PROPOSED TERMS OF REFERENCE(TOR) FOR EIA & EMP STUDY

1.0 Introduction

The Government of India (GoI) is aimed at improving the connectivity in border areas under 'Bharatmala' Scheme, for which National Highways Authority of India (herein after referred to as the "Authority" or "NHAI") plays a key role. NHAI has been assigned the work of Project Management Consultancy for the selected stretches/corridors of various roads in few states across India. As part of this endeavour, NHAI has decided to undertake the project namely "Consultancy services for preparation of DPR for development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to improve the efficiency of freight movement in India", through Public Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (DBFOT) basis or Engineering Procurement Construction (EPC) mode.

In order to fulfill the above task, the NHAI has entrusted M/s Aarvee Associates Architects Engineers & Consultants Pvt. Ltd. (herein after referred to as the "Consultant") to provide services for Tamil Nadu Bharatmala project stretches. Details of Terms of Reference of **Kumbakonam - Sirkazhi road** stretch is given in this Report. The index map showing the proposed project stretch is shown in Figure 1.

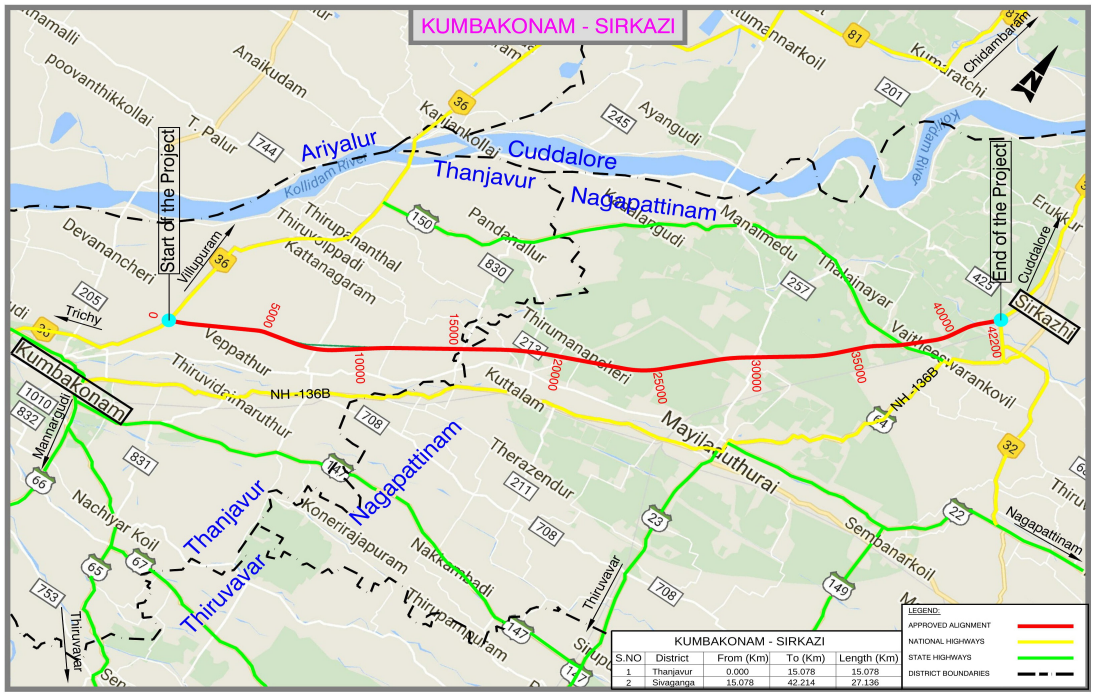

Figure 1: Index Map

2.0 Project Description

The proposed project corridor, Kumbakonam to Sirkazhi in the state of Tamil Nadu is chosen as one of the inter corridor route. The project highway is a section of SH-64 between Kumbakonam and Sirkazhi and traverses through Umamaheswarapuram, Tirubuvanam, Thiruvidaimaruthur, Govindapuram, Aduthurai, Thiruvavaduthurai, Thiruvalangadu, Mathirimangalam, Kuttalam, Katuvalavu, Muvalur, Mayiladuthurai, Solasakaranallur, Natham, Athukudi and Vaitheeswarankovil. The alignment traverses through Thanjavur and Nagapattinam districts in the state of Tamil Nadu. It passes mostly through plain terrain and a mixed land use of residential, commercial and agricultural can be seen throughout the project corridor. Length of the proposed project stretch is about 51.800 km. The details of the stretch is given in Table 1. The salient fetures of the project road are placed in Table 2 and Engineering features are placed in Table 3.

Table 1: Chainages of the proposed project stretch

Location	Design Chainage	Districts
Kumbakonam to Sirkazhi	Ch. Km 1.600 to Ch. Km 53.400	Thanjavur and Nagapattinam
Total length of the proposed project stretch = **51.800 Km**		

Table 2 : Salient features of the project road

S. No.	Parameter	Description
1	Location of project	Kumbakonam to Sirkazhi in Tamilnadu state
2	Terrain	Plain
3	Major settlement along the project stretch	Kumbakonam, Umamaheswarapuram, Tirubuvanam, Thiruvidaimaruthur, Govindapuram, Aduthurai, Thiruvavaduthurai, Thiruvalangadu, Mathirimangalam, Kuttalam, Katuvalavu, Muvalur, Mayiladuthurai, Solasakaranallur, Natham, Athukudi, Vaitheeswarankovil and Sirkazhi.
4	Rivers/ streams/ canals	Cauvery
5	Forest area and sanctuaries	-

S. No.	Parameter	Description
6	Length of the existing alignment	-
7	Existing carriageway width	-
8	Administrative locations	Kumbakonam, Sirkazhi, Thiruvidaimaruthur, Kuttalam
9	State	Tamilnadu

Table 3 : Engineering features of the project road

S. No.	Parameter	Proposed
1	Right of way (RoW)	60m
2	Design speed	100 Kmph
3	Major bridges	1
4	Minor bridges	21
5	No. of railway crossings	-
6	Railway over bridge (ROB)	-
7	Railway under bridge (RUB)	-
8	No. of culverts	182
9	Pedestrian/cattle underpasses	15
10	Vehicular Underpasses / Overpasses	10
11	Fly overs	0
12	Foot over bridges	-
13	Bus bayes-	-
14	Truck lay byes	-

S. No.	Parameter	Proposed
15	Rest areas	-
16	Toll plazas	1
17	Bypasses/realignments	-
18	Total number of trees affected	2537
19	Tree Plantation Proposed (minimum 1:3)	7611
20	Land to be acquired	254.31
21	Project cost	749.51 crores
22	Generation of solid waste/waste soil in the project	-
23	Utilisation of the waste soil in the project	-
24	Carting provision of the waste soil in low lying areas	-

2.1 Site and its Environs

This section provides an overall description of the existing environmental status of the study region. Studies are undertaken to generate baseline data within 10 Km radius of the study region along the proposed project road stretch on topography, geography, climate, soil, drainage pattern etc. From these inputs, possible significant impacts will be identified and quantified and an appropriate Environmental Management Plan (EMP) will be prepared to manage and mitigate these impacts. The proposed alignment traverses through Thanjavur and Nagapattinam districts of Tamil Nadu state.

2.1.1 Geographical Location

Thanjavur District:

Thanjavur district lies in the East Coast of Tamil Nadu. It is located between $9^0$50’ and $11^0$25’ of the Northern Latitude and $78^0$45’ and $70^0$25’ of the Eastern Longitude. The district is bounded on the north-west by the Coloroon river which demarcates itself from

Tiruchirapalli, Perambalur and Cuddalore districts, and on the north and east it is bounded by Nagapattinam and the Thiruvarur districts, and on the South by the Palk Strait and Pudukottai district and on the West by Pudukkottai and Thiruchirappalli districts. The district has its headquartes at Thanjavur and has a geographical area of 3411 Sq. Kms divided into 14 blocks. The area constitutes just 2.6 % of the area of the state.

Nagapattinam District:

Nagapattinam district is a small district with a total geographical area of 2715.83 Sq. Kms. This constitutes just 2.09% of the area of the state. The district lies on the shores of the Bay of Bengal between Northern Latitude of 10.10' and 11.20' and Eastern Longitude of 79.15 and 79.50'. The district capital, Nagapattinam lies on the eastern coast, 350 kilometers down south of the State capital Chennai and of Tiruchirappalli. Coastal length of the district is 188 Kms. The district boundaries are, East: Bay of Bengal, West: Tiruvarur district, North: River Kollidam and Cuddalore district and South: Palk Strait.

2.1.2 Geomorphology and Soil types

Thanjavur District:

Different geomorphic units like flood plain, delta plains, natural levees and sedimentary high ground are noticed in Thanjavur district. Sedimentary high ground ranging in elevation between 60 and 80 m amsl found in southern side of Thanjavur town mainly constitute laterites. Area north of Thanjavur had been fully covered by flood plains. Isolated levee complexes are found parallel to the Vennar river course.

The Thanjavur district is occupied by different geological formations. The different types of soils are derived from the formations are;
Quaternary: Sand, silt and clay super imposed sand, natural levee complexes

Pliocene: Clays heavily weathered super imposed old drainage morphology

Miocene: Sands, clay bound, clays gravels

Cretaceous: Reddish and yellowish calcareous sand stones, clays and lime stones.

Nagapattinam District:

The present geomorphic set up in the district is the result of action of the major rivers with their distinct tributaries, oscillations in the sea level, tidal effects of Bay of Bengal and forces of wind. The landforms are delineated under erosional and depositional regime. The depositional regime comprises of a coastal plain under marine influence, a flood plain of fluvial regime with an intermixing section of both fluvial and marine

influence. The entire area is a peneplained terrain with a gentle slope towards east and southeast. The maximum elevation is about 21 m above mean sea level in the west.

The major part of the district is covered by black clay and isolated patches of brown clay loam in the area bordering the NE boundary of Karaikal region is seen. Some patches of arenacious soils are also found along the coastal line.

2.1.3 Drainage

Thanjavur District:

The district is a part of delta formed by Cauvery river. It has gentle slope towards east and southeast. The Kollidam river forms the northern boundary and flow from west to east. The Grand Anaicut is located at the western boundary, at this point Cauvery splits into Cauvery and Vennar. A regulator at Tirukkatupalli splits Cauvery into Cauvery and Kodamurti rivers. At Thenperumbur anaicut Vennar splits into Vennar and Vettar. In addition to these, the rivers split into many streams before reaching the sea.

Nagapattinam District:

The district is drained by Kollidam and Cauvery in the north, Virasolanar, Uppanar in the central part and Arasalar, Vettar, Vedaranyam canal and Harichandra nadi in the southern part of the district.

2.1.4 Rainfall and Climate

Thanjavur District:

Rainfall is uneven in Thanjavur district. The annual normal (1988-1996) varies partially from 1179 mm (Lower Anaicut) to 763 mm (Budalur). The rainfall is high on the eastern part of the district compared to the western part. The district receives major portion of its annual rainfall during northeastern monsoon (Oct-Dec). A moderate amount of rainfall is received during the southeast monsoon period (Jan-Sept). Since the northeast monsoon rainfall is dominating, its effect is felt on the eastern part of the district (Kumbakonam-698 mm, Aduthurai-611 mm, Lower Anicut-706 mm). The intensity decreases gradually towards west and the western most part of the district (Thiruvaiyaru-387 mm, Budalur-377 mm). The rainfall in the coastal area is heavy because of cyclonic storms and depressions formed in the Bay of Bengal.

The climate of the Thanjavur district is humid and tropical. The mean maximum temperature of the district (Adithurai) shows variation between 36.5°C in June and 27.8°C in May. The mean minimum temperature shows variation from 22.1°C to 27.1°C in December. The relative humidity varies between 70 and 85 percent, highest occurs during the months of Dec-Jan and the lowest during the month of June.

Nagapattinam District:

The district receives rainfall under the influence of both southwest and northeast monsoon. A good part of the rainfall occurs as very intensive storms resulting mainly from cyclones generated in the Bay of Bengal especially during northeast monsoon. The district receives rainfall almost throughout the year. Rainfall data analysed (period 1901-70) shows the normal annual rainfall of the district is 1230 mm. The rainfall pattern in the district shows interesting features. Annual rainfall, which is 1500 mm at Vedaranyam, the southeast corner of the district, rapidly decreases to about 1100 mm towards west of the district. The district enjoys humid and tropical climate with hot summers, significant to mild winters and moderate to heavy rainfall. The temperatures various from 40.6 to 19.3°C with sharp fall in night temperatures during monsoon period. The relative humidity ranges from 70-77% and it is high during the period of October to November.

2.1.5 Demographics

Thanjavur District:

According to 2011 census, Thanjavur district had a population of 2,405,890 with a sex-ratio of 1,035 females for every 1,000 males, much above the national average of 929. A total of 238,598 were under the age of six, constituting 121,949 males and 116,649 females. Scheduled Castes and Scheduled Tribes accounted for 18.91% and 0.15% of the population respectively. The average literacy of the district was 74.44%, compared to the national average of 72.99%. The district had a total of 605,363 households. There were a total of 974,079 workers, comprising 117,321 cultivators, 327,673 main agricultural labourers, 26,430 in house hold industries, 363,060 other workers, 139,595 marginal workers, 12,592 marginal cultivators, 87,688 marginal agricultural labourers, 4,770 marginal workers in household industries and 34,545 other marginal workers.

Nagapattinam District:

According to 2011 census, Nagapattinam district had a population of 1,616,450 with a sex-ratio of 1,025 females for every 1,000 males, much above the national average of 929. A total of 165,245 were under the age of six, constituting 84,335 males and 80,910 females. Scheduled Castes and Scheduled Tribes accounted for 31.54% and 0.23% of the population respectively. The average literacy of the district was 75.04%, compared to the national average of 72.99%. The district had a total of 413,837 households. There were a total of 671,994 workers, comprising 54,329 cultivators, 216,353 main agricultural labourers, 7,925 in household industries, 207,721 other workers, 185,666 marginal workers, 13,153 marginal cultivators, 128,704 marginal agricultural labourers, 3,630 marginal workers in household industries and 40,179 other marginal workers. The

birth rate on a scale of one thousand in rural areas of the district is 19.9, urban is 17.8 and the combined birth rate is 18.85. The death rate on a scale of one thousand in rural areas of the district is 8.2, urban is 6.7 and the combined rate is 7.45.

(Sources: District Industrial Profile Reort by Ministry of MSME of GoI, District Groundwater Brochure by CGWB)

3.0 Scope of the Study

The report contains the findings of the study to identify risks, identification of most likely risks, health and Environmental hazards/Impacts along the Right of Way (RoW) & possible natural and man made disasters happening in the project area and suggesting suitable remedial measures in all stages of the projecti.e. Design phase, Construction phase, and Operation phase and preparation of Disaster Management Plan.

The scope of the environmental report is given below:

- Reconnaissance survey, environmental screening and categorization framework for the proposed project to include the environmental aspects from the planning stage of the project.
- Review of National, state and local environmental regulatory requirements on environmental aspects, including necessary clearances from State and Central Government in the context of proposed expressway project.
- Collecting secondary baseline data from relevant sources for various environmental attributes around the project site.
- Conduct environmental analysis of alternatives for different project components and provide specific inputs to technical analysis of alternatives.
- An environmental impact assessment for the proposed project to identify and quantify potential impacts of the project.
- Impact prediction and assessment of key aspects of the project such as ambient air, noise, water etc., and assessment of other aspects of the project with sustainable mitigative measures.
- Suggesting a typical environmental management plan with appropriate line estimates duly addressing the key environmental attributes.
- Suggesting post project environmental studies to be carried-out.

The objectives of the study are:

i. Identify the hazards

ii. Decide areas of hazards in the project and how it shows impact.

iii. Evaluation of risks and decide on precautions

iv. Record of findings and its implementation

v. Assessment of hazards likely likely happening due to result from the proposed project and suggesting suitable mitigation measures.

vi. Preparation of Disaster Management Plan in order to support in the event of road accidents (major road mishaps, gas tanker explosions, fire hazards etc.) and natural calamities (floods, cyclones, earth quakes etc.).

4.0 Terms of Reference for EIA study

4.1 Study Area

A detailed study of all the environmental features falling within the immediate corridor of impact, which has been considered as 500 m on both sides from center line of road. The other sensitive environmental issues such as protected areas notified under wildlife (protection) Act 1972, critically polluted areas as notified by Central Pollution Control Board, notified Eco-sensitive areas, interstate boundaries and international boundaries, water bodies of ecological significance etc., were identified within 15 km from the alignment. The detailed informations from the RoW as well as the area falling within 500 meters on the either side road were collected from primary sources and the other environmental features within 15 kms aerial distance as explained above were collected from secondary data sources. Rapid EIA studies will be carried out for the proposed project in accordance with the Environmental Impact Assessment Notification, 2006 and amendment thereof as well as MoEF EIA Guidance Manual, 2010.The Environmental Baseline data will be generated based on the EIA Guidance Manual, 2010. Environmental Baseline monitoring report will be prepared as per Standard ToR given in EIA guidance manual by MoEF and the same is enclosed in Appendix V. The details of the EIA study is given below.

4.2 Description of the Environment

The baseline data on various environmental features will be collected from secondary and primary sources from field surveys and investigations in order to describe the environmental settings of the project area. The data on different environmental components along the project corridor will be collected by site reconnaissance survey in order to establish environmental condition of the project area. The study area covers 15 km either side of the project stretch.

4.3 Baseline Data Generation

(a) Secondary Data Collection:

Secondary data will be collected from secondary sources like publishes, literature from various government and private agencies, NGOs, or institutions on physical, biological and social components of environment. The data will be reviewed for establishing existing environmental and ecological status within the project area.

(b) Field Survey:

Field survey carried out for the identification of the environmental sensitive zones within the study area and physical verification of all the identified sensitive zones with respect to the location of the project alignment and activities proposed. Field surveys are included with the measurement of environmental quality in terms of ambient air quality, water quality, soil quality, background noise level and ecology (Flora, fauna and roadside trees). Procedure for the measurement of environmental quality surveys carried out as per guidelines of the Ministry of Environment and Forests, Government of India. Following details on different environmental features will be collected either from the secondary sources or from field surveys.

(i) Physical Environment:

- **Topography:** Topography, ground conditions, altitude, slope, etc.

- **Soil and Geology:** Soil type and it characteristics, soil erosion and land slide problem, geology of the area.

- **Water Environment:** An inventory survey of all water bodies located within 500 m on either side of the project road sections will be carried out. Details of rivers, streams, springs, lakes, reservoirs within 500 meters of the proposed road right of way will be collected from the site along with their usage and importance for the local population. Study of hydrology of the project road, natural drainage of the project region, existing drainage pattern of the project road, runoff flow direction, possible flooding, erosion were collected. Information on ground water table, ground water availability in the project area, exploitation of ground water was studied from the generated primary data.

- **Meteorological Data:** Meteorological data covering maximum and minimum

wind speed, wind direction, rain fall, relative humidity and temperature for last 30 years period will be collected from the nearest Indian Meteorological Department (IMD) station i.e station. History of special weather phenomenon like cyclones, cloud bursts, etc., will be collected from the nearest meteorological station for a period of 50 years. The wind velocity, wind direction and wind rose, rainfall, temperature and relative humidity along the proposed alignment are being recorded using a micro-meteorological station during the study period.

- **Environmental Quality:** Baseline environmental quality data in terms of water, ambient air, noise levels and soil quality would be generated as follows:

Ground & Surface Water Resources and Quality: Water samples from ground water and surface water resources along the project road alignment will be collected and analysed for the physico-chemical & biological parameters. Surface water samples will be collected from different water bodies/rivers/streams along the project stretch and ground water samples from most commonly used ground water sources along the project road. Surface water samples will be analysed for Temperature, pH, Turbidity, EC, Colour,TSS,TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, Lead, Mercury, Boron, Chromium, Phenols, Cadmium, Total Coliform, Faecal Coliform etc., and ground water samples will be analysed for Temperature, pH, Turbidity, EC, Colour, TSS, TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, lead, Mercury, Boron, Chromium, Phenol, Cadmium, Total Coliform, Faecal Coliform etc.

Ambient Air Quality: Ambient air quality monitoring process will be carried out all along the project stretch covering different category of land use (residential, commercial/industrial, sensitive zones like schools, college and hospital) with a frequency of twice a week for one month. The ambient air quality monitoring are being carried out for Particulate Matter (size less than 10 µm) or PM_{10}, Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) by following the MoEF guidelines.

Noise Environment: The noise monitoring will be carried out along the project alignment covering sensitive locations such as residential, hospitals, schools, sanctuaries etc. The noise monitoring will be done for 24 hrs at each location. During nigh time and day time, equivalent noise levels will be generated for each monitoring locations to have an idea of noise pollution levels in the study area.

Soil Quality: The soil samples of different area along the project stretch will be collected for assessing the physico-chemical characteristics of the soil in the project area. The quality parameters are pH, electrical conductivity, sand, silt, clay, texture, moisture retention capacity, infiltration rate, bulk density, porosity, organic matter, nitrogen, potassium, phosphorous, Pb, iron and organic carbon.

Existing Land Use Pattern: Land use pattern will be established along the project road classifying forest area, agriculture land, barren land, urban & rural settlements, water bodies, hills etc., along the project road.

Environmental Monitoring Locations

The samples (surface water, ground water, noise and soil) were collected by the 1st week of May and air sampling is going on since mid of March. Interpretation and analysis of air, water, noise and soil monitoring results will be presented in the draft EIA/EMP report. The stated parameters will be collected and analysed as per the MoEF EIA Manual for Highways, 2010. References adopted from MoEF EIA Manual for Highways are given in the following Table.

Table : References adopted from MoEF EIA Manual for Highways

S. No.	Characteristics	No. of samples	Selection of the parameters
1	Micro-meteorological data (The wind velocity, wind direction & wind rose, rainfall, temperature and relative humidity)	1 station x 90 days = 90 samples	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page-17, Section 4.4: Air Environment) Meteorological data covering maximum and minimum wind speed, wind direction, rain fall, relative humidity and temperature for atleast 10 years period should be presented from the nearest meteorological station.
2	Ambient Air Quality Monitoring (Particulate Matter (size less than 10 µm) or PM_{10}, Particulate	4 stations x 2 days x 12 weeks = 96 samples	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.4: Air Environment) Baseline data for the parameters - Particulate matter size less than 10 µm or PM_{10} µg/m^3,

S. No.	Characteristics	No. of samples	Selection of the parameters
	Matter (size less than 2.5 µm) or $PM_{2.5}$, Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide)		particulate matter size less than 2.5 µm or $PM_{2.5}$ µg/m^3, Sulphur dioxide (µg/m^3), Nitrogen dioxide (µg/m^3) and Carbon Monoxide (µg/m^3) in the study area should be generated for one season other than monsoon as per CPCB norms.
3	Water Quality Monitoring - Surface and Ground water (Physico-Chemical, bacteriological and heavy metals analysis)	15	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.3: Water Environment) Details of surface water bodies within right of way and within 500 m from the right of way should be documented along with the present usage. The samples should be collected and analyzed as per the standard procedures.
4	Noise Quality Monitoring (L_{eq} day, L_{eq} night, L_{eq} min, and L_{eq} max)	10	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.5: Noise Environment) While selecting the monitoring locations specific importance is to be given for sensitive environmental receptors like thickly populated areas, hospitals, schools, wildlife corridors etc. Hourly monitoring of noise levels (L_{eq}) should be recorded for 24 hours by using integrated noise meter. Noise standards have been designated for different types of land use, i.e. residential, commercial, industrial areas and silence zones as per the Noise Pollution (Regulation and Control) Rules 2000.
5	Soil Quality Monitoring (Physico-Chemical and heavy metals analysis)	4	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.2: Land Environment) The soil profile of the highway alignment should be presented based on the soil series maps of National Bureau of Soil Survey and Land Use. The suggested parameters for soil analysis are pH, Electrical conductivity, sand (%), silt (%), clay (%), texture, moisture retention capacity (%), infiltration rate (mm/hour), bulk density (gm/ cc), porosity (%), organic matter (%), nitrogen (mg/1000g), potassium (mg/1000g), phosphorous (mg/1000g), sulphates and sodium sulphates.

Air Environment

Standard methods/procedures are adopted during environmental monitoring analysis. After a preliminary reconnaissance of the study region and taking into account the meteorological (predominant wind directions, wind speed), topographic conditions, major settlements & its traffic volume and details on existing industrial activities in the study region, one (01) micro-meterological station and four (04) ambient air quality monitoring stations were identified in the study area spread along Kumbakonam-Sirkazhi road alignment. Micro-meterological station gives climatological condition of the study area by giving temprature, relative humidity, wind direction, wind speed and rainfall data. The parameters being monitored by air quality monitoring instruments are PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO. List of the micro-meterological station and ambient air quality monitoring locations are given in the following Tables.

Table : Micro-Meterological station Location

Location Code	Location	Latitude	Longitude
MM-01	Kovilpathu	11.234685	79.719399

Table : Ambient Air Quality Monitoring Locations

Location Code	Location	Latitude	Longitude
AQ 01	Kallappuliyur	11.008802	79.405602
AQ 02	Kathiramangalam	11.070869	79.529158
AQ 03	Nidur	11.135181	79.643333
AQ 04	Kovilpathu	11.234611	79.719417

Water Environment

Selected physico-chemical parameter along with bacteriological indicators of pollution will be used for describing the baseline status of water environment. Generation of baseline data for water quality covers sources of groundwater and surface water. The assessment of water quality in the study area includes:

- Surface water quality (IS 2296)
- Groundwater quality (IS 10500)

Surface Water Quality

During the preliminary assessment, seven (07) surface water sampling locations were identified for assessing the water quality. These monitoring locations were identified by considering proximity to the project site, their activities and depending upon its utility by the people in the region. The details of the proposed sampling locations are given in Table 16 and photographs of some sampling locations are shown in the following Table.

Table : Surface Water Quality Sampling Locations

Location Code	Location	Latitude	Longitude
SW 01	Pond near Kallappuliyar	11.012842	79.402077
SW 02	Pond near Kathiramangalam	11.07739	79.535414
SW 03	Water body near Kaduvangudi	11.103533	79.584817
SW 04	Pond near Ponnur	11.120961	79.60577
SW 05	Water body btwn. Ch. Km.29 and Ch.Km. 30	11.145206	79.638161
SW 06	Water body near Keelamarudandanallur	11.171549	79.664060
SW 07	Stream at Panamangalam (CRZ Area)	11.220849	79.724220

Groundwater Quality

Groundwater is one of the main sources of water in the project corridor for domestic, commercial and other irrigation use hence the rate of extraction of ground water is at a massive scale. For assessing the groundwater quality in the study area, eight (08) sampling locations were identified (bore wells/dug wells). Selection of samples considered as per the utilization of the people along the proposed project stretch. The details of the proposed groundwater sampling locations are given in the following Table.

Table : Groundwater Quality Sampling Locations

Location Code	Location	Latitude	Longitude
GW 01	Kallappuliyur	11.008803	79.405848
GW 02	Kanjanoor	11.046787	79.493334
GW 03	Kathiramangalam	11.071716	79.52901
GW 04	Ponnur	11.121825	79.606554
GW 05	Kaduvangudi	11.145005	79.639958
GW 06	Kanniyakudi	11.180981	79.678948
GW 07	Punganur	11.20665	79.702371
GW 08	Kovilpathu	11.235149	79.719584

Noise Environment

Keeping in view of the proposed highway project, field monitoring were carried out and ten (10) noise monitoring locations were identified. The locations were selected based on

land use pattern, traffic intersections and diversions along the existing alignment. Precision integrated sound level meter having statistical unit with digital display was used for 24 hour noise level monitoring in the present study. The noise quality monitoring was planned and executed as per protocol for ambient level noise monitoring. Noise levels are recorded as L_{eq} day and L_{eq} night. The details of the proposed Noise Level Monitoring locations are given in the following Table.

Table : Noise Level Monitoring Locations

Location Code	Location	Latitude	Longitude
N 01	Kallappuliyur starting point	11.010989	79.40792
N 02	Junction near Thirumandurai	11.039963	79.470792
N 03	Junction near Kanjanoor	11.047198	79.495116
N 04	Junction near Kathiramangalam	11.071357	79.528452
N 05	Junction near Thirumanancheri temple	11.106484	79.570757
N 06	Junction near Kadalangudi	11.147937	79.638075
N 07	Junction near Keelamarudandanallur	11.163853	79.660212
N 08	Junction near Kanniyakudi	11.181019	79.679318
N 09	Junction near Vaitheeswarankovil	11.194829	79.703138
N 10	Junction near Panamangalam ending point	11.225969	79.720337
N 10	Junction near Kovilpathu	11.236080	79.720547

Land Environment

The soil samples of different area along the project stretch were collected from four (04) locations near agricultural areas for assessing the physic-chemical characteristics of the soil in the project area. The quality parameters will include pH, electrical conductivity, sand, silt, clay, texture, moisture retention capacity, infiltration rate, bulk density, porosity, organic matter, Nitrogen, potassium, phosphorous, iron and organic carbon. Soil sampling locations are listed in the following Table.

Table: Soil Sampling Locations

Location Code	Location	Latitude	Longitude
S 01	Kallappuliyur	11.011667	79.407906
S 02	Kathiramangalam	11.075088	79.526817

S 03	Kaduvangudi	11.144825	79.63362
S 04	Kovilpathu	11.228727	79.721642

(ii) Biological Environment

Flora and Fauna: Information on vegetation within the study areas will be collected from secondary source as well as through site investigation. The vegetation study includes forest area & road side plantation within the proposed RoW. List of flora and fauna within 10 km on either side of project road will also be collected.

Ecological Sensitive Locations: Details of ecological sensitive locations, such as Wildlife Sanctuary, National Parks, Bio-Reserve etc., will be collected & studied within 10 km on either side of project road.

Ecological Studies: Terrestrial and aquatic ecological studies will be conducted along & within the proposed RoW. Common trees, shrubs, other vegetation, common fauna, rare and endangered species are surveyed, identified and studied. The roadside trees within the proposed RoW will be surveyed for botanical & vernacular name of species, girth wise enumeration etc.,

(iii) Socio-Economic and Cultural Environment

Socio-economic Details: Study of demographic details including population, schedule caste, schedule tribe, literacy, occupation pattern in the settlements along the project road, economic and social conditions, life styles, etc., along the project road and study of infrastructure facilities in the settlements along the project road. The social study comprising socio-economic survey along the project road and reflect the number and details of Project Affected Persons (PAPs) along the project road. Following data will be collected:

- Details of the properties, houses, businesses etc.
- Activities likely to be effected by land acquisition and annual financial loses.
- Data covering the vulnerable groups or persons including women, children, elderly.
- People below the poverty line, indigenous people and people in notified settlements
- Data on diseases in the locality and existing health care facilities

- Data on demography including traditional skills and sources of livelihood along the proposed site.

Places of Tourist, Historic, Archaeological and Religious Interests: Places of tourist interest, historical, archaeological and places of religious interests (if any) will be identified along the project road in the immediate vicinity and also within study area (15 km on either side of the project road).

Common Resources: An inventory of common community resources such as educational institutions, health centres, recreation centres, courts, libraries, community centres, public toilets, religious and cultural features etc., situated along the project corridor are prepared.

4.4 Analysis of Alternatives to the Project Road

In-depth study of related maps, topographic sheets, physical inspection and environmental and social screening will be carried out in order to find out the technically and environmentally sound, most feasible and environmental friendly alignment. Alternatives are considered for the analysis of "without" and "with" project situations and components. The selected alternatives will be compared in terms of their potential social & environmental impacts, capital & recurrent costs, suitability under local conditions, institutional training and monitoring requirements. For each alternative, environmental costs and benefits will be quantified and criteria for the selection of alternative will be stated. Analysis of alternative includes alignment selection, finalization of bypasses, road widening to reduce the cutting of tree, minimizing the demolition of structures, grade separators, services roads, vehicular, pedestrian and cattle underpass, quarry materials, road safety, etc.

4.5 Anticipated Environmental Impacts and Mitigation Measures

The environmental impact assessment will be conducted in accordance with the requirement of the Ministry of Environment & Forests (MoEF) norms and guidelines. The collected primary and secondary data are compiled and analyzed to establish a comprehensive database and assess the existing baseline environmental condition. After establishing the baseline status of the study corridor and analysis of the project proposals and activities, the potential impacts on environmental components would be identified for pre-construction, construction and operational stages of the project. On the

basis of the existing baseline environmental condition within the project area and the nature and extent of activities envisaged in construction/operation phase, **the impacts would be identified and assessed for "Without and With Project Scenario"** during construction and operation phases of the project**.** Wherever practicable, a quantitative analysis will be performed for the impacts by using appropriate modeling method. All potential direct and indirect influence due tothe proposed project will also addressed. The scope of work not confined only to alignment but the impacts due to the associated construction activities assessed. The following aspects are given due importance during assessment of impacts and recommending remedial measures:

- Alignment of the project road and topographical changes.
- Roadside drainage to avoid water logging, erosion & environmental degradation.
- Impact on soil along the project road.
- Impact of solid waste generated and solid waste management plan.
- Impact on borrow area and quarries.
- Impact on road safety.
- Impact on ambient air quality due to air pollution during construction activities and vehicle movement. Prediction of ambient air quality due to projected vehicular traffic would be carried out using computer based CALRoads View software (CAL3QHCR).
- Impact of noise level during construction activities and vehicle movement. Prediction of noise levels would be carried using Federal Highways Noise Administration (FHWA) model during operation phase.
- Assessment of impacts of road construction on ground and surface water sources in the study area.
- Impact of solid waste generated during construction phase of the project.
- Nature, quantity and disposal of construction spoils, wastes and waste water.
- Impacts of flora and fauna and ecological resources due to construction and operation of the project.
- Public health & sanitation, and occupational health & safety of construction workers.
- Impact on safety of local people during construction and operation phases.
- Population affected and socio-economic impacts.

4.6 Public Consultation and Information Disclosure

Public consultations will be conducted in the affected areas along the project road. The issues discussed during public consultation will be incorporated in the design framework, environmental management and mitigation plan.

4.7 Environmental Monitoring Programme

Environmental monitoring plan for construction and post construction phases of the project road will be formulated to ensure effectiveness of implemented environmental mitigation measures. Cost of Environmental Monitoring Plan for construction and post construction phase of the project will be given in EIA/EMP report.

4.8 Environment Management Plan

After detailed analysis of all the environmental impacts and issues, a proper and adequate Environmental Management Plan (EMP) will be prepared with the aim to avoid, mitigate or eliminate the adverse impacts due to the project. This will cover roles and responsibilities for mitigation operations, emergency response procedures & supervision, financing, monitoring and reporting. EMP also includes the prospects of environmental enhancement within the project area. EMP will envisage the plans for the proper implementation of mitigation measures to reduce the adverse environmental impacts due to project activities during construction and operation phase. The following issues are addressed in the EMP:

- Preventive, mitigation, compensatory & enhancement measures for minimization & abatement of the undesirable impacts caused during the construction and operation stage.
- Details of management plans (compensatory plantation, solid waste management plan, borrow area management plan, occupational safety and health plan) including their implementation schedule and supervision programme.
- Identified/recommended institutional set up for implementation of the EMP including institutional requirements, staffing and training.
- Environmental monitoring programme during construction and operation phase including performance indicators, monitoring mechanisms, implementation programme and cost.
- Resettlement action plan for affected families as per NHAI Policy and NRRP 2007.
- Environmental Management Budget considering the environmental aspects for the project.

4.9 Structure of EIA Report

EIA report is followed the structure as per EIA Notification, 2006 and consists of the following Chapters:

- Introduction

- Project Description
- Analysis of Alternatives (Technology and Site)
- Description of the Environment
- Anticipated Environmental Impact & Mitigation Measures
- Public Consultation
- Resettlement and Rehabilitation Plan
- Project Benefits
- Environmental Monitoring Program and Environmental Management Plan
- Summary & Conclusion