavation is over.
- Stockpiles of construction materials should be located away from rivers, streams, fertile agricultural lands, recorded forest lands or inhabited area.
- Appropriate measures should be installed around stockpiles to retain runoff water and any silt it contains.
- Use of fly ash as a substitute to top soil in construction of roads should be done but only after careful analysis of site conditions such as ground water level, soil texture, infiltration rate *etc.* The usage of the fly ash in different forms such as fly ash mix cement, fly ash bricks, ready-mix concrete *etc.* during construction phase should be encouraged to comply with relevant laws.
- Earth dikes and contour trenching should be provided around the soil dump area.
- Temporary seeding should be adopted to reduce erosion and sedimentation from disturbed areas that will not be stabilized for long period and where permanent plant growth is not appropriate.
- Mulching should be anchored to the ground to hold the mulch in place, where the land has steep slopes, steeper than 2:1 (*Source: EPA, Chapter 3-Sediment and Erosion Control*).

5.16.2 Operation Phase

No major impact on soil is expected during the operation phase of the project as MAHSR runs either on viaduct or through tunnel.

5.17 IMPACTS ON CULTURAL HERITAGE

5.17.1 Construction Phase

1) Impacts

- Construction work may affect designated monuments or sites if carried out close to these areas and excavation could reveal and damage previously unknown remains.
- As per the result of the field survey, there is no notified heritage site falling within the RoW limit.
- During the field survey it has been observed that two heritage sites-Sidi Bashir Mosque - (Jhulta Minar) near Kalupur Railway Station Road, Sakar Bazar, Kalupur, Ahmedabad about 138 m on the LHS of MAHSR alignment and another historic Site S. No. 431,435 near Near Natraj Township, Vadodara about 125 m on the RHS of MAHSR alignment are within the zone of influence.

2) Mitigation Measures

- If construction work is carried out in the limits of prohibited area (within 100 meters) or regulated area (100-200 meters) of any designated heritage or archaeological sites and remains, permission should be obtained from the relevant authorities.
- No building or structure of historical importance which has been in existence for more than 75 years should be demolished without informing the concerned authorities.
- Prescribed procedures for taking permission from the local authority or village panchayat or local community should be done before excavation of any burial ground, graveyard or Eidgah.

5.17.2 Operation Phase

1) Impact

No major adverse impact is anticipated during the operational phase of MAHSR as there is no cultural heritage site/ archaeological site notified by the Archaeological Survey of India (ASI) falling within the RoW limit.

2) Mitigation Measures

Blasting should be avoided near the heritage sites or any old structure which has been declared as unsafe by the local authorities.

5.18 IMPACTS ON COMMUNITY HEALTH

5.18.1 Construction Phase

1) Impacts

- Associated risks from accidents and incidents could affect health and safety of workers and others on site.
- Since location of most of the construction sites will be away from the medical centers/hospitals/nursing home improper first aid facilities on site could affect health and safety of workers and others on site.

2) Mitigation Measures

- Relevant labour laws should be strictly complied with pertaining to the health and safety of workers, employees and others.
- All workers and staff should be provided with Personal Protective Equipment (PPE) appropriate to their job on-site.
- All construction sites should be surrounded with secure tamper-proof fence, with security lighting, regular security patrols and other security measures.
- All materials and components should be stored and stacked safely in dedicated secure areas.
- Avoid use of any paints containing lead or its compounds as well as high VoCs
- Avoid roofing materials containing asbestos.
- Smoking should be prohibited near areas of fire or explosion risk.
- Sufficient supply of potable water should be ensured for all workers and employees on-site.
- Ensure that first aid kits are available in all work areas, supplied with adequate material to treat common workplace injuries.

- Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. Record of all nearest hospitals and health centers should be kept at each construction sites.
- A regular medical facility should be provided at each labour camp with suitable qualified staff and equipment to treat minor ailments and injuries.
- An effective alarm system should be established to warn track workers of approach of trains on existing IR lines in parallel route alignment.
- Protect all electric sub-stations, high-tension towers and other areas from electrocution risk by providing security fencing and lights, warning signs and security patrols.

5.18.2 Operation Phase

1) Impacts

No adverse impact is envisaged on the health during the operation phase of MAHSR. Hence, no mitigation plan is recommended.

5.19 IMPACTS ON LABOUR HEALTH (with specific focus on HIV/AIDS)

5.19.1 Construction Phase

1) Impacts

Existing survey results indicate that HIV infection rates in rural areas are low in India. However, the number of people infected with HIV/AIDS in the whole of India is 2.39 million which is second most in the world. The highest risk of HIV transmission is apprehended during the construction phase. The construction phase is expected to bring groups with high prevalence of HIV infection *e.g.* Long route truck drivers, commercial sex workers *etc.* in direct contact with groups at high risk of vulnerability of HIV infection *e.g.* single migrant male. Injectable drug users and men who have sex with men are also expected to be present in large numbers.

2) Mitigation Measures

- Mass campaign shall be organized regularly at each construction camp.
- The workers shall be educated about the HIV and its precaution.
- Easy availability of personal protection devices like condoms and diaphragms.
- Sustained ICE activities and counseling mechanism.
- Regular home visit holidays.
- Collaboration with local police to curb the sale and use of Narcotics.

5.19.2 Operation Phase

1) Impacts

Due to HSR commissioning, it is anticipated that increased movement of people between urban and rural areas will occur, thus increasing the possibility of spreading infectious diseases in the rural areas.

2) Mitigation Measures

The project developers are also advised to act in consonance with the new HIV / AIDS Prevention and Control) Act, 2014 with regards to employment, termination of employment, access to health care, housing, access to other facilities *etc.*

5.20 IMPACTS DUE TO LABOUR CAMPS

5.20.1 Construction Phase

1) Impacts

- Labor camps can damage trees, crops, habitats and landscape when built and affect water and air quality and cause social problems when in use.

2) Mitigation Measures

- Camp locations should be carefully selected to minimize loss of trees/habitats/crops.
- Camps should be located away from inhabited areas, fertile agricultural lands, notified forest areas, and rivers or streams.
- Camps should be designed as per the local laws and guidelines.

5.20.2 Operation Phase

1) Impacts

No impact is anticipated during the operation phase

5.21 IMPACTS ON ETHNIC/ INDIGENOUS PEOPLE

5.21.1 Construction Phase

1) Impacts

- As per the census records of 2011 the population of the Scheduled Tribes (ST) in the study area/Zone of Influence stood at 104560.
- The exact number of ST to be displaced have been documented in RAP.
- Especially in Palghar district, a number of STs shall lose their land and some of them may be displaced.
- Fishermen communities were also found near Bharuch, Ulhas River-Brahmangaon and other places also.
- Fishermen may get affected during the construction phase of the project.
- The project alignment does not intersect the fishing ground while crossing the Narmada River near Bharuch and there is no mangrove in the ZOI (Zone of Influence).
- As for as other place is concerned, the project is running under tunnel from 0.000km to 21.000km and after that on elevated structure with height varied from 11 to 26m, so that there is no significant impact is anticipated on fishermen community due to the project.
- Advance Press notification was published in the local newspaper prior to environmental information disclosure public consultation followed with the individual intimation to each village Panchayat of the district. The public consultation was open to everybody including the fishermen communities of the village.

2) Mitigation Measures

- Suitable RAP has been formulated.
- As specified in the IPP & RAP Report, the priority shall be given to ethnic/indigenous people in the employment under un-skilled category.

5.21.2 Operation Phase

1) Impacts

No impact is anticipated during the operational phase of the project on the ethnic community and indigenous people.

5.22 IMPACT ON INVOLUNTARY DISPLACEMENT

5.22.1 Construction Phase

1) Impacts

The proposed alignment of MAHSR is very extensive and has sections of very large curve radii to enable high speed train operation. Due to these factors, relocation of a large number of residences cannot be avoided. This will accompany involuntary resettlement. The impact shall be avoided and/or mitigated as much as possible. The acquisition of land and private property shall be carried out in accordance with the RAP. Compensation and assistance package has been planned in RAP, for which Social Impact Assessment Study has been carried out.

2) Mitigation Measures

The mitigation measures envisaged for ameliorating the impacts as discussed above is detailed in Table 5.22.1.

5.22.2 Operation Phase

1) Impacts

No impact is envisaged during the operational phase of the project. Moreover, this issue shall be settled and mitigated at the construction phase of the project.

Table 5.22.1: Mitigation Measures for Social Environment

Item of Impact	Mitigation Measures	Implementing Organization	Responsible Organization
Involuntary Resettlement	<ul style="list-style-type: none"> - Conduct census survey and local stakeholder meeting. - Prepare RAP involving the following measures. - PAPs must be acknowledged as an eligible for compensation. - Identify the eligibility of non-titled people at the census survey intended to PAPs and ensure the compensation and support. 	NHSRCL	NHSRCL

Item of Impact	Mitigation Measures	Implementing Organization	Responsible Organization
	<ul style="list-style-type: none"> - Refer the previous/on-going projects by other donors, determine the requirement for social vulnerability and compensate to them. - Resettlement site must be prepared when PAPs need it. - Confirm if resettlement activities conform to RAP or not by internal monitoring <i>etc.</i> - Establish Grievance Redress Committee - Establish external monitoring committee consists of the third party. 	NHSRCL	NHSRCL
Local economies, such as employment, livelihood <i>etc.</i>	<ul style="list-style-type: none"> - Prepare RAP involving the measure to restore PAPs' livelihood 	NHSRCL	NHSRCL
Land use and utilization of local resources	<ul style="list-style-type: none"> - Provide urban planning to enhance appropriate development of the MAHSR corridor. - Utilize local materials and products, human resources related to construction and operation. 	NHSRCL	NHSRCL
Social institutions, such as social infrastructure and local decision making institutions. Existing social infrastructure and services	<ul style="list-style-type: none"> - Social utilities; such as power supply, drinking water, drainage and communication line are to be diverted before starting the construction activity in consultation with the social groups/Panchayats/Gram Sabha. 	NHSRCL	NHSRCL
Poor People	<ul style="list-style-type: none"> - To minimize impact on present agricultural activities, the construction schedule should be disclosed to the PAPs at the earliest possible stage. - The proper compensation should be given to the PAPs. 	NHSRCL	NHSRCL
Indigenous or ethnic minority people	<ul style="list-style-type: none"> - Prepare IPP involving the measure to restore STs' livelihood 	NHSRCL	NHSRCL
Misdistribution of benefits and damages	<ul style="list-style-type: none"> - Conduct a further SHMs and confirm a physical misdistribution - When issues will be settled by providing structures, it will be considered in D/D 	NHSRCL	NHSRCL

Item of Impact	Mitigation Measures	Implementing Organization	Responsible Organization
Local conflicts of interest	<ul style="list-style-type: none"> - Conduct a further SHMs and confirm a physical misdistribution - When issues will be settled by providing structures, it will be considered in D/D 	NHSRCL	NHSRCL
Gender	<ul style="list-style-type: none"> - When women group employed, provide their own toilet and rest station 	NHSRCL	NHSRCL
Children's right	<ul style="list-style-type: none"> - When the school is affected due to HSR Project, construct their new school prior to start the construction activity - Present commuting distance must be considered when prepare settlement site. 	NHSRCL	NHSRCL
Infectious diseases such as HIV/AIDS	<ul style="list-style-type: none"> - HIV/AIDS related workshops shall be provided for construction workers - Periodic health checks and HIV/AIDS tests shall be provided for construction workers 	Contractor	PIU
Working Conditions	<ul style="list-style-type: none"> - Construction personnel provided with the necessary safety gears such as protective hard hat and safety belt. - Contractor/owner of rolling stock inspection and repair must provide temporary scaffolding, temporary landslide protection wall <i>etc.</i> to protect workers. 	Contractor	PIU
Social Consensus	<ul style="list-style-type: none"> - The SHM was organized at every affected Tehsil/Taluka/District by NHSRCL as a part of the SIA and RAP. 	NHSRCL	NHSRCL

Source: Study Team

5.23 CONSOLIDATED IMPACT EVALUATION

Based on JICA's guidelines on Environmental and Social Considerations issued in April 2010 and the components of the MAHSR project, the envisaged impact matrix is discussed and presented in Table 5.23.1, which compares the impact evaluation carried out in the scoping stage (Yellow column) and the one after the EIA study (Green column).

Table 5.23.1: Result of Impact Evaluation

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase	
Pollution Control	1 Air Pollution	A-	B-	A-	B-	<p>Construction Phase Fugitive dust emission is expected during the construction phase due to running of construction vehicles and construction equipment. Hence the impact was evaluated as A-.</p> <p>Operation Phase No major impact is envisaged on the air quality in the operation stage of the project the impact was evaluated as B-.</p>
	2 Water Pollution	B-	D	B-	D	<p>Construction Phase Contamination of natural water course is envisaged during the construction phase due to surface run off and discharge from the labour camp. Hence the impact was evaluated as B-.</p> <p>Operation Phase Because in the operation stage of the MAHSR project, no major impact is envisaged on the water quality. Only at the station some domestic effluent may be generated which shall be discharged only after the proper treatment, the impact in the operation phase was evaluated as D.</p>
	3 Wastes	A-	C	A-	D	<p>Construction Phase Huge quantity of waste shall be generated during the construction stage. Hence the impact was evaluated as A-.</p> <p>Operation Phase Only municipal solid waste shall be generated during the operation stage of the project, hence the impact has been evaluated as D.</p>
	4 Soil Pollution	B-	B-	B-	D	<p>Construction Phase In case of leakage of the lube oil/HSD from the construction yard can lead to deterioration of soil quality. In view of this</p>

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation	
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase		
Natural Environ						the impact was evaluated as B-.	
	5	Noise and Vibration	B-	B-	B-	B-	<p>Operation Phase No major threat to soil contamination or soil pollution is envisaged during the operation phase of the project. Thus, the impact in the operation phase was evaluated as D.</p>
	6	Ground Subsidence	B-	B-	B-	C	<p>Construction Phase It is expected that noise and vibration shall be propagated due to running of HEMs and blasting in the hard basaltic rocks particularly in the Thane Creek. The impact was evaluated as B-.</p> <p>Operation Phase Noise and vibration are envisaged due to running of high speed train. Tunnel sonic boom is expected during the MAHSR operation, the impact was evaluated as B-.</p>
	7	Offensive Odor	B-	D	B-	D	<p>Construction Phase Minimal offensive odor is envisaged during the construction phase mainly because of the use of paints and oil in the construction yard. Thus the impact was evaluated as B-.</p> <p>Operation Phase After completion of the construction activities, the impact would be negated. Thus, the impact in the operation phase was evaluated as D.</p>
1	Protected area	A-	A-	A-	B-	<p>Construction Phase Significant impact on SGNP, TWLS and Thane Creek Flamingo Sanctuary is envisaged</p>	

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation	
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase		
						<p>during the construction phase, as the MAHSR alignment passes through these protected areas. Thus the impact was evaluated as A-.</p> <p>Operation Phase The impact on the wildlife habitat would be temporary and eventual. Hence the impact was evaluated as B-.</p>	
	2	Ecosystem	A-	A-	A-	B-	<p>Construction Phase There may be loss of wildlife habitat due to construction activities in the ecologically fragile area. The movement of habitat may get hampered due to running of HEM. Therefore, the impact in the pre-construction/construction phase was evaluated as A-.</p> <p>Operation Phase Since no impact to ecosystem is considered in the operation phase, the impact was evaluated as B-.</p>
	3	Hydrology	B-	B-	B-	B-	<p>Construction Phase There is a possibility of adverse impact on hydrology by the bridges construction on rivers and by the tunnel construction. Thus the impact was evaluated as B-.</p> <p>Operation Phase No adverse impact on hydrology is envisaged in the operation phase. Therefore, the impact was evaluated as B-.</p>
	4	Topography and Geology	B-	B-	B-	D	<p>Construction Phase Embankments, cuttings, viaduct structure and tunnel excavation may lead to changes in the topography of the local site. Thus the impact was evaluated as B-.</p> <p>Operation Phase No adverse impact on topography and geology is envisaged in the operation phase of the project. Hence, the impact was</p>

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase	
						evaluated as D.
Social Environment	5 Bottom Sediment	B-	D	B-	D	<p>Construction Phase There may be some disturbance to the bottom sediment during the construction phase, particularly during the bridge and tunnel constructions. Therefore, the impact was evaluated as B-.</p> <p>Operation Phase No adverse impact on bottom sediment is envisaged in the operation phase. Thus the impact was evaluated as D.</p>
	1 Resettlement	A-	A-	A-	D	<p>Construction Phase Structures including residences, shops, factories, warehouses <i>etc.</i> shall be displaced due to the HSR project. Once the resettlement is completed, adverse impacts will not remain. Therefore, the impact was evaluated as A-.</p> <p>Operation Phase No adverse impact is envisaged in the operation phase. Thus the impact was evaluated as D.</p>
	2 Water Use	B-	B-	B-	C	<p>Construction Phase Due to large quantity of water demand during the construction phase, the impact on availability of water for the downstream users can be expected. However, this will be temporal in nature. Thus the impact was evaluated as B-.</p> <p>Operation Phase Minor impact on water use is expected in the operation phase. Therefore the impact was evaluated C.</p>
	3 Living and Livelihood	A-	A-	A-	B-	<p>Construction Phase Some project affected persons (PAPs) will be forced to change/lose their jobs, on the other hand, the construction activity will</p>

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase	
						<p>create job opportunities for the local people. Thus the impact was evaluated as A-.</p> <p>Operation Phase The MAHSR project is expected to enhance the local economy significantly as well as create job. On the other hand, it is assumed that there might be a possibility of residual impact to aforesaid PAPs. Therefore, the impact was evaluated as B-.</p>
4	Cultural Heritage	B-	B-	B-	B-	<p>Construction Phase There may be displacement of some of the Temples/Eidgah/ Mosque due to construction and land acquisition. Thus the impact was evaluated as B-.</p> <p>Operation Phase No significant impact is expected during the operation phase of the project. Thus the impact was evaluated as B-.</p>
5	Landscape	B-	B-	B-	B-	<p>Construction Phase Due to coming up of viaduct structure of the MAHSR, new landscape would be created. Thus the impact was evaluated as B-.</p> <p>Operation Phase Impacts on existing landscape is envisaged due to coming up of proposed HSR structure. Thus the impact was evaluated as B-.</p>
6	Ethnic minorities and Indigenous peoples	B-	B-	B-	B-	<p>Construction Phase In certain section of the proposed alignment, the presence of indigenous/ethnic and minority group has been encountered. Their social status may get affected due to inflow of external people. Therefore, the impact in the pre-construction/construction phase was evaluated as B-.</p> <p>Operation Phase This issue may persist during the operation phase also to a certain extent. Thus the impact was evaluated as B-.</p>

Category	Impact Item	Evaluation on Scoping		Evaluation based on the Impact Assessment		Reason of the Evaluation
		Pre-construction/Construction Phase	Operation Phase	Pre-construction/Construction Phase	Operation Phase	
Evaluation:						
A: Significant Impact, B: Some Impact, C: Impact unknown, and D: Impact is minor						
+: Positive Impact, -: Negative Impact.						
The parameters of this scoping were determined based on the JICA guidelines.						

Source: Study Team

5.24 LOCATION SPECIFIC IMPACTS

The proposed MAHSR alignment traverses through various land uses, topography and ecological set up from Mumbai to Ahmedabad comprising sensitive receptors and valuable natural resources in the form of ponds, lakes, mortuary, protected areas, forests, cultural heritage sites, religious structures, old structures of old civilization.

While the previous sections presented information on generic impacts across environmental themes, during the construction and operational phases of the project there would also be specific and localized impact on some of the receptors mentioned above. The magnitude of impacts on these natural resources and structures are elaborated in this section.

5.24.1 Mangroves

The MAHSR alignment passes through thick mangrove patches at several locations in Thane Circle. During the construction phase mangrove area of about 32.2168 ha shall be cleared for service/maintenance/access roads and pier's foundation. The details of affected mangrove area to be affected are given in Table 5.24.1.

Table 5.24.1: Mangrove Areas Affected

Sl. No.	Chainage Start (Km)	Chainage End (Km)	Length (m)	Location	Area Affected (Ha.)	Degree of Impact	Structure
1	7245	9800	2555	Thane Creek	7.9921	None	Tunnel
2	12750	14791	2041	Kopar Khairane / Thane		None	Tunnel
3	25000	36700	11700	Mahatardi, Bharodi, Dive, Kasheli, Kalher, Kopar, Thane	17.7079	Severe	Viaduct
5	36700	41600	4900	Kewani, Kharbhav, Thane	1.6611	Severe	Viaduct
6	41600	46600	5000	Malodi, Payegaon,	4.1436	Severe	Viaduct

Sl. No.	Chainage Start (Km)	Chainage End (Km)	Length (m)	Location	Area Affected (Ha.)	Degree of Impact	Structure
7	71000	71900	900	Paye, Thane Shirgaon, Ghaskopari, Palghar	0.8852	Severe	Viaduct
Total Area					32.3902		

Source: Study Team

From chainage Km 43535 to Km 45916 involves the alignment passing south / southwest of a thickly vegetated and healthy mangrove patch. The construction of a access / service road along the alignment, and the nature of the mangrove layout, is expected to cut off the northern area of the mangroves completely from diurnal tidal water exchange and threatens the long term survival of the mangroves in this area. Since this access road is a permanent structure that will continue as a service road in the operational phase, hence proper engineering mitigation to allow tidal water exchanges has to be incorporated.

5.24.2 Forests

Based on the Land Acquisition Plan (LAP), about 1415.75 ha. of land shall be acquired for the project. Out of this, 132.2235 ha. of forest land comprising Protected Forest, Reserved Forest and un-scheduled forest, shall be diverted including the mangrove forest (Reserved Forest) of 32.3902 ha. in the state of Maharashtra. The forest land of Maharashtra falls in Thane, Dahanu Division and Mangrove Cell, Thane under Thane Forest Circle. The proposal for forest clearance has been submitted as the Proposal No. FP/MH/RAIL/31785/2018 for the forest land falling in Maharashtra. The forest proposal for the diversion of forest land of 6.1034 ha. has been submitted vide proposal No. FP/GJ/RAIL/33381/2018.

Apart from the forest land, a number of trees on the private/Govt. land shall be felled during the construction phase. At this stage the number is not certain but as per the estimate of the desktop study it will be in the range of 60000. The exact number shall be ascertained after tree counting is completed.

5.24.3 Sensitive Receptors- Religious Structure/Educational Institution/Hospital/Eidgah/Mosque

A number of religious structures/educational institutions/hospitals/mosque/eid-gah come under the RoW and zone of influence of the MAHSR alignment. The structures falling under the RoW shall be relocated or demolished. Three hospitals, four educational institutions and six religious sites shall be required to be either demolished or relocated (refer Table 5.24.2).

Table 5.24.2: Sensitive Locations likely to be Affected

Chainage Km	Geo- Coordinates		Name	Distance from CL (m)	Side
Hospitals					
1+750	19° 4'33.97"N	72°52'44.62"E	Guru Darashan Hospital	25	R.H.S
496+350	22°59'41.20"N	72°36'49.52"E	Shaishav Children Hospital	20	R.H.S
503+590	23° 3'19.98"N	72 °35'26.58"E	Retina Foundation Eye Research Centre	18	R.H.S
Educational Institutions					
31+100	19°13'12.19"N	73° 2'40.07"E	Madhyamik marathi school	15	L.H.S

Chainage Km	Geo- Coordinates		Name	Distance from CL (m)	Side
450+950	22°39'44.70"N	72°51'30.97"E	Euro School Anand	3	R.H.S
503+550	23° 3'18.78"N	72°35'26.70"E	The Rosery School	17	R.H.S
504+970	23° 4'4.23"N	72°35'20.72"E	Vision School of Science	10	R.H.S
Religious Structures					
1+100	19° 4'21.84"N	72°52'24.51"E	Madarsa Masjid	20	R.H.S
63+550	19°25'22.32"N	72°50'25.70"E	Durga Temple	15	L.H.S
83+850	19°35'58.77"N	72°47'41.97"E	Ekvira Temple	10	R.H.S
292+450	21°25'26.82"N	72°55'1.01"E	Mahadev Temple	25	R.H.S
429+150	22°32'16.15"N	73° 1'0.44"E	Shree Krishna Pranami Temple Shree Indravatipuri Dham, Mogar	6	R.H.S
494+400	22°58'42.44"N	72°37'12.87"E	Sai Temple	15	L.H.S

Source: Study Team

5.24.4 Protected Monument/Heritage

During field survey and on perusal of records of Archaeological Survey of India, it has been observed that eight heritage sites fall within 500 m of the MAHSR alignment. Out of these, two sites-Sidi Bashir Mosque - (Jhulta Minar) Nr. Kalupur Railway Station Road, Sakar Bazar, Kalupur, Ahmedabad about 138 m on the LHS of MAHSR alignment and another Historic Site S. No. 431,435 near Near Natraj Township, Vadodara about 125 m on the RHS of MAHSR alignment are within the zone of influence.

5.24.5 Protected Areas/National Parks/Wildlife Sanctuaries

MAHSR alignment passes through ecosensitive zone of 2 protected areas- Sanjay Gandhi National Park, Tungareshwar Wildlife Sanctuary and core zone of 1 protected area-Thane Creek Flamingo Sanctuary. The total land under ESZ works out to 44.8986 ha for which the application for the wildlife clearance from Standing Committee of NBWL has been submitted on 18-May-2018 vide proposal No. FP/MH/RAIL/31785/2018 (refer Table 5.24.3).

5.24.6 Water Bodies

The MAHSR alignment intersects 23 nos. of river / streams, rivulets, creeks and estuaries and 32 nos. of ponds (refer Table 1.3.2 in Chapter 1).

No major impact is envisaged either in construction or operational phases of the MAHSR project as it runs on viaduct at these locations. Potential impacts during construction phase have been identified and their mitigation measures have been addressed in the foregoing sections of this chapter.

5.25 IMPACTS DUE TO ANCILLARY FACILITIES

The MAHSR project comprises of various components like station, tracks, maintenance depots and electrical substations. These components may have impacts on the surrounding environment. In the subsequent sections, the anticipated impacts have been discussed.

Table 5.24.3: Protected Areas/Eco-Sensitive Zones

Segment No.	Chainage -Start	Chainage -End	Length (Km)	Location	Viaduct /Tunnel
1	0+000	32+200	32.200	ESZ-TCFS	Tunnel
2	9+428	11+750	2.322	Thane Creek Flamingo Sanctuary-Core Zone ⁴ - Thane Creek, Maharashtra	Tunnel
3	49+106	51+764	2.658	SGNP-ESZ, Borivalli, Naigaon East, Thane	Viaduct
4	31+781	74+891	43.110	Tungareshwar Wildlife Sanctuary-ESZ	Viaduct
Total Length			80.290		

Source: Study Team

5.25.1 Depot

Two maintenance depots (rolling stock maintenance)-one at Thane and another at Sabarmati, Ahmedabad have been proposed.

1) Thane Depot

Impacts

- There will not be any significant impact due to establishment of Thane Depot.
- Positively, the abandoned mined out area shall get face lift.

Mitigation Measures

- A green belt development plan shall be implemented and afforestation shall be carried out with native plant species all along the periphery of the Thane Depot and at all vacant spaces.
- Suitable pollution control measures shall be put in place to limit the emission.
- During the construction phase, proper fencing shall be created to check the surface runoff as the proposed site is close to Ulhas river on the higher elevation.
- The construction camp shall be established towards Northwest at appreciable distance from the Ulhas river.

2) Sabarmati Depot

Impacts

- There will not be any change in land use as present land is under Railways and it shall be used for the proposed MAHSR project.
- There will be loss of trees planted by the Railways in its premises.
- There will not be any significant impact on the remaining barren land which would be acquired for Sabarmati Depot.

⁴ The MAHSR alignment passes through the Thane Creek Flamingo Sanctuary in tunnel 30 m below the creek bed.

Mitigation Measures

- A green belt development plan shall be implemented and afforestation shall be carried out with native plant species all along the periphery of the Sabarmati Depot and at all vacant spaces.
- Suitable pollution control measures shall be adopted to limit the emission.

5.25.2 Stations and Access Road

The proposed HSR stations have been planned keeping in view the connectivity to existing roads. In addition, a 4 m wide service road along the viaduct is also planned which will provide additional connectivity. Land requirement for this have been worked out and RAP has been prepared covering such requirement of land. As decided in the meeting of Joint Committee on 21/11/2017 and Working Group meeting on 21st March, 2018, Station Area Development Committee for development of Transit infrastructure around Station has been formed. As per the ToR proposed by JICA, Multi Modal integration schemes are being developed in coordination and consultation with Station Area Development Expert Committee (SADEC) team. These proposals will include augmentation of existing transport infrastructure and development schemes around HSR stations in consultation with all concerned stakeholders (*i.e.* local administration, municipal corporations *etc.*). Any additional requirement of land will be dealt accordingly.

5.25.3 Electricity Sub-Stations

Following electrical infrastructure for the entire project has been proposed by General Consultant (*i.e.* JICC):-

- 1) Traction substation (TSS)- 12 numbers
- 2) Distribution substation (DSS) – 18 numbers
- 3) Sectioning post (SP) – 11 numbers
- 4) Sub Sectioning Post (SSP) - 19 numbers
- 5) Auto transformer post – 1 number

The total land requirement of these infrastructures including the land requirement of 7.5 m access road from the nearest state highway or district road for movement of trailer for transportation of heavy transformer to these substations has been worked out and the S-EIA covers above land requirement also.

Chapter 6
**Environmental Management Plan and
Monitoring Programme**

Chapter 6 Environmental Management Plan and Monitoring Programme

6.0 ENVIRONMENTAL MANAGEMENT PLAN

This chapter presents an environmental management and monitoring plan based on the significant environmental impacts and mitigation measures, discussed in the previous Chapter 5.

While it was not possible to avoid or reverse all of the adverse impacts of the proposed project, an effort has been made to address some of the significant impacts, by careful consideration and selection of project alternatives (as described in the Chapter 2.0). Further, suitable measures to minimize, control and manage the residual environmental impacts have been identified and described in the EMP in this chapter.

The EMP has been prepared based on a hierarchy of impact avoidance, minimization, mitigation and control of residual impacts, for both, construction and operation phases for all the relevant environmental attributes. It describes administrative aspects of ensuring that mitigatory measures are implemented and their effectiveness is monitored over the life of the project. This chapter also proposes green belt development plan and Environmental Monitoring Programme (EMoP).

Mitigation measures have been identified along with the following supporting aspects for effective implementation of the proposed EMP:

- Institutional arrangements, human resource requirements and their role & responsibilities;
- Budgetary estimates of financial resources required
- Performance indicators for tracking mitigation measures

While Section 6.1 summarizes stage wise environmental management plan, detailed management plans on each impacted item are recommended in the subsequent sections.

As per the Employers' requirement of the contract between NHSRCL and the awarded contractor(s), the contractor(s) shall prepare its Construction Environmental Management Plan (CEPM) and get approval from NHSRCL before the commencement of any construction work. Sample format for the CEMP is given in the **Annexure 6 (a), Volume-II** of S-EIA Report.

6.1 STAGE WISE ACTIVITIES OF ENVIRONMENTAL MANAGEMENT PLAN

As in the case of large infrastructure projects, the MAHSR project will also be executed in a phase-wise manner; site Preparation and pre-construction activities (Planning /Design stage), Construction and Operation stages. The planning/design phase concentrates on project area reconnaissance and finalization of the preferred alignment, along with decision on traction technology, track design and other technical aspects. In the construction stage, the location for the borrow areas, quarry sites and waste disposal sites should be identified before commencement of the construction activities. The Operational stage includes running the HSR and operating stations and maintenance activities.

The following tasks are required for the execution of the EMP:

- Allocation of budget by NHSRCL for the EMP;
- Establishing the institutional structures for the implementation of the EMP;
- Implementation of the proposed mitigation measures and monitoring by respective agencies as per responsibilities allocated in the EMP, in concurrence with project development activities;
- Training and capacity building of the stakeholders;
- Tracking of the environmental performance indicators through periodic audits and inspections by NHSRCL (third party assessors could be used); and
- Reporting to the designated institutions and regulatory authorities based on the audit outcome;

The EMP provides guidance on how the project activities are to be planned, implemented and monitored in order to minimize and manage environmental and social impacts. Tables 6.1.1, 6.1.2 and 6.1.3 summarize the main management activities for significant adverse impacts in Planning/Design, Construction and Operation stages respectively. They provide mitigation/management measures for significant impacts and an estimated budget provision for their implementation. They also identify the parties to incur the costs and implement the measures.

During the operation phase, NHSRCL should take responsibility for the implementation of mitigation measures. NHSRCL would, therefore, need to develop close working relationships with the local stakeholders identified above during the construction phase and maintain these relationships through the operation phase.

Table 6.1.1: Environmental Management and Responsibilities during the Planning/Design Phase

Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
Land acquisition and Resettlement	<ul style="list-style-type: none"> - The acquisition of land and private properties should be carried out in accordance with the RAP and the Entitlement Framework for the project, approved by NHRCL / JICA. - Social Environmental Management Unit (SEMU) should ascertain that any additional social or environmental impacts resulting from acquisition of land should be addressed and integrated into the EMP and other relevant documents. 	Parties should be determined in a separate RAP Study.	NHRCL/ JICA	Respective State Govts.	To be determined in a separate RAP Study.
Tree / Mangrove Cutting & Afforestation	<ul style="list-style-type: none"> - Avoidance of non-essential tree-cutting - Special care should be taken at the eco-sensitive areas like SGNP, TWLS, TCFS and mangrove areas - Cutting of old trees such as banyan and other native species should be avoided - Cutting of firewood within the natural areas should not be allowed - Cutting of vegetation should be avoided which may lead to complete breakage of canopy cover in closed-canopy forests - Planting of alien tree species such as eucalyptus and acacia wattles should not be taken up - Any grove or tree deemed sacred by local communities and related places of worship should not be felled - Should avoid felling of all banyan, peepal, neem, and tamarind trees, and any other species valued by local communities as determined through open consultations or deemed useful for local people and village communities - Clearing should not be undertaken in such a manner that there is slashing of all under-storey vegetation - Green belt development at the sensitive locations along the alignment such as residential areas should be taken up. 	Design Consultant and Contractor	NHRCL/ JICA	Respective State Forest Department / Honorable Bombay High Court	Refer Table 6.2.2.
Crushers, and Concrete Batching Plants	<ul style="list-style-type: none"> - All construction yards should be sited 1 km away from settlements downwind if possible of agricultural operations and residential / commercial establishments. - Construction Yards (tentatively planned at every 25 km along the alignment) should be located at least 500 m away from the nearest dwelling preferably in the downwind direction. - Wherever hot mix plants are used, they should be set up at least 2 km away from settlements and a minimum area of 200 sq. m. surrounding the site should be devoid of vegetation. 	Design Consultant and Contractor	Engineer and Supervisor Consultant	Respective, SPCB, CPCB, State Ground Water Authority, and State Department of Mines & Geology	Item specific cost not available Additionally, Statutory consent fees should be required, which vary from State to State.

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<ul style="list-style-type: none"> - Arrangements to control dust pollution including respirable dust through provision of wind screens, water sprinklers, and dust suppressant and extraction systems should be provided at all such sites. - Specifications for crushers, and concrete batching plants should be designed to comply with the requirements of the relevant emission control legislation at the State level. - Consent for the establishment and operation from State Pollution Control Boards should be obtained before establishment and operation of work sites, respectively. 				
Construction Vehicles, Equipment & Machinery	<ul style="list-style-type: none"> - All vehicles, equipment and machinery to be procured for construction should conform to the relevant Bureau of India Standard (BIS) norms. - The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 1988 should be considered while procuring vehicles. - The silent/quiet equipment available in the market should be preferred. 	Design Consultant and Contractor	NHSRCL/ JICA	State Transport Department and SPCBs	Item specific cost not available
Construction Water	<ul style="list-style-type: none"> - Ground /surface water for construction requires necessary permissions which should be obtained from the respective State Irrigation Departments and CGWA. 	Design Consultant and Contractor	Engineer and Supervisor Consultant	CGWA	The statutory consent fees should be required, which varies from State to State.
Quarry Areas	<ul style="list-style-type: none"> - Procurement of construction materials from quarries should be finalized after assessment of the availability of sufficient materials, quality, regulatory and other logistic arrangements. - Necessary clearances should be obtained for the locations selected from the statutory agencies like the State Pollution Control Boards and from the Mining Department. - Planning of haul roads for accessing quarry areas should be undertaken during this stage. - The haul roads should be routed to avoid agricultural areas as far as possible and will use existing village roads wherever available. - The sand should be procured from identified sand mines as far as possible. - Permissions to be obtained from the statutory departments of the state. 	Design Consultant and Contractor	Engineer and Supervisor Consultant	State Govt. Mines & Geology Dept.	Item specific cost not available
Borrow Areas	<ul style="list-style-type: none"> - The earth material is to be borrowed from select borrow areas, until the formal agreement is signed between landowner and the executing 	Design Consultant and	Engineer and Supervisor	Revenue Department&	Item specific cost not available

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<p>agency.</p> <ul style="list-style-type: none"> - Locations finalized and the necessary clearances should be obtained from the statutory agencies like the State Pollution Control Boards and from the Mining Department. - Planning of haul roads for accessing borrow areas should be undertaken during this stage. - The haul roads should be routed to avoid agricultural areas as far as possible and should use the existing village roads wherever available. 	Contractor	Consultant	Owner of the land	
Labour	<ul style="list-style-type: none"> - Unskilled labour required for the works should preferably be drawn from local communities to maximize their benefits. 	Contractor	NHSRCL/ JICA	Labor Department	Item specific cost not available
Construction Camp	<ul style="list-style-type: none"> - The construction camps will be located at least 200 - 500 m away from habitations at identified sites to avoid conflicts and stress over the infrastructure facilities with the local community. - Location for stockyards of construction materials should be identified at least 500 m away from watercourses. - The sewage and solid waste treatment and management for the camp should be designed, built and operated (preferably by the respective contractor agencies). - All sites used for camps should be adequately drained. - The camps must be located such that the drainage from and through the camps will not endanger any domestic or public water supply. - The labour camp/construction camp should be established as per the provision of Occupational Safety and Health Administration. 	Contractor	NHSRCL/ JICA	Revenue department, Owner of the land, local community, municipal corporation	Item specific cost not available
Disaster	<ul style="list-style-type: none"> - The seismic factors should be appropriately incorporated in the civil and structural designs of major structures in MAHSR project. - Services of an engineering geologist should be used to identify any slope instability potential among the uniform rock structure. NHSRCL/JICA should take up such a study through suitable experts/institutes during detailed engineering stage. - Adequate cross drainage channels (longitudinal and median drains) should be provided along MAHSR route at suitable locations for the smooth passage of the surface run-off to prevent flooding. 	Design Consultant and Contractor	NHSRCL/ JICA	District Collectors National Disaster Management Authority (NDMA)	Item specific cost not available
Labour Health and Welfare - HIV/AIDS	<p>The project developers should make provisions for the prevention of HIV transmission amongst the workmen. A few of the recommendations are given below as an illustration:</p> <ol style="list-style-type: none"> i. Easy availability of personal protection devices like condoms and diaphragms. ii. Sustained ICE activities and counseling mechanism. iii. Provide work breaks for periodic home visit holidays 	RAP Consultant	NHSRCL	District Collector, Health Department	Built in Construction Cost

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	iv. Collaboration with local police to curb the sale and use of narcotics.				
Women & Children's Rights	<ul style="list-style-type: none"> - Children and young persons below the prescribed age (as defined in the respective statutes), should not be deployed at any stage of the project. - Women rights should be protected by the contractor agencies and suitable care & welfare services should be provided as necessary (such as crèche, feeding / changing rooms etc.) 	RAP	NHSRCL	District Collector	No cost envisaged
Labour Health & Safety	<ul style="list-style-type: none"> - During the construction phase, a large workforce is expected to be deployed at various locations throughout the alignment. - The construction period being assumed to be of 4-5 years, it is reasonably expected the workers to bring along their family. - A construction labour housing camp for the workers (proposed at every 25 km along the alignment) should be established having provisions for health care facilities to the workforce. - Regular health check up of the deployed workforce (including employees and contracted employees) should be undertaken to see any degradation in health. This facility should be provided through the entrusted construction contractors, in line with the BOCW Act and Rules (State level). - During the operation phase, all the stations should be provided with primary health care (PHC) facilities (the specific requirements of a PHC should be specified somewhere). - At the maintenance depot, it should be mandatory to have well equipped health care facilities manned by qualified doctors. - During operations, the trains should be provided with a basic primary health care setup to combat with any eventuality during travel for the passengers as well as staff on board. - OSHA guidelines (29-CFR) for Health and Safety should be adhered to. 	RAP	NHSRCL	District Health Department	Cost is built up in cost of the construction
Ethnic Community and Indigenous People	<ul style="list-style-type: none"> - The right and interest of the ethnic community and indigenous people should be protected by the NHSRCL. - Right of 'any section of the citizens' to 'conserve' its 'distinct language, script or culture'; [Article 29(1)] - Right of all Religious and Linguistic Minorities to establish and administer educational institutions of their choice;[Article 30(1)] - Freedom of Minority-managed educational institutions from discrimination in the matter of receiving aid from the State;[Article30(2)] 	RAP	NHSRCL	Panchayat / Village community / Collector	Built in Construction Cost
Cultural and Religious site	<ul style="list-style-type: none"> - Pier spacing should be adjusted to avoid the demolition of the religious structures falling within RoW. 	RAP	NHSRCL	Panchayat / Village	Built in Construction Cost

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		Planning and Implementation	Supervision and Reporting		
	<ul style="list-style-type: none"> - However, if it is unavoidable, the every step should be taken to shift these structures at a suitable place in consultation with the local community. - Following mitigation measures should be taken for the religious and cultural sites - Construction yards/labour camps should be located 1000 m away from the religious structures/sites. - Enclosures should be provided at the construction sites which are close to religious sites - Effective noise barriers/screens should be provided close to working heavy equipment. - Night time working shall be avoided. 			community / Collector	

Source: Study Team¹

¹ The study team comprising the following organizations:

- GPS Technologies: S-EIA Report, collection and assessment of primary / secondary environmental data
- JICC: Project Specifications / Data / Maps / Project Drawings
- NHSRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: Resettlement and Rehabilitation Action Plan

Table 6.1.2: Environmental Management and Responsibilities during the Construction Phase

Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
Air Pollution	<ul style="list-style-type: none"> - Water sprinkling system should be put in place. - Covering the construction material/waste during transportation to/from the construction site should be considered to reduce diffusion of dust. - Equipment and trucks should be properly maintained at regular intervals. - Roads leading to or at construction sites must be paved and blacktopped (<i>i.e.</i> metallic roads). - No excavation of soil should be carried out without adequate dust mitigation measures in place. - No loose soil or sand or Construction & Demolition Waste or any other construction material that causes dust should be left uncovered. - Grinding and cutting of building materials in open area should be prohibited. - Construction material and waste should be stored only within earmarked area and road side storage of construction material and waste should be prohibited. - Uncovered vehicles carrying construction material and waste should not be permitted. - Construction and Demolition Waste processing and disposal site should be identified and required dust mitigation measures be notified at the site. - Motorized vehicles at site should be restricted to a maximum speed of 10-15 kilometer/hr. This results in improved safety and less dust emission. - Wheel washing facility at exit of construction sites should be provided - Dust mitigation measures should be displayed prominently at the construction site for easy public viewing. 	Contractor and Supervisor Consultants	NHSRCL/JICA	SPCB/CPCB	Rs. 300000 per site for Water sprinkle for entire duration of construction.
Noise Pollution	<ul style="list-style-type: none"> - Construction activities generating high noise levels should be carried out at different time intervals to curtail the noise levels. - The equipment used should have exhaust mufflers to reduce noise levels. All equipment should be properly lubricated. - The construction yards located near sensitive receptors should be provided with noise barriers. - Avoid night time activities. - Periodical inspection and effective maintenance of vehicle and equipment 	Contractor and Supervisor Consultants	NHSRCL/JICA	SPCB / CPCB	Item specific cost not available
Clearing and	<ul style="list-style-type: none"> - If required, vegetation should be removed from the construction zone 	Contractor	NHSRCL/JICA	Concerned Local	Item specific

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
Grubbing of Vegetation	<ul style="list-style-type: none"> before commencement of construction after obtaining necessary permissions. - All works should be carried out such that the damage or disruption to flora other than in those areas identified for cutting is kept to a bare minimum. - Trees identified under the project should be cut only after getting permission from the designated authorities. 			Authority/ Municipality	cost not available
Disposal of debris from dismantling structures	<ul style="list-style-type: none"> - The construction and demolition waste generated during the construction phase should be managed in accordance with the C&D Waste Management Rules, 2016. 	Contractor	NHSRCL/JICA	SPCBs/ CPCB/district collector	Item specific cost not available
Stripping, stocking and preservation of top soil	<ul style="list-style-type: none"> - Stockpile should be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, silt fencing will protect the edges of the pile. - Stockpiles will not be surcharged or otherwise loaded and multiple handling should be kept to a minimum to ensure that no compaction will occur. - The stockpiles should be covered with sheets or vegetation. - Proper drainage systems should be provided to prevent stagnation of water. 	Contractor	NHSRCL/JICA	Local Administration	Item specific cost not available
Traffic diversions and detours	<ul style="list-style-type: none"> - The temporary traffic detours should be kept free of dust by sprinkling water during the daytime depending on weather conditions. 	Contractor	NHSRCL/JICA	State Transport Department and SPCB	Item specific cost not available
Borrow areas and quarry sites	<ul style="list-style-type: none"> - Borrow areas and quarry sites should be away from human settlements. - The excavation of borrow should be specified as per the guidelines. - Access to the quarry operated area and borrow sites should be strictly controlled. - All workers at the quarry site should be provided with personal protective equipment. - All the haul roads are watered regularly to reduce dust emissions. - A vegetative barrier should be created to surround the borrow area and quarry sites. 	Contractor	NHSRCL/JICA	District/ State Mines and Geology Department	Item specific cost not available
Transporting Construction materials and haul road management	<ul style="list-style-type: none"> - Dumpers and trucks carrying the construction material should be spill-proof. - Trucks and dumpers should be properly maintained. - Water should be sprinkled on the haulage roads. - Strict speed limits should be followed at the settlement areas and on the haulage roads. 	Contractor	NHSRCL/JICA	State Transport Department and SPCBs	Item specific cost not available

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<ul style="list-style-type: none"> - All the truck and dumper drivers should be properly trained. - All the truck and dumper carrying materials should be properly covered. 				
Construction water use and wastewater generation from construction yard and labour camps	<ul style="list-style-type: none"> - Water required for construction should be drawn from surface water bodies only after obtaining prior permission from the appropriate government departments. - If ground water is drawn then permission from the CGWA or equivalent State GW authority should be obtained. - The wastewater from construction yard and labour camp should be treated (as per applicable discharge standards) before being discharged into natural water bodies. 	Contractor and Supervisor Consultant	NHSRCL/JICA	SPCB/ CPCB	Item specific cost not available
Siltation in water bodies	<ul style="list-style-type: none"> - Construct silt fencing at the base of the embankment construction site and around the stockpiles at the construction sites. - The fencing should be provided prior to commencement of earthwork and continue until the stabilization of the embankment slopes. - Construction materials containing fine particles should be stored in an enclosure such that sediment-laden water does not drain into nearby water bodies. - If necessary, siltation pond shall be installed to avoid discharging silt water from the site. 	Contractor and Supervisor Consultant	NHSRCL/JICA	SPCB/ CPCB	Item specific cost not available
Slope protection and control of soil erosion	<ul style="list-style-type: none"> - Soil erosion and sedimentation should be minimized by constructing breast walls, retaining walls, pilot bioengineering methods, dykes, sedimentation chambers, basins, fibre mats, mulches, grasses, slope, drains and other such devices. 	Contractor	NHSRCL/JICA	SPCB/ CPCB	Item specific cost not available
Petroleum Oil and Lubricants	<ul style="list-style-type: none"> - Such products should be handled with special care. - The necessary permissions should be obtained for handling and use of the POL Products. - The used oil and lubricants should be sold to authorized parties. - The storage places for POL should have restricted entry. - Accidental spillage of oil and lubricant should be immediately cleared. - The trucks and dumpers will not be washed at the nearby water bodies, instead of that they should be cleaned in the construction yard and the waste water should be collected in a settling tank before it can be re-used for some other purposes. 	Contractor	NHSRCL/JICA	District Authorities	Item specific cost not available
Public Health And Safety	<ul style="list-style-type: none"> - Barriers (e.g., temporary fence), should be created at construction areas to deter pedestrian access - The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation. - Speed restrictions should be imposed on deployed vehicles and equipment when traversing areas with sensitive receptors (residential, schools, temples, churches, hospitals etc.). 	Contractor and Supervisor Consultant	NHSRCL/JICA	District Authority	Item specific cost not available

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<ul style="list-style-type: none"> - Marshaling attendants should be provided at traffic junctions outside construction yard sites to regulate material / construction vehicles and general vehicular traffic / pedestrians in a safe manner. - Traffic diversion plans should be prepared / executed and communicated in areas where construction is being carried out on or near existing roads / highways. These plans should be approved by the local traffic police office. 				
Construction Yards	<ul style="list-style-type: none"> - Site construction yards should minimize adverse impacts by good management practices. - Implement malaria control, HIV/AIDS education. - Plan and carry out post construction site clean-up. 	Contractor and Supervisor Consultant	NHSRCL/JICA	Forest Department/ Local Administration/SP CB/ CPCB	Item specific cost not available
Installation and Operation / Maintenance of Electrical Equipment	<ul style="list-style-type: none"> - All necessary fencing and lights should be provided to protect the public in construction zones. - All machines to be used in the construction should be kept in good working order, and should be regularly inspected and properly maintained. 	Contractor	NHSRCL/JICA	Electrical Department/Fire Department	Item specific cost not available
Establishment and Operation of the Labour Camps	<ul style="list-style-type: none"> - The labour camps should be established as per the OSHA guidelines - Labour Camps should be provided with adequate treatment system and drainage to avoid accumulation of stagnant wastewater. - Space of ≥ 35 sq. m per person should be provided for accommodation at the labour camps. - HIV/AIDS awareness and prevention program should be implemented under the Project. - The following facilities should be provided at the workers' camps: <ul style="list-style-type: none"> - Washing facilities or showers should be provided at the workers' camps. - Toilets/sanitation facilities with proper flushing provisions in accordance with local regulations to prevent any hazard to public health or contamination of land, surface or groundwater. These facilities should be well maintained to allow effective operation. - Accommodation for taking meals and for shelters during interruption of work due to adverse weather conditions. - First aid room or station under the charge of qualified first aid personnel or a nurse should be provided at a readily accessible place for treatment of minor injuries and as a rest place for seriously sick or injured workers. - Construction equipment should be operated by workers who have received appropriate training in accordance with laws and regulations. - The drivers and operators of vehicles and materials handling equipment should be medically fit, trained and qualified and of at least the 	Contractor	NHSRCL/JICA	Labor Department	Item specific cost not available

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<p>prescribed minimum age as required by the government rules and regulation.</p> <ul style="list-style-type: none"> - Suitable scaffolds from the ground should be provided for the work force, who are working at elevated heights, if a ladder is used proper foot holds and hand holds should be provided on the ladder. - Safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work locations. - The contractor should be responsible for observance by his sub-contractors, of all health and safety provisions. - The contractor should take adequate measures for the control of malaria, typhoid, dengue, cholera etc. - All vehicles used in the construction yard should have reverse horns - There should be proper demarcation of work areas with sign boards showing the work areas. The signboards should be in local and English language. - Suitable warnings should be displayed at all places where contact with or proximity to electrical equipment can cause danger. - Persons operating electrical equipment should be fully instructed as to any possible dangers associated with the equipment concerned. All electrical equipment should be inspected before use to ensure that it is suitable for its purpose. - Water transport tanks, storage tanks and dispensing containers should be designed, used, cleaned and disinfected at suitable intervals in a manner approved by the competent authority. - Water that is unfit to drink should be conspicuously indicated by notices prohibiting workers from drinking it. - Secure storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinder, paints and other such materials in order to deter trespassers. - Smoking should be strictly prohibited and no smoking notices be prominently displayed in all places containing combustible or flammable materials - Only suitably protected electrical installations and equipment, including portable lamps, should be used. - Oil rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place. - Fire-extinguishing equipment should be provided at construction camps, asphalt plants, storage areas for combustible materials and other areas where fire hazards are found. Such equipment should be properly maintained and inspected at suitable intervals by a competent person. 				

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Interested parties	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision and Reporting		
	<ul style="list-style-type: none"> - All site workers should be provided with personal protective equipment such as safety shoes, helmets, earmuff, nose mask as relevant to the risks that they are exposed to <i>etc.</i> - Welders should be provided with face shields and gloves. - Ear plugs / muffs should be provided for workers working in high noise zones. - Workers will not be allowed to work without the appropriate personal protective equipment. - Workers should be provided with an adequate potable water supply. - Provision of reflective clothing or colored devices or otherwise conspicuously visible material when there is regular exposure of workers to danger from moving vehicles. - Monitoring and control of the working environment and planning of safety and health precautions should be performed as prescribed by laws and regulations. - There should be provision of penalty on the contractors for non-compliance of the SHE standards/guidelines. - There should be provision of award to the contractors based on SHE/OSHA compliance to encourage them. 				

Source: Study Team

Table 6.1.3: Environmental Management and Responsibilities during the Operation Phase

Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Concerned Authorities	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision & Accepting Report		
Noise	<ul style="list-style-type: none"> - Noise barriers should be erected at appropriate locations such as residential areas and sensitive receptors, which are adjacent to the corridor. - The necessary height of a barrier depends on factors such as the source height and the distance from the source to the barrier. For example, a barrier located very close to the nearest track need only be 1 m above the top of rail to effectively reduce wheel-rail noise, providing noise reductions of 6–10 dB. 	SEMU	NHSRCL/JICA	SPCBs/CPCB	Estimated at the detail design stage
Vibration	<ul style="list-style-type: none"> - E5 series Shinkansen shall have inbuilt vibration control design - The track structure should be designed to produce low ground-borne vibration 	NHSRCL	NHSRCL/JICA	SPCBs/CPCB	Cost is built in the procurement of rolling stock.
Maintenance Performance	<ul style="list-style-type: none"> - Monitoring of the operational performance of the various mitigation/enhancement measures should be carried out as a part of the project. - The indicators selected for monitoring include the survival rate of trees; utility of enhancement provision for relocated utilities, hand pumps and other relocated structures if any; status of rehabilitation of borrow areas; and noise barriers, which are proposed at different locations. 	SEMU	NHSRCL/JICA	SPCBs/CPCB	Included in Routine cost of operation
Borrow areas and quarry sites	<ul style="list-style-type: none"> - Incorporate adequate drainage and fill in borrow pits and quarries. Before doing the activity local concerns should be considered. The village authorities should also be consulted. - Maintain borrow pits and quarries by landscaping them after operation by growing native species. - All borrow areas are to be reclaimed properly and should be restored to a level that is acceptable level to the land owner. - The guidelines issued by the State Mines and Geology Department for minor minerals as given below should be complied with. <ol style="list-style-type: none"> 1. The borrowing/excavation activity should be restricted to a maximum depth of 2 m below general ground level at the site. 2. The borrowing/excavation activity should be restricted to 2 m above the ground water table at the site. 3. The borrowing/excavation activity should not alter the natural drainage pattern of the area. 4. The borrowed/excavated pit should be restored by the project proponent for useful purpose(s) 5. Appropriate fencing all around the borrowed/excavated pit shall be 	SEMU	NHSRCL/JICA	Mines and Geology Department of concerned States	Shown in Table 6.1.3

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Concerned Authorities	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision & Accepting Report		
	<p>made to prevent any mishap</p> <p>6. Measures should be taken to prevent dust emission by covering of borrowed/excavated earth during transportation</p> <p>7. Safeguards should be adopted against health risks on account of breeding of vectors in the water bodies created due to borrowing/excavation of earth.</p> <p>8. Workers / labourers should be provided with facilities for drinking water and sanitation.</p> <p>9. A berm should be left from the boundary of adjoining field having a width equal to at least half the depth depth of proposed excavation.</p> <p>10. A minimum distance of 15 m from any civil structure should be kept from the periphery of any excavation area</p> <p>11. No borrowing of earth / excavation of 'brick earth' or 'ordinary earth' should be permitted in case the area of borrowing/ excavation is within 1 km of boundary of national parks and wild life sanctuaries</p>				
Green belt Development and Management	<ul style="list-style-type: none"> - Maintenance of plantation - Local pollutants tolerant species like <i>Acacia arabica</i> (Babul) • <i>Citrus species</i> • <i>Dyospyros species</i> • <i>Ficus bengalensis</i> (Banyan) • <i>Ficus religiosa</i> (Peepal) • <i>Polyathia lotigifolia</i> (Ashok) • <i>Tamarindus indica</i> (Imli) • <i>Thuja occidentalis</i> (Cedar) • <i>Prosopis Juliflora</i> (Mesquite) • <i>Zizypus jujuba</i> (Jujuba), etc. should be selected for plantation. 	SEMU	NHSRCL/JICA	State Forest Department	Incl. in routine cost of operation
Training for operational staff	<ul style="list-style-type: none"> - The training should be for all the executives regarding the environment and safety. - The process should be followed for a minimum period for first six months. - The training should be about the implementation of standards and requirement of OSHA pertaining to Safety, Health and Environment . 	SEMU	NHSRCL/JICA		
Emergency Preparedness and Response Management	<ul style="list-style-type: none"> - Maintenance of cross drainage channels (longitudinal and median drains) should be carried out. - The rolling stock and stations should be provided with the alarm for advance notice of earthquake, cyclone, flood etc. - Risk and Disaster Management Plan should be formulated for safe and smooth running of the high speed train. 	SEMU	NHSRCL/JICA	IMD	
Maintenance Depots and Yards	<ul style="list-style-type: none"> - The two major maintenance depots have been proposed at Thane and Sabarmati end. - The depots shall function in accordance with the provision of the Factory 	NHSRCL	NHSRCL	Respective Factory Inspector	Incl. in routine cost of operation

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Project / Environmental Component	Mitigation/ Management Measures	Responsibility Allocation		Other Concerned Authorities	Indicative Budget Estimate in INR
		Planning and Implementation	Supervision & Accepting Report		
Act, 1948 and State level Factories Rules, as applicable.					

Source: Study Team

6.1.1 ENVIRONMENTAL MANAGEMENT PLAN FOR TUNNELING

The EMP for tunneling has been described and presented in Table 6.1.4.

Table 6.1.4: Environmental Management Plan for Tunneling Component

Environmental Impact/Aspect	Proposed Mitigation Measures	Implementation Issues		Cross reference
		Responsibilities	Monitoring	
Excavation of Tunnel Tubes	<p>Tunnelling work should be carried out with Tunnel Boring Machine (TBM) and New Austrian Tunnelling Methodology (NATM) as described in DPR of MAHSR.</p> <p>All excavation and blasting work should be carried out after assessing the safety/ legal requirements</p> <p>OSHA Guidelines for Tunnel / Underground Construction-</p> <ol style="list-style-type: none"> 1. Check-in/check-out procedures 2. Control of access and egress 3. Ground support of portal and subsidence areas 4. Ground support of underground areas 5. Ground support of shafts 6. Fire prevention and control 	Contractor	NHSRCL/PMU	DPR/HSE/Australian New Tunnelling Method Nov 2013, DPR
Ventilation	<ul style="list-style-type: none"> - Fresh air must be supplied to all underground work areas in sufficient amounts to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases. If natural ventilation does not provide the necessary air quality through sufficient air volume and air flow, the employer must provide mechanical ventilation to ensure that each employee working underground has at least 200 cubic feet (5.7m³) of fresh air per minute. - The ventilation system should be designed to provide ventilation throughout the tunnel during construction, use and maintenance. This includes providing extra localized extraction ventilation for 	Contractor	NHSRCL/PMU	HSE/ Australian New Tunneling Method Nov 2013/ DPR

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Environmental Impact/Aspect	Proposed Mitigation Measures	Implementation Issues		Cross reference
		Responsibilities	Monitoring	
	<p>dust, heat or fumes during excavation, post-blasting, operating large plant or other activities like maintenance.</p> <ul style="list-style-type: none"> - The workplace must be ventilated to enable workers to carry out work without risk to health and safety. - Proper illumination be provided during tunneling operations (see 29 CFR 1926.56 for details). When explosives are handled, only acceptable portable lighting equipment may be used within 50 feet of any underground heading. - The Contractor shall also provide suitable movable lamps to illuminate any area in Underground Works including areas for instrumentation and where the Engineer may wish to carry out inspection and rock mechanics tests or instrumentation - The contractor shall design, install and operate ventilation system for the Underground Works and provide an underground atmosphere monitoring system. - The contractor should check and record concentrations of noxious or other harmful gases and dust throughout the works at every shift. Allowable concentrations should be as stated in the applicable laws/ standards for underground construction. - All items of inspection records and automatic record data of instructions should be included in a daily working report and should be maintained for the duration of the works. - All parts of the Works should be maintained in a manner, which will not be injurious to the health of the personnel. The air in underground works shall contain no less than 19.5% oxygen (by volume) and shall not contain concentration of gases, vapors or dust greater than is safe for the health or workmen, having regard to the effects of time, temperature, humidity and the combined effects of contaminants. - The ventilating system should be kept in operation also after break-through in tunnels in order to maintain the fresh air-volume requirements stated hereinafter - The contractor shall ensure the required quantity of fresh air at the heading face. The check of the air-tightness or joints and control of the air ducts for leaks should be performed periodically. Any deficiency discovered or reported by the Engineer should be immediately repaired by the contractor, The ventilation design should check there is: <ul style="list-style-type: none"> • no dead spots • no low air speed areas • no flow reversals 			

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Environmental Impact/Aspect	Proposed Mitigation Measures	Implementation Issues		Cross reference
		Responsibilities	Monitoring	
	<ul style="list-style-type: none"> no areas of dust concentration no recirculation, and inspection points are fitted where blockages are likely to occur 			
Air Cooling in Underground Work	<ul style="list-style-type: none"> The quantity of air supplied or extracted from the face should be so the average air velocity at a full cross section of the tunnel or shaft is between 0.3 m/s and 2 m/s at all times. The minimum quantity of air for people should be 1.5 m³ per minute per worker and 4 m³ per minute per kW of rated diesel power. (Federal Register 54 (16): 3904-3916, January 26, 1989). Workers in areas with a wet globe bulb temperature in excess of 27 ° C should be provided with control measures .The contractor shall make suitable arrangements for cooling of air so as to maintain the temperature in the underground construction sites. The temperature should be jointly measured by the contractor and the engineer at regular/ weekly intervals. Temperature measurements should be taken during normal working conditions with the specified degree of ventilation and with the air cooling system turned off. 	Contractor	NHSRCL/PMU	Australian New Tunneling Method Nov 2013/ DPR/HSE
Control of Dust, Noxious Gasses in Underground Work	<ul style="list-style-type: none"> To reduce the amount of dust, only wet drilling should be allowed and during mucking, muck piles should be kept constantly damp by sprinkling with water. The use of high pressure water jets for this purpose will not be permitted. The contractor should measure and monitor the concentration of fine dust and content of silicon dioxide (SiO₂) in all dust producing underground operations by a method to be approved by the Engineer. The Contractor should provide and maintain equipment for measuring and monitoring the content of noxious gases and oxygen at each heading face throughout the content if excavation works. Tests for determining concentrations of carbon monoxide, carbon dioxide, nitrogen dioxide, methane, other inflammable gases, and oxygen should be made before and after each blasting and at the beginning of each shift by qualified personnel. A record of reading should be maintained and be made available to the Engineer as and when asked for. 	Contractor	NHSRCL/SEM U	Australian New Tunnelling Method
Energy Management	<ul style="list-style-type: none"> Contractor shall use and maintain equipment so as to conserve energy and should be able to produce demonstrable evidence of the same upon SEMU request. Measures to conserve energy include but not limited to the following: <ul style="list-style-type: none"> Use of energy efficient motors and pumps 	Contractor	NHSRCL/SEM U	Contractor obligatory requirement

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Environmental Impact/Aspect	Proposed Mitigation Measures	Implementation Issues		Cross reference
		Responsibilities	Monitoring	
	<ul style="list-style-type: none"> • Use of energy efficient lighting, which uses energy efficient luminaries • Adequate and uniform illumination level at construction sites suitable for the task • Proper size and length of cables and wires to match the rating of equipment • Use of energy efficient air conditioners <p>Site offices should be designed for maximum daylight and minimum heat gain. The rooms should be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.</p>			
Noise	<ul style="list-style-type: none"> - Personal hearing protective equipment should be provided to workers - The maximum noise levels of the equipment should be reduced to 85 dB (A) - Effort should be made to reduce the noise emission at sources of noise generated by the machinery - Place cover over the source - Fit larger mufflers to exhaust and ventilation fans - Erect screen to separate the source of noise from other working areas - Improved maintenance of the machines - Improvement in design of the machines - Reduce the exposure time 	Contractor	NHSRCL/SEMU	Contractor obligatory requirement
Ground Water	<ul style="list-style-type: none"> - Care should be taken to avoid the works being flooded from outside sources - Fissures in rock often contain water under pressure. If water is anticipated, exploratory probing or drilling ahead of the face should be carried out to confirm the quantity, the quality and the pressure - Blowout preventers shall be used during drilling in accordance with the risk assessment - Adequate protective clothing should be provided for those working in the wet area - If ground water is encountered and the ground requires sealing, this should be done ahead of the excavated face - Measures shall be put in place for evacuation of workers in case of sudden flooding - Water should be removed from the working area either by open drain or by pump and pipes. Intermediate holding tanks and pumping stations should be set up where water has to be 	Contractor	NHSRCL/SEMU	Contractor obligatory requirement

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Environmental Impact/Aspect	Proposed Mitigation Measures	Implementation Issues		Cross reference
		Responsibilities	Monitoring	
	transported over a large distance - If water from the tunnel is to be used for drinking or spraying purposes, it should be regularly tested for contaminants and treated as appropriate - Where water from the tunnel is discharged it may require treatment (settling ponds etc.) to avoid pollution of surface water			

Source: Study Team

6.2 NOISE AND VIBRATION MANAGEMENT

6.2.1 Mitigation Measures

1) Construction Phase

To curtail noise levels various barriers are designed. The type of the noise barriers most commonly employed consist of earth mounds or walls of wood, metal or concrete which form a solid obstacle between the communities and the construction site. There are several measures indicated to curtail the noise levels emanating from the construction sites in the EMP:-

- Noise barriers such as temporary walls or piles of excavated materials should be established around the yard near residential area and sensitive receptor during the activities such as blasting and pile driving which generate the high level of noise;
- Reroute truck traffic away from the residential areas, if possible select streets with fewer homes if no alternative route is available;
- Site equipment to be placed away from the residential location and sensitive areas;
- Construct walled enclosures around especially noisy activities or clusters of noise generating equipment;
- All plant equipment and vehicles being fitted with appropriate noise suppression equipment to reduce noise levels as far as possible;
- All equipment should be operating in good condition. Use of equipment having inbuilt enclosed air compressor and mufflers on all engines;
- All site workers are trained in noise reduction such as proper use of machinery and hearing protection;
- All site workers must wear appropriate hearing protection if in close proximity to machinery for extended periods;
- Avoid night time construction activities as much as possible in noise sensitive areas;
- Avoid pile driving work where possible in noise sensitive areas by quieter alternatives where geological conditions permit their use;
- Control noise and vibrations at the sources which includes track measures like rail grinding, welding to smooth discontinuity, lubrication, use of soft rail pads and relocation of signals or turnouts. The other mitigation measures include wheel lubrication, use of disc brakes, dampening of wheel and use of resilient wheels; and
- Plantations of trees and shrubs (as green belts) for instance would contribute little to actual noise reduction, but they do have a psychological effect in reducing the perceived nuisance of the construction noise, and they are often used to soften the visual appearance of mounds and walls [refer **Annexure 6(b), Vol-II**] Plantation Strategy as a reference guideline].

2) Operation Phase

The purpose of mitigating noise and vibration is to minimize the adverse impacts that project ground borne vibration will have on residents living nearby. Because ground borne vibration is not as common as noise, the mitigation measures are not well defined. Perceptible ground borne vibration is generally limited to the areas within 25 to 50 m of the railway system.

However, following mitigation measures are suggested for curtailing both the noise and vibration levels:

- The vibrations can be reduced considerably by ensuring and keeping correct track geometry by advanced measurement;
- Effective maintenance programs are essential for controlling ground borne vibrations;
- Expanding the rail right of way sometimes the easiest method of reducing the vibration impact;
- Controlling rail traffic time;
- Controlling noise and vibrations at the source. This includes track measures like rail grinding, welding to smooth discontinuity, lubrication, use of soft rail pads and relocation of signals or turnouts. The other mitigation measures include wheel lubrication, use of disc brakes, dampening of wheel and use of resilient wheels;
- Avoid vibratory rollers and packers near sensitive areas;
- Operate earth moving equipment away from the vibration sensitive areas;
- Earth moving and ground impacting operations should not carry at the same period of time;
- Avoid night time activities. People are more aware of vibration in their homes during the night time hours.

6.2.2 Controlling the Transmission of Noise and Vibration

This includes the construction of noise barriers, installation of resilient base plates and ballast mats and noise treatment on the bridges. Barriers should be used selectively. They are a high cost approach, and their effectiveness in controlling impacts will depend on the situation. Barriers are more effective if they are near the source or the receiver. Their effectiveness is also determined by their height, the material used (absorptive or reflective) and their density. Barriers can take a number of forms including free standing walls, grass or earth mounds or bunds, trenches, and trenches or cutting with in which noise sources are sited.

6.2.3 Policy Approach

Other than the physical measures, such as measures to sound source (improvement of train car) and measures to sound propagation path (installment of sound barrier), soft measures, such as policy measures to prevent the issues in advance.

In this section, case study in Japan for land-use measures and housing measures is discussed to consider the application along the high speed railway in India, based on the impact extent discussed above section.

1) Case Study Of Land-Use Measures In Japan

As a case of community renovation in Japan, control and derivation of land-use is carried out by municipality basis to harmonize between transport infrastructure and area along the infrastructure.

Enforcement policy for regulating and guiding land-use is shown in Table 6.2.1. And cases of regulating and guiding, targeting the railway facility, are shown in Table 6.2.2.

Table 6.2.1: Enforcement Policy for Regulating and Guiding Land-use

Policy	Contents	Basis
Master plan for city	To specify the basic policy for city planning by the prefecture	City planning act, 1969 Article 18.2
Application plan	To determine the application of the area (district, zone, block). Depending upon the application of the area, the kind of building is regulated.	City planning act, 1969 Article 8
District plan	To stipulate the area (district, zone, block) to establish the detailed regulation	City planning act, 1969 Article 12.4
Allocation of buffer zone, such as park and green belt	To establish park or green belt to function as a buffer zone. There are two (2) types of buffer zone: 1) installed by municipality and 2) by the area developer.	Approach based on the city plan

Source: Study Team

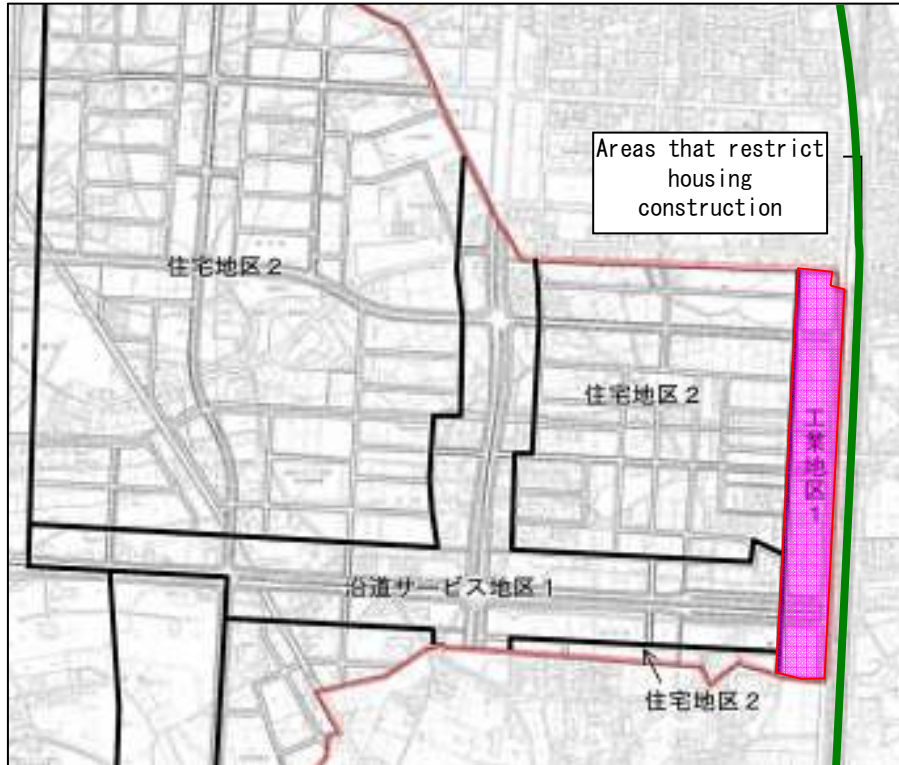
Table 6.2.2: Cases of Regulating and Guiding, Targeting the Railway Facility

Municipality	Facility	Activity	Contents	Note
Yatsushiro City	Kyushyu Shinkansen	Involvement into the city master plan	The city enhances location of commercial and business facilities around the area, considering the unified urban development and good living environment.	Around the Shinkansen station
Kawasaki city	Convention al railway		The city leads the land-use diversion in a strategic and agile manner to unify industrial function and living environment.	
Itami city	Sanyo Shinkansen		The city plans to install green line along the Shinkansen railway to formulate an urban space, where the user can feel a nature closely.	Focusing the contact with nature
Ministry of Environment	Kyusyu Shinkansen	Ministry notification regarding the area application	The ministry suggests follows, considering the optimized land-use to satisfy the environmental standard: 1) To avoid using the area as a residential area. 2) To lead a land-use which is not adversely impacted by the noise caused by Shinkansen.	Kagoshima Prefecture has changed the application area and categorization area for noise standard
Morioka city	Tohoku Shinkansen	Regulation of house construction along the railway	The city has limited the development of residential area along the railway.	Refer to Exhibit 6.2.1

Municipality	Facility	Activity	Contents	Note
Toda city	Tohoku-Zyoetsu Shinkansen	Installment of buffer-green zone along the railway	The city is improving the both side of Shinkansen and conventional railway as buffer zones (20m each side).	Improvement-from-possible-area approach

Source: Study Team

Exhibit 6.2.1: Limitation of Development as a Residential Area by Morioka City



Source: http://www.city.morioka.iwate.jp/res/projects/default_project/page/001/009/898/19-seinan.pdf

2) Case Study of Housing Measures In Japan

Housing measure is a policy to lead residential development with high acoustical insulation. In Japan, local government leads/requires estate developer to install that kind of facility by announcement of municipal bylaw or guideline.

Since this measure targets each individual house, clarifying the technical matters (detailed capability, architectural standard, confirmation method of acoustic insulation capability) and establishment of management structure to secure the sustainability of the policy are necessary. Table 6.2.3 shows the cases of housing measure in Japan.

Table 6.2.3: Cases of Housing Measure in Japan

Municipality	Activity	Detail
Yokohama city	Setting of target value for the measure	<ul style="list-style-type: none"> 60dB (Averaged maximum sound level (L_{Asmax}) in the room) <http://www.city.yokohama.lg.jp/kankyo/mamoru/koutsukankyo/bouon/index/bouon.pdf>
Osaka city		<ul style="list-style-type: none"> <45dB during day time, <40dB during night time (Equivalent sound (L_{Aeq}) in the room) 60dB (Averaged maximum sound level (L_{Asmax}) of top 10 in the room) <http://www.city.osaka.lg.jp/toshikeikaku/page/0000200720.html>
Yokohama city	Advanced explanation to the new resident	<ul style="list-style-type: none"> Developers must explain about the impact of noise in advance to the new residents. Impact of noise must be clearly explained in the brochure of the residence. Developers must remind the new residents about the impact of noise upon signing the contract. <http://www.city.yokohama.lg.jp/kankyo/mamoru/koutsukankyo/bouon/index/bouon.pdf>
Osaka city		<ul style="list-style-type: none"> Developers must explain about the impact of noise, source of noise and its measures in advance to the new residents. <http://www.city.osaka.lg.jp/toshikeikaku/page/0000200720.html>

Source: Study Team

3) Recommended Mitigation Measures for Operational Noise Reduction

Mitigation measures for railway noise should be considered from various approaches. One approach is to take measures on the sides of cars and structures as the ones to be adopted for noise sources. Various measures for the cars have been developed and applied in practice for Shinkansen in Japan as discussed above.

As discussed above, railway noise comes from various places of the car such as current collecting system including pantographs, upper and lower parts of the car, and structure. There are several types of noise from different places. Aerodynamic noise is generated from all places of the car; spark noise and interactive noise are specific from the current collecting system; and rail and wheel and gear noise are specific from the lower part of the car. Thus, mitigation measures have been developed for HSR (Shinkansen) corresponding to these places and types so that the noise can be reduced as much and as effectively as possible.

Table 6.2.4 summarizes major mitigation measures to reduce noise impacts from the cars and structures which are recommended to be adopted for the HSR in India considering expected results and costs.

Table 6.2.4: Recommended Mitigation Measures for Railway Noise

Mitigation Measures	Characteristics	Advantage	Disadvantages	Workability	Expected Outcome	
On the side of Structure	Install sound proof wall	The effect of the installation is predictable.	It is possible to reduce noise of lower part of the car mainly.	There are some problems on sunshine Obstruction and view from the car window.	Relatively easy, but it is necessary to Set up the base for installation.	High
	Adopt long rail and Expansion Joint (EJ)	It is possible to reduce noise by reducing the number of joints by adopting longer rails.	It is possible to reduce noise as well as vibration.	When replacing the rails, workability is relatively difficult	It requires professional and special hardware for the rail welding	High
	Thorough maintenance of track such as grinding rail	Adjust the wear-out of running surface of rail or the track part above the ground to reduce operation noise.	It can be done as part of routine maintenance. It is possible to reduce not only noise but also vibration.	The effect is Relatively short in a few months by the realignment of track.	It requires special devices or skills for grinding rail or track realignment.	Medium
On the side of Car	Streamlining of car head shape	By reducing constant drag (CD) value by decreasing the roughness of the car body. It is possible to reduce aerodynamic noise.	The effect is continuously maintained.	The trial of obtaining effects of reducing noise will be required.	As it is not easy after the operation, streamlining of the cars needs to be considered from the planning and order stages.	High
	Smoothing of car shape	By reducing CD value by decreasing the roughness of the car body, it is possible to reduce	The effect is Continuously maintained.	The trial of obtaining effects of reducing noise will be required.	As it is not easy after the operation, smoothing of the cars needs to be	Low

Mitigation Measures	Characteristics	Advantage	Disadvantages	Workability	Expected Outcome
	aerodynamic noise.			considered from the planning and order stages.	
Adopt low noise type pantograph and reduction of the number	By decreasing the opportunities interaction between electric cables and pantographs, it is possible to reduce the noise	It changes Dramatically only by changing the Pantographs and the cover.	The trial of obtaining effects of reducing noise will be required	It takes time to change at the car factory. But, as it is not easy after the operation, adoption of said pantographs needs to be considered from the planning and order stages	High
Covering of car seam parts	By decreasing the roughness of the car body, it is possible to reduce aerodynamic noise.	It is possible to repair partly between boogies.	The trial of obtaining effects of reducing noise will be required.	It takes time to covering works at the car factory. But, adoption of covers needs to be considered from the planning and order stages.	Low
Thorough maintenance of cars	By decreasing the roughness and maintenance of accessories, the initial condition of lower part's noise is maintained.	It can be done as part of routine maintenance.	Adjustment of train operation schedule or for maintenance is necessary.	Relatively easy as it can be done as part of routine maintenance	Medium

Source: Study Team

Among the above mitigation measures, the ones to be adopted for the cars such as streamlining of the head shape of the car, smoothing of the car shape, adopting low noise type pantographs and reduction of its number, and installation of cover in seam parts of the cars are normally incorporated in the design or specification of the cars, as in the case of Shinkansen recently. Thus, it can be said that rolling stocks to be used for HSR in India for the proposed MAHSR are expected to adopt all these mitigation measures as preinstalled ones.

While those mitigation measures introduced above are hardware approach, software approach introduced by the case study in Japan (refer Section 5.2.6) shall be considered.

During the operation peak, the impact to the area alongside of the railway is considered increase with the increase of number of train and operation speed. Expansion of residential area with the increase of population is also considered, causing expose of noise impact.

Thus, planning for introduction of physical measures and soft approach such as policy dissemination, considering the involvement of the policy into the city plan, must be important.

Approaches for improvement the noise impact are summarized as below:

- To regulate the land-use alongside of the railway for commercial or business purpose to avoid the noise impact;
- To install buffer zone or green belt to secure the seriously impacted area;
- To lead land developers to install high acoustic insulation residence;
- To carry out the above policies for already densely built-up area when a land redevelopment case has arisen;
- To know the situation of noise impact and effectiveness of mitigation measures, continuous monitoring of sound level along the railway is highly recommended.

6.3 WASTE MANAGEMENT

6.3.1 Construction Waste Management

In such a large scale of project, huge quantity of waste shall be generated which cannot be ruled out. The waste generated during the construction should be handled and managed in accordance with the provision of Construction and Demolition Waste Management Rules, 2016.

In order to avoid associated health and aesthetic problems caused by improper management, the following measures should be taken into consideration for construction waste management.

- Avoid uncontrolled solid waste dumping which could be breeding ground for vermin, and as such could pose a vector for disease. Uncontrolled solid waste dumping invariably attracts casual dumping by others and also this could encourage improper disposal of hazardous wastes.
- Segregation of waste depending on the nature of the materials should be carried out. Special attention should be given to diverting hazardous materials/wastes for proper management in accordance with applicable regulatory requirements as detailed below.
- The prevailing rules and act such as C&D Rules 2016, MSW Act, 2016 *etc.* should be strictly adhered to.

6.3.2 Storage, Handling and Emergency Response for Hazardous Materials

Safe handling of fuel is everyone's responsibility. One can take steps to ensure their own safety and health, as well as that of those around and ensure that the environment is protected. Improper handling of fuel and hazardous material can result in serious injury or death caused by fire, explosion, or asphyxiation.

The storage and handling of hazardous materials and waste should be done in compliance to the provision of the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and the Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.

To deal with any emergency Risk Management and Disaster Management Plan have been prepared. The action plan recommended in the report should be followed.

Handling Hazardous Materials

Whenever it is feasible, engineering controls should be used to reduce employee exposure to hazardous materials. When engineering controls are not available, or they fail to adequately reduce hazards, other personal protective equipment is required. Examples of personal protective equipment include: safety glasses, hearing protection, gloves, respirators, etc. Personal Protective Equipment (PPE) devices must be provided and worn in accordance with the manufacturer's recommendations indicated on the label of the product or as stated in the Material Safety Data Sheet for the product. Hazardous chemical spills can be handled effectively when a plan of action has been developed. Spill procedures should include the following general procedures:

- If the spilled material is flammable, turn off ignition and heat sources;
- Attend to any person who may have been infected or affected;
- Notify individuals in the area about the spill;
- Evacuate non-essential personnel;
- Avoid breathing vapours of spilled material. Establish an exhaust or ventilation, if it is safe to do so. Air handling units are not to be used because they re-circulate the hazardous vapours. Contact Safety, Health and Environment (SHE) for information about the proper ventilation or exhaust required;
- If a spill is relatively large, or involves a highly toxic material, a carcinogen or flammable material, contact SHE for assistance in cleaning up the spill and disposing of the hazardous waste resulting from the cleanup.

Hazardous wastes undergo different treatments in order to stabilize and safe disposal.

- Recycling
- Neutralization
- Hazardous waste landfill

6.4 BORROW AREA (AND QUARRY SITE) MANAGEMENT

It should be the responsibility of the contractor to identify borrows areas and negotiate with the owners. However, it is proposed that an appropriate Borrow Area Management Plan should be formulated to control the degradation of the surrounding landscape due to the excavation work.

The national standard adopted by the MoEFCC and which applies to the borrowing of earth is the IRC: 10- 1961 and these guidelines should be followed at all times.

The guidelines for quarry site management for the contractors has been explained in detail and appended with the report as **Annexure-6(c), Vol-II** and the disposal site management as **Annexure 6 (d), Vol-II**.

The Borrow Area Management Plan will specify the following:

- Names, locations and ownership of the borrow or quarry areas;
- Existing land use of the areas (including the access roads to be developed) to be quarried;
- Approximate quantities of the materials available;
- The number of trees and the species of the trees to be removed;
- Total area involved;
- Arrangements with the owners;
- Whether purchased or leased;
- A statement from the owners saying the actual arrangement (not in terms of exact monetary compensation) with him is agreeable for him;
- The exact restoration plan indicating the number of trees that should be planted;
- The action plan for leveling and landscaping in order to bring the area in conformity to the neighboring land uses;
- The access roads rehabilitation: and
- Compliance certificate of tax, levy, royalty, EC, etc. provisions.

The following principles should guide the selection of locations, management and rehabilitation of the borrow areas:

- No borrow areas should be located inside protected areas or recorded forest areas;
- Borrow areas should be located (at least 1 km) away from villages and settlements;
- Barren or wasteland areas should be prioritized for use as borrow areas;
- 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;
- No borrow area should be opened without the prior permission from the relevant local administrative bodies such as Village Panchayats, State Industries and Mines Department (SIMD) and State Pollution Control Board (SPCB);
- Borrowing of earth should not be done continuously. Slopes of edges should be maintained not steeper than 1:4;
- During works execution, the contractor shall ensure spreading of stripping material to facilitate water percolation;
- During excavation the removal of trees is to be avoided wherever possible;
- Where trees felling are unavoidable, adequate compensatory plantation should be taken up;
- Top soil (15 cm) from all areas may be preserved in stockpiles and utilized for redevelopment of borrow/quarry areas;
- Rehabilitation of borrow areas should be mandatory and must be included in the agreement made with the contractor;
- Landscaping of borrow areas and quarry sites should be carried out such that trees, shrubs and grasses/herbs are planted so as to rehabilitate the areas as grassland, orchard, or woodland areas;

- The rehabilitation of borrow areas should be specified in the contract with the contractor and include consultation with appropriate authorities (*e.g.* SIMD, SPCB, or other appropriate planning agencies).

6.5 CONSTRUCTION CAMP MANAGEMENT FOR ITS DEVELOPMENT, OPERATION AND DEMOBILIZATION

Construction camps may damage trees, habitats and landscapes when they are constructed, and affect water quality when in use. Poor accommodation management could lead to affect the workers physically, physiologically and psychologically, and also cause social problems around the camp sites. Therefore, the following mitigation measures are proposed.

- Camps should be located carefully to minimize loss of trees/habitats;
- The construction camps will be located at least 200 - 500 m away from habitations at identified sites;
- Camps should be designed as per the local laws and guidelines;
- Proper accommodation should be provided to all employees who are working at significant distance from their home;
- Water storage tanks should be located above ground and boreholes should be away from toilets/drains;
- Clean and properly staffed and equipped canteen should be provided at camps;
- Wastewater from the camps should be suitably treated and disposed away from the sites as per the applicable standards and guidelines;
- Regular spray of a mixture made from diesel and insecticides should be done at all water stagnation areas to avoid mosquito breeding and spread of any vector borne diseases; and
- Garbage bins should be provided at suitable locations and should be ensured that each site is tidied and refuse taken to a licensed site regularly.

The following mitigation measures are proposed for demobilization of the contractor:

- All garbage, debris and hazardous materials should be removed from the construction sites and deposited at designated approved disposal sites.
- Consult with the owner of the site and leave any buildings, well or any structure if wanted by them.
- All trenches should be filled and all equipment, plant and materials should be removed from the site.
- Compensate for rehabilitating the landscape and vegetation disturbed during construction activities.

The guidelines for sanitation and housekeeping at the labour /construction camps is detailed in ***Annexure 6 (e), Vol-II.***

6.6 SOIL EROSION MANAGEMENT

Construction activities include land clearing and earth works which can be designed to reduce the risk of damaging the soil and to fit the project into its environment with minimal adverse impacts.

Following action should be put in place to avoid the soil erosion:

- Plantation on the slope of embankment;
- Plantation at near the stock pile of soil;
- Plantation on the slope of the dump site.

Guidelines for top soil management are discussed in **Annexure 6(f), Vol-II** of the S-EIA Report.

6.7 SOCIAL ENVIRONMENT MANAGEMENT

Land Acquisition and Resettlement Management

The acquisition of land and private property should be carried out in accordance with the Resettlement Action Plan (RAP). Compensation and assistance package have been planned in RAP.

It has to be ensured that all resettlement and rehabilitation activities including the payment of the compensation may be reasonably completed before construction activities commence on any section of the MAHSR. There are some utility services along the proposed MAHSR alignment such as electric poles, telephone lines, cable line, pipelines, religious facilities, existing railway quarters and structures, the affected lines should be shifted in consultation with the concerned local government departments, Indian Railways and communities before the commencement of the construction activity. There are several roads crossing along the proposed alignment. The structures should be shifted in consultation with the concerned local government departments, Indian Railways, communities.

6.8 OCCUPATIONAL HEALTH AND SAFETY (OHS) MANAGEMENT

6.8.1 Construction Phase

During the construction phase construction/labour camps should be located along the project area. Large numbers of workers are likely to cause a significant increase in the local population in the project area. A proper Construction Camp Development Plan has to be formulated to control degradation of the surrounding environment due to the location of the proposed construction camp. The contractor must provide and maintain adequate living conditions and ancillary facilities that must be included in the contract document provided to the Contractor [refer **Annexure 6 (e), Vol-II**].

The following actions should be undertaken at construction/labour camps and stipulated in construction contracts:

- Sufficient supply of potable water must be provided at camps and working sites. If the drinking water is obtained from an intermittent public water supply, then storage tanks must be provided. All water supply storage must be at least 15 m away from the toilets or drains.
- Adequate washing and bathing facility must be provided in clean and drained condition.
- Adequate sanitary facilities must be provided within every camp. The place must be cleaned daily and kept in strict sanitary condition. Separate latrines, bathing and changing areas must be provided for women.

- Collection of domestic waste and its suitable disposal must be carried out on a regular basis.
- Adequate supply of fuel in the form of kerosene or LPG must be provided to construction labourers to avoid the felling of trees or collection of firewood for cooking and other household activities. No open fires should be allowed in camps.
- The sites are to be access controlled.
- Construction equipment and POL products should be stored 500 m away from the local settlements, workers living areas and it should be away from the water resource.
- The contractor should be required to submit and obtain approval for a health and safety plan prior to the commencement of work;
- Adequate training on medical surveillance, engineering control, good work practices and handling of hazardous material, housekeeping and emergency response.
- There should be provision of adequate health care facilities; and
- Workers should be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

1) First Aid Facilities

- The contractor should be responsible for ensuring that first aid, including the provision of trained personnel, is available. Arrangements should be made for ensuring medical attention of workers who have suffered an accident or sudden illness.
- The manner in which first aid facilities and personnel are to be provided should be prescribed by national laws or regulations and drawn up after consulting the competent health authority and representative organizations of employers and workers concerned.
- Where the work involves risk of drowning, asphyxiation or electric shock, first aid personnel should be proficient in the use of resuscitation and other life-saving techniques and in rescue procedures
- Suitable rescue and resuscitation equipment, as required, including stretchers should be kept readily available at the construction site.
- First-aid kits or boxes, as appropriate, should be provided at the work places, including isolated locations such as maintenance gangs, and on motor vehicles, locomotives, boats and floating equipment, and be protected against contamination by dust and moisture.
- First- aid kits and boxes should be simple with clear instructions provided and be kept under the charge of a responsible person qualified to render first aid and be regularly inspected and stock properly maintained.

2) Fire Prevention and Fire Fighting

- All the appropriate measures should be taken by the contractor to avoid the risk of fire control quickly and efficiently any outbreak of fire and bring about a quick and safe evacuation of persons.
- Secured storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinder, paints and other such materials in order to deter trespassers.
- Smoking should be prohibited, and NO SMOKING notices be prominently displayed in all places containing readily combustible or flammable materials

In confined spaces and other places in which flammable gases, vapors and dust can cause danger:

- Only suitably protected electrical installations and equipment, including portable lamps, should be used.
- Oil rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place.
- Adequate ventilation should be provided.
- Combustible materials such as packing materials sawdust, greasy/oily waste and scrap wood or plastic should not be allowed to accumulate in work places and should be kept in closed metal containers in a safe place.
- Regular inspections should be made of places where there are fire risks. These include the vicinity of heating appliances, electrical installations, and conductors, stores of flammable and combustible material, hot welding and cutting operations.
- Places where workers are deployed should, if necessary to prevent the danger of fire, be provided as far as practicable with:
 - Suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible
 - An adequate water supply at ample pressure.
 - Fire-extinguishing equipment should be properly maintained and inspected at suitable intervals by a competent person.
 - Where necessary to guard against danger, workers should be suitably trained in the appropriate actions to be taken in the event of fire, including the use of means of escape.
 - Where appropriate, suitable visual signs should be provided to indicate clearly the direction of escape in case of fire.
 - Means of escape should be kept clear at all times.

3) Sanitary Facilities

- The provision of toilet or sanitary facilities, and the construction and installation of water flush toilets, privies, chemical closets, plumbing or other toilet fixtures should comply with the requirements specified by the competent authority.
- No toilets other than a water flush toilet should be provided and they should be adequately ventilated and not open directly into occupied rooms.
- Adequate washing facilities should be provided as near as possible to toilet facilities.

Guideline for sanitation is attached as **Annexure 6 (e) Vol-II**.

4) Housekeeping

A suitable housekeeping program should be established and continuously implemented on each construction camp site which should include:

- The proper storage of materials and equipment;
- The removal of scrap, waste and debris at appropriate intervals;
- Loose materials which are not required for use should not be placed or allowed to accumulate in the site so as not to obstruct access to and egress from workplaces and passageways;
- Workplaces and passageways that are slippery, owing to oil or other causes should be cleaned up or strewn with sand, saw dust, ash or the like;
- Special housekeeping staff would be in charge of each work section;

- Each section will maintain the site reasonably clean and keep from obstruction, and properly store any construction equipment, tools and materials. Any wreckage and/or rubbish should be temporarily stored in wreckage and rubbish bins. These rubbish bins and wreckage should be cleaned at frequent intervals;
- General housekeeping should be carried out and ensured at all times at work sites, labour camps, stores and offices;
- Full height fence, barriers *etc.* should be installed at the site in order to preserve the surrounding area from excavated soil, rubbish *etc.*;
- Arrangements to control dust pollution including silica dust through provision of wind screens, water sprinklers, and dust extraction systems should be provided at all site, likely crushers, concrete batching plants, quarry area and sand sites;
- The contractor will ensure that all sub-contractors maintain the site reasonably clean through sub-contractor provision related to housekeeping;
- All staff and supervisors and engineers working at the site will also be educated on the necessity of good housekeeping;
- Immediate disposal of the weeds, trash and debris resulting from site clearing;
- The garbage should be separated into biodegradable and inert material and disposed of separately. The food items should be collected in trash cans with a firm lid;
- Oil and grease dripping from machinery should be collected in a drip pan of suitable size. The area should be cleared after the repair and maintenance of the construction equipment.
- Efficient drainage and leveling of the low-lying areas should be done at all construction sites to prevent the creation of stagnant pools or puddles of water;
- Empty oil drums, cans and other receptacles, which may retain water, should be disposed of regularly.

In addition, the contractor must provide and maintain adequate working and living conditions and ancillary facilities that must be included in the contract documents provided to the contractors. The following are major actions to be undertaken at construction yards or camps for adequate working and living conditions:

- Sufficient supply of potable water must be provided at yards and camps. If the drinking water is obtained from an intermittent public water supply, then storage tanks must be provided. All water supply storage must be at least 15m away from the toilets or drains.
- Adequate washing and bathing facility must be provided in clean and drained condition. Separate bathing and changing areas must be provided for women.
- Adequate sanitary facilities must be provided within the areas of each yard and camp. Water flush toilets are desired which should be adequately ventilated and washing facilities should be provided near toilet facilities. The facilities should comply with the requirements specified by the competent authority.
- Collection of domestic waste and its suitable disposal must be carried out on a regular basis.
- Adequate supply of fuel in the form of kerosene or LPG must be provided to construction labours to avoid the felling of trees or collection of firewood for cooking and other household activities. No open fires should be allowed in the camps.
- Construction equipment, and petroleum, oil and lubricant (POL) products should be stored 500 m away from the local settlements and workers living areas and it should be away from the water resource.
- Adequate trainings on good work practices including handling of hazardous materials, housekeeping and emergency response *etc.*

- There should be provision of adequate health care arrangements including first aid facilities and personnel (qualified first aid personnel or a nurse) for workers who suffer an accident or sudden illness. The manner in which first aid facilities and personnel are to be provided should be prescribed by national laws or regulations and drawn up after consulting the competent health authority and representative organizations concerned.
- Suitable rescue and resuscitation equipment, as required, including stretchers should be kept readily available at the construction site.
- First-aid kits or boxes, as appropriate, should be provided at the workplaces and be protected against contamination by dust and moisture.
- Workers should be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

Furthermore, a suitable housekeeping program should be established and continuously implemented on each construction site which should include:

- General housekeeping should be carried out and ensured at all times at worksites, construction camps, stores and offices.
- All staff and supervisors and engineers working at the site should be educated on the necessity of good housekeeping.
- The contractor should maintain the site reasonably clean through sub-contractor provision related to housekeeping.
- Special housekeeping staff would be in charge of each work section.
- Loose materials, which are not required for use should not be placed or allowed to accumulate in the site so as not to obstruct access to workplaces and passageways.
- Workplaces and passageways that are slippery, owing to oil or other causes should be cleaned up or strewn with sand, sawdust, ash or the like.
- Each section shall maintain the site reasonably clean and keep from obstruction, and properly store any construction equipment, tools and materials. Any wreckage and/or rubbish should be temporarily stored in wreckage and rubbish bins. These rubbish bins and wreckage should be cleaned at frequent intervals.
- Full height fence and barriers should be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc.
- Arrangement to control dust pollution including silica dust through provision of wind screens, water sprinklers, and dust extraction systems should be provided at all site, likely crushers, concrete batching plants, quarry area and sand sites
- Immediate disposal of the weeds, trash and debris resulting from site clearing.
- Oil and grease dripping from machinery should be collected in a drip pan of suitable size. The areas should be cleared after the repair and maintenance of the construction equipment.
- Efficient drainage and leveling of the low-lying areas should be done at all construction sites to prevent the creation of stagnant pools or puddles of water.
- Empty oil drums, cans and other receptacles which may retain water should be disposed of regularly.

As for fire prevention and firefighting, the following actions should be done by the contractors;

- All the appropriate measures should be taken to avoid the risk of fire control quickly and efficiently any outbreak of fire and bring about a quick and safe evacuation of persons.

- Secure storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinder, paints and other such materials in order to deter trespassers.
- Smoking should be prohibited, and no smoking notices be prominently displayed in all places containing readily combustible or flammable materials.
- In confined spaces and other places in which flammable gases, vapors and dust can cause danger:
 - Only suitably protected electrical installations and equipment, including portable lamps, should be used.
 - Oil rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place.
 - Adequate ventilation should be provided.
- Combustible materials such as packing materials sawdust, greasy/oily waste and scrap wood or plastic should not be allowed to accumulate in work places but should be kept in closed metal containers in a safe place.
- Regular inspections should be made of places where there are fire risks. These include the vicinity of heating appliances, electrical installations, and conductors, stores of flammable and combustible material, hot welding and cutting operations
- Suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible
- Fire-extinguishing equipment should be properly maintained and inspected at suitable intervals by a competent person.
- Where necessary to guard against danger, workers should be suitably trained in the appropriate actions to be taken in the event of fire, including the use of means of escape.
- Where appropriate, suitable visual signs should be provided to indicate clearly the direction of escape in case of fire.
- Means of escape should be kept clear at all times.

The contractors are required to prepare, submit and obtain approval for a safety, health and environment (SHE) plan which contains the above measures, but not limited to them, prior to the commencement of the construction works.

Guideline for housekeeping at the labor/construction camps is attached as **Annexure 6 (e), Vol-II**.

6.9 NATURAL ENVIRONMENT MANAGEMENT

It is standard practice within an EIA to incorporate a greenbelt development plan, however in this case where certain environmental impacts on wildlife and their habitats are perceived, an integrated greenbelt, habitat restoration and wildlife management plan is proposed as follows:

1) Green Belt Development

Greenbelt development, reestablishment or strengthening is proposed for the entire section as a major component of the EMP. Greenbelt along the RoW serves a number of environmental enhancement and mitigation purposes including:

- The improvement of landscape aesthetics by hiding the maintenance/service road behind a vegetated screen, hedgerow or tree line/beautification of the corridor;

- The significant reduction of noise pollution and vibration;
- The mitigation of air pollution both in terms of the local or micro level by absorbing pollutants and by contributing to global efforts to combat climate change through the absorption of carbon dioxide;
- The protection of soils and reduction of soil erosion;
- The provision of valuable wildlife habitat for numerous species which have become accustomed or adapted to living in agricultural and urban human dominated or anthropogenic landscapes;
- The creation or strengthening of a hedgerow or tree line along the service/maintenance roads also serves the practical purpose of demarcating the RoW and therefore, prevents or reduces encroachment.

In Gujarat section, the proposed MAHSR alignment runs parallel to the existing railway track on viaduct. There has been previous greenbelt of the existing track's RoW such that a mature hedgerow now exists along the alignment. For certain sections, removal of this existing hedgerow may not be necessary and preserving it should be a priority wherever possible. In such sections, efforts should focus on the strengthening of the existing tree line and the replacement of groundcover and shrubs within the RoW. In other sections, it seems likely that the existing hedgerow or tree line will have to make way for the alignment.

Efforts should also focus on restoration of natural habitats and the strengthening of natural ecological corridors for the benefit of wildlife populations and their movement across the alignment, beyond the protected area boundary and in the wider landscape.

A number of measures are proposed for greenbelt creation, reestablishment and restoration as below:

- i) Firstly, where there is a pre-existing hedgerow or tree line it should be preserved wherever possible;
- ii) Special efforts should be made to avoid the removal of mature keystone trees along the alignment, especially if they are native species providing valuable nesting sites and fodder to birds and mammals;
- iii) Along the SGNP and TWLS section during the biodiversity assessment particular keystone trees were noted as magnets for biodiversity on a microhabitat level. If such species cannot be avoided, transplanting should be considered where feasible as a part of habitat restoration efforts or to strengthen natural ecological corridors. Growth and regeneration rates are extremely low in this arid region and, therefore, it may take up to two decades for some of these trees to be adequately replaced in terms of their ecosystem function by planting of saplings.
- iv) The plantation of trees should be completed in the construction stage so that substantial growth is achieved when the project is commissioned.
- v) Overall the replacement rate should be double the number of trees to be removed along the alignment. This should generate a surplus of trees to be planted in the areas where there are trees in the RoW. This surplus should be used for a) the creation of a greenbelt with hedgerow/tree line and b) for natural habitat restoration and strengthening ecological linkages in the SGNP-TWLS landscape.
- vi) Greenbelt creation and re-establishment includes the plantation of trees as well as shrubs and grasses/herbs. A mix of native species should be preferred. Appropriate species should be relatively quick-growing (in order to rapidly be able to absorb pollutants, act as

an effective screen and perform all the functions of a greenbelt) and hardy (for survival in a harsh, arid climate). A list of suggested species is provided below but competent authorities should be consulted prior to investment. Special notes are provided on the selection of species for the SGNP-TWLS section below.

- vii) Tree planting and groundcover restoration work should be undertaken early-on in the monsoon season (July).
- viii) Saplings should be procured from local nurseries in close proximity to the plantation areas (but they should also be carefully checked for diseases and quality).
- ix) Different planting techniques are required for different species of trees/shrubs.
- x) The proposed alignment also passes through the patches of mangrove which will require to be cleared. Necessary permission should be secured from the Bombay High Court for felling of mangrove in these sections.
- xi) Management and Conservation Plan for mangrove is finalized by MSI and the recommendations of the same should be implemented in consultation with the APPCF (Mangrove Cell), Thane.
- xi) Grasses are used to provide surface cover on slopes, but it also needs a well prepared surface in which to be planted. For a well spread grass cover, the surface should not be disturbed in the initial stages of sowing. The grass species recommended are *Cynodondactylon*, *Cythoclinepurpurea*, *Solanumnigru*, *Xanthiumstrumerium*. *Desmostachyabi pinnata*, and *Aristidahysterix* are recommended for side embankment of eroded and dry patches.
- xii) Relatively intensive work is required over the first three months in tending and weeding to ensure the establishment of the saplings and groundcover vegetation.
- xiii) Ongoing monitoring and maintenance of the planted greenbelt areas is required and should be performed by the competent authorities (*i.e.* DCF/ Social Forestry Department). Lopping will not be an immediate concern but may be required after 10-15 years depending on the tree species. Grasses/herbs and ground cover will retreat considerably during the dry, hot summers before returning during the monsoon season in this arid region which should make management relatively straightforward *i.e.* once established the area can be left to regenerate naturally without significant landscaping, surgery or constant chopping back.

2) Compensatory Afforestation

Compensatory Afforestation (CA) is one of the most important conditions stipulated by the Central Government while approving proposals for de-reservation or diversion of forest land for non-forest uses. The CA scheme shall be prepared by the Concerned Divisional Forest Office which include the details non-forest/degraded forest area identified for compensatory afforestation, map of area to be taken up for compensatory afforestation, year-wise phased forestry operations, details of species to be planted and suitability certificate from afforestation/management point of view along with the cost structure of various operations.

Compensatory afforestation (CA) shall be done over equivalent area of non-forest land provided by the District Collector. Where non-forest lands are not available or non-forest land is available in less extent to the forest area being diverted, compensatory afforestation may be carried out over degraded forest twice in extent to the area being diverted or to the difference between forest land being diverted and available non-forest land, as the case may be. However, Forest department will charge cost involved in raising and maintaining the afforestation area/plants up to 10 years.

Special provisions for Central Government Undertaking Projects

- b. Compensatory afforestation may be raised on degraded forest land twice in extent of forest area being diverted.
- c. The user agency will deposit the amount for compensatory afforestation with the concerned State Govt. on receiving the demand and the actual transfer/use of forest land will be affected only after the receipt of the demanded amount.
- d. The State Governments will identify 'blank forest' or degraded forest lands for compensatory afforestation. The State Governments of Maharashtra and Gujarat will identify such degraded forest land in their States for compensatory afforestation of central projects in their respective States.

Elements of Schemes for Compensatory Afforestation

The scheme for compensatory afforestation should contain the following details: -

- Details of twice in extent of degraded forest land identified for raising compensatory afforestation;
- Delineation of proposed area on suitable map;
- Agency responsible for afforestation (like concerned Forest Division);
- Details of work schedule proposed for compensatory afforestation (up to 10 years);
- Cost structure of plantation, provision of funds and the mechanism to ensure that the funds will be utilized for raising afforestation and its maintenance up to 10 years;
- Details of proposed monitoring mechanism by the Forest Department.

As mentioned above, NHRCL has submitted the Forest proposal to both the States and proposals are under examination with the Forest department. The total forest area in Maharashtra accounts for 77.4541 ha including 18.9258 ha. of Mangrove forest and Gujarat accounts for 6.1034 ha. There is no mangrove forest falling under the RoW of MAHSR alignment in Gujarat. Hence total forest area for the entire MAHSR alignment accounts to 65.6317 ha.

Being a Central Government project, the CA scheme shall be prepared and provided by the Forest Department during processing of forest proposal of MAHSR project as the proposal submitted is under examination. During finalization of forest proposal for Stage-I clearance, the forest department shall prepare the Compensatory Afforestation Plan for all forest patches including mangroves. Similar process was followed in case of DFCC. NHRCL shall bear the cost of the Compensatory Afforestation on receipt of the demand letter along with Stage –I clearance. However, NHRCL shall update JICA about progress of the forest clearance from time to time.

3) Mangrove Afforestation (Plantation) Plan

The afforestation should be carried out in two ways:-

- a. Direct planting in the intertidal area, swamp or soft mud.
- b. Raising seedlings in the nursery

a) Direct Seed Plantation

Seeds or naturally grown seedlings which are healthy, non-infected and fully matured should be collected from the wild and are used for direct planting. Any intertidal area (between the high tide and low tide) where mangroves are absent and the substratum is of soft clay or mud and is

inundated by regular tidal waters every day is suitable for direct mangrove seed planting. The collected seeds or seedlings to be planted in to a hole made in a mud along the line transect. A hole should be made in to the mud two times wider and two times deeper than the root ball of the seedling. While placing the seedling in the hole, care should be taken that roots should dangle freely without touching the bottom of the hole. Roots in contact with the bottom will curl up wards that will lead to stunted growth of the seedlings. The spacing between each seed or seedlings should be maintained at 1 m x 1 m along the line transect.

b) Raising Seedlings in the Nursery

i) Site Selection for Nursery Development

A suitable site in the intertidal area should be selected in consultation with District Collector and Mangrove Cell, Thane to raise mangrove nursery. An appropriate site, that is both technically and ecologically likely to succeed in rehabilitating healthy mangroves should be selected. Preferred sites should be characterized by:-

- Relatively flat land preferably in the intertidal area;
- Should be gradual in slope;
- Site should be a sheltered area with low wave action;
- Easy transportation access;
- Good drainage (not waterlogged);
- Close proximity to planting site;
- Receives tidal water once in a day with tolerable salinity range;
- Site should be easily manageable.

ii) Preparation of Nursery Plot

Once site for mangrove nursery is selected, it is cleaned of debris and other unwanted material. Plots of 10 m x 1 m are to be made in the intertidal area to raise the seedlings. Like this series of plots should be made as per the requirement of the seedling production for planting. The distance between each plot should be kept 1 m in such a way that every plot is accessible for supervision and maintenance. The plot is required to be strengthened with bamboo poles to be kept intact and not to get washed off during the incoming /outgoing tides. Polyethylene bags of 4" x 10" size to be used to raise mangrove seedlings.

iii) Technical know-how for Seed Collection

The seeds for nursery are required to be collected from nearby mangrove area and also from other far of places for the species of mangroves which are not available in the vicinity. Although, mangrove seeds are available throughout the year the best season to collect seeds is June to September. It is necessary to have a look at the individual species autecology of the mangroves as well as their synecology depending on the variety of species to be raised.

The different mangrove species have varying size and shape of seeds/seedlings with typical morphological characteristics. Some seeds are pod like with tapering end as in case of *Rhizophora* spp., radicle in *Bruguiera* spp. Is triangular in shape as in *Avicennia* spp. while, round ball like in *Sonneratia* spp. etc. The seedlings of various shapes and sizes of propagules can float differently and changes that seeds/ seedlings are undergoing during afloat vary with the species.

It is important to consider the different plant zonation which is characterized by different conditions, depending on the tidal zone and the position of the restoration site, such as the scope of tidal inundation, salinity and the amount of fresh water available.

Collected seeds should be examined for the presence of diseases or pests or borer before being brought to the nursery site. Only mature, healthy, without any injuries, non- infected with insects and seed complete in all respect should be selected.

iv) Seed Storage

Collected seeds to be stored wet till planting. The storing capacity of seeds varies with the species *i.e.* *Rhizophora* spp. and *Bruguiera* spp. can be stored moist for 6-7 days, *Sonneratia* can be stored for longer period, while species of *Kandelia* should be transplanted immediately either to the nursery or in the field. While storing the seeds it should be ensured that during handling and storing seeds are not damaged if they are placed in the intertidal area due to incoming and outgoing water movement. It is however, always advisable to store these seedlings partially immersed (pointed end root side in water) in seawater.

v) Raising Seeds in Nursery

Mangrove nurseries can be developed in the upper part of the intertidal region where seedlings can be grown in polyethylene bags supported with bamboos. The mangrove nursery may be located near the estuary or sea where seawater or estuarine water is available. The nursery may be on the open ground or in the low lying protected areas where seawater reaches. The area of nursery should receive water once in a day.

The polyethylene bags should be filled with soft mangrove mud without shells, stones and other debris and staked in the rectangular frame made by bamboo so that the bags are not washed away by the outgoing tide. Perforations in the bags are made to drain excess water from the bag. Then the collected seeds (pod like seedlings) are planted upright in each polyethylene bags while other seedlings which are round or small seeds are placed directly in the polyethylene bags filled with mud and left to grow. It takes about 6 to 8 months or a year or sometime more for seeds to grow depending on the mangrove species.

vi) Seed Management and Maintenance of the Nursery

Planted seeds should be checked regularly for pest, borer and damage, especially, when they are sprouting as seeds are more susceptible to damage at this stage. Regular monitoring of the planted seeds are required to be done to replace dead and affected seeds with new seeds and also to replace washed off bags by outgoing tide. Seeds will germinate after 7 to 8 days. Seeds should be checked for insect attack and fouler such as seaweeds especially, *Enteromorpha* spp., barnacles, gastropods and others.

vii) Criteria for the readiness of Seedlings for Planting

About 4-5 months after planting, seedlings are ready for transplanting:

- Seedlings should be healthy
- Height: 60-80 cm and bearing 7- 9 leaves
- Stem: upright with profuse root system

- Healthy with no symptoms of disease or insect attack.

viii) Criteria for Seedling Plantation

Initially, a survey has to be carried out at various localities along the coast to select a suitable site for plantation. The site selection for plantation should be done on following criteria:-

- An intertidal area that is sheltered from high energy waves such as those in estuaries and lagoons;
- In area where the difference between the high and the low tides is large (2 m or more) and the intertidal area is flushed well every day;
- Suitable Hydrological conditions of intertidal zones;
- Availability of nutrients for plant growth.

ix) Nursery Raised Seedling Plantation

Once a site for plantation is selected, nursery raised seedlings should be transported to the plantation site. The seedlings from the nursery should be collected carefully without any damage and transported to the plantation site. At the plantation site line transect should be marked with the help of rope perpendicular to the shore. Polyethylene bags of the seedlings to be cut open and seedling with root and mud to be removed carefully. The holes should be made along the line transect and then the seedlings should be planted firmly in the mud. The spacing between each seedling should be maintained at 1 m x 1 m or 2 m x 2 m depending on the locality along the line transects. The zonation pattern for different mangrove species has to be maintained. Before planting, it is necessary to find out at what position the mangrove species is being planted depending on the zonation. Plantation of seedlings may be undertaken according to length of the seedlings. For example, *Rhizophora* spp. can be planted towards waterfront followed by *Kandelia*, *Bruguiera* etc. Species with smaller seeds like *Avicennia*, *Sonneratia* etc. could be planted towards landward side.

x) Survival Rate

If due care is taken in selecting the seedlings to be used for plantation, then the survival rate is very high (about 90 to 95%).

6.9.1 Mangrove Conservation and Management Plan

Considering the magnitude of the MAHSR project, an Integrated Mangrove Conservation and Management Plan [refer **Annexure 4.15 (a), Vol-II** of the S-EIA Report] has been formulated after a scientific study carried out by the Mangrove Society of India, Goa under the expert guidance of Dr A G Untawale. About 24.3981 ha. of mangrove area shall be cleared for the construction of MAHSR alignment and its associated facilities. To ameliorate and compensate the loss of mangrove, compensatory afforestation should be taken up in consonance with the prevailing rules and regulations. The compensatory afforestation plan shall be prepared by the Office of the Mangrove Cell, Thane and Mangrove Conservation Unit, Mumbai during the Stage-I Forest Diversion proposal. Actual compensatory afforestation shall be undertaken on the degraded forest land allocated by the District Collector. The cost of the land and expenditure for compensatory afforestation shall be borne by the NHSRCL.

Conservation of mangrove should be linked with sustained economic benefits of the coastal community. Ultimate goal of the mangrove conservation is to provide diverse products on sustainable basis to meet diverse need including ecological security to the coastal people.

Keeping in view the magnitude and intensity of anticipated impacts due to construction and operation of Mumbai-Ahmedabad High Speed Railway Project, the specific conservation and management plan for mangrove is presented below:

- The tidal water flow, channels and other inlets to mangrove area at any cost should not be blocked or diverted. Regular tidal water flow should be maintained, if it is blocked in any case, the following two specific measures are advised
 - Drainage structures *i.e.* culverts for cross drainage should be designed to ensure continuous inter tidal flow thus preventing ponding and flooding.
 - Balancing culvert should be provided from Km 43+535 to Km 45+916 as per IRC guidelines.
- Compensatory afforestation of the cleared mangroves should be undertaken with 1:5 ratios at the suitable and environmentally acceptable location in the mangrove areas in consultation with the Mangrove Cell, Thane.
- The effects on the mangrove ecosystem are not preventable but a full-fledged afforestation activity in the vicinity should be undertaken, so that the ecosystem of the development area will be restored to a certain extent, which will make the new habitat unique.
- The afforestation plan should be drawn up based on the topography of the planting area and decided on the pattern of planting. During afforestation, zonation and diversity of mangrove species should be maintained at all level.
- To protect remaining mangroves during construction activities, a silt screen should be placed around the entire perimeter to preserve environment. This is particularly applicable due to changing environmental conditions in the surroundings.
- The causeway should be designed to maintain adequate tidal flow for the support of mangrove habitat.
- Water quality of the Ulhas River (Vasai Creek), has to be monitored regularly to see the impact of construction and reclamation activities.
- Regular inspection of trucks, machinery and equipment used for the project to be done to ensure that they are in good working condition, thus avoiding excessive discharge of carbon monoxide.
- Spraying of water on mangroves as well as on construction roads two to three times a day may be considered during the dry season.
- Contractor has to maintain their equipment to contain or prevent any possible leaks of fuel, used oil, solvents, pesticides, petroleum products *etc.*
- No labour camps /construction yards should be located within this stretch and within 2.0 km of the mangrove patch.
- Contractor has to observe careful procedures for any burials and use of any instruments or tools that would cut off water flow to the mangrove area.
- The construction activities should not be taken up in the night time (6.00 PM to 6.00 AM).
- Only machine with noise enclosures should be deployed in this area.
- The construction waste should not be disposed of in this stretch as it is part of the CRZ.
- A site management plan should be developed by the contractors for this stretch.
- There should be cap on speed within this stretch to minimize the impact of eddy current as the height of the mangrove varies from 10 m to 15 m.

- To protect the mudflat in this area from continuous shaking due to ground borne vibration, a trench shall be created which will be filled with rubber sheet between piers and maintenance road.
- A wind screen/noise barrier of 2.0 m height shall be installed on the overhead structure along the track.
- Along the service road mangrove plantation should be done with *salicornia*, *casuarinas*, *red mangrove Rhizophora* spp. and appropriate species of halophytes will represent a “win-win” situation both for nature and coastal human habitations.

6.9.2 Conservation and Management Plan for Thane Creek Flamingo Sanctuary

Report on the Conservation and Management Plan for Thane Creek Flamingo Sanctuary [refer **Annexure 4.15 (b), Vol-II** of the S-EIA Report] has been prepared by the Zoological Survey of India, Ministry of Environment, Forest and Climate Change, Government of India. Keeping in view the magnitude and intensity of anticipated impacts due to construction and operation of Mumbai-Ahmedabad High Speed Railway Project, the specific conservation plan is presented below:

- Monitoring on flamingos and other migratory birds of Thane Creek should be given top priority; especially ecological aspects such as habitat requirement, habitat suitability, migratory corridors, feeding and breeding behaviors etc. and for this, funding should be available.
- Dedicated administrative and scientific staff required for monitoring as well as associating with scientific research and monitoring of specific taxon, events and status by professional scientific agencies.
- Regarding public awareness, there is already exist one Coastal and Marine Biodiversity Centre by the Mangrove Cell of Maharashtra Forest Department, Govt. of India. Such interpretation facilities should be utilized for outreach materials and regular awareness programme, for habitants of nearby Thane Creek resident.
- The management plan for Thane Creek Flamingo Sanctuary need to be reviewed at a time interval of every five years through a review committee, for further suggestions and improvement for better conservation and management.

6.9.3 Conservation and Management Plan for SGNP and TWLS

The MAHSR alignment passes through the ESZ (Buffer Zone- Outside of the Core Zone) of Sanjay Gandhi National Park (SGNP) and Tungareshwar Wildlife Sanctuary (TWLS). The site specific Conversation and Management plan has been delineated for SGNP and TWLS as ESZ of both the protected areas share the common boundary:

- Periodic clearing of vegetation ('jungle clearing', 'weed clearing') along MAHSR alignment shall ensure that all such clearing work is sensitive to local natural vegetation types.
- Safe, clean, humane, and habitable accommodation shall be provided for all workers during construction and repair work outside the ESZ boundary. Residing in ESZ areas shall not be permitted and transport shall be provided to bring workforce to site everyday from designated outside campsites and nearby villages, townships, or cities. Budget and logistics for housing and transport of workers should be integral to projects from the planning stage onwards.
- The construction of the linear intrusions should be in a manner (quick, with minimum disturbance) and with adequate design and technology to minimise the long-term impacts

- including by using prefabricated and special methods to reduce the time taken in the erection/construction of the intrusions.
- All vehicles delivering loose construction material and any such material gathered at the site must be covered by appropriate material such as tarpaulins to prevent dust spreading, pollution, or wastage.
 - Movement of vehicles should be strictly restricted to existing roads and tracks, and creation of new roads and tracks or off-roading shall be prohibited in connection with alignment and maintenance roads in natural areas.
 - Movements of vehicles and use of heavy machinery along riverine areas and water courses should also be avoided.
 - Wherever possible natural vegetated crossings existing across linear intrusions (such as tree canopy overlapping overhead or low natural vegetation below viaduct) should be retained or encouraged.
 - Along the alignment and maintenance road, natural ground, shrubby, or tree growth must be encouraged at periodic, designated points not less than 200 m apart, to provide for habitat cover and facilitate animal crossings in all the ESZ area as well as other habitats such as dry thorn forest and scrublands.
 - No material including earth should be used from the ESZ area. All construction materials should be brought from outside the ESZ area including earth, stones *etc.*
 - All outside material left over after construction or repair (including stones, sand, cement, packaging material, papers, cartons, oils, cans, bags, wires, metal objects, housing sheds, plastics and glass) should not be left on site, but should be carefully removed and carried away outside the natural area and safely disposed of or reused elsewhere.
 - Avoiding work during nights to facilitate movement of many species, especially large mammals and carnivores.
 - Avoiding camping of people/workers and use of domestic animals at the construction camp.
 - The dumping of wastes shall be segregated and carried to nearby designated disposal sites.
 - Open burning of waste should not be allowed.
 - Dumping of solids and any wastes, including waste water, oils, and liquids shall be done outside the ESZ boundary of the protected areas.
 - Cutting of old trees such as banyan and other native species shall be avoided. Planting of alien tree species such as eucalyptus and acacia wattles shall not be taken up.
 - The workers camp and parking facilities of the vehicles shall be established outside the natural areas.
 - Washing vehicles and equipment at or along streams, rivers, or water bodies should not be carried out in the natural areas.
 - Cutting of firewood within the natural areas shall be strictly prohibited.
 - Cutting of vegetation leading to complete breakage of canopy cover in closed-canopy forests should not be permitted.
 - All banyan, peepal, neem, and tamarind trees, and any other species valued by local communities as determined through open consultations or deemed useful for local people and village communities should not be felled unless unavoidable.
 - Any grove or tree deemed sacred by local communities and related places of worship should be avoided.
 - Preference for employment of local people shall be given in the area through which the MAHSR alignment passes (especially from tribal communities) over outside workers in all vegetation clearing operations, as local people are better at identifying native and alien plant species.

Although, the MAHSR alignment does not pass through the CORE ZONE of neither SGNP nor TWLS, NHSRCL will implement the conservation and management plan during construction and operation phase of the project. The NHSRCL will work in close coordination with the Scientists and officials of SGNP and TWLS to avoid Human- Wildlife Conflict (HWC) during the construction phase. However, during the operational phase of the project, this is not envisaged as the MHASR alignment runs on viaduct without causing any hindrance to wildlife corridor.

6.10 ENVIRONMENTAL MONITORING PROGRAMME (EMoP)

6.10.1 Introduction

An Environmental Monitoring Plan (EMoP) provides a basis for monitoring the status of different components of environment in the construction and operation phases of the project. The information derived from environmental monitoring activities can be used to mitigate and reduce environmental impacts and enhance project benefits through adaptive management. The implementation of the EMoP is adopted in all project works. An EMoP is important as it provides useful information and helps to:

- Assist in detecting the development of any unexpected environmental or social situation and thus provides opportunities for adopting appropriate control, management or mitigation measures.
- Defines the responsibilities of the project proponents, site engineers, contractors and environmental monitors and provides means of effectively communicating environmental issues among them.
- Defines the monitoring mechanism and identifies monitoring indicators, methods and parameters.
- Provides information, which allows for the evaluation of the performance and effectiveness of mitigation measures proposed in the EMP and enables managers to make improvements in management plan.
- Identifies training requirement at various levels.

6.10.2 Environmental Monitoring Plan

As per the Employers' requirement of the contract between NHSRCL and the awarded contractor(s), the contractor(s) shall prepare its/their Construction Environmental Management Plan (CEPM). The contractor(s) are responsible to prepare its/their site inspection sheets, weekly monitoring report format, monthly monitoring report format and quarterly monitoring report format and those formats must be approved by NHSRCL before the commencement of any construction work.

NHSRCL is supposed to combine the report from contractor(s) and submit a quarterly environmental monitoring report to JICA.

Sample format of the environmental monitoring report for NHSRCL (construction phase and operation phase) are given in **Annexure 6 (g), Vol-II** of the S-EIA Report, together with the list of environmental monitoring standards and guidelines in **Annexure 6 (h), Vol-II**.

A monitoring plan normally involves three main types of activity:

Routine Supervision of the Work: Observation of the construction/operation work to ensure mitigation measures are implemented effectively. This work should be conducted as general

operation working/maintenance progress including daily work (refer Table 6.10.1). Such a programme is primarily conducted by the contractor and design consultant.

Environmental and Social Impact/Mitigation Monitoring: The monitoring to be conducted to determine the social impact (refer Table 6.10.1). Such a programme is primarily conducted by the Social & Environmental Managing Unit (SEMU).

Comprehensive Environmental and Social Monitoring: Broad area is monitored comprehensively to confirm the effectiveness of mitigation measures, conducting by SEMU.

A comprehensive Environmental Monitoring Programme (EMoP) has been formulated for NHSRCL (during Construction and Operation Phases of the project) and for contractors for construction phase and presented in Table 6.10.2 (a) and 6.10.2 (b).

Table 6.10.1: Overall Environmental Monitoring Plan

Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/ Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
Social Impact	Planning /Design phase	To ensure that the adverse impacts of land and property acquisition &resettlement are addressed &compensated	- as per RAP and IPP	as per RAP and IPP	as per RAP and IPP	as per RAP and IPP	SEMU	NHSRCL
	Construction	To ensure that the adverse impacts of construction activities are minimized and mitigated	as per RAP and IPP	as per RAP and IPP	as per RAP and IPP	As per employer's requirements for the Contractors as per RAP and IPP	Contractor SEMU	NHSRCL
Crops and Vegetation	Planning /Design phase	To minimize the direct impacts on crop production and other vegetation	as per RAP and IPP	as per RAP and IPP	as per RAP and IPP	as per RAP and IPP	SEMU	NHSRCL
Impacts on MAHSR Design	Planning/ Design/ Construction phase	To ensure that the Recommendations given with the conditional approval by the NHSRCL/JICA and followed by design consultant	- ROB and RUB have been designed - Existing irrigation, protection measures have been identified.	- Check final design drawing and original plan	/	Before the start of construction activities	Design Consultants Contractor	NHSRCL/ Supervision Consultant
Air Pollution	Construction	To minimize air pollution from	- Watering on open surfaces especially in the settlement areas	- Check watering as per the		PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO	Monthly	Contractor

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
		construction activities	and on the unpaved way - All construction vehicles should be maintained in good condition to minimize emissions and shall have valid PUC certificate	frequency given in the EMP. - Proper implementation can be achieved by site inspection along with interviews with local residents.				
		To understand baseline values along the alignment	N/A	N/A	PM ₁₀ , PM _{2.5} , SO ₂ , NOx, CO	Quarterly	SEMU	NHSRCL
	Operation	To minimize air pollution from MAHSR operation	- Continuous measuring is conducted to know the transition of environment alongside of the alignment.	- Continuous monitoring by static monitoring systems, early recognition of issues and enforcement of necessary countermeasures	PM ₁₀ , PM _{2.5} , SO ₂ , NOx, CO	Continuous measurement	SEMU	NHSRCL
Noise and Vibration	Planning /Design phase	To minimize the noise and vibration level resulting from MAHSR. To control noise levels within tolerance limit	- Establishing standards and regulations for noise levels for various equipment used at the site - Strict enforcement of regulations	- Determination of critical sites and methods of mitigation during the construction period.	Noise: L _{eq} , L _{max} , L _{day} , L _{night} Vibration: ppv	Monthly/ As necessary	Design Consultants SEMU	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
		on Viaduct, Bridge sections taking into account the increase in traffic volume	- Awareness programs					
Noise and Vibration	Construction	To minimize the noise and vibration level resulting from road traffic, To control noise pollution from exceeding tolerable levels on Viaduct, Bridge sections taking into account the increase in traffic volume	- All construction vehicles must have working mufflers and be maintained in good condition - Noise barriers should be established around the yard near residential area and sensitive receptor during the activities such as blasting and pile driving.	- Check that the Contractor is performing mitigation measures. - This can be achieved by interviewing the locals and site inspection.	Noise: L_{eq} , L_{max} , L_{day} , L_{night} Vibration: ppv	A daily inspection of the construction yards must be carried out	Contractor	SEMU/NHSRCL
		To understand baseline values along the alignment	- Monitor actual level - Ref. Annexure 6(e) on Recommendation on Mitigation of Operational Noise and Vibration Emissions	- Measurement by portable equipment	Noise: L_{day} , L_{night} Vibration: rms in L_{Vday} , L_{Vnight}	Quarterly	SEMU	NHSRCL
	Operation	To minimize the noise and vibration level resulting from MAHSR	- Maintenance of the rail, sound barrier as wall as well as equipment rolling stock	- Continuous monitoring by static monitoring systems, early recognition of issues and enforcement	Noise: L_{day} , L_{night} Vibration: rms in L_{Vday} , L_{Vnight}	Continuous measurement	SEMU	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
				of necessary countermeasures				
Water Quality	Planning /Design phase	To control the impacts on the quality of surface and groundwater	- Maintain existing concentrations of chemicals sediments and water at specific locations. - Design appropriate mitigation measures	- Check final planning and approve if proposal suitable		Before the Commencement of construction activities	Design Consultants	NHSRCL
	Construction	At the bridge construction areas	- Avoiding chemical discharge and spills in soil and water at specific locations like bridge construction areas. - Design appropriate mitigation measures	- Visit site and check drain provision/functioning	As per IS 2296 (1982)	During the Construction stage a weekly site inspection is necessary for the proper assessment of the site.	Contractor	SEMU/NHSRCL
		Impact to surface water and ground water	- To know the contamination to surface water and groundwater	- Sampling and chemical analysis - Measurement of ground water level	As per IS 2296 (1982)	Monthly	Contractor	SEMU/NHSRCL
		Condition of drinking water and wastewater treatment	- To know the actual level of water quality	- Sampling and chemical analysis	As per IS 10500, IS 2296 (1982) Schedule VI the Environment (Protection) Rules (1986)	Quarterly	SEMU	NHSRCL
	Operation	Impact to surface water and ground water	- To know the contamination to surface water and groundwater	- Sampling and chemical analysis	As per IS 10500, IS 2296 (1982) Schedule VI the Environment	Quarterly for the initial 2years and	SEMU	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
				- Measurement of ground water level	(Protection) Rules (1986)	annual from the 3 rd year		
		Condition of drinking water and wastewater treatment	- To know the actual level of water quality	- Sampling and chemical analysis				
Oil spills and Hazardous Wastes	Construction	Impact to surface water and ground water	- To know the contamination to surface water and groundwater	- Sampling and chemical analysis - Measurement of ground water level	As per IS 2096	Monthly	Contractor	SEMU/NHSRCL
Spoil Disposal	Construction	Condition of drinking water and wastewater treatment	- To know the actual level of water quality	- Sampling and chemical analysis	As per IS 10500	Monthly	Contractor	SEMU/NHSRCL
Construction Waste Disposal	Construction	To minimize the impacts from the disposal of construction Waste	- Preparation and implementation of waste management plan based on Estimating the amounts of construction waste	Interviews with local residents will also give a proper assessment of the issue	Quantity of Spoil	Daily	Contractor	SEMU/NHSRCL
Land slide and Soil Erosion	Planning /Design phase	To minimize landslides resulting from excessive erosion of slopes and water ways with corresponding silting of the eroded soil.	- Maintaining proper vegetation cover and erosion protection - Constant surveillance as part of routine maintenance	Visit site and Check land plans, alignment		Site visits, one check	Design Consultants	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
Land slide and Soil Erosion	Construction	Constructed activity could be a source new slides if not protected from erosion by rain fall	-Work plan: excavate mainly in dry season	A site inspection along with the review of the design plans is necessary		During Construction and specially during rainy seasons	Contractor	SEMU/NHSRCL
Loss of or Damage to Religious places and Eco-sensitive areas	Planning /Design phase	To minimize damage to religious sites and eco-sensitive areas	- Avoid encroachment on religious and eco-sensitive areas in planning the alignment	Check encroachment on religious and eco-sensitive areas		- Before and during construction phase	Design Consultant, SEMU Contractor	NHSRCL
Earthworks operation	Construction	To ensure that the earthworks are safe and do not have adverse environmental impacts	- Use appropriate designs and size of drainage structures in accordance with designs approved by the client, - Structural stabilization of drainage system - Hauling material to be carefully transported to designated dumping areas	- Ensure the contractor performs detailed design and instability checks - Check if erosion or instabilities were observed. - The conditions at the site can be observed by a site inspection along with review of the design plan.		Before Commencement of construction	Contractor	SEMU/NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
Traffic safety	Planning /Design phase	To avoid and minimize traffic accidents during construction	<ul style="list-style-type: none"> - Make traffic marking such as sign boards - Observe speed limits - safe loading and covering of materials being transported - Planning of transport routes 	Visit site and Check around traffic situation and construction plan		Before start of construction	Contractor	SEMU/NHSRCL
	Construction	To avoid and minimize traffic accidents during construction	<ul style="list-style-type: none"> - Traffic sign boards for proper movement of construction vehicles, - limit speed of vehicles - Safe loading and covering of materials being transported - Planning of transport routes 	Checking the traffic problems at the Construction site.	Record Accidents	Weekly	Contractor	SEMU/NHSRCL
Disturbance to Flora	Construction	<ul style="list-style-type: none"> -To minimize direct impact on vegetation. -Prevent damage to vegetation outside RoW 	<ul style="list-style-type: none"> - Prohibit vegetation cutting outside Row - Record Row, Check no cutting out side 	Inspect RoW boundary and adjacent area (visual observation)	Density & Diversity	Weekly/ Monthly	Contractor	NHSRCL
	Operation	Impact to flora	<ul style="list-style-type: none"> - Confirm the no or insignificant impacts out of ROW - Take necessary countermeasures if it is necessary 	- Scientific survey (species composition etc.)	Density & Diversity	Monthly Biannually for the initial 2years and annual from the 3 rd year	SEMU	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
Disturbance to Fauna	Construction	To minimize direct impacts on fauna. This applies in the case of SGNP, TWLS and TCFS and at Eco-sensitive areas like mangrove forest in Thane district	<ul style="list-style-type: none"> - Consultation with Forest Department Authorities and Department of Wildlife. - No construction camps or quarries in wildlife habitat areas <i>e.g.</i> Eco-sensitive areas - Avoiding alignment route within sensitive habitats of important species, keystone tree species, conservation areas <i>etc.</i> - No hunting, poaching, or unnecessary habitat destruction - Training for staff working in wildlife areas (or at least briefings) 	Visit site and check the proposed alignment & construction area	Count of died/killed fauna	Monthly	Contractor	NHSRCL
	Operation	Impact to fauna	<ul style="list-style-type: none"> - Confirm the no or insignificant impacts out of ROW - Take necessary countermeasures if it is necessary 	- Scientific survey (species composition <i>etc.</i>)	Density & Diversity	Monthly Biannually for the initial 2years and annual from the 3 rd year	SEMU	NHSRCL
		Bird strike	To know the degree of strike	- Observation	Species, number	Monthly	SEMU	NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
Trees / Compensatory afforestation	Planning /Design /Construction	Number of cutting trees and their species Number of planted trees and their species	Offsite afforestation	-Identify and record kind and the number of cutting/planted trees	Number of trees Species	Monthly	Appointed agencies by SEMU DFOs (and District Authorities if applicable)	DFOs, District Authorities District/State Authorities, MoEFCC (SEMU will get the information)
	Operation	Growth and survival of trees		- Survived number of trees vs. sapling numbers - The growth of saplings	Density & Diversity of trees	Assess growth every year for initial seven years		
Mangroves / Compensatory afforestation	Construction	The impact on the mangroves should be minimized. This should be observed in the State of Maharashtra between Thane and Palghar Districts	- Avoidance of mangroves in the alignment - Not to encroach into the mangrove areas. - Disposal of construction waste material should be strictly restricted - No storage should be allowed near the sensitive areas. - Refer Annexure 6 (f) for mitigation measures. Chainage from Km 43+535 to Km 45+916	Visit site and check the proposed alignment and drain/waste material around mangroves	Density & Diversity of Mangrove	Monthly	DFOs Contractor (project site inspection only)	Mangrove Cells, DFOs State Environment Department
		Number of cutting mangroves	Offsite afforestation	-Identify and record kind and the number of cutting/planted trees	Number of trees Species	Monthly	Appointed agencies by SEMU	Mangrove Cell (SEMU will get the information)

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
		Number of planted mangroves					Mangrove Cell	District/State Authorities, MoEFCC (SEMU will get the information)
	Operation	- No impacts on the mangroves should be maintained - Growth and survival of trees	- Removal of access roads within Mangrove area - Refer Annexure 6 (f) for mitigation measures. Chainage from Km 43+535 to Km 45+916 - Offsite afforestation	- Survived number of trees vs. sapling numbers - The growth of saplings	Density & Diversity of trees	Assess growth every year for initial seven years	SEMU (within and along ROW only) Mangrove Cell (offsite afforestation)	District/State Authorities, MoEFCC (SEMU will get the information)
Loss or Damage of cultural sites or religious places	Construction	To avoid or minimize damage to cultural sites or religious places	- Avoid alignment encroachment to the cultural site - Local population will also be consulted if there are any religious place	Interviews with local residents will also give a proper assessment of the issue.		Before and during construction Monitoring should be done once in six months.	Contractor	SEMU/NHSRCL
Construction labour force and its impacts	Planning /Design phase	To minimize impact on workers	- Establish minimum standards for construction workers camp layout and housing provision, provide sanitary facilities and insect control particularly as related to Malaria and other vector borne diseases	- Check construction workers camp layout and equipment		Before the start of construction work. As necessary	Contractor	SEMU/NHSRCL
	Construction	To minimize impact on workers during construction	- Conduct special briefing on site training on environmental	- Confirm the compliances of the Contractor's		Weekly	Contractor	SEMU/NHSRCL

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Environment Component	Project Stage	Issue	Mitigation Management	Supervision Method	Parameters	Duration/Frequency	Organization	
							Planning & Implementation	Supervision & Responsible
			requirements and safety for the workers. - Strictly instruct workers not to interfere in local affairs	management plans. - Check with the communities and construction staff if any conflict as occurred, if yes find out reason. - This can be achieved by regular site inspections. The frequency should be once in fifteen days.				
Work camp Operation	Construction	To ensure that the operation of work camps does not adversely affect the surrounding environment and residential areas	- Identify sufficient locations for disposal sites and design disposal sites in the contract - The location should be approved by the consultant	- During construction and after completion of the works. - The inspection should be planned once every two months throughout the project period	Health Records	Monthly	Contractor	SEMU/NHSRCL

Source: Study Team

Table 6.10.2 (a): Environmental Monitoring Programme for Construction Packages

Monitoring Category	Types of the Works Packages			
	Civil, Particular Bridge, Depot	Track	Electric	Rolling stock, Maintenance /Inspection car
Air	required	required	N/A	N/A
Noise	required	required	N/A	N/A
Vibration	required	required	N/A	N/A
Drinking Water Quality-Ground Water	required	required	required*	required*
Water Quality-Surface Water	required	required	required*	required*
Waste	required	required	required	required
Hazardous waste	required	required	required	required
Complaints and PR activities	required	required	required	required
Visual site observation	required	required	required	required
Regulatory framework updates	required	required	required	required
Mangrove	required	required	required	required
Labour	required	required	required	required

Source: Study Team

* Only construction yards and camps and/or inspection yards

Table 6.10.2 (b): Environmental Monitoring Programme for Contractors

Env. Component	Monitoring						Institutional Responsibility	
	Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Construction Stage								
Air	PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO,		CPCB (2011) Guidelines for the Measurement of Ambient Air Pollutants, Manual Sampling & Analyses	One representative location for each Hot mix Plant / Batching Plant, Construction Yards, Construction Camp, Asphaltting plant for roads. The closest residential or commercial facility (one location) within 100m from each active construction section/site	24-hrly with frequency of twice a week at each location For CO, 8-hrly	During the entire construction period	Contractor with NABET/NABL Accredited Laboratory	SEMU/NHSR CL
Noise and Vibration Levels	L _{eq} , L _{max} , L _{day} , L _{night}	Free field at 1 m from the equipment generating high noise	CPCB (2015) Protocol for Ambient Level Noise Monitoring DGMS Standards	At construction yards/equipment yards	Monthly 24-hrly at each location using Noise Meter fitted with data logger	During the entire construction period	Contractor with NABET/NABL Accredited Laboratory	SEMU/NHSR CL
	PPV (mm/sec)	Ground borne vibration near the tunneling, piling and heavy equipment should be measured with the help of vibrator meter For weak and	IS 14884 (2000)	Tunnel Section, Piers locations, Construction yard Closest residential or commercial facility (one location) within 100m from each active construction section/site	Monthly with 30 minutes at each location	During the entire construction period	Contractor with NABET/NABL Accredited Laboratory	SEMU/NHSR CL

Env. Component	Monitoring						Institutional Responsibility	
	Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
		vulnerable building structures identified, vibration or crack detection meters should be installed and these structures should be periodically inspected for potential damage due to construction activities						
Drinking Water Quality-Ground Water	All the parameters specified in per IS 10500:2012	Drinking water: construction yards and labour camps The ground water sample to be collected from the tube well/bore well located within 100 m of the construction yards/labour camps	IS 10500:2012	At the construction yards and labour camp	Monthly	During the entire construction period	Contractor with NABET/NABL Accredited Laboratory	SEMU/NHSR CL
Water Quality-Surface Water	IS 3025 (2008) & IS 2296 (1982) & CPCB (2012)	Grab sample collected from source and to be analyzed as per Standard	IS 2296 & IS 10500, CPCB Guidelines / EPR, 1986	Upstream and downstream of the river and natural water course located within 100 m of the	Monthly	During the entire construction period	Contractor with NABET/NABL Accredited Laboratory	SEMU/NHSR CL

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Env. Component	Monitoring						Institutional Responsibility	
	Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
	Guide Manual Water and Wastewater Analysis	Methods for Examination of Water and Wastewater of CPCB		construction yards and labour camps				
Waste and oil spills	All items specified by the Solid Management Rules 2016 & the Construction and Demolition Waste Management Rules 2016, and any specified parameters specified by local authorities	Waste Quantum generated by category	Not available but fully complying with monitoring the quantities of wastes specified by the Solid Management Rules 2016 & the Construction and Demolition Waste Management Rules 2016	Each construction camp and each active construction section/site wise	Monthly with 30 minutes at each location	During the entire construction period	Contractor	Local authority as per the applicable rules SEMU/NHSR CL
Hazardous Waste	All items specified by the Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016, and any	Hazardous waste quantum generated, by category	Not available but typed reporting (not hand writing) fully complying with monitoring the quantities of wastes specified by the Hazardous and Other Wastes (Management	Each construction camp and each active construction section/site wise	Monthly with 30 minutes at each location	During the entire construction period	Contractor	Local authority as per the applicable rules SEMU/NHSR CL

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Env. Component	Monitoring					Institutional Responsibility		
	Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
	specified parameters specified by local authorities		and Transboundary Movement) Rules 2016,					
Complaints and PR activities	Complaints: Phone logs, emails, written complaints, minutes of the meetings, consent documents, etc. PR: activity logs (ex. PR news, event)	Number and category of complaints based on source of queries	Not available but typed reporting (not hand writing) with original evidences (phone logs, email, written documents,	All works related locations	Weekly or as received basis	During the entire construction period	Contractor	SEMU/NHSR CL
General compliance of site management	Number of observations / inspections	Environmental monitoring items specified by CEMP and instructed by the Employer/ Engineer	Not available but typed reporting (not hand writing)	Daily visual site inspections at all Works' related locations	Daily		Contractor	SEMU/NHSR CL
Regulatory framework updates	Regulatory updates in terms of amendments and new rules	Any update of the relevant environmental and social safeguard regulatory frameworks	as per the SEMU's reporting forms and their requirements	All Works' related locations and their authority office or websites	Monthly, Quarterly (April, July, October, January)		Contractor	SEMU/NHSR CL

Source: Study Team

6.11 INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION OF EMP AND EMoP

In order to efficiently manage the multitude of environmental Institutional arrangements are essential in project management to provide the necessary human resources in a structured form so as to achieve certain level of quality in the work execution during implementation of various project components by NHRCL

These arrangements also serve to ensure the conduct of activities in line with the loan agreement between JICA and NHRCL as well as JICA's E&S safeguards and national / State level statutory compliance.

NHRCL, headed by the Managing Director is responsible for the overall implementation of the MAHSR Project. The Officer on Special Duty (OSD) is also the Project monitoring officer in the NHRCL set up for the implementation of the project.

Ensuring the better implementation of EMP, NHRCL has need to develop a Social and Environmental Management Unit (SEMU) one in Mumbai and another in Ahmedabad working under a central Project Implementation Unit (PIU) at NHRCL Headquarters, Dwarka, New Delhi.

The SEMU will have the following staff:

1. One Environmental Expert with Masters in Environmental Science or Master in Environmental Engineering followed by minimum 15 years of experience in linear projects including 3 in railway or metro in each unit, *i.e.* total 3 experts,
2. One Social Expert with Masters in Sociology followed by 10 years of experience in preparation and implementation of RAP/EMP in each unit, *i.e.* total 3 experts

The institutional framework for environmental management and monitoring is presented in Exhibit 6.11.1.

1) Construction

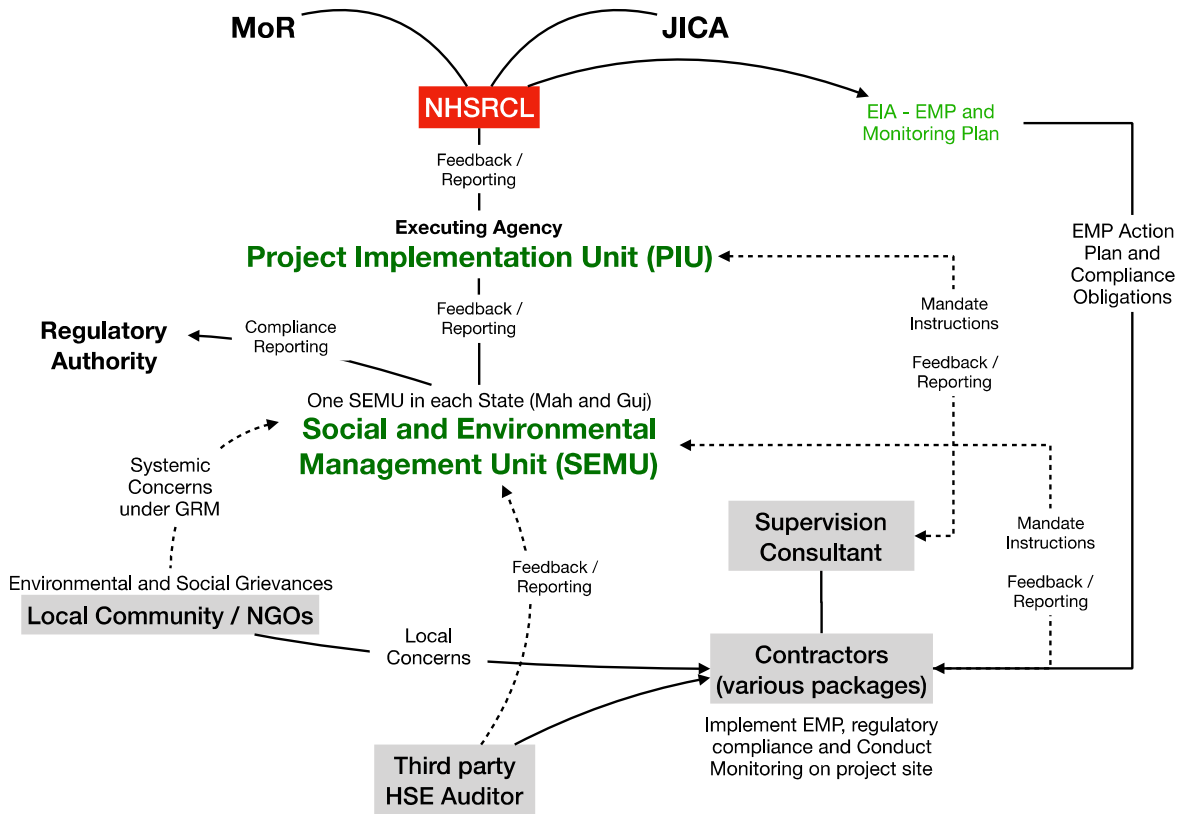
- MoEFCC: CRZ Clearance should be obtained before commencement of the project activities.
- NBWL: Necessary permission from NBWL should be obtained for commencement of construction activities in the eco-sensitive zones like SGNP, TWLS and TCFS.
- State Pollution Control Board: Consent to Establish should be secured before commencement of the construction activities.
- The Department of Mines & Geology: The Department is responsible for giving all necessary permissions for the borrow sites and quarry pits.
- The State Department of Irrigation: If the contractor uses surface water or river water, then necessary permission from the Irrigation Department of the respective States.
- Central Ground Water Board: If the Contractor uses ground water for the construction then necessary permission should be obtained from CGWA.
- MoEFCC: Forest Clearances should be secured for the diversion for forest land.
- District Magistrate/Local State Authority: For tree felling necessary permission should be secured (only for the trees of reserved categories) on the non-forest land.

- The Labour Department: The labour laws should be strictly followed during the construction and at the time of operation.
- The Department of Explosives: The Contractor should obtain necessary permission for using explosives and for storing the same.
- State Pollution Control Boards will also play a major role at the time of hazardous material management.
- The Disposal of Waste requires proper permission from the local municipal authorities.
- The road crossing requires permissions from the National Highway Authority of India (NHAI) of India in case of NH and for others like SH, District roads from the State Government Highway Department.
- For utilities like the pipe lines the permission are required from the respective state department.
- For utilities like power transmission lines requires permission from the State Electrical Department.
- The State Transport Department: The necessary permission for the construction vehicles should be obtained from the State Transport Authority.
- The State Police and the District Medical Departments are considered during any exigencies.

2) Operation

The most important government agencies during the operation stage are the Ministry of Railways, NHRCL, Ministry of Environment, Forest and Climate Change, Local Administration, Forest Department and State Pollution Control Boards.

Exhibit 6.11.1: Institutional Framework for EMP



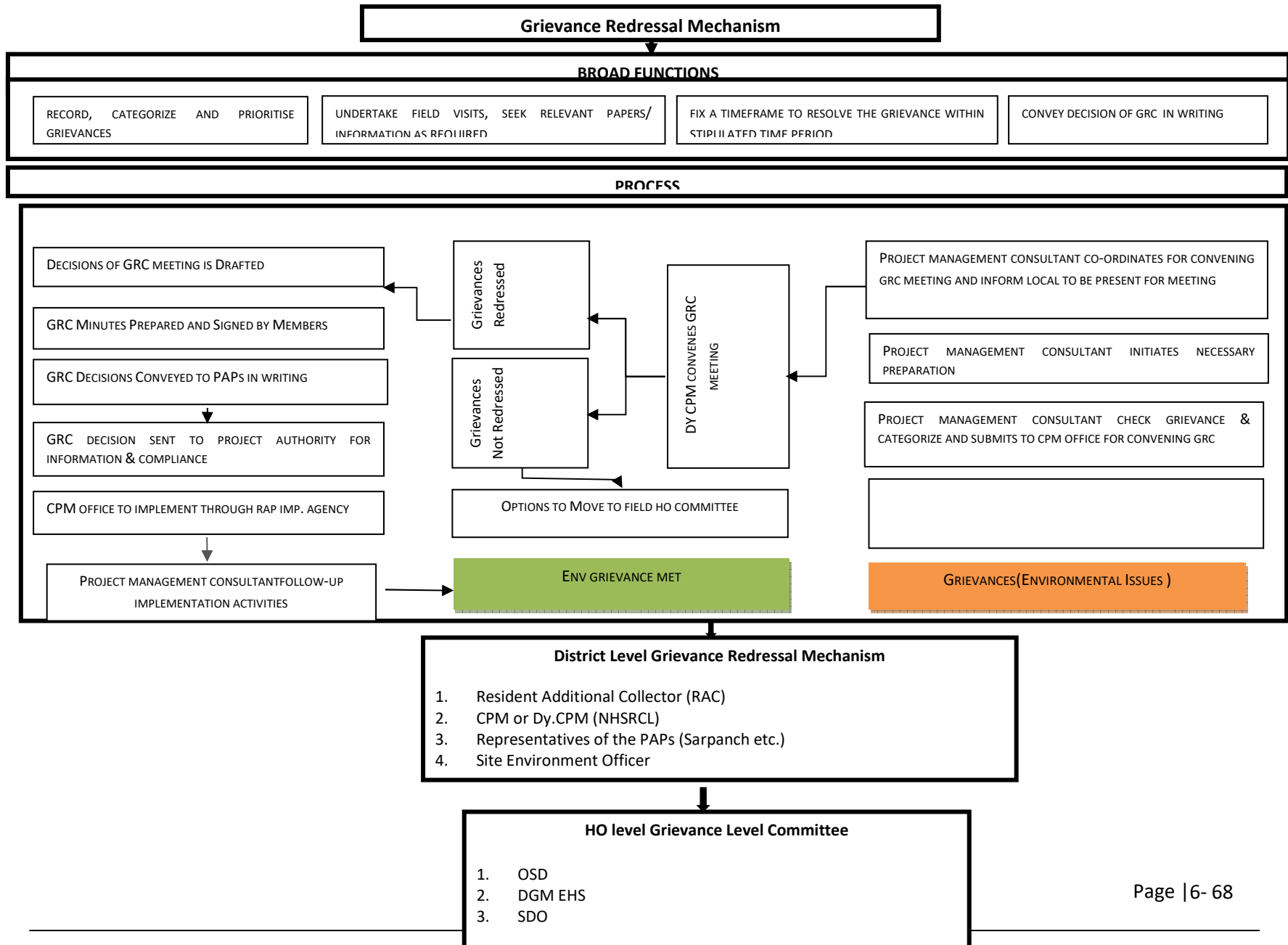
Source: Study Team

6.12 GRIEVANCE REDRESSAL MECHANISM UNDER EMP

The main complaints associated with railway projects are normally related to the process of compulsory acquisition of land and property, and include the amounts of compensation offered, the way the process is conducted, and other issues. For project, the related matters should be dealt with through a Grievance Redressal Mechanism (GRM) for Land Acquisition and Resettlement, which has been established by the NHSRCL. This involves consideration by Grievance Redress Committees at local/field and headquarters, if necessary, with further recourse to the Competent Authority and an official government Arbitrator/Ombudsman if necessary.

Grievances/complaints on environmental matters are expected to be relatively few and straightforward so a simplified procedure is more appropriate in this case. Local concerns mainly arise as a result of inappropriate implementation of the EMP and EMoP, the main aim of which is the reduction of adverse impacts to acceptable levels. These issues are best addressed through open dialogue and a responsive approach, with acknowledgement of errors where appropriate, followed by rapid remedial action. This should be the principal philosophy of the environmental GRM. The grievance redressal mechanism structure is illustrated in Exhibit 6.12.1.

Exhibit 6.12.1: Grievance Redressal Mechanism



6.12.1 Reporting Arrangement

The Site Engineer (SE) shall report regarding compliance of the EMP and other environment related issues by concerned stakeholders to SEMU in his periodic progress report for reviewed by SEMU during the construction stage. Monthly report of the SE shall indicate clearly regarding the compliance of environmental provisions by Contractor. Contractor's failures to implement the environmental provisions are to be reported to SEMU regularly with request for action. Incidents of contamination or pollution due to Contractor's activities whether due to negligence or otherwise are to be reported in periodic reports.

6.13 BUDGETARY PROVISION FOR IMPLEMENTATION OF EMP AND EMoP

The project environmental impact mitigation measures that are proposed in the EMP should be implemented by the Civil Construction Contractor. The budgetary provision for implementation of the EMP and EMoP are detailed in Table 6.13.1, Table 6.13.2 and Table 6.13.3. While arriving at the budgetary provision for implementation of the EMoP, the total construction period has been considered as 4 years (48 months) and for the operation phase a period of 10 years has been taken into account.

Table 6.13.1: Budgetary Provision for Implementation of the EMP and Environmental Protection Measures

Sl. No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
Environmental Management/Mitigation Measures					
1	Compensation for tree cutting in forest, Plantation and Mangroves.				
a	Tree cutting, (Non Forest)	35000	Nos	2,500	8,75,00,000
b	for tree cutting, (Forest)	5000	Nos	2,500	1,25,00,000
c	for compensatory plantation (Forest)	10000	Nos	5,000	5,00,00,000
d	Mangrove Cutting = 18.9258Ha RoW of 17.5m for clearance.	18.9258	Ha	1,25,000	23,65,725
e	for compensatory plantation Mangrove @ of 5 times the area cleared in Item 1d	94.629	Ha	6,25,000	5,91,43,125
2	Noise & Vibration barrier construction at Identified Sensitive Locations as per Chapter 4, Section: Protected Areas.				
a	A Type (68 Locations which are less than 100m at each location both side protection average Length 100m)	6800	m ²	18,000	12,24,00,000
b	B Type (210 Locations which are more than 100m and are up to 250m. A Noise Barrier on one side average 100m in length)	21000	m ²	9,000	18,90,00,000
	Type (278 Locations which are less than 100m at each location both side protection average Length 100m)	27800	m ²	35000	97,30,00,000
3	Maintain borrow pit site by landscaping and re-vegetating after operation	10	site	2,50,000	25,00,000

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Sl. No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
3	Maintain borrow pit site by landscaping and re-vegetating after operation	10	site	2,50,000	25,00,000
4	Maintain quarry site by landscaping and re-vegetating after operation	100	site	5,00,000	5,00,00,000
5	Sprinkling water on the road, especially in/near the settlement areas	48	month	12,00,000	5,76,00,000
6	Re-vegetate where riverside vegetation is cleared by bridge construction for 60Nos of Bridge	19	bridge	5,00,000	95,00,000
7	Make workers aware on STD and HIV/AIDS	Lump Sum		20,00,000	20,00,000
8	Post construction clean-up to ensure no dangerous debris are left behind the camp	Lump Sum		50,00,000	50,00,000
9	Restoration of Mudflats in the TCFS	Lump Sum		200,00,000	200,00,000
Sub Total (A)					1,64,25,08,850

Source: Study Team

Table 6.13.2: Budgetary Provision for Implementation of the EMOp (Construction Phase) Environmental Monitoring Programme during Construction

Sl.No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
1	Air Quality 20 SITES (1 site for every 25 km at Construction Camp Locations), Cost Rs 50,000 / site / Continuous Monitoring / month.	12	Quarterly	1,00,00,000	1,20,00,000
2	Noise and Vibration 20 SITES (1 site for every 25 km) Cost Rs 75,000 / site / Month.	12	Quarterly	15,00,000	1,80,00,000
3	Ground Water quality 20 SITES (2 locations in each SITE i.e. Construction Camp = 40 Locations) Rs 5000 / location / biannual.	8	biannually	2,00,000	16,00,000
4	Ground water level (1 site for every 25 km, 20 Location), Rs 2000/Location/month.	8	biannually	40,000	3,20,000
5	Water quality (Drinking and Waste water)	12	Quarterly	2,00,000	24,00,000

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Sl.No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
	(1 labour camp at every 25 km, 2 samples (water & wastewater) /labour camps total Camps = 20), Rs 10,000/Camp/month)				
6	Plantation Supervisor	48	Month	3,50,000	1,68,00,000
	(35,000 per supervisor per month for 48 months), 1 supervisor for every 50Km				
7	Ecological Study for the assessment of floral and faunal composition of species for complete stretch by reputed scientific institute like Zoological Survey of India <i>etc.</i>	48	Month	10,00,000	4,80,00,000
8	Installation of Time delay cameras in TCFS for monitoring of the Flamingo and continuous monitoring of the benthic fauna including bottom sediment.	48	Month	15,00,000	7,20,00,000
Sub Total B					17,11,20,000
TOTAL (A+B)					1,81,36,28,850
					INR Million
					1,814

Source: Study Team

Table 6.13.3: Indicative Costs for Implementation of the EMoP (Operation Phase)

Environmental Monitoring Programme During Operations & Maintenance					
Sl. No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
1	Air pollution	10	Year	86,40,000	8,64,00,000
	12 SITES, Cost Rs 720,000 / site / Continuous Monitoring / year.				
2	Noise and Vibration	10	Year	2,70,00,000	27,00,00,000
	20 SITES (1 site for every 25 km) Cost Rs. 13, 50,000 / site / Continuous Monitoring / year.				
4	Water quality (Ground water)	10	Years	12,00,000	1,20,00,000
	10 SITES (1 location in each SITE) Rs 120,000 / location / Years.				
5	Water quality (Drinking and Waste water)	10	Year	36,00,000	3,60,00,000
	15 Sites, 1 Sample of Water & 1 Sample of waste water @ Rs 10000/- each sample				

Environmental Monitoring Programme During Operations & Maintenance					
Sl. No.	Item	Quantity	Unit	Unit Cost (INR)	Total Cost (INR)
	per month. i.e. Rs 240,000/Site/ Years)				
7	Long term flora monitoring and advisor (Rs.50,000 per supervisor per month for 120 months), 1 supervisor for every 50Km	10	Year	60,00,000	6,00,00,000
8	Long term fauna monitoring and advisor including (TCFS monitoring) (Rs.50,000 per supervisor per month for 120 months), 1 supervisor for every 50Km	10	Year	60,00,000	6,00,00,000
Total					52,44,00,000
INR Million					525

Source: Study Team

Chapter 7
**Information Disclosure and
Public Consultation**

Chapter 7

Information Disclosure and Public Consultation

7.0 ENVIRONMENTAL INFORMATION DISCLOSURE

In compliance with JICA's Guidelines on Environmental and Social Considerations, April 2010, the project proponents are required to publicly disclose information about the environmental and social considerations of the projects and seek the opinion/suggestions of the stakeholders through Public Consultation. The proposed Mumbai-Ahmedabad High Speed Railway (MAHSR) Project is being implemented by National High Speed Rail Corporation Limited (NHSRCL), a special purpose vehicle created by the Government of India.

For the purpose of appraisal of the projects, JICA categorizes a project in the following categories:

- Category A: Likely to have significant adverse impacts on the environment and society;
- Category B: Potential adverse impacts on the environment and society are less adverse than those of Category A projects;
- Category C: Like to have minimal or little adverse impact on the environment and society;
- Category F1: JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and those sub-projects are expected to have a potential impact on the environment.

The MAHSR project, based on the criteria laid down in Section 2.2 of JICA's Guidelines for Environmental and Social Considerations (April 2010) is classified as **Category A**, as the project is likely to have significant adverse impact on Environment and Society.

The information disclosure and public consultation are important tools for disseminating information of the project, its environmental and social impacts and consulting all relevant stakeholders of the host country as per Sections 2.2 and 2.4 of JICA's Guidelines.

In the subsequent sections, the outcomes of the public consultation and stakeholder meetings organized during the Feasibility Study (F/S) stage of the project (2014-15) and during the Supplemental EIA Study at the Detailed Design Engineering stage (2017-18) have been discussed and presented.

Environmental public consultations at F/S Stage were conducted during December 2014 (4/12/2014-18/12/2014), whereas under the S-EIA, environmental public consultations have been conducted in each district along the alignment from April to June 2018 (04/04/2018-02/06/2018). The consultations have involved discussions with environmental experts, local NGOs and the other stakeholders in each of the districts. Outcome of these public consultations have been recorded and analysed for incorporation in the S-EIA Report. Suitable recommendations have been made in project planning, design and operation based on relevant outcome of the consultation process.

7.1 PUBLIC CONSULTATION

In compliance with the JICA's guideline and keeping in mind the significance of consultation and participation of the people likely to be impacted due to the MAHSR project, consultations were carried out during the Environment Impact Assessment (EIA) study and Socio-Economic Assessment (SEA) process during the Feasibility Study stage of the Project and Detailed Design Engineering Stage.

Public consultations were held in two rounds; first during the primary socio-economic assessment or census and Inventory of Loss survey phase and the second upon preparation of the Resettlement Action Plan (RAP) document for disclosure purposes. Both formal and informal discussions were conducted with stakeholders during field visits from 04/12/2014 to 18/12/2014 and recently for the Detailed Design Engineering stage during 04/04/2018 to 02/06/2018.

During these public consultations discussion of issues regarding nature of project and its features, impacts on account of land acquisition, loss of structures and policy frameworks governing project implementation, key impacts on environmental components, mitigation measures were disclosed and related suggestions/issues/concern recorded.

7.2 IDENTIFICATION OF PROJECT STAKEHOLDERS

The proposed MAHSR project has multiple stakeholders including the NHSRCL, Project Affected Families, Project Affected Persons, NGOs, Environmental Experts, local governments, *etc.* The following stakeholder groups are relevant for conducting Public Consultation for the MAHSR project:

- a. Project Affected Persons/families;
- b. NGOs/CBOs: those active and operational in the project affected area and may be representing the local community in voicing their opinions about the project and its impacts;
- c. Media: print and visual media agencies that cover and report on the project;
- d. District Level Officials from Revenue Department, Agriculture Department, Forest Department, Tribal Development Department *etc.*;
- e. MoEFCC / CPCB/ MPCB / GPCB / NGT and other regulatory authorities concerned with the project approvals, construction and operation;
- f. Development Planning bodies such as MMRDA, Municipal Corporations, Gram Sabha, Gram Panchayat, *etc.*;
- g. Residents along the proposed alignment.

Project affected persons/families are the primary stakeholders in the context of public consultations as they are the most affected by the project. Other stakeholders like the local media and the NGO/CBOs, Environmental Activists also hold significance, as they are representative of collective knowledge and voice of the affected communities. The district level officials for this project are from various departments and exercise their official jurisdiction over matters such as land and property, livelihoods, natural resources such as forest, water (surface and ground) *etc.* which will be impacted by project implementation. Consultations with these departments would provide critical inputs on aspects of availability of land, land acquisition and R&R processes and policies that can be integrated to develop an appropriate RAP. Hence, public consultations held for this project invariably sought participation from all the plausible stakeholder categories.

7.3 COORDINATION OF STAKE HOLDER MEETING (SHM's) AND METHODOLOGY

7.3.1 Coordination and Holding SHM's

Detailed and extensive consultations were carried out during environmental baseline and socio-economic survey stage with various sections of affected persons such as traders, women, squatters, kiosks and other inhabitants. These consultations were held at all level with representation from prospective Project Affected Persons (PAP) and officials from key Government Departments. Objective of such consultations were to inform affected persons about the project, its features (such as nature of physical constructions, alignment *etc.*), expected impacts, policies that govern project related land acquisitions and R&R benefits such as compensation, income restoration, employment generation, information flow, grievance redress *etc.* This report incorporates all issues raised during public consultations and recommends institutional strengthening measures in response to issues raised. The following methods were adopted for conducting public consultation:

- Informal individual/group consultation by the field surveyors that informed the PAPs about the project, purpose of survey and clarifications on their queries;
- In-depth individual interviews/discussion with key representatives from the communities, leaders and with the District and State level government officials;
- District level stakeholders' meetings/Public Consultation with the affected families and district officials.

While the first two of the approaches qualify more of an informal approach, the district level public consultations were organized in a more formal setting. Formal stakeholder meetings were held at district level. One such meeting was organized in each of the project affected districts, keeping in view that the project was still in feasibility assessment stage. A more detailed exercise will be taken up at later stage, once the project is conceptualized and formal clearance is given by the NHRCL, inviting all PAPs and the event organized at village/taluka level or as per directions from the project proponents. The methodology adopted for conducting district level consultations included the following:

- **Information to PAPs:** The PAPs were informed beforehand about the purpose of the meeting; in a way also ensuring the proposed Stakeholder Meetings observed the principle of Free, Prior and Informed Consultation.
- **Identification of Suitable Venue:** These venues (at district headquarters) were chosen in a way so that they can be easily approached by the district officials and the PAPs/PAFs coming from various villages.
- **Formal Invitation to participants for the meeting:** Participants included the project affected persons and district officials from key line departments such as revenue, agriculture, forest, social welfare and tribal welfare. Invitation to district officials was sent through formal letters 5-6 days in advance. Further follow up was done either through visit to their offices or telephonically. Such visits also provided the opportunity to brief district officials about the project and the objective of the proposed public consultations.

Keeping in view the stage (*i.e.* project Detailed Design Engineering stage) public consultations were conducted with the cooperation of the district administration, NHRCL and stakeholders. Adequate public disclosure as per JICA norms was ensured by news paper advertisements and participation was open to all public. Government officers, Panchayat heads were informed by letters in addition to the news paper advertisements. On an average 50-60 participants were approached over phone or through direct visit. Conscious efforts were made to ensure higher representation of women, amongst the project affected

persons. Between 20-250 persons turned up at each meeting. The procedure followed ensured that participants represented the socio-economic strata of the project affected population.

7.3.2 Methodology Adopted at SHM's

Stakeholder Consultation/Meeting at district level included formal power point presentation to the participants, followed by open discussion and clarification of queries and concerns raised by the present participants. The environmental public consultations meeting on an average lasted 1 hours.

Proceedings of the stakeholder meetings were recorded both on paper and video. In addition to the public consultations, discussed above, separate discussions (outcome discussed later in this chapter) were held with district officials to get further insight on their perception, likely challenges and recommendations on various aspects related to project implementation.

Parallel to the district level stakeholder consultations, meetings with various officials were also held in their offices in each of the district along the corridor of MAHSR. The objective of these meetings was to seek valuable inputs from relevant district offices on issues around land acquisition, R&R policies, practices and their perception *vis-à-vis* HSRC, likely challenges and suggestions in these respects. Following sections summarize outcome of various stakeholder consultations held, inputs obtained from participants.

7.4 DISCLOSURE AND PUBLIC CONSULTATION

The meetings witnessed participation from project affected persons, representatives from district level departments and local NGOs, Environmental Experts/Activists details of which are provided in the Table 7.4.1 for Feasibility Stage (FS) and in Table 7.4.2 for Detailed Design Engineering Stage.

Table 7.4.1: Primary Details of District Level Consultations during FS Stage.

Sr. No.	Date	District	No. of Participants*	Representation from District Department**
1	04.12.2014	Navsari	20 (5)	Deputy Collector (Land Acquisition), Navsari
2	05.12.2014	Surat	15 (1)	Mamlatdar, Surat City, Head Clerk, District Agriculture Office
3	06.12.2014	Valsad	30 (0)	Deputy Collector, Valsad
4	06.12.2014	Dadra and Nagar Haveli	6 (0)	
5	08.12.2014	Palghar	22 (3)	SDO&SDM, Palghar
6	10.12.2014	Thane	28 (0)	
7	12.12.2014	Vadodara	18 (2)	Special Land Acquisition Officer and Deputy Mamlatdar
8	15.12.2014	Bharuch	15 (0)	
9	16.12.2014	Anand	21 (0)	
10	17.12.2014	Kheda	27 (0)	District Agriculture Office
11	18.12.2014	Ahmedabad	96 (21)	

Sr. No.	Date	District	No. of Participants*	Representation from District Department**
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* No. in parenthesis denote female participants present in the meeting

** In addition to the above, in 2 districts there was representation from local NGOs (Adivasi Ekta Parishad, Palghar, Conservation Action Trust, Mumbai. Local Media presence was also observed in Navsari stakeholder consultation

Source: Stakeholder Meetings Attendance Register, 2014

Table 7.4.2: Details of District Level Consultations during Detailed Design Engineering Stage

Sr. No.	Date	District	No. of Participants*	Representation from District Department
1	04.04.2018	Kheda	114 (5)	District Collector, Deputy Collector, SDM Kheda
2	16.04.2018	Silvassa	45 (8)	RDC Silvassa, President District Panchayat, Mamlatdar, DDA, DCF, PWD,
3	30.04.2018	Anand	161 (10)	Deputy Collector, DDC, DCF, ACF. Anand, AE GPCB, Anand
4	30.04.2018	Vadodara	37 (5)	SDM, Vadodara
5	09.05.2018	Ahmedabad	52 (10)	DC, RAC, SDM, LAO. Ahmedabad
6	10.05.2018	Bharuch	70 (5)	RAC, SDM Bharuch
7	14.05.2018	Surat	102 (12)	DC, Dy DC Surat
8	29.05.2018	Navsari	92 (11)	RDC Navsari
9	29.05.2018	Thane	245 (28)	RDC Thane, SDO – Bhiwandi, SDO – Thane, RO-MPCB, Govandi
10	30.05.2018	Valsad	206 (22)	DC, Prant Officer (LR) Valsad
11	30.05.2018	Mumbai	16 (2)	RDC, RO-Govandi MPCB
12	02.06.2018	Palghar	271 (52)	District Collector, Dy Collector (LAO)

* No. in parenthesis denote female participants present in the meeting.

Source: Public Consultation Attendance Sheet, 2018

The box below presents outline of a typical consultation event held in one of the project districts.

Public Consultation Meeting: Content Outline

1. Welcome and Attendance of the participants
2. Sharing of objective of the meeting that were
 - To brief potential stakeholders about proposed High Speed Passenger Railway
 - About track route
 - Type of construction
 - Brief about various stages/processes associated with an infrastructure project of such nature
 - To collect stakeholder perception, concerns, opinion and suggestion and share with project proponents
 - About Impacts and its mitigation
 - About possible land acquisition process
 - About R&R policy and process
3. Brief about the project: Sharing the proposed alignment (on google earth), list of major towns, villages etc. falling along the alignment, types of construction involved (bridges, viaducts,

- tunnel etc.)- participants were informed that project is currently at feasibility assessment stage
4. Project Cycle: Briefing on various stages/milestones associated with infrastructure projects of this nature. Informing on various stages that this project will pass through till its closure. These typically include project conceptualization, pre-feasibility and feasibility studies, project finalization and DPRs, Detailed SIA and EIA, systematic R&R and Land Acquisition related activities, project construction and subsequent closure activities- Participants were informed that JICA/World Bank policies would influence R&R activities under this project.
 5. Current project status: Progress status of the project in the chain of activities/millstones
 6. Key features of R&R policies of JICA (including concept of cut-off date)
 7. Project related opinions/suggestions and concerns
 - About Impacts and its mitigation
 - What are these (positive and negative) and how?
 - Who will be most impacted if they are?
 - How best these can be mitigated considering project significance
 - About applicable land acquisition process
 - Opinion and suggestions
 - About R&R policy and processes
 - Suggestions on type of assistance and support (besides compensation)
 - Institutional and implementation arrangements
 - Any other suggestions?
 8. Meeting Closure (with refreshment and tea)

The consultation meetings brought valuable viewpoints and suggestions from the stakeholders relating to

- change of proposed alignment to minimize impact;
- use of existing surplus of land with railways;
- aligning it with DFCC alignment and proposed road expressways;
- construction of over bridges;
- compensating loss with prevailing market rates;
- minimizing impact on livelihoods;
- barricading of the proposed line to avoid tress-passing;
- possible places for construction of over bridges, railway gates, and most importantly;
- the need for greater engagement and participation of affected families in decision making processes specifically the MAHSR alignment.

The detailed outcome of the meeting is discussed in the section below.

7.5 OUTCOME OF STAKEHOLDERS MEETING/PUBLIC CONSULTATION

Table 7.5.1 summarizes the key outcomes of the district level consultations of feasibility Stage. Details of the District level consultations of Detailed Design Engineering Stage including schedule, attendance, Minutes of Meeting of the Public Consultation Proceeding (Key Outcomes/Concerns/Suggestions from Meeting) and pictures are provided in **Annexure 7.1, Vol-II** of the S-EIA Report.

Table 7.5.1: Summary of District Level Consultations of FS Stage

Sr. No.	District/ Date	Key Outcome/Concerns/Suggestions from Meeting
1	Navsari 04/04/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> Alignment should consider avoidance of impact to religious structures, open/dug wells, to the extent possible. Participants also identified a school in Manekpur village, having historical importance and requested for rerouting of alignment in a manner that avoids damage to it. <p><i>On Impact</i></p> <ul style="list-style-type: none"> Most of the participants belonged to farming communities and hence concern above loss of livelihood due to farm land acquisition. It was suggested that Government should, therefore, consider land against land for compensation. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> Compensation for land acquisition should be done at more than the market rate. Disbursement of compensation should be done within a reasonable time; Sufficient advance notice should be served to affected families to enable them to shift affected structures. People complained about previously lost land under various government projects in the past and not receiving adequate compensation hence requested minimal land acquisition. <p><i>Others</i></p> <ul style="list-style-type: none"> The ADM present in the meeting summed it up saying that people would not object to land acquisition, if proper and adequate compensation is provided to them. The participants, most of them agreed to the statement made.
2	Surat 05/12/2014	<p><i>On Impact</i></p> <ul style="list-style-type: none"> Safety should be the first priority during construction and operation of the project. <p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> Width of land for MAHSR Track should be reduced to minimize land acquisition. Flyovers / under passes should be constructed near important crossing especially near school and temples. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> Compensation for affected land and structures should be provided more than the prevailing market rates. Market rates should not be decided as per the circle rate/stamp duty register (<i>Jantri rate</i>) and fresh market value assessment should be done by the government before acquiring land. In addition to the compensation for loss of land and assets, MoR/GOI should give priority to affected households for jobs in government departments in accordance with the qualification of the candidate. All shop keepers should be rehabilitated by constructing market complex in nearby area. Compensation should be given for loss of land and structures. Most of the business persons of village Chhedcha and Antroli were of the view that they would prefer to relocate their shops at Surat for which adequate support should be provided by the Government. Disbursement of money should be done before the commencement of civil works; advance notice period should be served to the PAF.
3	Valsad and Dadra & Nagar Haveli 06/12/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> Participants suggested that alignment should be redesigned or should be underground to avoid dismantling of any structures or acquisition of land so as to minimize impact on their livelihoods. Existing vacant land at Valsad District should be used for station instead of commercial and residential land of local people. <p><i>On Impact</i></p> <ul style="list-style-type: none"> Majority of the villagers are dependent on agriculture for their livelihood and hence loss of agriculture land will have adverse impacts on their

Sr. No.	District/ Date	Key Outcome/Concerns/Suggestions from Meeting
		<p>livelihood.</p> <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> Affected persons should be duly consulted before finalization of rehabilitation and resettlement plans. <p><i>Others</i></p> <ul style="list-style-type: none"> Participants also strongly recommended for organizing meetings at village level rather than at the district level for ensuring larger participation. Some of the stakeholders resisted the proceeding in the consultation and remarked all affected people should be invited for consultation about the project and allowed to make representations. It was explained to them such an exercise will be conducted once the project gets finalized. Participants also sought presence of MoR representatives in future consultations.
4	Palghar 08/12/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> Participants opposed the proposed HSR alignment as it will result in considerable damage to residential structures (particularly in Vasai taluka in Mumbai suburbs) and homestead land and requested re-consideration of the same. Existing vacant land should be used for infrastructure creation rather than acquiring built up commercial and residential land. <p><i>On Impact</i></p> <ul style="list-style-type: none"> Project area (specifically in Talasari and Dahanu taluka) is mainly inhabited by tribal population. Most of the participants (from tribal community) vehemently shared their opposition to the project saying that they solely depend on farming for livelihoods and hence any acquisition of their farm land will impact their livelihoods. Alternatively, they should be provided land against land. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> Participants requested consultations to be held at village level, allowing all affected persons to participate in the meeting. One of the PTGs named Katkariis live in the area, so their needs and livelihood security need to be protected. <p>People expressed the view that most of the area in Palghar district is coming under Panchayats (Extension to Scheduled Areas) Act 1996 (PESA) rule wherein panchayat's written permission is required to take up any kind of work.</p> <ul style="list-style-type: none"> Participants believed that there are separate rights for indigenous people who protect them from projects that may have adverse impact on their welfare and in such an eventuality the HSR project cannot come up. <p><i>Others</i></p> <ul style="list-style-type: none"> They fear that many other industrial and infrastructure projects will coming up in future in this district and most of the people from this area will be relocated which is not a sustainable way of development. The participants also shared that they have already given land for ongoing Expressway (Road) in the district. One of the participants also expressed his displeasure, recalling a past instance where 4000-6000 acre of land was acquired in Dabtari village for dairy project, resulting in massive displacement. Later the project failed and the land instead of being returned to farmers was sold for some other project at a higher price.
5	Thane/ Mumbai 10/12/2014	<p><i>On Alignment and Structure and Impact</i></p> <ul style="list-style-type: none"> Rajiv Puri (Territory Manager, BPCL) - BPCL has started a company owned petrol pump at Bandra Kurla Complex (BKC), Navi Mumbai which caters to around 2600 vehicles with 8000 lt. petrol/diesel per day. Hence any relocation of the petrol pump will also affect the local population. Company representative also shared that many of their petrol pumps have been closed due to litigation and finding a suitable place in such places is extremely difficult.

Sr. No.	District/ Date	Key Outcome/Concerns/Suggestions from Meeting
		<ul style="list-style-type: none"> • Indian Corporation, a private company has warehouse structures in 754 acre and 117 acre plots in Bhiwandi and requested for minor realignment of the track to spare the infrastructure. The affected parties are willing to allow viaducts to pass over vacant land parcel owned by them however; a minor realignment will spare the existing infrastructure. • In Vasai, a public ground for a large residential area is being affected by the prospective alignment and hence realignment is requested. • In Kaman, proposed track alignment is cutting the infrastructure of Siddhi Press diagonally which will result in loss of structure and livelihoods. Hence, should be compensated appropriately at market rate. • In Shilphata, Datta Mandir, a 200-year-old temple is being affected by the proposed alignment. Also, a lot of residential structure will be affected if the proposed alignment is finalized. Participants have suggested an alternative line to avoid this loss- The proposed route can be via Nilgegaon and Daighar which will minimize the impact and thus save government's money on compensation <p><i>Others</i></p> <ul style="list-style-type: none"> • Sufficient land has already been acquired for the proposed express highway between Mumbai – Ahmedabad. Participants requested if the proposed high-speed railway line can use this already acquired land.
6	Vadodara 12/12/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> • Proposed track alignment should be parallel and along the Dedicated Freight Corridor. • Inverted “S” shape alignment near Chhani (on northern outskirts of Vadodara) is very sharp, which may not be technically feasible. • Major physical structures (Rajpath Club hotel, Lalita Tower, etc.) around the Baroda railway station may be damaged if the proposed alignment is approved. Alternate option of underground track and station (tunnel structures) should be considered within the city should be considered. <p><i>On Impact</i></p> <ul style="list-style-type: none"> • There are many villages such as Sihor, Ikhriya, Berpur, Mezat, Khusipur and Kotwada which will face water inundation problem if the line is constructed as it would interfere with existing drainage pattern. Appropriate measures should be taken avoid such problems. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> • Compensation should be given to PAFs for both land and infrastructure. Acquisition benefits should also be given prior to land acquisition. • Large part of Ambika Vijaya Society near Chani, where 48 families are residing, will be affected. These families are living in row house tenement. Most of them have business within 2 km of radius of their place of living. Hence any relocation should provide them resettlement site around their business locations only. Similar issue was raised by residents of Shilalekh society. • All the acquisition should be done under the supervision of court.
7	Bharuch 15/12/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> • The proposed track alignment should be along the DFC line or the national highway as sufficient land has already been acquired for creation of these infrastructures, much of which remain unused. <p><i>On Impact</i></p> <ul style="list-style-type: none"> • Talkeswar Mahadev Temple in Telod village will be affected by the project. The temple is highly revered and place of high importance to the locals, as evident from the fact that village derives its name from the temple. Hence, the participants demanded that alignment be changed, in absence of which the project will face vehement opposition from villagers and the matter would become sensitive. The villagers will also object to shifting of the temple as they consider the temple deity origin to be of natural creation and not manmade. • There is no land (to convert use to residential purpose) available for

Sr. No.	District/ Date	Key Outcome/Concerns/Suggestions from Meeting
		<p>constructing houses apart from their farmland and existing residential houses, the families would find it difficult to get new residential plot and construct their houses</p> <ul style="list-style-type: none"> • People will also face difficulty in getting electricity connection for their farm bore wells which may be affected by the proposed project. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> • Monetary compensation has to be provided at market value to people whose properties/assets are being affected by the proposed track. • Many of the affected are living in joint families while the ownership is with one person. Hence compensation should consider these complexities also and provide benefits to individual family units.
8	Anand 16/12/2014	<p><i>On Alignment and Structure</i></p> <ul style="list-style-type: none"> • Participants recognized the benefits and significance of the project. They however, suggested the alignment to be shifted along the express highway for expansion of which sufficient land has already been acquired. • Three over bridges will be required in Boriavi alone as the proposed track is passing through 3 State highways- Chandra Nagar – Chaklasi, Samarkha – Sakti Nagar, Jivapara – Samarkha <p><i>On LA and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> • There are several commercial establishments (shops, marriage halls, etc.) that draw and depend on location advantage. These affected people should be compensated with equally sized land parcels and the cost of construction/ land development (at market value) and within 2 km of their existing structure. • People whose 60 percent or more land is likely to be acquired would prefer the entire land parcel to be acquired by the government. • Participants also wanted to know about the fate of wells (irrigation resource) if the line passes between the well and agriculture land, making the irrigation source redundant.
9	Kheda 17/12/2014	<p><i>On Alignment and Structure and Impact</i></p> <ul style="list-style-type: none"> • Participants suggested that the track should be shifted and taken along the express highway which has surplus land (acquired) by its side. • In Malataj (Also Sandra, Sanket, and Nenpur) village, the proposed track is passing between houses of the villagers and their farms. This will make it difficult for people to approach their farms. Hence Bridges should be provided at appropriate places. • The proposed track is crossing a number of important connecting roads such as Nenpur-Malataj, Memdabad-Kheda, Bavra-Kakatpura-Memdabad, Kheda-Mahuda, etc. As per the alignment as shown on Google Earth, the proposed track is an embankment type structure. The participants therefore suggested for bridges over these road crossings. • In Bavra village, the school and the dairy cooperative society will fall on the other side of the proposed track. These two places are frequently visited by the villagers and children and hence the proposed track will create lot of inconvenience. Further, there is no government land available in the village where the school can be relocated. Hence acceptable solutions and consideration must be made by government while executing this project. • In Degam village too, government school is being affected by the line and there are no alternative government land for its relocation. • Fencing of the line is suggested by the villagers to avoid accidents as this is high speed railway line and the response time (during crossing of the track) will be less. <p><i>On Land and R&R Policy, Process and Measures</i></p> <ul style="list-style-type: none"> • Villagers of Bavra said that they should be given land and construction cost (as per market rate) as compensation to the people whose house will be affected.
10	Ahmedabad	<i>On Alignment and Structure</i>

Sr. No.	District/ Date	Key Outcome/Concerns/Suggestions from Meeting
18/12/2014		<ul style="list-style-type: none"> The track alignment should be such designed that it minimizes impact on residential and commercial structures. <p><i>On Impact</i></p> <ul style="list-style-type: none"> Participants from Shahibaug area opined that both house (slum) and livelihoods will be affected. People from Asarva Bridge/Fatwa Masjid said the affected people are mostly Muslims from poor economic status <p><i>On Land and R&R Policy and Process and Measures</i></p> <p>Shahibaugh area:</p> <ul style="list-style-type: none"> People residing in this area are mostly earning their livelihoods within a radius of 2 km therefore any relocation plan should consider this fact so that their livelihoods are protected. These people have been paying taxes for the places where they have been living, however they are not the owner of these houses rather their status in the receipt are shown as secondary occupant. All the affected families from same locality should be shifted to same place which is near to their present location. They should be given house against house not money and or land as relocation benefit. <p>Asarva Bridge/Fatwa Masjid area</p> <ul style="list-style-type: none"> Families residing in houses that may be affected by the proposed line will be interested in cash compensation (at market rate) only as they fear that in case of relocation they may not be relocated in adjacent locality/preferred location. There are a few people who have purchased houses recently, but they do not have legal documents for ownership. Compensation and R&R benefits should factor in these complexities as well Most of the affected are slum dwellers whose livelihood activities/operations are based out in nearby areas only. Hence any relocation and resettlement should be done in areas in vicinity of their current residence only.

Source: SHM December 2014

Table 7.5.2: Summary of District Level Consultations of Detailed Design Engineering Stage

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
1.	Kheda (Gujarat)- 04/04/2018	○ Impact on ground water due to pier foundation.	Geo-hydrological study has been conducted at each pier location and the foundation has been suitably designed to avoid any impact on the ground water aquifer. During construction of piers, care will be taken to ensure that groundwater quality is not adversely impacted
		○ How Domestic animals (cow, goat, buffalo etc.) will cross the farm fields after construction of the alignment.	Since the maintenance road planned along the alignment will not be fenced near the villages / habitation, it will allow free movement of people and livestock across the alignment.
		○ What is the Methodology used in the EIA study, what kind of experts are undertaking this study,	Standard Methodology and Terms of Reference (ToR) of MoEFCC and JICA are followed in the S-EIA Study. Environmental experts certified by NABET

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
		EIA is planned according to which international/ treaty law.	have been engaged in the study. Governmental / Semi-governmental Institutions of repute such as Zoological Survey of India (ZSI), National Institute of Oceanography (NIO) and Mangrove Society of India (MSI) are also part of the study team.
		○ Was the EIA study carried out according to Himachal Pradesh High Court order of 2012?	The Study is being conducted as per JICA's Guidelines for Environmental and Social Considerations issued in April 2010.
		○ Is there any office at village level where local can submit their inputs regarding the Environment impact of the MAHSR Project?	<p>Stakeholders may submit their written environmental concerns to the respective Chief Project Managers of NHSRCL (Ahmedabad, Vadodara, Thane/Palghar and Mumbai) or the main office of NHSRCL in Dwarka, New Delhi.</p> <p>The Environmental PCs are being conducted to seek suggestions and inputs from the local stakeholders at District Level.</p> <p>The comments/ suggestions received and issues raised have been duly addressed in the S-EIA Report which shall be uploaded on the NHSRCL website for public information.</p> <p>Suggestions / comments received after uploading the S-EIA Report, will also be reviewed and relevant suggestions shall be incorporated in the S-EIA Report as the EIA is a continuous process and shall be updated, as required.</p>
		○ TOR of MoEFCC for this study?	The MAHSR Project (Railway sector projects being exempt) does not attract the provisions under EIA Notification, 2006 for a Prior EC and Public Hearing. The Study is being conducted as per JICA's Guidelines for Environmental and Social Considerations issued in April 2010.
		○ Was sensitization at local level was done, if not then, why?	<p>During the Feasibility Study Stage the stakeholders meeting (SHM) was conducted at District level and locals were made aware of the project and EIA components.</p> <p>During 2017-18, various ground level</p>

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
			teams of NHSRCL have been meeting villagers and local stakeholders and discussing various issues related to MAHSR project
		<ul style="list-style-type: none"> ○ If the project is exempted from the EC, then why is money spent on the public consultation for EIA. 	The MAHSR Project (Railway sector projects being exempt) does not attract the provisions under EIA Notification, 2006 for a Prior EC and Public Hearing. The Study is being conducted as per JICA's Guidelines for Environmental and Social Considerations issued in April 2010.
		<ul style="list-style-type: none"> ○ How is loss of agricultural land compensated? 	It is an irreversible impact and the loss of land is being compensated in terms of monetary value. This aspect has been addressed in the SIA and RAP report of the MAHSR project.
		<ul style="list-style-type: none"> ○ How is the food for domestic and wild animal grown on the RoW of proposed alignment compensated? Has there been any study done on the subject? 	The Land Acquisition Plan (LAP) indicates that there is no loss of grazing land along the proposed alignment of the MAHSR. However, it is expected that the grass carpeting (landscaping) on the shoulder of the maintenance road would act as grazing land for the livestock.
2.	Silvasa (DNH)-16/04/2018	<ul style="list-style-type: none"> ○ As an example of a recent project, NHAI stated that there will be a service road along NH and the villagers will be able to use the road. However, no road has been constructed. 	For the MAHSR project the total width to be acquired is 17.5 metres, which includes the elevated viaduct structure of 13.5m width and a maintenance road (4m wide). The maintenance road will be necessary for the HSR and will be constructed along with the track. Since the maintenance road planned along the alignment will not be fenced near the villages / habitation, it will allow free movement of people and livestock across the alignment.
		<ul style="list-style-type: none"> ○ Will there be any local employment generation 	Various job opportunities shall be created during the construction, operation & maintenance of the MAHSR project. During the construction phase, locals shall be preferred depending their skill and qualifications as per prevailing law of land. New stations will also open new market and entrepreneurship opportunities for the local population. NHSRCL will provide skill training for employment or self-employment. NHSRCL will provide skill training for employment or self-employment.

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
		<ul style="list-style-type: none"> What will happen, if the onboard passengers use toilets? It may pose sanitation issue to the habitants located on either side of the MAHSR track. 	<p>The Shinkansen E5 series being used for MAHSR does not use conventional railway toilet system.</p> <p>The HSR will be a zero-discharge train and its toilet facilities will operate similar to those in commercial aircrafts.</p>
3.	Anand (Gujarat)- 30/04/2018	<ul style="list-style-type: none"> NHSRCL should provide full time job to one family member for all project affected household (PAH). 	NHSRCL will carry out local recruitment as per Rules & Regulations of the Railways. However, the preference shall be given to persons from project affected households (PAHs).
		<ul style="list-style-type: none"> Will there be any NoC required to be obtained for construction of pipeline crossing the MAHSR RoW after commissioning? 	NHSRCL will be acquiring land only for the 17.5m RoW. However, there is no such rule against the provision of immediate structure after the RoW. The bye-laws of the local municipal authority shall be applicable.
		<ul style="list-style-type: none"> Can farmers use the road developed? 	Yes. The villagers can use the maintenance road to be constructed along the viaduct alignment.
4.	Vadodara (Gujarat)- 30/04/2018	<ul style="list-style-type: none"> Why you have not provided any information about environment to all farmers, if provided then in which form. 	The Executive Summary (in English as well local language) of the Draft S-EIA Report was made available at the Office of the District Collector for public viewing and inspection well in advance before the Public Consultation. The copy of the Summary was also circulated to each gram Panchayat in advance during the handing over the individual notification about the Public Consultation.
		<ul style="list-style-type: none"> When you start working on project at that time it's possible so many crops will be harm. Then will you provide them whatever they lose. 	The compensation will be provided as per RFCT LARR Act 2013. However, the final decision on this will be taken by the District Administration. The value of the crops shall be evaluated by the concerned Agriculture Officer and the farmer shall get compensated.
		<ul style="list-style-type: none"> Government of Gujarat is requested please to provide job to one family member of PAHS as per their qualification. 	NHSRCL will carry out local recruitment as per Rules & Regulations of the Railways. However, NHSRCL shall impress upon the deployed contractors during the construction phase to give preference to locals for employment as per their skill, experience and qualification.
5.	Ahmedabad (Gujarat)- 09/05/2018	<ul style="list-style-type: none"> How will farmers get the compensation? 	Amount of compensation will be credited in the bank account of PAHs directly and compensation will be paid as per Jantri published in 2013.

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
		<ul style="list-style-type: none"> If our house is partly affected in this project, so what about compensation? 	<p>During the Joint Feasibility Study Stage, we conducted tentative survey and that time alignment was not fixed. But now we have exact alignment and after Joint Measurement Survey we have actual figure of all affected plots and their alignment. We will also build concrete pillars for RoW. If your house is partly affected, you will get full compensation.</p>
6.	Bharuch (Gujarat)- 10/05/2018	<ul style="list-style-type: none"> Asked to revise Jantri and provide compensation amount as per new Jantri rate. After 17.5m land acquisition, what about rest part of land? Can we get compensation about rest part of land? 	<p>The compensation will be provided as per RFCT LARR Act 2013. However, the final decision on this will be taken by the District Administration.</p>
		<ul style="list-style-type: none"> What is the arrangement for crossing the animals/livestock for grazing? 	<p>The maintenance road shall not be fenced, and livestock/domestic animals can cross the maintenance road provided within RoW below the viaduct.</p>
		<ul style="list-style-type: none"> Rate of Jantri is differing from village to village, so what about compensation? 	<p>The compensation shall be provided as per RFCT LARR Act 2013. However, the final decision on this will be taken by the District Administration.</p>
7.	Surat (Gujarat)- 14/05/2018	<ul style="list-style-type: none"> Locals PAHs should be given priority in employment. 	<p>The priority shall be given to the local people depending on the skill, experience and qualification of the person. Detailed skill development and livelihood programme has been framed in the SIA.</p>
8.	Navsari (Gujarat)- 29/05/2018	<ul style="list-style-type: none"> Why farmers and all were unaware of this meeting? 	<p>The notification of the Public Consultation was published well in advance in the local news papers and also the notice was also circulated to each Panchayat.</p>
		<ul style="list-style-type: none"> Will farmers get employment due to MAHSR? 	<p>NHSRCL will carry out local recruitment as per Rules & Regulations of the Railways. However, the preference shall be given to persons from project affected households (PAHs).</p>
		<ul style="list-style-type: none"> Why official notice was not passed to all the affected persons? 	<p>The notification of the Public Consultation was published well in advance in the local news papers and also the notice was also circulated to each Panchayat.</p>
		<ul style="list-style-type: none"> When will we come to know about the exact alignment of the land? 	<p>Now the entire alignment has been finalized and the fixing of Centerline and RoW pillar is underway.</p>
9.	Thane	<ul style="list-style-type: none"> ZSI did not take any field 	<p>Mr. Rahul Datar, JICC responded and</p>

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
	(Maharashtra) -29/05/2018	visit and the impact on the entomology has not been studied	confirmed that the ZSI started the field study from June 2017 and continued till February 2018. The outcome of the study has been incorporated in the S-EIA report.
		○ Whether endangered species have been identified or not?	Detailed biodiversity study has been conducted by the expert and the finding has been incorporated in the S-EIA Report comprising listing of encountered flora and fauna as per IUCN list.
		○ Impact on the river width due to constriction of bridge and danger of flood due to obstruction in water flow	100 years data of water flow and flood including the HFL have been taken into account for development of design of the bridge.
		○ As per the figure brought out in the Executive Summary about 10% of the mangrove area shall be cleared	Mangrove cutting permission shall be obtained from the Bombay High Court. As per the directive of the Forest Department, Mangrove Cell of Thane and Mangrove Conservation Unit, Mumbai, the compensatory afforestation shall be undertaken at the identified land allocated by the District Collector.
		○ Impact on the Flamingo and migratory bird at Thane Creek	During the study period spanning from June 2017 to February 2018, ZSI team did not observe any impact on the flamingo population due to existing traffic movement across the Vashi bridge. However, detailed monitoring schedule has been planned during construction and operation phase of MAHSR project. The counter measures and conservation management plan have been detailed in the "Study on Faunal Components and Management and Conservation plan for Thane Creek Flamingo Sanctuary" prepared by Zoological Survey of India, MoEFCC, Government of India, Kolkata. After the review of the monitoring result, if any adverse impact is observed, the mitigation measures shall be revisited and strengthened suitably.
		○ Impact on wildlife habitat and wildlife corridor as the project alignment passing through the ESZ of SGNP and TWLS. There is leopard migratory route.	The MAHSR alignment passes through ESZ of TWLS and SGNP and does not intersect the Core Zone in the form of Viaduct and also through the Core Zone and ESZ of Thane Creek Flamingo Sanctuary in a tunnel. No physical disturbance is anticipated to this wildlife

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
			<p>habitat.</p> <p>The proposal for permission from the Standing Committee of NBWL has been submitted for TCFS, TWLS and SGNP. The proposed MAHSR alignment passes through the ESZ of SGNP and TWLS through viaduct and wildlife movement would not be affected.</p>
		<ul style="list-style-type: none"> ○ What will be the effect on the aquifer and ground water due to tunnel? 	<p>During the hydro-geological study, drilling was done up to 70 m below the bed of the creek, aquifer was not encountered. The basaltic rock in solid form was recovered during the drilling, continuously up to 70 m. Therefore, no any adverse impact is envisaged on the aquifer and ground water body.</p>
		<ul style="list-style-type: none"> ○ What is the protection plan for the water bodies (pond & lake)? 	<p>Adjustment of span shall be done during the construction phase to save the water bodies.</p>
		<ul style="list-style-type: none"> ○ What is the Solid Waste Management? 	<p>Every effort shall be made to reuse the construction debris to the extent possible. If it is inevitable, the solid waste shall be handled as per C & D Rule 2016 and SWM Rules 2016.</p>
		<ul style="list-style-type: none"> ○ Local employment 	<p>The priority shall be given to the local people depending on the skill and capability of the person. Detailed skill development and livelihood programme has been framed in the SIA.</p>
		<ul style="list-style-type: none"> ○ Whether traffic planning has been done for proposed HSR station? 	<p>Most of the HSR stations have been planned in the outskirts of the city areas close to the existing roads, which will not pose any load on the existing infrastructure of the local bodies. The access road shall be part of the RoW envisaged for the MAHSR Project. However, local bye laws and guidelines suggested in the Development Plan of the city shall be followed.</p>
		<ul style="list-style-type: none"> ○ Impact on flamingo due to construction induced vibration 	<p>The MAHSR alignment passes through the Thane Creek Flamingo Sanctuary in a tunnel 30 m below the bed of the creek. A scientific study has been carried out by the Japanese Expert team to study the impact of vibration due to construction of tunnel and it has been concluded that the construction induced vibration is unlikely to propagate up to the creek surface. Therefore, no adverse impact on the</p>

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
			flamingo sanctuary is envisaged.
10.	Valsad (Gujarat)- 30/05/2018	o Affected Tree count is incorrect it will be approximate 6 lac, please check the exact figure.	The tree count incorporated in the report is based on the LIDAR data for the land falling under the RoW and not for the entire district. The physical counting is underway, and the result shall be submitted once the final count is received.
		o Every farmer does not read the news paper. How they were informed?	The notice for the Public Consultation was published in the local news paper in local language (Gujarati). Further to give more publicity and awareness, every Panchayat was informed individually with a copy of the Summary of the Draft S-EIA Report in Gujarati (local language).
		o Without permission HSR project work has been started since December 2017.	The official permission was taken during the Joint Feasibility Study Stage of the project in 2014-15 and in continuation to that the present study is being undertaken.
		o For every meeting every farmer and affected people should get the agenda, booklets, pamphlets to all.	The Summary of the Draft S-EIA was made available at the Office of the District Collector and also to all Panchayats. Before start of the Public Consultation it has been distributed to all interested farmers in Gujarati.
		o Please develop existing railway, we do not require Bullet train.	The present Mumbai-Ahmedabad High Speed Railway Project has been sanctioned for implementation as per the finding of the "INDIAN RAILWAY VISION 2020". The modernization and augmentation of the existing railway system is underway.
11.	Mumbai Suburban (Maharashtra) -30/05/2018	o Whether waste disposal site has been identified?	The construction waste during the tunneling shall be reused for other construction activities / ballast in metro rail construction, DFCC and service roads. The unused waste shall be disposed off at the identified and approved site in consultation with the local municipal authorities.
		o Identification of compensatory afforestation and survival rate.	The land for the compensatory afforestation shall be identified and allocated by the concerned District Collector and the afforestation shall be undertaken in coordination with the Forest Department. The effort shall be made for transplantation in the vicinity at the

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
			available land. Scientific methods shall be adopted to achieve optimal survival rate.
		○ Waste water discharge	Every effort shall be made to recycle and reuse of the waste water after proper treatment depending upon the quality of the treated water.
		○ Is there ventilation shaft in Mangrove area?	No. The shaft has been provided on the private land and there is no mangrove area involved there as per MSI studies as well as Godrej officials.
		○ Why is not EIA shared with the public till date? There is lack of information in the executive summary	The Environmental Information Disclosure and Public Consultation has been completed in various districts. The suggestions and concerns of the public shall be incorporated in the S-EIA report and uploaded on the NHSRCL website in public domain. The revised and updated Summary (in English and local language) shall be made available in the public domain. EIA being a continuous process, it will be further updated based on the suggestions/ observations received from the stakeholders.
		○ Is there planning of underground reclamation	Reclamation has not been envisaged in the detailed design engineering.
		○ If the alignment is going through tunnel in Mumbai section, then how will NHSRCL take care of flood as Mumbai gets flooded at the time of monsoon season	This aspect has been taken care in the design of the tunnel.
		○ Does the NHSRCL alignment coincide with the Mumbai metro alignment?	The MAHSR alignment does not coincide with the Mumbai Metro alignment.
		○ What will be the effect on the aquifer and ground water due to tunnel?	During the hydro-geological study, drilling was done up to 70m below the bed of the creek, aquifer was not encountered. The basaltic rock in solid form is recovered during the drilling continuously up to 70 m. Therefore, no any adverse impact is anticipated on the aquifer and ground water body.
		○ What will be the impact on mangroves due to underground tunnel?	The tunnel shall be 30 m below the bed of the creek. No any adverse impact mangrove is envisaged. Further, the roots of the mangrove are limited to 3 m only.

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
12.	Palghar (Maharashtra) -02/06/2018	<ul style="list-style-type: none"> NHSRCL promised to disclose the information and distribute Summary of S-EIA in advance. But no such documents were made available to the public. The local tribal people have lost today's wages due to this meeting. 	<p>The project authority clarified that adequate advance notifications were published in the local news paper and also it was individually sent to each affected Panchayats. The disclosure document i.e. the Summary of the Draft S-EIA Report (English and Marathi) was also made available at the Office of the District Collector and every Panchayat.</p>
		<ul style="list-style-type: none"> People representative demanded to give complete project information in local languages (Marathi) to all persons and suggest the conduct of the Public hearing meeting only after giving proper and complete information to all the people. 	<p>Adequate and complete project information is disclosed in the Summary of Draft S-EIA Report.</p> <p>The suggestions and concern of the public shall be incorporated in the S-EIA report and uploaded on the NHSRCL website in public domain.</p> <p>The revised and updated Summary (in English and local language) shall be made available in the public domain. EIA being a continuous process, it can be further updated based on the suggestions/ observations received from the stakeholders.</p>
		<ul style="list-style-type: none"> A cumulative EIA study should be taken up for the entire Palghar District because a number of government projects are planned in/through Palghar district 	<p>In case the necessity arises, the State Authority may take carrying capacity study of the region.</p>
		<ul style="list-style-type: none"> People demanded the EIA report in Marathi language. 	<p>As requested by public and district administrations, NHSRCL will publish "Enriched" executive summaries, adding more technical information to address the interests of the public during the public consultations, in Marathi, Gujarati and English. The full Supplemental EIA Report in English will be published on the JICA disclosure website and its link will be available on the NHSRCL website.</p>
		<ul style="list-style-type: none"> There are total 73 gram panchayats in Palghar district. Executive summary of EIA should be given to all gram panchayats. 	<p>The project authority confirmed that the Summary of the Draft S-EIA Report was made available to each Panchayat in Palghar District.</p>

Sl. No.	District/ Date	Issue Raised	Response-NHSRCL
		<ul style="list-style-type: none"> The people suggested the proposed budget of the bullet train should be used for strengthening and upgrading the existing Indian Railway System instead of constructing the bullet train 	The present Mumbai-Ahmedabad High Speed Railway Project has been sanctioned for implementation as per the finding of the “INDIAN RAILWAY VISION 2020”. The modernisation and augmentation of the existing railway system is underway. It will be start of new era in the public transport. Every Indian should be proud of having Bullet Train in the country.
		<ul style="list-style-type: none"> The people demanded to cancel the public consultation 	The DC assured the public that their concern/suggestions shall be addressed satisfactorily within the E&S framework of JICA.

Source: Public Consultation, April-June 2018

7.5.1 Discussion with District Level Officials

In addition to the public consultations held at district level, discussions were held with officials of the District Administration of various departments. Discussions were focused on the existing policy and practices on land acquisition pertaining to projects of the nature of MAHSR, challenges faced, suggestions and recommendations, perceived project impacts etc. The list of officials contacted during the field survey is presented in Table 7.5.3.

Table 7.5.3: List of Officials Contacted

Designation	District
Deputy Collector and Sub Divisional Magistrate	Navsari
Mamlatdar, Navsari City	Navsari
District Agriculture Officer	Navsari
Dy. Conservator of Forest	Navsari
Deputy Collector	Surat
Additional Collector (Land Reforms)	Surat
Dy. Conservator of Forest	Surat
District Agriculture Officer	Surat
District Statistical Officer	Surat
Collector & District Magistrate	Valsad
Resident Additional Collector & Additional District Magistrate	Valsad
Dy. Conservator of Forest	Valsad
District Agriculture Officer	Valsad
District Tribal Welfare Officer	Valsad
Collector & District Magistrate	Palghar
Resident Deputy Collector (Land Reforms)	Palghar
Dy. Conservator of Forest	Dahanu, Palghar
District Agriculture Officer	Palghar
District Tribal Welfare Officer	Dahanu, Palghar
Sub Divisional Officer	Palghar
Resident Deputy Collector	Thane

Designation	District
Tahsildar	Thane
Nayab Tahsildar	Thane
Resident Additional Collector (R.A.C.)	Thane
Deputy Collector	Vadodara
Additional District Magistrate	Vadodara
Deputy Mamlatdar and Special Land Acquisition Officer	Vadodara
District Agriculture Officer	Vadodara
Deputy Collector	Bharuch
Resident Additional Collector (R.A.C.)	Bharuch
Deputy Collector	Kheda
District Agriculture Officer	Kheda
Resident Additional Collector (R.A.C.)	Kheda
Nayab Tahsildar	Kheda
Deputy Collector	Anand
District Agriculture Officer	Anand
Resident Additional Collector (R.A.C.)	Anand

Source: Public Consultation April – June 2018

Key discussions on outcome are summarized below:

Key Challenges (as reported by the District Level Officials)

- One of the key problems faced by the district implementing authority is the lengthy time frame in processing of proposals / issuance of notifications and disbursement of payment.
- Another important problem is non-availability of proper land records / very old records with land revenue department, resulting in challenges in establishing land ownership etc.
- At the initial stage of the project, the few land records were not available at village level. Subsequently, this issue was escalated to the higher authority at district level. With their initiatives these records were made available to NHSRL/study team by appropriate sources.
- Inadequate manpower at Block/District level to implement the land acquisition plan. Absence of policy for dealing with encroachers/squatters who have encroached/settled recently, establishing their period of occupation and estimation of compensation.
- Other expected challenges are on account of local resistance and subsequent law & order situation; non-standardization of procedures - varying with projects and state boundaries.

Suggestions/Remarks

- Alignment of the track should be shared with the district administration as soon as possible so that land can be earmarked by the town planning authority /development authority for this project purpose (opinion expressed in Bharuch).
- Specialized land acquisition department / agencies by State Governments may facilitate land acquisition process.
- Uniform R&R Policy in the country will be of immense help for infrastructure projects such as these that involve multiple States.
- Regular updating of land records, digitization, Data bank of land for public purposes, Maintenance of comprehensive and intelligent map database, Instant production of

Cadastral maps of any scales, themes and sizes, etc. will be helpful in proper and smooth implementation of the RAP.

- Mumbai Metropolitan Regional Development Authority (MMRDA) in Mumbai area has land reserve and related development plans of its own. Hence due consultation should be done before finalizing the alignment.

Key SHM Outcome and Its Reflection in RAP

This RAP document has incorporated the viewpoints of participants from the SHMs and the State Department Officials. These are reflected in the entitlement matrix prepared and other R&R policy recommendations and the implementation arrangements suggested. Few important considerations in this context may be noted as:

- Preference should be given to 'land for land' based compensation approach ensuring that land parcel provided is of equal productivity/value.
- In cases where cash-based compensation is adopted, replacement cost will be given to affected families.
- Relocation sites will consider preferences of affected families.
- Acquiring authority will acquire the entire land parcel, in cases where a portion of affected land is orphaned or rendered unusable because of acquisition.
- Track alignment should be reconsidered, in order to minimize project impact (physical structures in particular and sensitive receptors like temples, schools etc.). Adequate provision of foot over bridge, under passes or viaducts will be made to minimize impacts.
- Advance sharing of project alignment is done with State administration for updating of land records. Grievance Redressal Mechanism also is set up to assist affected persons to resolve land record and ownership claim issues timely.
- Special consideration and assistance and consultation be done with tribal communities in Palghar and Valsad and alternate design option/change may be considered to minimize land acquisition in these areas.
- The project has proposed the bare minimum land as per the design requirement after detailed analysis of all the alternative options. Project has avoided any development (except essential requirement of operating the HSR) related to project facilities in these two districts especially within the Schedule V areas to minimize the land requirement in Palghar and Valsad.
- Adequate advance notice is given to affected families to allow them to salvage materials from affected structures and reorganize themselves.

7.6 RECOMMENDATIONS AND MECHANISM FOR FUTURE STAKEHOLDERS CONSULTATION

Consultations at the feasibility stage have clearly brought out the existing demand of the affected persons for greater participation and consultation during the design stage of the project. Such demands are recognized and recommended to be brought in to practice during the project roll out stage. Similar exercises should be carried out at a later stage for disclosure of RAP.

At the design engineering stage, Public Consultation should be organized at District level to have the views and issues related to environment.

Besides, the stakeholder consultations to be held for the RAP preparation and the one proposed for its disclosure, there should be several other mechanisms available for

stakeholder participation. The list (but not limited to) enumerated in Table 7.6.1 identifies these.

Table 7.6.1: Mechanism of Stakeholders Participation

Mechanisms/ Opportunities of Stakeholder Participation	Responsible Agency/ Stakeholder Agencies
Census and SES (with queries on PAF perception and preferences for R&R options)	RAP preparation agency
Public Consultations (for RAP preparation)	RAP preparation agency
Grievance Redressal Mechanism (GRM)	RAP Implementation Agency/ Local NGO/CBOs as vigilantes supervisors
Public Consultation (for environmental issues)	EIA preparation/Designated Agency
M&E related interface with Community	M&E agency
Additional Public Consultations (for further strengthening of existing RAP with information/ input from land losers, not included in this RAP)	Designated External Consultant

Source: Study Team¹

7.7 Some Photographs during the Public Consultations

Exhibit 7.7.1: Photographs of the Environmental Public Consultation during S-EIA at Detailed Design Engineering Stage



¹ The study team comprising the following organizations:

- GPS Technologies Pvt. Ltd.: S-EIA Report, Collection and assessment of primary/secondary environmental data
- JICC: Project Data / Maps / Drawings
- NHRCL / RITES: Land Acquisition Plan and related details
- ARCADIS: LAP details, Excerpts of SIA/RAP



Anand



Vadodara



Bharuch



Navsari



Surat



Valsad



Silvasa



Mumbai Suburban



Palghar



Thane

Source: Study Team

Appendix-I Disclosure of Consultants Engaged

Disclosure of Consultants Engaged

The consultant GPS Technologies Pvt. Ltd., in association with Amaltas Enviro Industrial Consultants LLP (NABET Certificate No. NABET/EIA/1518/IA 0017) have conducted this Supplemental EIA study.

This study has been carried out by the EIA co-coordinator, Functional Area Experts duly accredited by the National Accreditation Board for Education and Training (NABET)/Quality Council of India (QCI). The laboratory analysis has been carried out by NABL/NABET accredited laboratory. The EIA Study has been conducted in accordance with the latest Guidelines of Ministry of Environment Forests and Climate Change (MoEFCC), Japan International Cooperation Agency (JICA) on Environmental and Social Considerations, 2010, the rules and regulations notified by the participating states-Maharashtra and Gujarat, and Union Territory, Dadra and Nagar Haveli from time to time.

Considering the requirement of various clearances, following additional studies have been carried out with the various reputed organizations-

1) National Institute of Oceanography (NIO), Vishakhapatnam

Demarcation of HTL/LTL for the candidate CRZ area at seven locations-six in Maharashtra and one in Gujarat. The details are discussed in Chapter 3 of the S-EIA Report.

2) Zoological Survey of India (ZSI), Ministry of Environment, Forest and Climate Change (MoEFCC), Govt. of India, Kolkata

Conservation and Management Plan for the Thane Creek Flamingo Sanctuary (TCFS) to assess the impact of the undersea tunnel and formulate management and conservation plan for the migratory bird Flamingo and other faunal species.

3) Mangrove Society of India (MSI), Goa

Preparation of Conservation and Management Plan for the mangrove affected by the MAHSR alignment at seven locations. The study aims at assessing the number and area of mangrove to be felled and to delineate the compensatory mangrove afforestation plan at the identified locations in consultation with the Mangrove Cell, Thane, Maharashtra.

GPSTPL Key Information

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NABET Certificate No. NABET/EIA/1518/IA 0017

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