GOVERNMENT OF TAMIL NADU

UPDATION OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA), ENVIRONMENT MANAGEMENT PLAN(EMP), FOR CHENNAI PERIPHERAL RING ROAD SECTION V FROM SINGAPERUMAL KOIL AT NH 45 TO MAMALLAPURAM

FINAL DRAFT REPORT

NOVEMBER 2022

PROJECT PROPONENT

HIGHWAYS DEPARTMENT

TNRDC

Tamil Nadu Road Development Company Ltd.

ENVIRONMENTAL CONSULTANT

ABC Techno Labs India Private Limited

An ISO : 9001:2008, ISO:14001:2004 & OHSAS:18001:2007 Certified Company

(Accrediated by NABL, NABET, MoEF)

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LIST OF ABBREVIATIONS

CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
CPCB	Central Pollution Control Board
CPRR	Chennai Peripheral Ring Road
CRZ	Coastal Regulation Zone
EC	Environmental Clearance
ECR	East Coastal Road
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GoI	Government of India
GoTN	Government of Tamil Nadu
GRC	Grievance Redressal Committee
IRC	Indian Road Congress
ITEL	IT Expressway Limited
JICA	Japan International Cooperation Agency
MOEF & CC	Ministry of Environment, Forest and Climate Change
NBWL	National Board for Wildlife
NH	National Highways
NHAI	National Highway Authority of India
OMR	Old Mamallapuram Road
ORR	Outer Ring Road
RF	Reserved forest
SEZ	Special Economic Zone
SEAC	State Expert Appraisal Committee
TNPCB	Tamil Nadu Pollution Control Board
TNRDC	Tamil Nadu Road Development Company
ToR	Terms of Reference
UN	United Nations

EXECUTIVE SUMMARY

Chennai is one of the fastest-growing metro cities in India. Over a decade Chennai has witnessed a significant increase in urban agglomeration. Due to the increase in the population, there is a growing demand for infrastructure facilities, which includes Water supply, Underground sewerage, Electricity, and Roads. The major arterial road network in Chennai Metropolitan Area consists of National Highways (NH 16, NH 716, NH 48 and NH 32) as major radial roads and Inner Ring Road (IRR), Chennai Bypass and Outer Ring Road (ORR) as ring roads. However, the available road network observed to be limited concerning the growing population and hence to cater to the traffic congestion, Tamil Nadu Highways Department has chosen to develop Chennai Peripheral Ring Road (CPRR). The CPRR has 5 segments as follows.

Section	CPRR Break-up	Length (km)
1	Northern Port Access Road– Ennore port to Thatchur on NH 16	25.31
2	Thatchur on NH 16 to Start of Thiruvallur Bypass	26.10
3	Start of Thiruvallur Bypass to Sriperumbudur on NH 48	30.10
4	Sriperumbudur on NH 48 to Singaperumal Koil on NH 32	23.80
5	Singaperumal Koil on NH 32 to Mahabalipuram	27.471
	Total	**132.781**

Section 1 has been proposed to be developed under the Japan International Cooperation Agency (JICA) financial assistance. Sections 2 and 3 are proposed to be developed under financial assistance from the Asian Infrastructure Investment Bank (AIIB). Section 4 has been implemented under the state fund and Section 5 is proposed to be developed in the later stage. The JICA financing will focus on the implementation of Section 5 (hereby referred as Project in this report). As per the JICA guidelines, this project has been undertaken Environmental Impact Assessment Study, it mandates a full assessment of environmental and social impacts, and the preparation of the Environmental Impact Assessment (EIA) including Environmental Management Plan (EMP).

The key national and state rules and regulations applicable for this project is as follows

- Environmental Impact Assessment Notification and Amendments
- Coastal Regulation Zone Notification and Amendments
- Notification on use of fly ash (subsequent amendments)
- Forest (Conservation) Act
- Wildlife (Protection) Act
- Biological Diversity Act
- Water (Prevention and Control of Pollution) Act (and subsequent amendments)
- Air (Prevention and Control of Pollution) Act (and subsequent amendments)
- Noise Pollution (Regulation and Control) rules

- Hazardous Waste (Management& Transboundary Movement) Rules and subsequent amendments
- The municipal solid waste management rules and subsequent amendments
- Environmental Clearance (EC) under EIA notification (and subsequent amendments) for new Quarry areas
- Central Motor Vehicle Act Central Motor Vehicle Rules
- The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act
- The Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Act, 2013 (Act 30 of 2013) (LARR)
- The Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007
- Tamil Nadu Highways Act, (TNHA)

This project mandates Environmental Clearance (EC) as per the EIA notification 2006 (under category B1 and project schedule 7(F) for state highways and accordingly the Form –1 and Form 1A have been submitted to the State Environment Impact Assessment Authority (SEIAA) and the EC for the same has been obtained in Aug 2018. Other clearance required for the project includes (i) Permission from WRD for construction of roads over the water bodies, (ii) Forest clearance from the Forest Department for the Forest Land Acquisition of 0.28 ha. (iii) Coastal regulation zone (CRZ) clearance from Tamil Nadu State Coastal Zone Management Authority, (iv) Permission for felling of avenue trees from District Revenue Officer for the trees located outside the forest area and from the Forest department for the trees located within the Reserved Forest area. Other project-related clearances to be obtained by the Contractor are detailed in the EIA report.

The project area has flat terrain without much elevation and it slopes towards the eastern direction. The project area has a typical tropical climate, were the temperature raises during the summer (max 42°C) season and in winter the temperature is between 18°C to 20°C. Northeast Monsoon dominates the rain pattern in the project area, annual rainfall ranges between 950 mm to 1,214 mm. The project area falls under the Zone III (Moderate Damage Risk Zone) for seismic activity and hence no major risks are anticipated to the proposed road formation as well as the ancillary facilities (including the bridge, CD's, Embankment, etc.,). Section 5 is dominated by the presence of the red soil.

The land use pattern in Section 5 is predominately agriculture due to the proposed Greenfield road, followed by water bodies and settlements. The Ambient Air Quality (AAQ) and the Ambient Noise levels in the project area were monitored and compared with the AAQ standards, from the comparison, it is evident that none of the monitored parameters are exceeding the stipulated standard limits prescribed by the CPCB. Similarly, water samples (surface water and groundwater) have been collected and analysed for its Physico-chemical properties and from the outcome of the analysis, the water quality in the project area is observed to be good and suitable for the potable purpose. The presence of flora and fauna in the project area is very much limited.

As per the road inventory survey, 27 species of trees have been identified in the project area, among them, Tamarind trees (*Tamarindus indica*), Coconut trees (*Cocos nucifera*), Arasa Maram (*F. Religiosu*), Veppa Maram (*Azadirachta indica*) are observed to be dominating species. Among the faunal Species, Indian grey mongoose (*Herpestes edwardsi*), Rat snake (*Ptyas mucosa*), Russels Viper (*Daboia russelii*) are commonly observed in the Mannur RF areas and surrounding agriculture areas. The common avifauna includes Crows (*Corvus splendens*), Pigeon (*Columba livia*), Cattle egret (*Bulbulcus ibis*), and the mammals includes Rabbit (*Orytolagus cuniculus*), Bat (*Pteropus madius*) and Indian palm squirrel (*Funambulus palmarum*). The observed floral and faunal species in the project area is not coming under critically endangered/ endangered/ vulnerable category as per the IUCN red list.

As part of the project preparation work, public consultation (in 2014) was conducted at 2 locations (Singaperumalkoil and Mamallapuram), the project interventions were detailed to the public/ local communities and the feedback /views from them have been obtained. Accordingly, suitable mitigation measures including realignment options, for obtaining Environmental Clearances for the project, one more Public Consultation has been organised in 2018 at two locations (Chengalpattu, Chengalpattu District and Thamaraipakkam, Thiruvallur District), representing the whole CPRR corridor. The suggestions and feedback shared by the public/ community were applicable to entire CPRR.

Two-tier Grievance Redress Committee (GRC) has been proposed for this project, the affected person shall submit the grievances to the Retired District Revenue Officer (DRO). For environmental related issues, it shall be shared with the Environmental Cell for obtaining suitable measures/ guidance in sorting out the same. The received grievance shall be redressed in 3 weeks and a written communication shall be sent to the complainant. If the complainant is still not satisfied with the outcome from the first level, he/she can approach the Project Director, CPRR (second level), on acceptance of the grievance it shall be redressed in 3 weeks and a written communication shall be sent to the complainant. If again, the complainant is still not satisfied with the outcome from the second level, he/she can approach the court of law.

Some of the significant environmental impacts of the proposed CPRR on the natural environment and nearby communities are discussed in the following section. These impacts could be largely mitigated through engineering design, good construction practices accompanied by site-specific mitigation measures.

Significant environmental impacts are anticipated in Section 5, due to the removal/cutting of avenue trees and impact to the water bodies. However, it has been minimised to the extent by proposing the green field alignment. There would be loss of habitat due to tree felling, and an increase in daytime temperature near the newly paved surfaces of the road due to an increase in the surface area of the blacktop of the widened road. This impact shall be mitigated by planting rows of avenue plantations.

Air quality along the CPRR alignment of Sections 5 in the settlement locations, and at construction establishments such as batching plants, hot mix plants, crushers, etc. will be adversely impacted temporarily during construction activities. Asphalt plants, crushers, and batching plants shall be sited at least 1 km in the downwind direction from the nearest human settlement. Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads. Water

will be sprayed on earthworks, temporary haulage, and detour roads regularly. The hot mix plants will be fitted with dust extraction units and cyclones/scrubbers to reduce exhaust gases. The assessed air quality impacts persist till the completion of the construction activities, during the operation stage, as per the air quality modelling and given traffic projection, the air quality in the project area shall improve due to the widening of the corridors as well as with less or no traffic congestion.

The noise impacts due to the project will be of significance in both construction and operation stages. The settlements/ communities abutting CPRR alignment and construction establishments will be adversely affected by an increase in noise level due to operating equipment and construction activities. All mitigation measures such as the use of enclosures, walls, installation of mufflers around noisy equipment; substituting quieter equipment or construction methods; timing of noisier construction and demolition activities; providing Personnel Protective Equipment (PPE) to the workers; locating construction establishments away from sensitive receptors, etc. have been proposed. Similar to the air quality, the assessed noise level impacts persist till the completion of the construction activities, during the operation stage due to the widening of the corridors and with no traffic congestion, the ambient noise level shall be reduced along the Section 5.

The project corridor will have a direct impact on the existing flora (Avenue trees). As a mitigation measure, compensatory afforestation shall be done in a ratio of 1:10, hence it is proposed to plant more than 30,000 trees along the project corridor. As suggested by the SEIAA, based on the tree girth size (<30cm) nearly 414 trees are proposed for transplantation, which shall be carried out in assistance from the forest department.

The generated construction waste (such as removed concrete, wood, trees and plants, packaging materials, empty containers, and other similar items) and hazardous wastes (including oils, lubricants etc.), will be managed through reuse, recycling, and disposal at designated/approved disposal areas. With the help of Chengalpattu and Mamallapuram Urban Local Bodies (ULB's), the construction and solid waste shall be managed.

Occupational health and safety impacts can arise from construction and maintenance works. Exposure to the work-related chemical, physical, biological and social hazard is typically intermittent and of short duration, but is likely to reoccur. Potential impacts are negative and long-term but reversible by mitigation measures. Overall, the contractor should comply with IFC EHS General Guidelines in terms of Occupational Health and Safety risks.

Manpower will be required during the 30 months construction phase. This can help generate contractual employment and an increase in local revenue. The Contractor shall employ the local labor force to the maximum extent (within the 2-km immediate area if manpower is available).

EMP deals with the implementation procedure of the guidelines and mitigation measures are recommended to avoid, minimize and mitigate environmental impacts anticipated during project implementation at various stages namely Pre-construction, Construction and Operation & Maintenance. The implementation of the EMP needs suitable organization set up and the success of any EMP depends on the efficiency of the group responsible for the implementation of the program. For this project, the approach/ standards adopted by the Tamil Nadu Highway Department (TNHD) in implementing the

project, the GoI, JICA, IFC guidelines whichever stringent shall be followed. The EMP given in the bid document will be implemented by the Contractor (Environmental and Safety Engineer) during construction. He/she will make sure that all the project related permissions/consents including the No Objection Certificate (NOC)/ Permissions from the competent authority will be obtained before contractors' mobilization. He/she will be responsible for conducting the environmental monitoring (as per the environmental monitoring plan) and the preparation and submission of the monthly monitoring report to the Supervision Consultant and the PIU who would be responsible for the implementation of the EMP, needs to be trained on environmental issues of specific road development projects. Suitable training programs have been worked out for the project as well as capacity building needs, which shall be conducted by the Supervision Consultant. The program consists of several training modules specific to target groups. Looking into the potential requirements of each of the target groups, several training modules have been planned. The training would cover the basic principles of environmental assessment and mitigation plans; implementation techniques; monitoring and management methods and reporting tools.

The environmental management budget has been worked out for the effective implementation of the EMP for a sum of INR 15848700/-, which covers various environmental mitigation measures, monitoring of environmental attributes during all the phases of the project.

Overall, the major environmental impacts associated with the project are limited to the construction phase and can be mitigated to an acceptable level by implementation of EMP and by best engineering practices. Project benefits far outweigh negative impacts.

1 Introduction

The transport system of a country plays an integral role in its growth for a multitude of reasons. Due to the quick and easy movement of raw materials, machinery, finished goods, etc., it benefits industries. A good transport system can broaden the market for goods. It can also make the movement of raw materials, fuel, equipment, etc. to the places of production easy. Further, it opens up remote regions as well as resources for production. Also, as transport facilities increase, the demand for motor vehicles, locomotives, ships, etc. increases too. This leads to the start of industries which specialize in these goods.

1.1 Roads and Transportation System in India

In India, roads are classified into four types:

National Highways – The National Highways cover a total road length of 66.8 thousand kilometers. This is a mere 1.5% of the total length of the road system in India. However, these highways take the burden of nearly 40% of the goods and passenger traffic. The National Highway system is our primary road grid. Further, it is the direct responsibility of the Central Government.

State Highways – The State Highways cover a total road length of 154.5 thousand kilometers. This is around 3.8% of the total length of the roads in India. The individual States are responsible for the construction and maintenance of State Highways.

District and Rural Roads – There are many roads that have been constructed under the Minimum Needs program (MNP), Rural Landless Employment Guarantee Program (RLEGP), National Rural Employment Program (NREP), and Command Area Development (CAD). The core idea is to link all the villages in the country.

Express Highway - Express highway are the highest class of road. They usually have 6 to 8 lanes. Currently, approximately 1,583.4 km of expressways are operational in India. The National Highways Development Project by Government of India aims to expand it by adding an additional 18,637 km by 2022.

1.2 Project Background

Tamil Nadu is a state in southern India. It is the tenth largest Indian state by area and the sixth largest by population. Its capital and largest city is Chennai. Tamil Nadu is the home of the Tamil people, whose Tamil language—one of the longest surviving classical languages in the world—is widely spoken in the state and serves as its official language.

The state lies in the southernmost part of the Indian peninsula, and is bordered by the Indian union territory of Puducherry and the states of Kerala, Karnataka, and Andhra Pradesh, as well as an international maritime border with Sri Lanka. It is bounded by the Western Ghats in the west, the Eastern Ghats in the north, the Bay of Bengal in the east, the Gulf of Mannar and Palk Strait to the south-east, and the Indian Ocean in the south.

The economy of Tamil Nadu is the second-largest in India, with a gross state domestic product (GSDP) of ₹24.85 lakh crore (USD 310 billion) and has the country's 11th-highest GSDP per capita of ₹225,106

(USD 2,800). It ranks 11th among all Indian states in human development index. Tamil Nadu is the most urbanised state in India, and one of the most industrialised states; the manufacturing sector accounts for more than one-third of the state's GDP. Its tourism industry is the largest among the Indian states.

1.3 Location of the Project

Chennai, formerly known as Madras (the official name until 1996), is the capital city of the Indian state of Tamil Nadu. The state's largest city in area and population as well, Chennai is located on the Coromandel Coast of the Bay of Bengal, and is the most prominent cultural, economic and educational centre of South India. According to the 2011 Indian census, Chennai is the sixth-most populous city in the country and forms the fourth-most populous urban agglomeration. The Greater Chennai Corporation is the civic body responsible for the city; it is the oldest city corporation of India, established in 1688—the second oldest in the world after London. The city of Chennai is coterminous with Chennai District, which together with the adjoining suburbs constitutes the Chennai Metropolitan Area, the 36th-largest urban area in the world by population and one of the largest metropolitan economies of India.

1.4 Existing Road Network in Chennai

As of 2019, the city corporation maintains about 471 bus route roads and 33,0000 interior roads. The Chennai–Mumbai and Chennai–Kolkata prongs of the Golden Quadrilateral system of National Highways start from the city. In addition, four major National Highways (NH), namely, NH 4 to Mumbai (via Bangalore and Pune), NH 5 to Kolkata (linked via NH 6) (via Visakhapatnam and Bhubaneswar), NH 45 to Theni (via Villupuram, Tiruchirapalli and Dindigul) and NH 205 to Madanapalle (via Tirupati) originate in the city, connecting it to other Indian cities. Chennai is connected to other parts of the state and the Union Territory of Puducherry by state highways.

The government has constructed grade separators and flyovers at major intersections, and built Inner Ring Road and Outer Ring Road. The Gemini flyover, built in 1973, crosses over the arterial road, and eases the traffic movements towards Anna Salai and towards the Kathipara Flyover. As of 2011, according to the Transport Department, there were 25.8 lakh two–wheelers and 5.6 lakh four–wheelers in the city, and the Metropolitan Transport Corporation (MTC) bus fleet were 3,421, equaling 0.1% of all vehicles in the city.

The other means of road transport in the city include vans, regionally known as Maxi Cabs, auto rickshaws, on-call metered taxis and tourist taxis. Chennai outer ring road is 62.3 km long connecting NH 45 (GST Road) at Perungalathur, NH 4 (GWT Road) at Nazarathpet, NH 205 (CTH Road) at Nemilicherry (Thiruninravur), NH 5 (GNT Road) at Nallur and TPP road at Minjur under the process by Chennai Metropolitan Area.

City has got three circumferential roads viz., Inner Ring Road, Chennai Bypass and Outer Ring Road which connects the radial roads. As the city is developing beyond the limits of these circumferential roads, a new circumferential road is required.

Chennai Airport is the third busiest airport in India. The city is served by two major ports,

1. Chennai Port is the largest in Bay of Bengal and India's second busiest container hub, handling automobiles, motorcycles and general industrial cargo and

2. Ennore Port currently handles cargo such as coal, iron ore, other bulk and rock mineral products and future expansion plans are on the anvil. Chennai city has got one more private seaport at Kattupalli near the northern town of Ennore. Road connectivity to the Ennore and Kattupalli Ports needs to be provided from the radial roads without congesting the city roads.

In the face of rapid developments in the districts surrounding Chennai and the expansion of the city, a new regional planning model on the lines of National Capital Region is being examined by the Chennai Metropolitan Development Authority (CMDA) and a detailed report was prepared for the Government's consideration. For balanced regional development, better infrastructure facilities like developing a larger road network, implementing an integrated transport plan, etc. will be planned besides decongesting the city.

Government of Tamil Nadu is in the process of identifying and implementing projects to bridge the huge gap in the demand and supply of infrastructure projects. One of the major projects included in VISION 2023 is Chennai Peripheral Road.

Chennai Peripheral Road is conceptualized to provide better connectivity around the city catering future traffic requirements and provide efficient commercial transportation by enhancing port connectivity. This road will facilitate container movement from southern districts to Ennore Port.

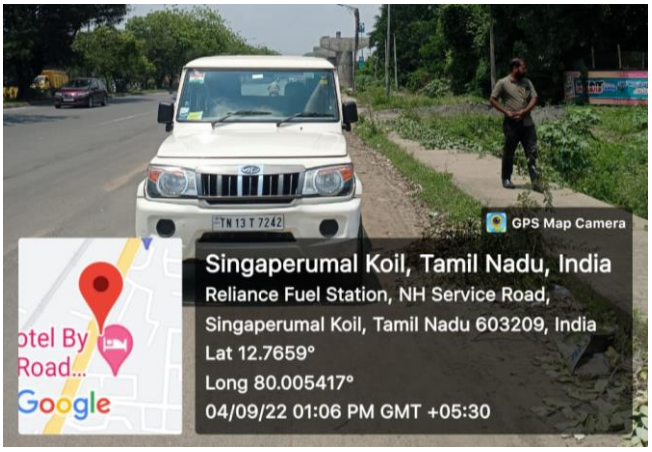


Figure 1-1 Starting Point of the Section 5 of CPRR

The total CPRR project length is 132.871 km which is divided into 5 sections as follows:

1. **SECTION 1** starts at Ennore Port and ends at Thatchur on NH-5, for a length of 24.60 km including TPP link road.
2. **SECTION 2** starts at Thatchur on NH-5 and ends at start of Thiruvallur Bypass, for a length of 26.40 km.
3. **SECTION 3** starts at Thiruvallur Bypass and ends at Sriperumbudur on NH-4, for a length of 30.60 km.
4. **SECTION 4** stretch of SH- 57 from NH-4 in Sriperumbudur to NH-45 in Singaperumalkoil, for a length of 23.80 km, which is widened to 6-lane with service road by Tamil Nadu Road Infrastructure Development Company Ltd. (TNRIDC).
5. **SECTION 5 starts at km 47/400 of NH-45 in Singaperumalkoil, where the Interchange-cum-ROB is under construction and ends at Poonjeri Junction in Mamallapuram, for a length of 27.471 km.**

1.5 Objectives

The main objectives of the consultancy services as per ToR is to establish the technical, economic and financial viability and prepare detailed Environmental Impact assessment reports for the proposed stretch Section 5 of CPRR.

State Government of Tamil Nadu has already selected a tentative alignment for the entire proposed peripheral ring road. Study this selected alignment along with other alternate alignments on the basis of technical and financial viability at first stage, carryout detailed design to fix the basic parameters of the project highway and facilities at second stage. Subsequently, as part of third stage, render financial consultancy services for proper structuring including prioritization of sections along the selected alignment and implementation of the project using various funding patterns.

The project highway Section 5 shall be designed as a partially/fully access controlled facility. The fixation of alignment shall be established taking into account the rough cost estimate with regard to quantum of work (pertaining to rehabilitation/up-gradation/ improvement of highway, requirement of service roads, grade separators, vehicle underpasses, people under passes, animal underpasses, cattle underpasses, rehabilitation/construction of bridges, road safety features, etc.) vis-à-vis the expected financial return through toll and other revenues.

Section 5 of Peripheral Road for the Chennai City has to be planned in a manner to:-

- Enhanced safety of the traffic and the road users.
- Enhanced operational efficiency.
- Fulfilment of the access needs.
- Minimal adverse impact on the road users, the local population and livestock due to construction.
- Ensure that the drainage pattern of the area should not be disturbed, natural environment, human habitation and heritage sites have to be fully protected.

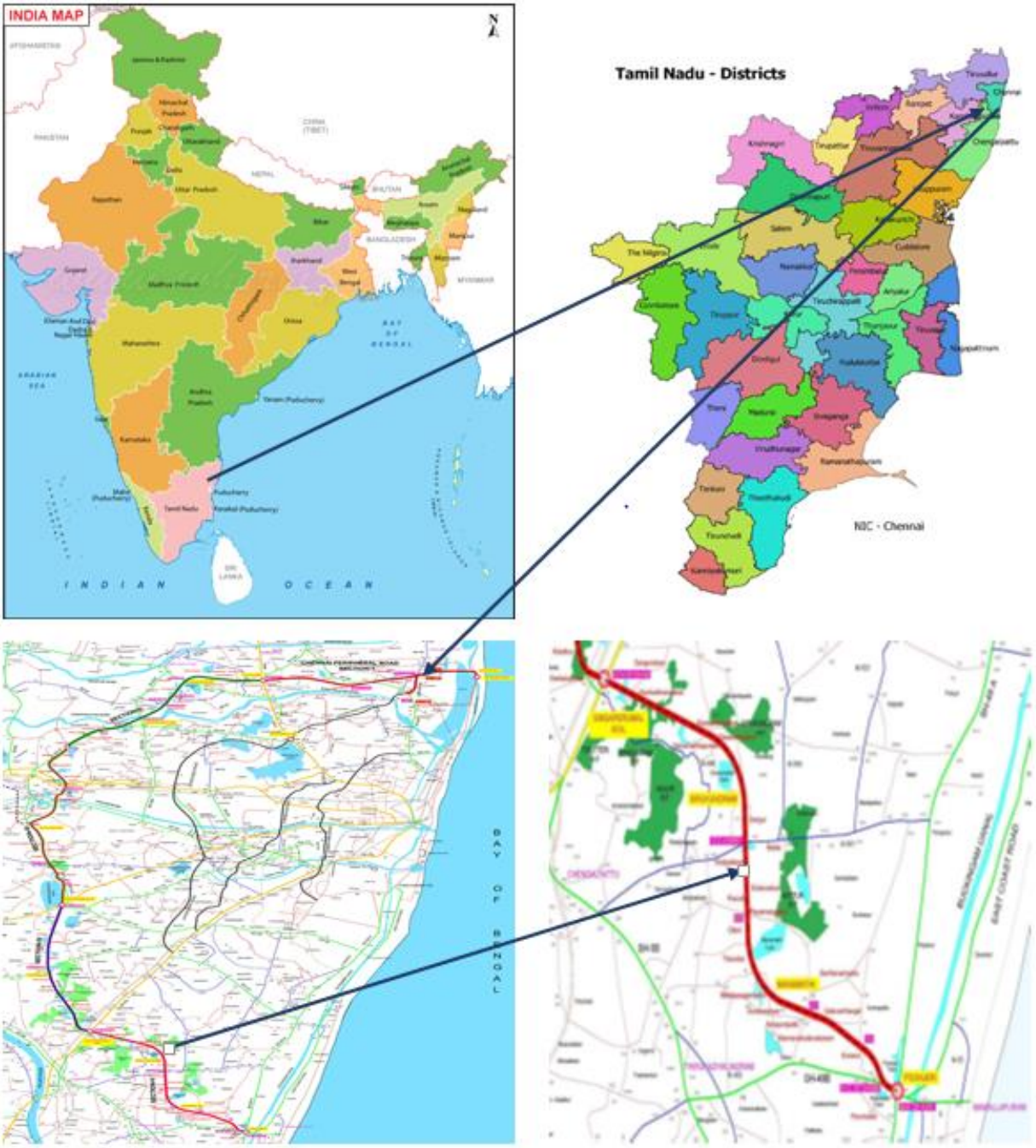


Figure 1-2 Project Location

1.6 Scope of Services

The scope of work of the consultants as per ToR includes but is not limited to the following:

1 **Terms of Reference** for updating of Environmental Impact Assessment (EIA) and Environment Management Plan (EMP)

2 **Project alternatives**: The alternatives are examined to identify ways of improving project

selection, siting, planning, design and implementation in order to apply the mitigation hierarchy for adverse environmental and social impacts and seek opportunities to enhance the positive impacts of the Project.

3 **Derivative, Secondary, and Cumulative impacts**: In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects are also examined and assessed, so far as it is rational. The impacts through a project life cycle are also considered.

4 **Scheme for environment attributes**: The baseline studies have been carried out during May, 2022 to July, 2022.

5 **Micro Meteorology**: One weather station has been installed at / near to the project road to measure wind speed, direction, temperature, rainfall, humidity and cloud cover at an interval of hourly basis. Other details like inversion height, stability class shall be taken from nearby IMD stations.

6 **Ambient Air Monitoring:** it was monitored at minimum 6 locations for the parameters like PM10, PM2.5, SO2, NOx comparing with national ambient air quality standards values and values stipulated in Environment Health and Safety (EHS) guidelines and other relevant international guidelines. Ambient Air Quality monitoring was carried out twice a week for 24 hours for one complete season except monsoon as per the National Ambient Air Quality Standards for the above parameters. Locations have been selected keeping in view the topography of the area and also the upwind, downwind, crosswind directions along with the sensitive areas to cover various distances from the core zone. Dust fall been also measured in both core as well as buffer zone.

7 **Surface Water Monitoring:** 4 locations have been selected for surface water sampling. These samples are analyzed for physicochemical parameters including heavy metals comparing with national standards values and values stipulated in EHS guidelines and other relevant international guidelines.

8 **Ground Water Monitoring**: 4 locations have been selected for ground water sampling. These samples were analyzed for physicochemical parameters including heavy metals comparing with national standards values and values stipulated in EHS guidelines and other relevant international guidelines. Location has been selected keeping in view the topography of the area and also the upstream and downstream directions along with the sensitive areas to cover various distances from the core zone

9 **Soil Analysis**: 6 locations have been selected for soil sampling. These samples are analyzed for physical and chemical parameters comparing with national standards values and values stipulated in EHS guidelines and other relevant international guidelines.

10 **Noise:** 6 locations have been selected for noise sampling within the plant premises and in the buffer zone comparing with national standards values and values stipulated in EHS guidelines and other relevant international guidelines. These locations at sensitive receptors such as residential area, hospitals and schools have been selected based on the high noise areas.

11 **Ecology:** Terrestrial (forests, hills) and aquatic (rivers, streams, wetlands) ecology have been studied in the buffer zone and available secondary data including the list of endangered species (IUCN red list categories) has also been studied

12 **Socio Economic Survey**: The survey has been carried out in the core and buffer zone area and available secondary data is also be utilized.

13 **The impacts of the air pollution** are dealt in the updated EIA report by conducting micro meteorology study and base line concentration of the concerned pollutants like PM10, PM2.5, SO2, NOx, CO. Necessary dispersion modeling exercise has also been carried out know the impact on the air environment due to the operation of the proposed project.

14 Since the proposed project shall be based on "Zero Discharge" of effluents, the impact on the ground and surface water is negligible. However, to know the long-term impacts, necessary qualitative analysis has been done on the present ground and surface water sources.

15 **The solid / hazardous wastes generation** from the proposed project have minimal impact on the environment. However, proper Environmental Management Plan for its Collection, Handling, Storage and Disposal shall be provided. Standard Operating Procedure for handling of solid / hazardous waste and statutory requirement of generation, storage, handling and transportation shall be adopted.

16 **Noise study** has been carried out in the core / buffer zone. Necessary control measures shall be explored as a part of the Environmental Management Plan.

17 **Quantifiable impacts** are assessed on the basis of magnitude, prevalence, frequency and duration along with non-quantifiable impacts

18 **Impacts are predicted** by using appropriate methods including mathematical modeling for air and noise pollution.

19 **Impact to ecosystem** is assessed based on the qualitative evaluation on both terrestrial and aquatic ecosystems. In addition to the qualitative evaluation of surveyed ecosystems, "Qualitative" impact assessment on lost trees were conducted.

20 **The statutory requirements** for the projects has been updated. Environmental Clearance has been obtained from the SEAC for the CPRR (including all sections) on 10th August 2018. CRZ clearance is also obtained. However, additional clearance required like ASI clearance, Forest clearance etc. shall be assessed and reported in the updated EIA.

21 **Environmental Management Plan** for mitigation of the environmental impacts have been prepared depending on the impact predictions. The Environmental Management Plan shall involve detailed description of the pollution control measures related to the proposed project, efficiency, conformance to the permissible limits, reliability and efficacy of the Environmental Management Plan. The total expenditure on the environment protection measures is declared and documented. The

Environmental Management Plan shall also include the recurring expenditure for the operation and maintenance of the pollution control measures. The EMP shall cover the Covid protocol and Covid related social requirements. The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP is clearly spelt out.

22 **Post project monitoring** schemes shall include select environmental attributes for construction, commissioning and operation measures. Monitoring Plan shall include the type of pollutant to be monitored, frequency of sampling and analysis, sampling and analytical methodologies. The environment monitoring scheme is proposed.

23 **Risk Assessment and Disaster Management Plan** is finalized and documented as a part of the Environmental Impact Assessment Report.

1.7 Scope of Environmental Impact Assessment

The study envisages the preparation of a detailed Environmental Impact Assessment (EIA) for the proposed road project. The scope of environmental assessment includes processes such as

(1) Environmental screening and scoping,

(2) Environmental impact assessment and

(3) Environmental management plans (EMP) for construction and operation phases of the road project

The EA study also aims to develop a comprehensive environmental management framework for the road project.

1.7.1 Environmental Screening

(1) Screening under Indian Legal Framework

Environmental Notification 2006, with its amendment in 2009, 2011, and 2013, stipulates the conduction of EIA, Environmental Clearance (EC), and their procedures according to the type, size, and location of the proposed project. The proposed project can start only after the EC is granted.

For a State Highway (SH) project, acquiring an EC is stipulated as shown in Table 1-1. The proposed project includes new construction highway intervals; therefore, the Project is categorized B in 7(f) (i) wherein an EC is required.

HMPD (Chengalpattu Divisional Engineer (H)) has applied for EIA TOR for the CPRR Project on 26 October 2017. The Tamil Nadu State Environmental Impact Assessment Authority (TNSEIAA) issued the EIA TOR on 5 March 2018 to HMPD. HMPD submitted the draft EIA report to Tamil Nadu State Pollution Control Board (TNSPCB) on 11 April 2018. TNSPCB called for public comments, then, conducted public consultation meetings in Kancheepuram District on 10 July 2018 and in Thiruvallur District on 12 July 2018. The collected comments/opinions and records of the meeting were reflected on the final EIA report, and the report was submitted to TNSEIAA on 20 July 2018.

Table 1-1 Highway Project that Requires an EIA Report and Its Approval

Project or Activity		Category with Threshold Limit	
(1)	(2)	(3) Category A: Reviewed by Central Government	(4) Category B: Reviewed by State Government
7(f)	Highways	(i) New National Highways; and (ii) Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40 m on existing alignments and 60 m on re-alignments or by-passes.	(i) All New State Highway Projects; and (ii) State Highway expansion projects in hilly terrain (above 1,000 m AMSL) and or ecologically sensitive areas. (2011) Provided that the following shall not require Scoping. - (i) *Omitted.* (ii) all Highway expansion projects covered under entry (ii) of column (3) and column (4) under sub-item (f) of item 7 of the Schedule: Provided further that--- A. *Omitted.* B. The projects referred to in clause (ii) shall prepare EIA and EMP ·report on the basis of' model TOR specified by Ministry of Environment and Forests; (2013)

Source: Notification under Sub-rule (3) of Rule 5 of the Environment (Protection) Rules, 1986 (Gazette of India, Extraordinary, Part-II, and Section 3, Sub-section (ii), New Delhi 14 September 2006 (2009, 2011, 2013 amendment), http://envfor.nic.in/legis/eia/so1533.pdf

(2) Screening under JICA Guidelines

The Project is categorized A according to the JICA Guidelines for Environmental and Social Considerations (2022) because the road sector is likely to have significant adverse impacts on the environment, and its components are likely to have significant adverse impacts on the society regarding large-scale involuntary resettlement as shown in Table 1-2.

Table 1-2 Categorization Criteria of the JICA Guidelines

Category	Categorization Criteria
Category A	• Proposed projects are classified as Category A if these 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. • These impacts may affect areas broader than the sites or facilities subject to physical construction. • Category A, in principle, includes projects in sensitive sectors, projects with characteristics that are likely to cause adverse impacts, and projects located in or near sensitive areas. (Illustrative list of sensitive sectors, characteristics, and areas is provided in Appendix 3 of the JICA guidelines.)

Source: JICA Guidelines for Environmental and Social Considerations (2022)

Main requirements for Category A Project under the JICA Guideline are shown in Table 1-3.

Table 1-3 Requirements for Category A Project under the JICA Guidelines

Requirements for Category A Project
• Project proponents must submit environmental assessment reports for Category A projects. • For projects that result in large-scale involuntary resettlement, a Resettlement Action Plan (RAP) also must be submitted. For projects that require the measures for indigenous people, an Indigenous Peoples Plan (IPP) must be submitted as well. • JICA encourages project proponents to consult with local stakeholders about their development needs, potential adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project. JICA assists project proponents as needed. • JICA undertakes the environmental reviews based on the environmental assessment reports and other documents submitted by project proponents. Environmental reviews for Category A projects examine the potential positive and negative environmental and social impacts of the projects. JICA examines the necessary measures to avoid, minimize, reduce, mitigate, or compensate for potential negative impacts, as well as measures to promote positive impacts, if any of such measures are available. JICA also reviews the results of information disclosure and local stakeholder consultations.

Source: JICA Guidelines for Environmental and Social Considerations (2022)

1.7.2 Scoping for Environmental Impact Assessment

Project components and typically expected environmental and social impacts are shown in Table 1-4.

Table 1-4 Project Components and Typically Expected Environmental and Social Impacts

Phase	Project Components and Activities		Typical Impacts from Project Components and Activities
Planning Phase	Demarcation of work area	• Notification of the Project and restriction of land use • Land acquisition • Staking and construction of border fence • Decision of trees to be felled • Lease contract of land parcel(s) for stockyard, site office, etc.	• Notification of stoppage and relocation of existing land use and trespassing (vendor shack, utilities (electric poles, underground utilities, utilities attached to the existing bridge structure), road and footpath, footpath to the river, etc.) • Notification of loss of private properties • Temporary stoppage of use of land parcel(s) selected for stockyard, etc..
Construction Phase	Preparation		
	Set up of stockyard	• Set up of concrete yard • Set up of asphalt plant • Storage of oils and chemicals • Machine repair, re-fueling	• Risk of oil and chemical spill (soil contamination) • Generation of water demand for the concrete plant • Storage of asphalt materials • Concrete and asphalt may be procured from the market
		• Storage of other materials and tools	• Risk of robbery (crime)
	Set up of office	• Existence of engineers and office staff	• Water demand • Generation of wastewater • Generation of sewer • Generation of wastes
	Set up of workers camp	• Existence of work crew	• Water demand • Generation of wastewater • Generation of sewer • Generation of wastes
	Set up of work area	• Existence of work crew	• Water demand • Generation of wastewater • Generation of sewer • Generation of wastes

Phase	Project Components and Activities		Typical Impacts from Project Components and Activities
	Removal works (existing road, bridge, etc.)	• Removal of existing structures and vegetation • Removal and relocation of groundwater pumps and irrigation canals in ROW	• Generation of construction waste • Generation of needs for alternate water sources
	Set up and removal of temporal structures (Detour road, etc.)	• Slow speed at the detour road • Removal of existing structures and vegetation	• Increased risk of local occurrence of traffic jam • Increased risk of occurrence of traffic accidents • Generation of construction waste
	Earthworks Bank/berm construction Excavation for bridge structure	• Alteration of land form (fill, excavation) • Alteration of land form near water storage lakes (tanks) • Procurement of fill material	• Erosion (generation of muddy water) (on-site, off-site) • Alteration of land form (at the quarry site) • Alteration of capacity of water storage lakes (tanks)
		• Generation of transportation vehicle (mainly to transport fill material)	• Generation of exhaust gas (off-site) • Generation of noise (off-site) • Generation of traffic jam (off-site) • Increased risk of accidents (off-site)
	Construction general	• Operation of construction machinery and vehicles • Use of generators	• Emission of exhaust • Emission of noise
		• Disposal of construction wastes	• Disposal of construction wastes
		• Generation of employment • Procurement of materials, etc.	• Direct and indirect positive impact to local economy
Maintenance Phase	Opening of new road sections Existence of upgraded road and bridges		• Improved traffic network in Greater CMA, that leads to less emission of exhaust gas and noise along the existing arterial road • Increased generation of exhaust gas • Increased generation of noise • Existence of major bridge in tidal area

Source: Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018

With the expected source of impacts listed in Table 1-4, and with the results of field surveys, information collections and review of HMPD DPR volumes, the expected impacts were summarized according to the JICA Guidelines format as shown in Table 1-5.

Table 1-5 Scoping of Potential Impacts

	Impacts	Planning/ Construction	Operation	Reasons for Evaluation
	Pollution Control			
1	Air Pollution	B-	B-/+	**Construction Phase:** Operation of construction equipment and vehicles may cause air pollution due to the emission of exhaust gas; and dusts may be generated in the construction, boring, and excavation sites. **Operation Phase:** Increased number of vehicles is expected; thus, increase of pollution load is also expected. At the same time, smoother traffic flow is expected by the Project resulting to decrease of the total pollution load as a whole in Chennai area.
2	Water Pollution	B-	B-	**Construction Phase:** Excavation works and casting bridge pier in the drainages and rivers along the proposed intervals may cause increase of turbidity. **Operation Phase:** Soil runoff from the embankment may cause water pollution in drainages and rivers.
3	Waste	B-	D	**Construction Phase**: Wastes such as excavated soil, pavement materials, steel-frame, used fuel canister, and others are expected to be generated.
4	Soil Contamination	B-	D	**Construction Phase**: Fuel, oil, and chemical leakage from construction sites as well as stockyard may cause soil contamination.
5	Noise and Vibration	B-	B-/+	**Construction Phase**: Operation of construction equipment and generator may generate noise and vibration. **Operation Phase:** Increase in the number of vehicles in the proposed alignment may cause increase of noise and vibration, while a more efficiently distributed traffic by the Project may alleviate noise condition in the whole area of Chennai.
6	Ground Subsidence	C-	C-	**Construction and Operation Phases**: By the geological survey for DPR, thin layers of soft soil were found at several points. No subsidence is expected at the bridge section when the piers are placed on bearing ground. The embankment section, however, may cause subsidence if it is located on soft soil. In the scoping phase, no specific data on locations and characteristics on such soil is available. The possibility and significance of impact are unknown.
7	Offensive Odor	D	D	No construction component which may cause offensive odour is expected.
8	Bottom Sediment	D	D	No construction component which may cause pollution of bottom sediment by heavy metals and dioxin is expected.

	Impacts	Planning/ Construction	Operation	Reasons for Evaluation
	Natural Environment			
9	Sanctuary	D	D	Section 5 is not located in or near the designated areas for nature conservation or protection of historical and cultural heritages. No negative impact is expected in those areas.
10	Ecosystem	B-	B-	**Construction Phase**: Although no protected areas and habitats are located in or near the ROW of Section 5, the Project requires felling of 46 trees with girth above 90 cm for Section 5, according to the existing DPR EIA. Soil runoff from embankment and work areas may cause negative impacts on the habitat near the ROW. **Operation Phase:** Environmental change such as change in land use, increase of traffic volume may affect the habitat and ecosystem of existing plants and animals. Soil runoff from embankment and work areas may cause negative impacts on the habitat near the ROW.
11	Hydrological Situation	B-	B-	**Construction Phase:** Relocation of drainage as well as removal of ground water pumping facilities are planned to be conducted, while no significant adverse impact for hydrological situation and water level is expected. **Construction and Operation Phases:** On the other hand, there are some ponds working as storage reservoir which are close to the proposed alignment which may be affected by the construction work as well as the road existence.
12	Topography and Geographical Features	B-	D	**Construction Phase:** For the embankment of the proposed alignment in Section 5, large-scale soil excavation is expected; thus, some change of topography is expected around the borrow pit. In addition, soil erosion may be caused from the embankment.
	Social and Economic Environment			
13	Involuntary Resettlement, Loss of Land and Asset, Business Relocation	A-	D	**Planning Phase:** Private lands used for farming, residence, and commercial purpose shall be acquired and shall cause relocation and resettlement. **Construction Phase:** Temporal lease of land shall be necessary for the site office, stockyard, and other facilities.
14	The Poor	B-	D	**Planning and Construction Phase:** In case the compensation and assistances are not provided justly, the relocated or affected poor may face difficulty in recovering the livelihood.

	Impacts	Planning/ Construction	Operation	Reasons for Evaluation
15	Ethnic Minorities, Indigenous Peoples	D	D	Tamil Nadu designates homelands of the ethnic minorities and indigenous peoples. Such homelands are not located in the CMA including the project area.
16	Local Economy, Employment and Living, Livelihood	B-	B+	**Construction Phase:** At the section where the existing State Highway is to be expanded, the road side businesses need to be relocated or set back. This impact may negatively affect the business owners and customers. **Operation Phase:** The residents and businesses near the road shall enjoy easier access to the employment and customers in CMA. The positive economic impact shall be generated in the whole metro area since the traffic network and transportation of goods shall be improved by the Project.
17	Land Use, Local Resource Use	D	D	Section 5 shall mainly change the agriculture land and vacant land to road and related facilities. In the long term, the roadside area shall be urbanized. Existing land use or local resource use, however, shall not be affected in drastic or negative manner.
18	Water Use, Water Rights	B-	B-	**Construction and Operation Phases:** There is possibility that public and private groundwater pump facilities for irrigation and drinking water are located on or near the ROW. Section 5 may cause negative impacts to water users by the loss of these facilities.
19	Existing Public Facilities, Road and Transportation Facilities, Social Infrastructure, Social Services	B-	B-/+	**Construction Phase:** Temporal road closure or traffic control may be necessary at the crossing points with the existing roads. **Construction and Operation Phases:** Public facilities to be affected by Section 5 include church and graveyards. In case adequate consultation, negotiation, compensation, and assistances are not conducted, those facilities may need to stop their services. **Operation Phase:** The project road shall connect the local area with other parts of the metropolitan area. Improved connectivity may lead to modernization and renovation of existing social infrastructures and services.
20	Social Capitals, Local Decision Making Systems, Social Organizations	D	D	Section 5 is to develop a State Highway at the periphery of CMA. There are no negative impacts expected on social capitals such as NGOs or decision-making systems of districts and villages.

	Impacts	Planning/ Construction	Operation	Reasons for Evaluation
21	Uneven Distribution of the Project Impact and Benefit	D	D	No uneven distribution of project impact and benefit is expected in the project area.
22	Local Conflicts of Interest	D	D	No local conflicts of interest among the communities in the project area.
23	Split of Community	B-	B-	**Construction and Operation Phases:** Expansion of existing roads in Section 5 may generate difficulty of crossing during or after the construction works, wherein difficulty may cause some separation of community.
24	Historical Heritage, Cultural Resources	D	D	No nationally, state-, or district-designated historical and cultural resources are located on the ROW or in nearby areas.
25	Landscape	D	D	Section 5 will develop a State Highway at the periphery of CMA. No specific landscape resources or tourism activities are recognized. The project does not cause any specific negative impacts on landscape.
26	Gender	D	D	Section 5 does not cause any specific negative impacts on gender-related issues.
27	Children's Rights	D	D	**Construction and Operation Phases:** No specific impact is expected.
28	Sanitation, Public Health, Transmittable Diseases including HIV/AIDS	B-	D	**Construction Phase:** Stagnant water at the work areas and stockyards may become a breeding spot for mosquitoes that spread diseases. The workers to be employed in the Project may include migrant workers. There is a possibility that the number of patients of sexually transmitted diseases, including HIV, will increase. **Operation Phase:** The project road is the outermost circular road in CMA. Completion of the project road does not generate wider, cross-border movement of population. No significant risk of spread of diseases is expected.
29	Work Environment, Occupational Safety and Health	B-	B-	**Construction Phase:** Occupational accidents may occur at the work areas. **Operation Phase:** Workers shall be deployed for daily works, such as maintenance and toll station, and for periodic repair works. Those workers may be susceptible to accidents.

	Impacts	Planning/ Construction	Operation	Reasons for Evaluation
30	Accidents, Crime	B-	B-/+	**Construction Phase:** For Section 5, accidents may increase at areas to expand the existing road, in addition to the cross sections with existing roads in the new construction areas. **Operation Phase:** Accidents shall be observed on the new road sections. On the other hand, however, reduction of traffic accidents is also expected by securing pedestrians safety by construction of footpaths and by reducing traffic jams.
31	Climate Change, Cross-border Impacts	B-	B-/+	**Construction Phase:** Greenhouse gas (CO_2) shall be generated from the operation of construction machineries and transportation vehicles. **Operation Phase:** Increase of traffic volume shall result in increased emission of greenhouse gases. At the same time, the improved traffic condition of the road network, including the project road, shall lead to reduction of emission of greenhouse gas.

Note: A+/-: Remarkable positive/serious negative impact is predicted.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown (Further study is necessary).
D: Impact is very small or nil, and further survey is not required.
Source: Modified for the Section 5 of CPRR based on the Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018

1.7.3 Environmental Impact Assessment

Environmental assessment for project roads includes establishing environmental baseline in the study area, conducting organized stakeholder consultation, identify the range of environmental impacts, specify the measures to avoid, minimize, and mitigate negative impacts and maximize positive impacts and integrate possible environmental enhancement measures. The proposed measures will be formulated in the form of an environmental management plan with necessary budget and institutional roles for effective implementation. Separate EMPs have to be prepared for individual project roads and integrated in to project implementation agreements, including construction contract documents.

1.7.4 Environmental Management Framework

An Environmental Management Framework will be designed for the implementation of the project. The environmental management framework shall consist of overall framework which will be developed as a guidance document providing environmental planning and design criteria for of the current as well as future project roads, generic environmental management measures, institutional mechanism for implementation, capacity building and training process, and resource material to function adequately to mainstream the environmental management.

1.8 Structure of the Environmental Impact Assessment Report

The EIA report is prepared in accordance with the stipulation of the Environmental Impact Assessment Notification 2006, JICA Guidelines 2022. This EIA report has been structured as follows: The introduction chapter highlights the scope of the report and its component of EIA/EMP.

Chapter 1 Introduction, Project details, scope of work, objectives of the work, EIA scope and process and structure of the EMP report.

Chapter 2 Project Description - description of the project, such as, the type of project, need for the project, project location, highway alignment, utilities, implementation schedule and the estimated cost of the project.

Chapter 3 Policy, Legal and Institutional Framework presents a review of the existing policies, legislations and institutional framework relevant to the project, at the National and the State levels.

Chapter 4 Environment Profile of the Project Area, involves collection of data on the existing status of the environment which helps in identification and assessment of impacts due to the proposed road and during various phases of project cycle.

Chapter 5 Implementation Mechanism, describes the Implementation of Environmental Management Plan identified for the construction, which will be included in the bid documents for ensuring implementation of the environmental safeguards.

Chapter 6 Environmental Impact Assessment, this chapter assesses the maximum possible impact of this project on environment during the pre-construction, construction and operation phase of the project.

Chapter 7 Environmental Mitigation Measures, describes about the environmental methods to control and mitigate the impact due to the activities of the project.

Chapter 8 Environmental Management Plan to mitigate the identified impacts an Environmental Management Plan and Environmental Management Cost has been prepared. The likely adverse impacts on various environmental components, viz., Land, Air, Water, Biodiversity and Social & Aesthetic have been assessed. Based on the identified impact's potential, the management practice to be followed for minimizing and mitigating the impacts on the surround environment, the activity wise Environment Management Plan is drawn.

Chapter 9 Conclusion and Recommendation states that being a Greenfield corridor, the presence of the receptors are almost negligible and hence during the project construction and operation significant impacts are not envisaged.

2 Project Description

2.1 Profile of the District

Chengalpattu District is situated on the North East Coast of Tamil Nadu and is adjacent to the Bay of Bengal. It is bounded in the West by Kancheepuram district and Thiruvannamalai District, in the North by Chennai district, in the South by Villuppuram district and in the east by Bay of the Bengal. The District headquarters is located at Chengalpattu town. The Chengalpattu district came into existence on 29 November 2019 when it was carved out of erstwhile Kanchipuram district. The district has a Total area of 2944.96 km^2, with net irrigated area of 77966 ha. The forest area under the district is 19610.095 ha.

2.1.1 Administrative Set-Up

For administrative reasons, the district has been divided into 3 Revenue divisions comprising of 8 taluks with 636 revenue villages. On the development side, it is divided into 8 development blocks with 359 Village Panchayats.

Revenue Divisions	3
Revenue Taluks	8
Blocks	8
Municipalities	8
Villages	636
Town Panchayat	12
Village Panchayat	359

2.1.2 Coastal Areas

The District has a total coastline length of 57 km. Thiruporur, thirukkazhukundram and Cheyyur Taluks are the coastal taluks. 33 revenue villages are coastal villages in the district. The coastal villages are densely populated and contribute to economic activities such as fishing, agriculture, and tourism.

2.1.3 Climate

Chengalpattu features a tropical wet and dry climate. Due to its proximity to the sea, the summer is not very hot and the winters are not very severe.

2.1.4 Temperature

The fact that the district is close to the thermal equator and is also coastal prevents extreme variations in the seasonal temperature. The month of January with 25°C average temperature is the coldest month of the year.

Season	Maximum Temperature	Minimum Temperature
Summer	36.6° C	21.1° C
Winter	28.7° C	19.8° C

2.1.5 Rainfall

Average annual rainfall of the district is about 1400 mm. The district gets most of its annual seasonal rainfall from the north-east monsoon winds during the months of October and November. The pre-monsoon rainfall is almost uniform throughout the District. The coastal taluks get more rains rather than the interior regions. This District is mainly depending on the seasonal rains. Distress conditions prevail in the event of failure of rains. Northeast and Southwest monsoon are the major contributors with each accordingly for 54% and 36% respectively of the actual rainfall.

Table 2-1 Rainfall Data of Chengalpattu District for the Past Year - 2021

Raingauge Stations	JAN	FEB	MAR	APR	MAY	JUN	JUL
Thiruporur	44.1	0	0	3.4	0	11.4	78.7
Chengalpattu	38	0	0	20	0	18	91
Thirukalukundram	69.5	0	0	19.3	0	37.2	356
Mahabalipuram	43.6	0	0	24.8	29.2	30.6	325.8
Maduranthagam	6	0	0	21	0	90	222
Cheyyur	19.4	0	0	24.2	7	93.9	411.4
Tambaram	47	0	0	20	1	9	210.5
Kelambakkam	88	0	0	45.2	0	21.8	223.4
Total	355.6	0	0	177.9	37.2	311.9	1919
Average	**44.45**	**0**	**0**	**22.24**	**4.65**	**38.99**	**239.9**

Raingauge Stations	AUG	SEP	OCT	NOV	DEC	TOTAL
Thiruporur	28	8	81.8	345.7	162.8	763.9
Chengalpattu	22	30.5	106.5	467	251.9	1045
Thirukalukundram	118.5	132.6	179.1	418.7	342.8	1674
Mahabalipuram	111.6	93	142.6	427.2	329.7	1558
Maduranthagam	71	89	139	476.5	298	1413
Cheyyur	90.2	46	170.4	391.5	247.1	1501
Tambaram	84	97.5	60.3	531.1	257.1	1318
Kelambakkam	31.6	67	144.2	485.4	196.6	1303
Total	556.9	563.6	1024	3543	2086	10575
Average	**69.61**	**70.45**	**128**	**442.9**	**260.8**	**1322**

2.1.6 Demography of district

Table 2-2 Demography of District

Division	Taluk	Population
Chengalpattu	Chengalpattu	210,306
	Thirukalukundram	238,244
	Thiruporur	156,427
Tambaram	Tambaram	464,297
	Pallavaram	582,783
	Vandalur(new)	321,003
Maduranthagam	Madurantagam	333,902
	Cheyyur	249,282
Total		**2,556,244**

2.1.7 Agriculture

Agriculture is the main occupation of majority of people in this district. Even though the district is very close to Chennai, agriculture is the inevitable occupation of the people living in this district. Rice is the major crop grown throughout all over the district. Madurantakam, Cheyyur and Thirukkazhukkundram Taluks are major producers of rice in this district. Sugarcane also grown in some parts of the district. Tamil Nadu Government has a cooperative sugar mills in Padalam Village of Madurantakam Taluk. Groundnuts also grown as major crop in areas where/when there is scarcity of water or shortage of rainfall. Cheyyur and Thirupporur Taluks are well known for money crops such as groundnuts, Urid dhal, Moong dhal, Karamani, Seasame, etc.

Vegetables such as brinjal, ladies finger also grown in Thirupporur, Thirukkazhukkundram and Madurantakam Regions. Watermelons are cultivated in Kodur, Cheyyur and its surrounding areas during summer. Beetel leaves were produced in Karunguzhi.

Figure 2-1 District Map

2.1.8 Industries

Chengalpattu district consists of a number of industries and it contributes an significant share to the economy. Siruseri SIPCOT IT Park which is the largest IT parks in Asia is situated in Thirupporur Taluk. Madras Export Processing Zone has large number of IT and BPO based companies in Tambaram. Maraimalai Nagar is Detroit of Chengalpattu district having various automobile manufacturing units such as Ford motors, Hyundai, Rane TRW etc. Mahindra World City has large number of companies in IT SEZ, Auto Ancillary SEZ, Apparel & Fashion SEZ and DTA. Madras Atomic power station is present in Kalpakkam.Marg Swarnabhoomi SEZ present in Kodur.Ultra Mega Power Projects (UMPP) is about to be setup in Cheyyur by government of India. Distilleries are present in Chengalpattu and Madurantakam areas.

2.1.9 Soil and agro climatic zone

Chengalpattu district comes under the North-Eastern agro climatic zone of the state. The soil present here is Red sandy loam, clay loam and saline coastal alluvium.

2.1.10 Transport

Chengalpattu District is well connected with all means of transport such as roadways, railways etc.

2.1.11 Roadways

This district has well developed roads interconnecting all major towns, villages to the district capital. Below are the major road systems present in this district. NH45 passing through Meenambakkam, Pallavaram, Chromepet, Tambaram, Perungalathur, Vandalur, Guduvancheri, Maraimalai Nagar, Chengalpattu, Karunguzhi, Madurantakam, Melmaruvathur, Acharapakkam and Thozhuppedu connecting Chennai and southern parts of Tamil Nadu.

- Outer ring road starting from Vandalur connecting Mannivakkam, Thirumudivakkam to places in Thiruvallur districts such as Poonamalle, Thirunindravur, Minjur and Ennore Ports.
- East Coast road connecting East part of Chennai running through Kovalam, Vadanemmeli, Mamallapuram, Kalpakkam, Koovathur and Kadapakkam to Puducherry and other coastal districts of Tamil Nadu.
- Old Mamallapuram Road called with other names as Rajiv Gandhi Salai or IT Expressway connecting Madhya Kailash of Chennai to Mamallapuram through Navalur, Kelambakkam, Thirupporur, Paiyanoor.

Other major roads are Vandalur-Kelambakkam Road, Pallavaram- Thoraipakkam radial road,Pallavaram-Kundrathur-Poonamallee Road connecting Kundrathur of Kanchipuram District and Poonamallee of Thiruvallur District, Tambaram-Velachery road, Tambaram- Mudichur Road connecting oragadam of Kanchipuram District, Guduvancheri-Nellikuppam Road, Urapakkam-Adhanur Road, Singaperumal koil-Shriperumbudur Road, Chengalpattu- Thirupporur Highway, Chengalpattu-Mamallapuram Road, Bukkathurai-Uthiramerur Road, Padalam-Cheyyur Road, Padalam - Vedanthangal Road, Karunguzhi-Thirukkazhukundram Road, Madurantakam-

Vennagupattu Road, Cheyyur-Sothupakkam-Vandavasi Road, Thozhuppedu-Orathy-Thindivanam Road. Apart from these major roads, this district has many PWD roads which helps in connecting small villages to taluk or district headquarters.

2.1.12 Railways

Chengalpattu District is the one of the best districts in Tamil Nadu having good railway network. Major stations in this district are Tambaram (TBM), Perungalathur (PRGL) Chengalpattu (CGL), Melmaruvathur (MLMR), Madurantakam (MMK). Chennai suburban trains which starts from Chennai beach (MSB) towards Chengalpattu, Kanchipuram, Tirumalpur and Arakkonam covers major towns of this district.

Chennai Metro rail limited (CMRL) has proposed extension of Metro line from Airport Metro till Kilambakkam near Urapakkam touching Pallavaram, Chromepet, Mepz, Tambaram, Perungalathur, Vandalur to ease passenger commute in suburbs. Southern Railways are in planning to build Rail tracks parallel to East Coast Road.

2.1.13 Airways

The Chennai International Airport is located here opposite the Tirusulam Railway station, with the cargo terminal located at the adjacent Meenambakkam. Chennai International Airport (IATA: MAA, ICAO: VOMM) is the primary airport serving the city of Chennai. The airport is the regional headquarters of the Airports Authority of India for South India comprising the states of Tamil Nadu, Andhra Pradesh, Karnataka and Kerala and the union territories of Puducherry and Lakshadweep.

2.2 Chennai Road Network Analysis

Chennai is located on the shores of Bay of Bengal which makes the road layout in the metropolitan area is of radial pattern. There are 4 Primary road networks - NH-5 towards Kolkatta on North, NH-205 towards Tirupathi on North-West, NH-4 towards Bangalore on West and NH-45 towards Trichy in South. In addition, there are Secondary roads - Thiruvottiyur High Road, Arcot Road, OMR and ECR. Key Plan of existing road network is given in Figure 2-2.

The existing road network within city includes inner ring road of ~ 25 km which connects OMR in south and TPP road in north, crossing all radial roads. The Chennai Bypass is a full-access controlled expressway that interconnects all four radial National Highways, covering a distance of 32 km from NH-45 at Perungalathur to NH-5 at Madhavaram. This expressway now forms a part of the circular transportation corridor.

The existing outer most road for the city is Outer Ring Road. The Outer Ring Road is a major transport corridor being developed along the periphery of Chennai Metropolitan Area (CMA) by the Chennai Metropolitan Development Authority (CMDA). It is 62.3 km long connecting NH-45 at Vandalur, NH-4 at Nazarathpet, NH-205 at Pattabiram to NH-5 at Nallur and TPP road at Minjur. Outer Ring Road has six lane configuration with service roads on both sides of main road for entire length. The right of way for ORR is 122m, in which a strip of 50 m earmarked for commercial

development on the inner side of the alignment and a strip of 22m at center of carriageway is earmarked for locating a Public Transportation Corridor.

The Project is being developed in 2 phases under BOT (Annuity) mode. The Phase-1 of the project covers a distance of 29.65 km, is open to public on August 2014 and the Phase 2 covers a distance of 33.1 km is under construction.

In the face of rapid developments in the districts surrounding Chennai and the expansion of the city, it has become necessary to develop an alternative road facility away from ORR which will take away commercial and personalized vehicles entering city center and at the same time relieve city roads of traffic congestion. Ideally, Chennai should have a ring road beyond existing ORR with connection to ORR and city through radial roads (primary and secondary roads). This will reduce traffic congestion on all radial roads, ORR and city roads. Chennai Peripheral Road is one of the major projects included in VISION 2023.

The project is conceptualized to provide better connectivity around the city catering future traffic requirements and provide efficient commercial transportation by enhancing port connectivity. This road will facilitate container movement from southern districts to Ennore Port.

2.3 Proposed Project Stretch - CPRR Section 5

Section 5 starts at km 101/700 of NH 32 in Singaperumal Koil, where the Interchange- cum-ROB is under construction and ends at km 129/166 in Mamallapuram. Total length of this stretch is 27.471 km in which 2.0 km is improvement of existing SH 49B (from km 11/200 to km 13/200) and balance is new alignment (Greenfield Corridor). The land use pattern observed was predominantly agricultural fields/ vacant and barren land all along the road. The project road will be 4-lane with paved shoulder carriageway with 2-lane service road on both sides. Proposed right of way is 60 m. At-grade rotary intersection is proposed upto Mamallapuram.

There are 6 vehicular underpasses and 7 light vehicular underpasses proposed in this section. There is 1 major bridge proposed in this section. As the project section is developed as an access-controlled facility, entry/exit ramps from service road to Main carriageway are proposed on both sides of the project road. The road passes entirely through Kancheepuram district and falls under the Chengalpattu and Thirukalukundram Taluks covering around 28 settlements.

Figure 2-2 Existing Road Network of Chennai

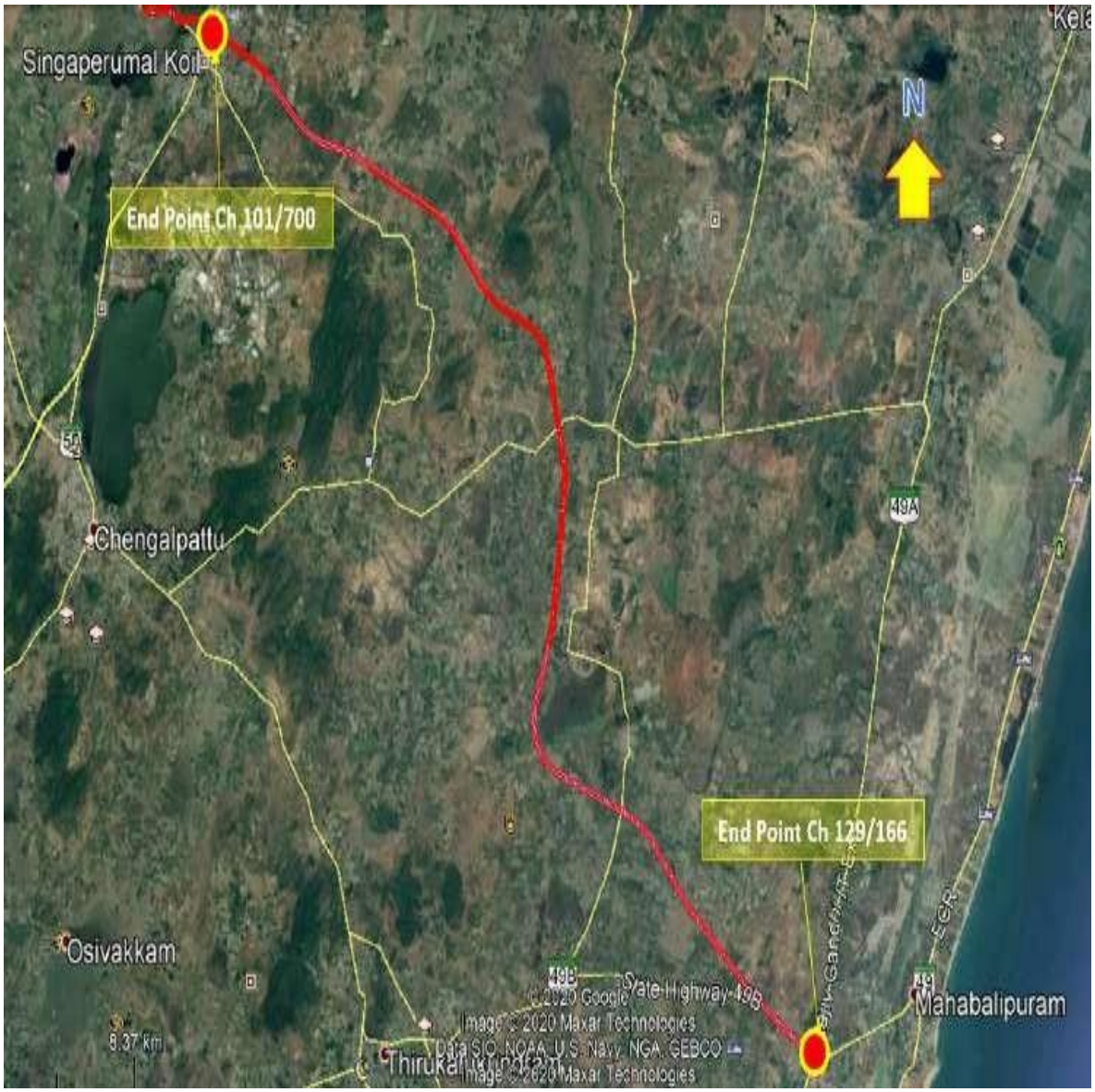


Figure 2-3 Section 5 – Satellite Imagery

2.4 Environmental Sensitivity of Project Site.

The environmental sensitivity is a study of the project site's current environmental conditions. A 25-km radius study was conducted around the project. The project site's environmental sensitivity is shown in the following table.

S. No.	Particulars	Details
1.	Latitude & Longitude – Start	12°45'57.15"N & 80° 0'19.17"E (SP Kovil)
	Latitude & Longitude – End	12°36'53.46"N & 80°10'7.16"E (Punjeri junction)
2.	Elevation above MSL	46m
3.	Nearest Roadway	NH - 332A (Tindivanam to Chennai) SH-49A Rajiv Gandhi Salai SH-49 ECR NH-32 Chennai to Tuticorin
4.	Nearest Railway Station	SP kovil Railway station – 0.17km (SW)
5.	Nearest airport	Chennai International Airport – 30.47km (NE)
6.	Nearest town/city	Edarkundram – 2.13 km (NE) Karumbakkam – 1.16 km (NW) Rayamangalam – 1.35 km (SSE) Kattakzhanai – 1.99 km (SSW) Konerikuppam – 2.93 km (NW) Peruthandalam – 3.48 km (NNW) Vembedu – 3.99 km (NNE) Sirunkundram – 4.48 km (N) Vadukambadi – 0.70 km (N) Ambalnagar – 0.30 km (W) Payanur – 0.80 km (NW) Karanai – 2.48 km (NNW) Thirunilai – 0.48 km (W) Chettipuniyam – 0.41 km (SSE) Krishnanagar – 1.25 km (WNW) Peramanur - 2.66 km (NNE) Karambur – 2.19 km (NNE) Kachadimangalam – 3.23 km (E) Echankarani – 0.98 km (WSW) Mahirindra World City – 1.88 km (SSW) Sengundram – 2.75 km (S) Thiruvadisoolam – 1.27 km (SW) Manampathy - 0.56 km (N) Otteri – 0.57 km (E) Pooluppai – 0.31 km (E) Kattankulathur – 7.63 km (NNE) Vadakkupattu – 9.98 km (WNW) Athur – 7.16 km (SW) Senneri – 1.94 km (SSW) Echankarani – 0.85 km (SSW) Kondamangalam – 0.41 km (SSW)
7.	Hills/ valleys	Vandalur hill – 17.01 km (NNE)
8.	National parks/Wildlife Sanctuaries/	Nil within 25 km radius
9.	Nearest Water body	Manampathy lake – 0.47 km (ENE) Illalur lake – 7.23 km (ENE) Dhasarikuppam lake – 3.15 km (NE) Kolavai lake – 5.61 km (S) Chettipunyam Lake – 1.78 km (NE) Pon Vilantha Kalathur Lake – 11.02 km (NE) Nandivaram Lake – 10.06 km (NE) Guruvanmedu Lake – 5.97 km (NNW)
10.	Reserved/ Protected Forests	Vallam reserved forest – 9.45 km (WNW)

		Vandalur reserved forest – 17.01 km (NNE) Thirutheri Reserved forest – 0 km (SW) Sengundram reserved forest – 0 km Sirugundram reserved forest – 0 km Appur reserved forest – 4 km Siruvanjur reserved forest – 4.6 km Kattankulathur reserved forest – 3.1 km Gudlur reserved forest – 3.8 km Kumili reserved forest – 8.7 km sand duenes – 3.5 kms Mangroves – 2.5 kms
11.	Seismicity	Zone II (Low risk Zone)
12.	Defense Installations	Nil within 25 km radius
13.	Nearest Sea Port	Chennai Port – 53.08 km (NNE)

2.5 Analysis of Alternatives

2.5.1 Evaluation of alternative plans and proposed plan for whole CPRR sections

Evaluation of alternative plans and proposed plan for whole CPRR section was conducted under the JICA Preparatory Study for Chennai Peripheral Ring Road Development in 2018 as follows.

The Government of Tamil Nadu proposed a draft alignment of the Chennai Peripheral Road, herein after called the Original Plan, which had a total length of 162.1 km consisting of 85.1 km new installation and 77.0 km existing road improvement as described in Figure 2-4.

The DPR does not contain information on the timing of the start of the study on the Original Plan. On the other hand, DPR states that the New Plan (Current Plan), shown in red in Figure 1, was approved by HMPD in July 2014. Therefore, it is assumed that the Original Plan was studied by June 2014 or before. The major characteristics of the Original Plan are as follows:

- The point of origin in the Original Plan was set in Mahabalipuram in the south of Chennai, and the end point was set in Kattupalli in the north. In the New Plan, Mahabalipuram is set as the end point, while Kattupalli is set as the point of origin.
- Maximum utilization of the existing road for improvement.
- Bypassing the major residential areas from south to north, a total of about 26 km:
  - Sriperumbudur Bypass about 4 km,
  - Thiruvallur Bypass about 12 km,
  - Thamaraipakkam Bypass about 2 km,
  - Vengal Bypass about 3 km,
  - Vadamadurai Bypass about 2 km, and
  - Periyapalayam Bypass about 3 km.
- The new installation sections, a total of about 58 km, except for the bypass, consist of:
  - 1) from the point of origin in Mahabalipuram to Singaperumalkoil for about 27 km, and
  - 2) from Kattupalli to the end point in Puduvoyal for about 31 km.

The Government of Tamil Nadu sets up three committees, namely the Steering Committee, the Technical Committee, and the Sub-technical Committee, for assessing the Original Plan. The Steering Committee assessed the plan from the political aspect, while the Technical Committee and Sub-technical Committee assessed the plan from the technical aspect and delivered the following comments for the improvement of the plan:

- The point of origin in Mahabalipuram is in the World Heritage sites, where alterations to existing conditions are not permitted by the Archaeological Survey of India.
- The proposed Sriperumbudur Bypass passes through built-up sections and water bodies and wetlands of Sriperumbudur Lake and surrounding areas.
- The proposed Thiruvallur Bypass starts/passes through built-up sections and industrial areas.
- The section between NH5 in Thatchur and the Ennore Port is a new road alignment.

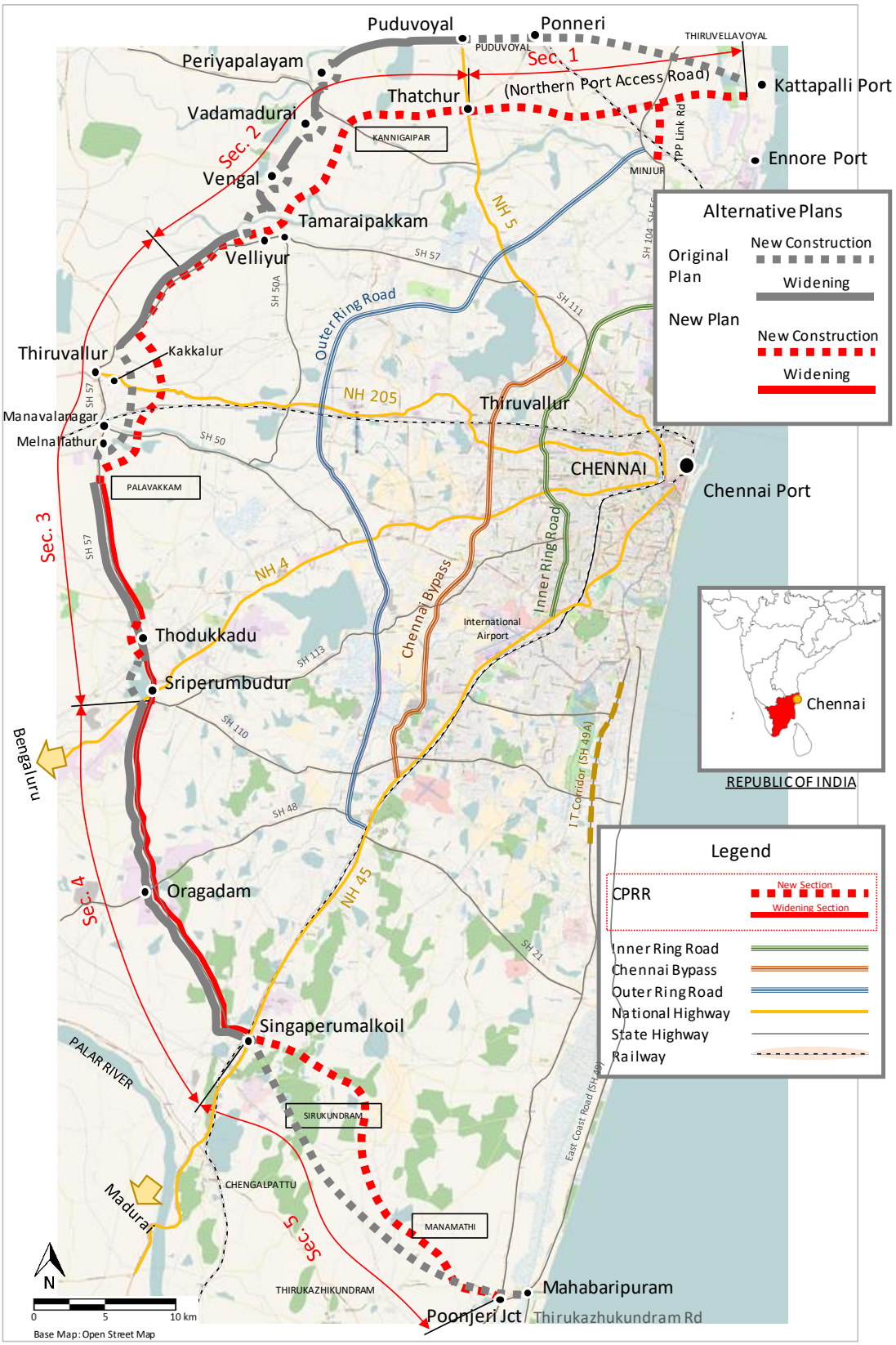
Considering the items pointed out by the committees as described above, HMPD prepared the DPR with the New Plan. The New Plan was approved by the Principal Secretary of HMPD on 9 July 2014.

The outline of the major characteristics and mitigation measures by section of the New Plan (Current Plan) are described in Table 2-3. Section-wise comparisons of the Original Plan and the New Plan in Section 5 of CPRR is shown in Figure 2-5.

Table 2-3 Consideration of Avoidance, Mitigation, and Minimization of Impacts in the New Plan

Sec. 1	• The alignment of the Main Road and the TPP Link Road, which had been prepared by NHAI independently, is also followed in the New Plan. • The alignment of the Main Road and the TPP Link Road passes south of the Original Plan to avoid residential areas such as Puduvoyal, Ponneri, and others.
Sec. 2	(North of Tamaraipakkam) • The New Plan avoids residential areas, such as Vengal, Vadamadurai, and Periyapalayam. The Vengal Bypass Road and the Vadamadurai Bypass Road are no longer necessary. (South of Tamaraipakkam) • Not by improving the existing road but by constructing a new bypass road, the New Plan avoids the residential areas, such as Tamaraipakkam and Velliyur, as well as religious facilities, such as Hindu temples and Christian churches.
Sec. 3	• The New Plan avoids the residential areas, such as Thiruvallur, Kakkalur, and Manavalangar, as well as Melnallathur industrial area in order to minimize the adverse impacts. • For the area close to Sriperumbudur residential area and Srperubudur Lake, the adverse impacts are minimized by improving the existing road rather than installing a new road.
Sec. 4	• Improvement of the existing road is planned for this section, so there is no difference between the Original Plan and the New Plan.
Sec. 5	• By traversing the north of Singaperumalkoi through farmlands as well as paddy fields, the New Plan avoids adverse impacts to the residential area. • By moving the end point to the cross point of NH49 close to Poonjeri, the New Plan avoids adverse impacts on the World Heritage sites. The end point, originally set up as the start point, is at Thirukazhukundram Road in Mahabalipuram.

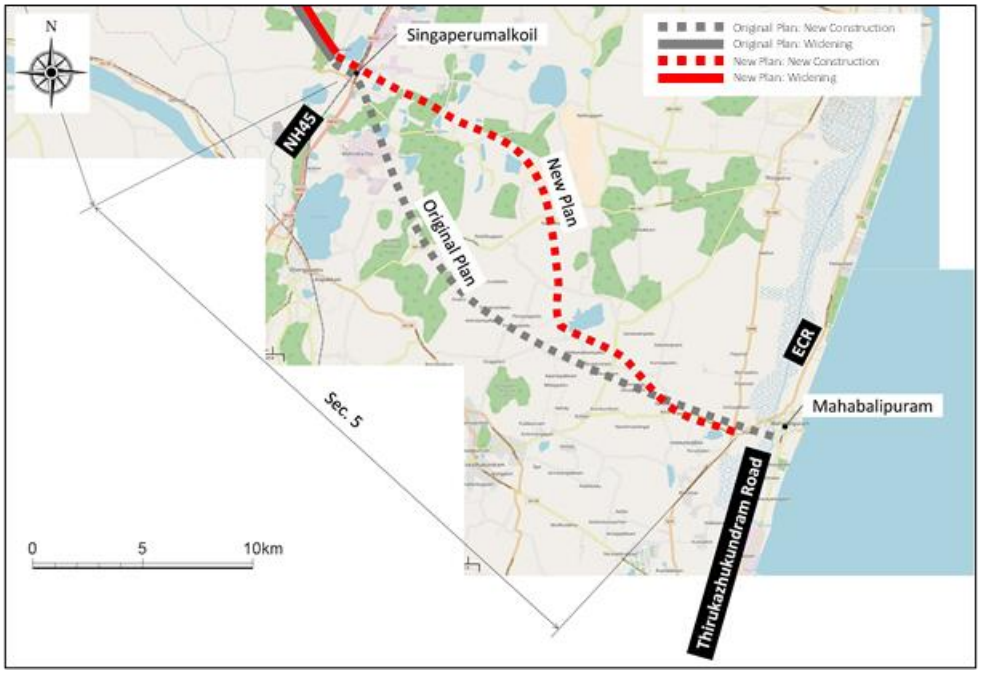
Source: Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018



Note: The new installation intervals are expressed in gray line while the existing road improvement intervals are in gray dotted line.

Source: Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018

Figure 2-4 Original Plan and New Plan of CPRR



Source: Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018

Figure 2-5 Comparison of the Original Plan and the New Plan for Section 5 of CPRR

The JICA Study Team compared five alternative plans, namely the zero-option (no project option), the Original Plan, the New Plan, the New Plan without ITS, and the New Plan without TPP Link Road. Table 2-4 shows the comparison of alternative plans. The JICA Study Team concluded that the New Plan is the most reasonable plan among the alternatives.

Table 2-4 Comparison of Alternative Plans

Compared Items	Plan-0 **Zero-Option** -without any project-	1.Original Plan	2.Proposed Plan (New Plan)	3.New Plan (without ITS)
Outline	・ The peripheral road is not implemented while the existing road network handles the expected traffic demand. ・ The current road network as well as the current traffic conditions are maintained.	・ In addition to the existing road network, the peripheral road with original alignment handles the expected traffic demand. Peripheral Ring Road : ・ L = 162 km ・ Main road with 4-6 lanes with one-lane service roads on both sides and a total length of 162 km consisting of 85.1 km of new installation intervals and 77.0 km of improvement (widening) intervals ・ Maximize the use of the existing road while bypasses are installed to avoid passing through the residential area along the suburbs of Chennai Metropolitan Area (CMA)	・ In addition to the existing road network, the peripheral road with the current proposed alignment and ITS facilities handle the expected traffic demand. Peripheral Ring Road : L=133 km ・ Main road with 4-6 lanes with one-lane service road on both sides and a distance of 133 km consisting of 96.2 km of new construction intervals 36.5 km of improvement (widening) intervals ITS Facilities : ・ Traffic control system covering the project proposed intervals consists of traffic management system and toll collection system ・ Traffic information system covers the whole CMA, City Bus Management System, and Traffic Control System in CMA ・ The alignment of Plan-2 is approved by the committees set by the state government.	・ In addition to the existing road network, the peripheral road with current proposed alignment and ITS facilities handle the expected traffic demand. Peripheral Ring Road : L=133 km ・ Main road with 4-6 lanes with one-lane service road on both sides and a distance of 133 km consisting of 96.2 km of new construction intervals 36.5 km of improvement (widening) intervals. ・ The alignment of Plan-2 is approved by the committees set by the state government.

Compared Items	Plan-0 **Zero-Option** -without any project-	1.Original Plan	2.Proposed Plan (New Plan)	3.New Plan (without ITS)
Improvement of the traffic condition	× ・ Without the project, the traffic condition is expected to be worsen according to the social and economic growth of Chennai area.	○ ・ The Peripheral Ring Road is expected to properly allocate the incoming traffic to Chennai by working as a ring road, and is expected to alleviate traffic congestion in the city in a certain level.	◎ ・ The Peripheral Ring Road is expected to properly allocate the incoming traffic to Chennai by working as ring road, and is expected to alleviate traffic congestion in the city in a certain level. ・ By including the TPP Link Road in this project and ITS implementation, systematic utilization of the road network in Chennai area becomes available; thus, the effects of traffic congestion alleviation are expected to be maximized. ・ The distance to the Ennore/Katapari Port from the industrial zone is shorter than that of Plan-1; thus, this plan contributes greatly to the improvement of accessibility to the ports. ・ By having longer new installation intervals, the flexibility of designing the alignment is increased. This leads to better traveling performance and road safety compared with those of Plan-1.	○ ・ The Peripheral Ring Road is expected to properly allocate the incoming traffic to Chennai by working as ring road, and is expected to alleviate traffic congestion in the city in a certain level. ・ By including the TPP Link Road in this project, systematic utilization of the road network in Chennai area becomes possible; thus, the effects of traffic congestion alleviation are expected to be better than those of Plan-1. ・ The distance to the Ennore/Katapari Port from the industrial zone is shorter than that of Plan-1; thus, this plan contributes greatly to the improvement of accessibility to the ports. ・ By having longer new installation intervals, the flexibility of designing the alignment is increased. This leads to better traveling performance and road safety compared with those of Plan-1.
Impact on living and local	△ ・ The degraded traffic condition	△ ・ Traffic congestion is expected to	△ ・ Traffic congestion is expected to	△ ・ Traffic congestion is expected to

Compared Items	Plan-0 **Zero-Option** -without any project-	1.Original Plan	2.Proposed Plan (New Plan)	3.New Plan (without ITS)
conditions	leads to the disturbance of community life, such as commuting to work, offices, and hospitals. In addition, the possibility of having health deterioration is expected to be higher due to the increase of exhaust gases from increased traffic. ・ No fragmentation of the community is expected.	be alleviated, and the possibility of health deterioration due to exhaust gas will be decreased. ・ By having a service road on both sides of the highway, the fragmentation of the local area will be alleviated to a certain degree.	be alleviated, and the possibility of health deterioration due to exhaust gas will be decreased. ・ By having a service road on both sides of the highway, the fragmentation of the local area will be alleviated to a certain degree.	be alleviated, and the possibility of health deterioration due to exhaust gas will be decreased. ・ By having a service road on both sides of the highway, the fragmentation of the local area will be alleviated to a certain degree.
Adverse impacts on natural environment and mitigation measures	◎ ・ Neither direct adverse impact nor any change by the project is expected.	△ ・ There is a possibility of having adverse impact on the natural environmental by altering the land use of the CRZ area and the reserved forest partially.	○ ・ There is a possibility of having adverse impact on the natural environmental by altering the land use of the CRZ area and the reserved forest partially. ・ The length of intervals passing through the reserved forest is shorter than that of Plan-1.	○ ・ There is a possibility of having adverse impact on the natural environment by altering the land use of the CRZ area and the reserved forest partially. ・ The length of intervals passing through the reserved forest is shorter than that of Plan-1.
Adverse impacts on social environment and mitigation measures	△ ・ No change regarding illegal occupation in the right-of-way (ROW) is expected while no resettlement occurs. ・ The degree of traffic congestion is expected to worsen.	× ・ Land acquisition and resettlement are required, which may cause adverse effects on the livelihood of the residents. ・ The total length of the proposed alignments is 162 km; therefore, the area for land acquisition becomes bigger than that of Plan-2. ・ In addition, the interval of the	○ ・ Land acquisition and resettlement are required, which may cause adverse effects on the livelihood of the residents. ・ The total length of the proposed alignment is 133 km; therefore, the area for land acquisition becomes smaller (255 ha) than that of Plan-1. ・ In addition, the intervals of the	○ ・ Land acquisition and resettlement are required, which may cause adverse effects on the livelihood of the residents. ・ The total length of the proposed alignment is 133 km; therefore, the area for land acquisition becomes smaller (255 ha) than that of Plan-1. ・ In addition, the intervals of the

Compared Items	Plan-0 **Zero-Option** -without any project-	1.Original Plan	2.Proposed Plan (New Plan)	3.New Plan (without ITS)
		improvement by widening the existing road is 77 km long; therefore, the expected number of residents for resettlement becomes larger than that of Plan-2. ・ There is a gap between the JICA guideline and the Indian legal system regarding resettlement. This can be filled by conducting gap analysis and proper countermeasures. ・ Traffic congestion in the central area will be alleviated.	improvement by widening the existing road is 37 km long; therefore, the expected number of residents for resettlement becomes smaller than that of Plan-1. ・ The shape of the alignment avoids the existing residential areas which is reasonable. ・ With the above reasons, the residential resettlement (198 households) is smaller than that of Plan-1. ・ Although the length of the new installation intervals is longer than that of Plan-1, the expected adverse impacts can be smaller than that of Plan-1 as long as proper compensation for farmland, wasteland, and paddy field is done where the alignment passes. ・ There is a gap between the JICA guideline and the Indian legal system regarding resettlement, but this gap can be filled by conducting gap analysis and proper countermeasures. ・ Traffic congestion in the central area will be alleviated.	improvement by widening the existing road is 37 km long; therefore, the expected number of residents for the resettlement becomes smaller than that of Plan-1. ・ The shape of the alignment avoids the existing residential areas which is reasonable. ・ With the above reasons, the residential resettlement (198 households) is smaller than that of Plan-1. ・ Although the length of the new installation intervals is longer than that of Plan-1, the expected adverse impacts can be smaller than that of Plan-1 as long as proper compensation for farmland, wasteland and paddy field is done where the alignment passes. ・ There is a gap between the JICA guideline and the Indian legal system regarding resettlement, but this gap can be filled by conducting gap analysis and proper countermeasures. ・ Traffic congestion in the central area will be alleviated to a certain extent.

Compared Items	Plan-0 **Zero-Option** -without any project-	1.Original Plan	2.Proposed Plan (New Plan)	3.New Plan (without ITS)
Economic Performance	○ ・ Initial cost and any operational costs are not required. ・ Social loss due to traffic congestion becomes worst.	△ ・ It is necessary to secure the cost as initial investment for equipment, construction, and its management and supervision, land acquisition and resettlement, compensation, as well as operation and maintenance cost for road and ITS. ・ Social loss due to traffic congestion becomes less than that of Plan-0.	△ ・ It is necessary to secure the cost as initial investment for equipment, construction, and its management and supervision, land acquisition and resettlement, compensation, as well as operation and maintenance cost for road and ITS. ・ Social loss due to traffic congestion becomes less than that of Plan-1.	△ ・ It is necessary to secure the cost as initial investment for equipment, construction, and its management and supervision, land acquisition and resettlement, compensation. ・ Social loss due to traffic congestion becomes less than that of Plan-1.
Total Evaluation*	△ ・ Due to the non-implementation of any project activity, no budget is required and no direct adverse impact on the environmental and social conditions is expected, but there are economical and social losses due to worst traffic condition.	○ ・ Although the initial cost and the operational costs are required, positive impacts on social environment are expected due to the alleviation of traffic congestion. ・ This plan may cause adverse impacts on both natural and social environments; thus, mitigation measures and monitoring activities are required.	◎ -Proposed plan- ・ Although the initial cost and the operational costs are required, positive impacts on social environment are expected due to the alleviation of traffic congestion over a side range. ・ This plan may cause adverse impacts, which are lesser than those of Plan-1, on both natural and social environments; thus, mitigation measures and monitoring activities are required.	○ ・ Although the initial cost and the operational costs are required, positive impacts on social environment are expected due to the alleviation of traffic congestion to a certain extent. ・ This plan may cause adverse impacts, which are lesser than those of Plan-1, on both natural and social environments; thus, mitigation measures and monitoring activities are required.

Source: Final Report for Preparatory Study for Chennai Peripheral Ring Road Development in India, JICA, Dec. 2018

2.5.2 Alternate alignment study at Thirutteri and Sengundram Reserve Forests

Alternate alignment study at Thirutteri and Sengundram Reserve Forests, which was conducted by TNRIDC and is described in the forest clearance application letter dated 3 March 2021[1], is shown as follows.

Thirutteri RF and Sengundram RF fall in the Section-V of the peripheral road which is entirely a new formation connecting Singaperumalkoil and Mahabalipuram with 4 lane carriageway ad service road on both sides with 60-m Right of Way.

As this section is new formation, alternate alignments were studied. The following things were taken into account before finalizing the alignment.

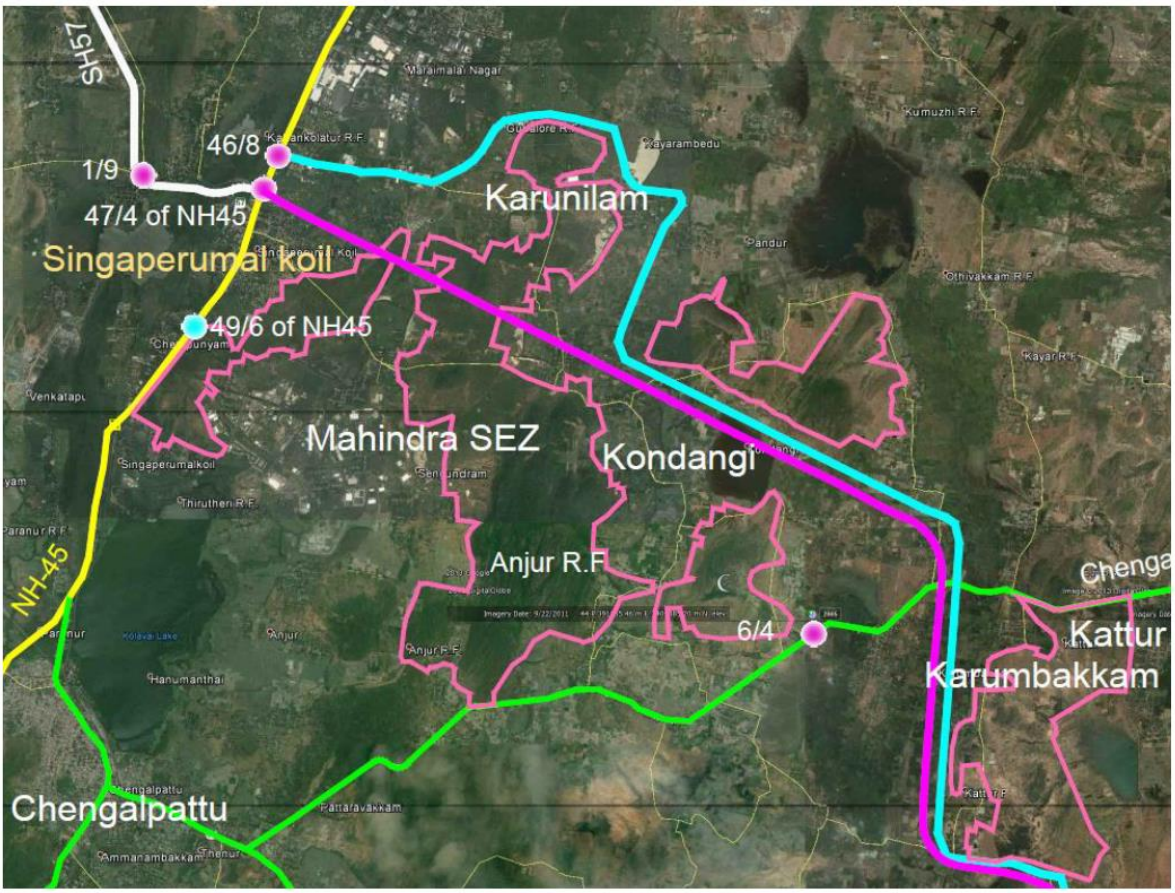
- There are number of Reserve Forests on the eastern side of NH-45 in the project area i.e. Thirutteri RF, Sengundram RF, Sirukundram RF, Irutteri RF, Anjur RF, etc.
- These forests are spread in north-south direction and located stagger to each other.
- In order to avoid forest area, an alignment was studied along the periphery of the forests. Due to the position and spread of these forests, the road alignment needs to take sharp turns, travel reverse direction, etc. As the proposed Peripheral road is an access controlled highway with 100 kmph design speed, this horizontal alignment in the periphery of Forest is not technically viable as per the standards set out by Indian Road Congress (IRC).
- Hence, another alignment was studied which runs through RF with minimum land requirement to cross the forest area. The alignment is designed as per the IRC standards.
- The length of the project road through forest area is about 3.5 km shorter than the alignment running in the periphery for avoiding the forest area.
- The proposed alignment requires about 21 ha of less land acquisition thereby cause less social impacts.
- The proposed alignments were reviewed by various technical committees and finally approved by the Steering Committee constituted by Government.

Further, during the inspection of DFO, Kancheepuram on 09.02.2021 in Thirutheri RF, the DFO has requested to explore the possibility of detouring the alignment in the boundary of Thirutheri RF to avoid fragmentation of small portion of forest land from the total area and also to avoid disturbances for the animal movements in the Forest area. The observation of DFO, Kancheepuram with regard to Thirutheri RF was studied. In this regard, it is informed that the alignments cannot be modified abruptly at particular location.

Here, in this case, shifting of horizontal alignment on Singaperumalkol side is not technically viable as per IRC Standards due to its nearest proximity to Singaperumalkol Town. Further this section is proposed to be connected to the Road Over Bridge already constructed in lieu of Railway level crossing at LC.No. 47 through an interchange at NH-32 near Singaperumalkol. Further the

[1] Lr. No.TNRIDC/CPRR/Forest Clearance/2019, Proposal for diversion of 10.23 Hec of Forest land in Mannur RF, Sengundram RD and Thirutheri RF for Forming Peripheral road Connecting Mahabalipuram to Ennore Port - Oneline proposal submitted - Justification of alignment - Furnishing - Reg

proposed road is an access-controlled Highway with 100 kmph design speed which requires large curve radius and do not cope for sharp and abrupt turns.



Source: TNRIDC

Figure 2-6 Comparison of Alternative Alignments

Cost-Benefit Analysis of the proposed alignment

- Length of selected alignment is about 3.5 km lesser than the alternate alignment, which reduces the construction cost of Rs. 138 crores and annual maintenance cost of Rs. 28 lakhs per year (in 2019) which will increases around 5% per annum throughout the life of the project road.
- Travel distance savings in selected alignment is about 3.5 km which will reduce vehicle operating cost for all the vehicles using the project road throughout the life of the project road.
- From the above, it is clear that the selected alignment will have more benefits to,
  - Government in terms of construction cost and maintenance cost
  - Road users in terms of savings in vehicle operating cost, travel time savings, etc.
  - Local people in terms of less social impacts, etc.

Correction in Area

Further, it is observed that, the user agency while applying online for forest clearance, it was proposed for diversion of 1.86 ha of land in Thirutheri RF and 8.09 ha of land in Sengundram RF. However, the area was corrected as 2.56 ha of land in Thirutheri RF and 7.39 ha of land in Sengundram RF after reconciliation of measurements while applying for transfer of two times of land to Forest Department. The District Collector, Kancheepuram has also recommended only the corrected area viz. 2.56 ha of land in Thirutheri RF and 7.39 ha of land in Sengundram RF to the Commissioner of Land Administration.

2.6 Salient Features of Project

Sl. No.	Description	Chainage/ No.	Remarks
1	Start of Project	Ch. 101/800	NH-32 - under constructing interchange at Singaperumalkoil
2	End of Project	CH. 128/100	SH-49B - start of proposed Trumpet interchange of NHAI for NH-332A
3	Length of Section	26.3 km	New alignment 25.3 km & existing road (SH-49B) 1 km
4	Vehicular Underpass (25m x 5.5m)	108+919	
		114+018	
		119+254	
		122+362	
		125+480	
		127+104	
5	Light Vehicular Underpass (12m x 4m)	103+590	
		106+780	
		111+497	
		117+788	
		120+762	
6	Small Vehicular Underpass (7m x 4m)	116+477	
		124+210	
7	Animal Underpass (7m x 4m)	7 Nos.	Forest area - 250m interval
8	Minor Bridges	102+790	5 spans of each 10m
		106+150	5 spans of each 10m
		110+277	5 spans of each 10m
		110+635	5 spans of each 10m
		115+474	3 spans of each 10m
		118+040	3 spans of each 10m
		118+500	2 spans of each 10m
		120+000	2 spans of each 10m
		121+404	5 spans of each 10m
		121+971	5 spans of each 10m

Sl. No.	Description	Chainage/ No.	Remarks
		122+835	2 spans of each 10m
		123+524	2 spans of each 10m
9	Toll Plaza	113+100	
10	Truck Lay-bye	107+550	On both sides
11	Entry / Exit Ramps	102+500	Entry on LHS & Exit on RHS
		108+200	Combined entry & exit on both sides
		121+630	Combined entry & exit on both sides
		126+400	Combined entry & exit on both sides
12	Horizontal curves	15 Nos.	Design speed 100 kmph
13	Height of Main Carriageway	3.1m average	5m in RF areas as requested by Forest Dept.
14	Height of Service Road	1.8m average	5m in RF areas as requested by Forest Dept.
15	Canal Realignment	3 stretches	Ch. 115/100 to 115/500 - 400m length on LHS - Addl. RoW of 15m reqd.
			Ch. 124/470 to 124/640 - 170m length on LHS - Addl. RoW of 10m reqd.
			Ch. 113/850 to 113/950 - 100m length on RHS - Addl. RoW of 10m reqd.

2.7 Traffic Study

For the formulation of the design, the following traffic surveys were carried out for Section 5.

Traffic Surveys	Section 5
Classified Traffic Volume Count Survey	5
Turning Movement Survey	4
Origin-Destination & Commodity movement Survey	15
Axle Load Survey	2
Pedestrian Count Survey	2
Truck Terminal survey	2

Analysis of the traffic survey data brings out the Annual Average Daily Traffic (AADT) of existing roads in the project area, peak hour turning movement of existing junctions, traffic characteristics and movement pattern along the project corridor, pedestrian movements in the project locations, vehicle loading characteristics and existing speed-delay characteristics on the project area and requirement of truck parking facility.

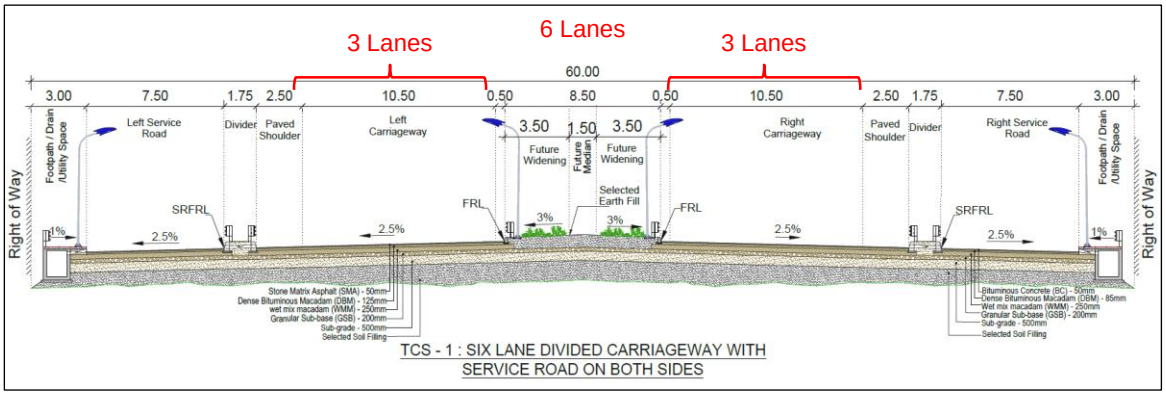
Section 5. The AADT of NH 32 is more than 95000 PCU. AADT in ECR is more than 14000 PCU. Peak hour share is 5.91 to 7.94% and the peak hour is identified during morning and evening hours. It is clearly observed that a significant movement of freight traffic takes place during night and early

morning. The passenger traffic movement takes place during the daytime. The expected traffic, which is mainly diverted traffic was identified to be 10000 PCU/day in Section 5. Traffic growth rate identified by the transport demand elasticity method for most likely scenario for section 5 is given in the following table.

Year	Two Wheeler	Passenger Auto	Car/Jeep	Bus	LCV	2 & 3 Axle Trucks	MAV
2013-2018	9.37%	5.34%	9.14%	5.55%	13.10%	7.33%	6.22%
2018-2023	8.43%	5.00%	8.22%	5.00%	11.79%	6.59%	5.60%
2023-2028	7.59%	5.00%	7.40%	5.00%	10.61%	5.93%	5.04%
2028-2033	6.83%	3.89%	6.66%	4.05%	9.55%	5.34%	4.53%
2033-2038	6.15%	3.50%	5.99%	3.64%	8.59%	4.81%	4.08%
2038-2043	5.53%	3.15%	5.39%	3.28%	7.73%	4.33%	3.67%

2.8 Proposed Design Interventions

The project road components are designed as an access-controlled road. The design is carried out primarily based on IRC: SP: 87-2013: Manual of Specification and Standards for Six Laning of Highways through Public Private Partnership and the recommendations made by the Steering Committee of the project. The individual components of the highway are designed as per the relevant standards of the Indian Roads Congress (IRC) and MORT&H specifications. Typical Cross section proposed for the Section 5 is depicted in Figure 2-7.



Source: Revised DPR (2022)

Figure 2-7 Typical Cross Section for Section 5

2.9 Pavement Composition

Section 5 has been designed for a life of 15 years for bituminous layers and 20 years for granular layers. Flexible payment is considered for the project to minimize the initial construction cost. Guideline of IRC: 37-2012 is followed for design of new pavement and IRC: 81 - 1997 is followed for strengthening of existing pavement layers.

In section 5, reconstruction of pavement crust is proposed for the existing road stretch SH-49B (2km length). The proposed pavement composition for sections 5 is given in the following table

Description	Main Carriageway	Service Road
Bituminous Concrete	50	40
Dense Bituminous Macadam	115	100
Wet Mix Macadam	250	250
Granular Sub-base	200	200
Total	615	590

2.10 Vehicular Underpass

For Sections 5, underpasses are proposed at important junctions and built-up sections. Two types of underpasses are proposed as per IRC-87:2013. Number of Vehicular underpass and Light Vehicle underpass are given in the following table

Vehicular Underpass (Vertical Clearance - 5.5m)

- 2 vents X 12 m for SH & MDR and
- 1 vent X 12 m for ODR & Panchayat roads

Light Vehicular Underpass (Vertical Clearance - 4.5m)

- 1 vent X 12 m for ODR & Panchayat roads

Project Section	Vehicular Underpass	Light Vehicular Underpass
Section 5	6	7

2.11 Drain facility

The design of surface and sub-surface drains are carried out as per the IRC: SP: 87-2013 and IRC: SP: 42-1994. As per Flood Estimation Report for Coast Region of Central Water Commission, 25-years 24-hour rainfall in the project area is 300mm and 50 years 24-hour rainfall is 320 mm. considering the minor difference, 320mm rainfall is considered in the project for designing the drain facility. The average MSL for section 5 is 36 m respectively.

Section 5: RCC Lined Covered Rectangular Drain has been proposed to provide under the footpath. As the CD structures are proposed in close interval, the length of this drain also generally will be 150 m to 250 m

2.12 Road safety measures

Road safety measures are common for section 5, the safety measures include the following:

- Cautionary, mandatory and informatory signs are proposed for the elevated road and interchanges main carriageway, service road and other project facilities, depending on the situation and function they perform, in accordance with the IRC: 67-2012.
- To regulate the traffic and for the psychological awareness to the road user, edge lane marking, lane markings, chevron markings, stop line, zebra crossing are also proposed at required locations.
- The hazard markers are proposed in curved stretches at the crash barriers of structures like interchange, underpasses, bridges, etc and the object hazard markers are proposed at the start of concrete crash barrier of these structures.
- Road studs are proposed at the edge lane marking, acceleration lane, deceleration lane, weaving portion, chevron markings, entry/exit ramps, bus bays, zebra crossings, etc as per IRC:SP:87-2013.
- The semi rigid, Thrie beam type steel barrier is proposed all along the project road at central median, earthen shoulder and footpath.
- The flashing beacons are proposed for the safety purpose at the at-grade junction in underpasses, truck parking locations, entry/exit ramps and rest area locations

3 Policy and Legal Framework

3.1 Introduction

A review of the existing institutions and legislation relevant to the environmental issues in this project at the National and State levels is presented in the following section. A regulation concerning procedures and requirements which may directly concern the projects has been addressed in this chapter.

3.2 National Constitution of India

Article 48A and 51A of Indian Constitution

As a sequel to the UN Conference on the Human Environment (1972), Indian Parliament in 1976 amended the Constitution of India by introducing articles 48A and 51A. These articles incorporated environmental concerns into the Directive Principles of state policy and postulated as a fundamental duty of all citizens to preserve and protect the environment.

3.3 JICA Guidelines

The Development Cooperation Charter positions human security as the guiding principle that lies at the foundation of Japan's development cooperation. Human security is defined as a concept that pursues the right of individuals to live happily and in dignity, free from fear and want, through their protection and empowerment. The Charter presents the priority policies for development cooperation, which encompass "inclusiveness" with leaving no one behind, "sustainability" over generations, "quality growth" with "resilience," in order to realize poverty eradication through such growth. The Charter also stipulates that full attention shall be given to the impacts of development on the environment and climate change, as well as on the social aspects which cover reducing disparities and consideration of the socially vulnerable, in implementing development cooperation. With efforts to engage a wide range of stakeholders, Japan's development cooperation shall give full considerations to ensuring environment and equity.

Quality Infrastructure Investment

The principle of integration of environmental and social considerations into infrastructure investments was recognized in "the G7 Ise-Shima Principles for Promoting Quality Infrastructure Investment," which was agreed at the G7 Ise-Shima Summit in 2016 and in "the Principles for Quality Infrastructure Investment," which was approved at G20 Osaka Summit in 2019. Japan has announced its intention to implement infrastructure investments in accordance with the principle.

Rationale behind the Environmental and Social Considerations for JICA

JICA, the executing agency of ODA, plays a key role in contributing to the "sustainable development" initiatives being implemented by project proponents. In order to realize sustainable development, environmental and social costs incurred by the development project need to be incorporated in the development costs. It is important to establish the social and institutional framework that allows the reflection and consideration of these costs in decision-making. JICA recognizes that the "environmental and social considerations" means materializing such internalization and institutional framework.

Respect for basic human rights, meaningful participation of diverse stakeholders, transparency of information, accountability and efficiency are all necessary in order to realize a democratic decision-making, which is crucial for environmental and social considerations to function. Relevant government agencies shall be accountable and stakeholders should be responsible for their own statements.

JICA ensures the participation of diverse stakeholders in society, including socially vulnerable local residents such as women, and supports the achievement of gender equality at all stages of development. These are necessary in order to achieve inclusive development, which leaves no one behind, based on the concept of human security. In addition, JICA contributes to the transition to a zero-carbon society based on the climate change actions of the international community.

Based on the above-mentioned principles, JICA shall implement the appropriate environmental and social considerations in accordance with the policies of the Government of Japan when implementing development cooperation.

3.4 Legal Framework

The Government of India has laid out various policy guidelines, acts and regulations pertaining to sustenance of environment. Ministry of Environment and Forests and Climate Change (MoEF&CC) serves as the administrative focal point for the planning, promotion and coordination of environmental laws and policies. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Central Ministry of Environment Forests and Climate Change (MoEF&CC) and the Central Pollution Control Board (CPCB) / State Pollution Control Board (SPCB).

3.5 Environmental Rules and Regulations

In order to understand the extent of the environmental and social assessment for the proposed improvement works, applicable laws, legislation and policies have been reviewed. A summary of environmental legislations / regulations relevant to the project is furnished in Table 3.1.

Table 3-1 Environmental Legislations / Regulations applicable to the project

Sl. No.	Policy/Act/Rule	Year	Purpose	Responsible Institution	Applicability
1	Environment (Protection) Act.	1986	To protect and improve the overall environment	MoEF & CC	Yes
2	Environmental Impact Assessment Notification and Amendments	2006, 2009 and 2013	To provide environmental clearance to new development activities following environmental impact assessment	MoEF & CC	Yes
3	Notification on use of fly ash	2007	To mandate the reuse of fly ash in large quantities of fly ash from the Thermal plants within 100 km from development project activities.	MoEF & CC	Yes
4	Wildlife Protection Act	1972	To protect wild animals and birds through the creation of National Parks and Sanctuaries.	MoEF & CC	No
5	The Forest (Conservation) Act	1980	To protect and manage forests by restricting conversion of forest area into non- forest areas and to check deforestation	Forest Department GoTN/ MoEF/CC	Yes
6	The Scheduled Tribes and Other Traditional Forest (Recognition of Forest rights Act)	2006	To recognize and vest the forest rights and occupation in forest land in forest dwelling STs and other traditional forest dwellers	Forest Department, GoTN & Dept. of Tribal Development	No
7	Bio Diversity Act	2000	Disclosure of species survey or collection activities to the National Biodiversity Authority	MoEF & CC	Yes
8	Water (Prevention and Control of pollution) and amendments Act	1974	To provide for the prevention and control of water pollution And the maintaining or restoring of wholesomeness of water	TNPCB	Yes
9	Air (Prevention and Control of Pollution) Act (and subsequent	1981	To provide for the prevention, control and abatement of air pollution and for the establishment of Boards to carry out these purposes	TNPCB	Yes
10	Hazardous Waste (Management, Trans boundary Rules, 2008	2008	Authorization for handling, storage, transportation and disposal of hazardous wastes	TNPCB	Yes

Sl. No.	Policy/Act/Rule	Year	Purpose	Responsible Institution	Applicability
11	Municipal Solid Waste (Management Handling) Rules, 2000	2000	Segregation, Handling & safe disposal of domestic solid waste	Local Body	Yes
12	Batteries (Management and Handling) Rules 2001	2001	Safe recycling of lead acid batteries	TNPCB	Yes
13	Public Liability and Insurance Act, 1991	1991	Protection from hazardous materials and accidents	CC /PIU	Yes
14	Minor Minerals and Development Conservation Rules, 2010	2010	For opening new quarry	District Collectorate and Mining & Geology Department	Yes
15	Explosive Act 1984 and Explosive Rules 2008	2008	Safe transportation, Storage and use of explosive materials	Chief Controller of Explosives	Yes
16	Tamil Nadu Minor Minerals and Concession Rules, 1956	1956	For opening new quarry	District Collectorate Mining & Geology Department	Yes
17	Coastal Regulation Zone Ac t(CRZ) Notification	2011	For construction of road in Coastal Regulation Zone Notification Area	MOEF / CRZ State Board	No.
18	Central Motor Vehicle Act, 1988, Central Motor Vehicle Rules 1989	1988/ 1989	To control vehicular air and noise pollution. To regulate development of the transport sector, check and control vehicular air and noise pollution.	Regional Transport Office	Yes
19	Noise Pollution (Regulation and Control) rules, 2000	2000	Noise pollution regulation and controls noise pollution	TNPCB	Yes
20	The Ancient Monuments and Archaeological Sites and Remains Amendment and Validation) Act), 2010.	2010	To protect and prevent the Ancient Monuments and Archaeological remains from damage and loss.	Department of Archaeology	No, as no ASI sites has been identified.

Source: GoI, MoEF&CC and GoTN

3.6 Other Legislations Applicable to the Project

Environmental issues during road construction stage generally involve equity, safety and public health issues. The road construction agencies require complying with laws of the land, which include inter alia, the following:

Workmen's Compensation Act 1923: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

Contract Labour (Regulation and Abolition) Act, 1970: The Act provides for certain welfare measures to be provided by the contractor to contract labour;

Minimum Wages Act, 1948*:* The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act.

Payment of Wages Act, 1936*:* It lays down as to by what date the wages are to be paid, when it will' be paid and what deductions can be made from the wages of the workers.

Equal Remuneration Act, 1979*:* The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees.

Child Labour (Prohibition and Regulation) A; 1986: 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. Employment of child labour is prohibited in Building and Construction Industry.

Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979:

The inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.

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

3.7 Environmental Clearance (EC)

EIA notification of the MoEF & CC dated 14th September 2006, categorizes all projects and activities into two categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and manmade resources. Environmental clearance is required for this corridor procedure given in the EIA Notification 2006 and subsequent amendments shall be followed as shown in Figure 3.1.

All projects or activities included as Category "A" in the Schedule, including new, expansion and modernization of existing projects or activities greater than 100Km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on realignments of bypasses shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) to be constituted by the Central Government for the purposes of this notification; All projects or activities included as Category "B" in the Schedule, including new, expansion and modernization of existing projects or activities as specified in sub paragraph (i) All new state highway projects (ii) State highway expansion projects in hilly terrain (above 1000m AMSL) or ecologically sensitive area which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification.

This project has already obtained Environmental Clearance from MOEF&CC through vide no: **SEIAA/TN/F.6474/EC/7(f)/61/2018** dated: **10.08.2018**.

3.8 Permissions and Consents to be Obtained

Consents from Tamil Nadu Pollution Control Board

The project corridors shall require obtaining "***Consent to Establish***" and "***Consent to Operate***" from Tamil Nadu Pollution Control Board for establishment and operation of Hot Mix Plant (HMP), WMM, Crushers and Constructors Labour Camps (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, Handling and Transboundary Movement) Rules, 2008, as amended.

Forest Clearances

The Section 5 is passing through Thirutteri Reserve Forest (RF) for a length of 500 m i.e. from Ch. 103+700 to Ch. 104+200 (2.56 ha) and Sengundra006D Reserve Forest for a length of 1260 m i.e. from Ch. 104+690 to Ch. 105+950 (7.39 ha), which requires forest clearance.

Forest clearance will be required under the Forest (Conservation) Act, 1980 for diversion of forest land. As per the Forest (Conservation) Act, 1980, Form "A" needs to be filled by the project proponent and has to be submitted along with the necessary enclosures to the District Forest Office, further stages of forest clearance (*as per IRC – SP-93-2011*) procedures is shown in Figure 3-2. (Formats for the same is given in Annexures)

Forest Clearances for Trees Felling

In Tamil Nadu state, road plantations along the MDR, ODR and State Highways (SH) are not declared as Notified Protected Forest (NPF), under Forest (conservation) Act 1980. Hence, in the identified corridors, including strengthening and widening activity would not attract Forest clearance for road side trees felling.

Permission of Eco Sensitive Zones

In the Tamil Nadu State, there are 8 wildlife sanctuaries, 12 Bird Sanctuaries, 5 National Parks, 3 Tiger Reserves, 4 Elephant Reserves and 3 Biosphere Reserves for protection and conservation of wild fauna and flora. These are considered ecological protected areas. In case any such protected area is located within the 10 km distance from the project road corridor, prior permission from National Board for Wildlife (NBWL) will be required under Environmental (Protection) Act, 1986 to start the construction of the project road corridor. No such permissions will be required for the project, as the project road do not fall under any of the Eco Sensitive Zones.

3.9 Wildlife Clearance from Supreme Court in Notified Wildlife Areas

The project road does not pass through a protected area, like, a national park, wildlife sanctuary, bird sanctuary, Tiger Reserve or biosphere reserve, no prior wildlife clearance will be required.

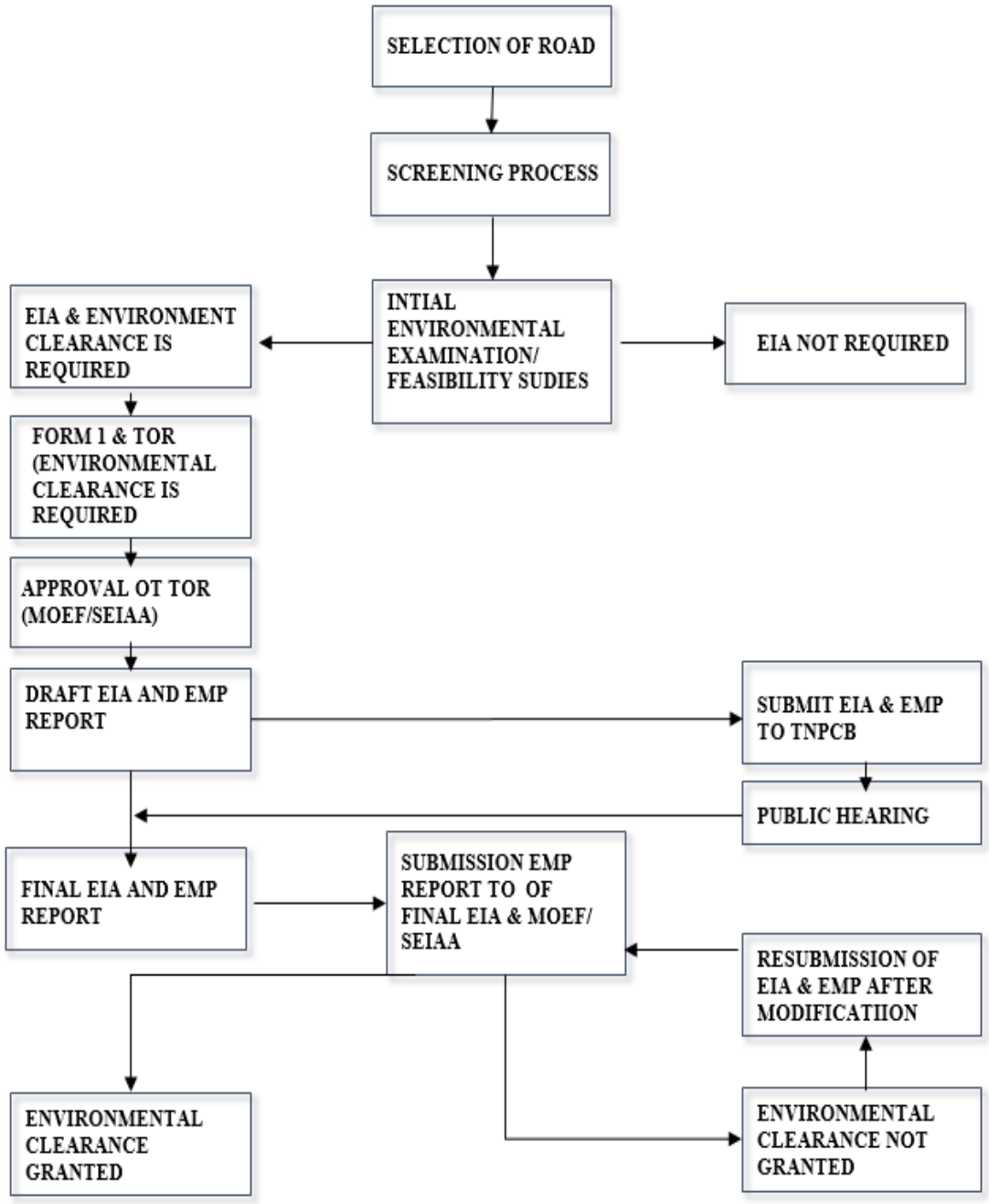


Figure 3-1 Environmental Clearance Procedures

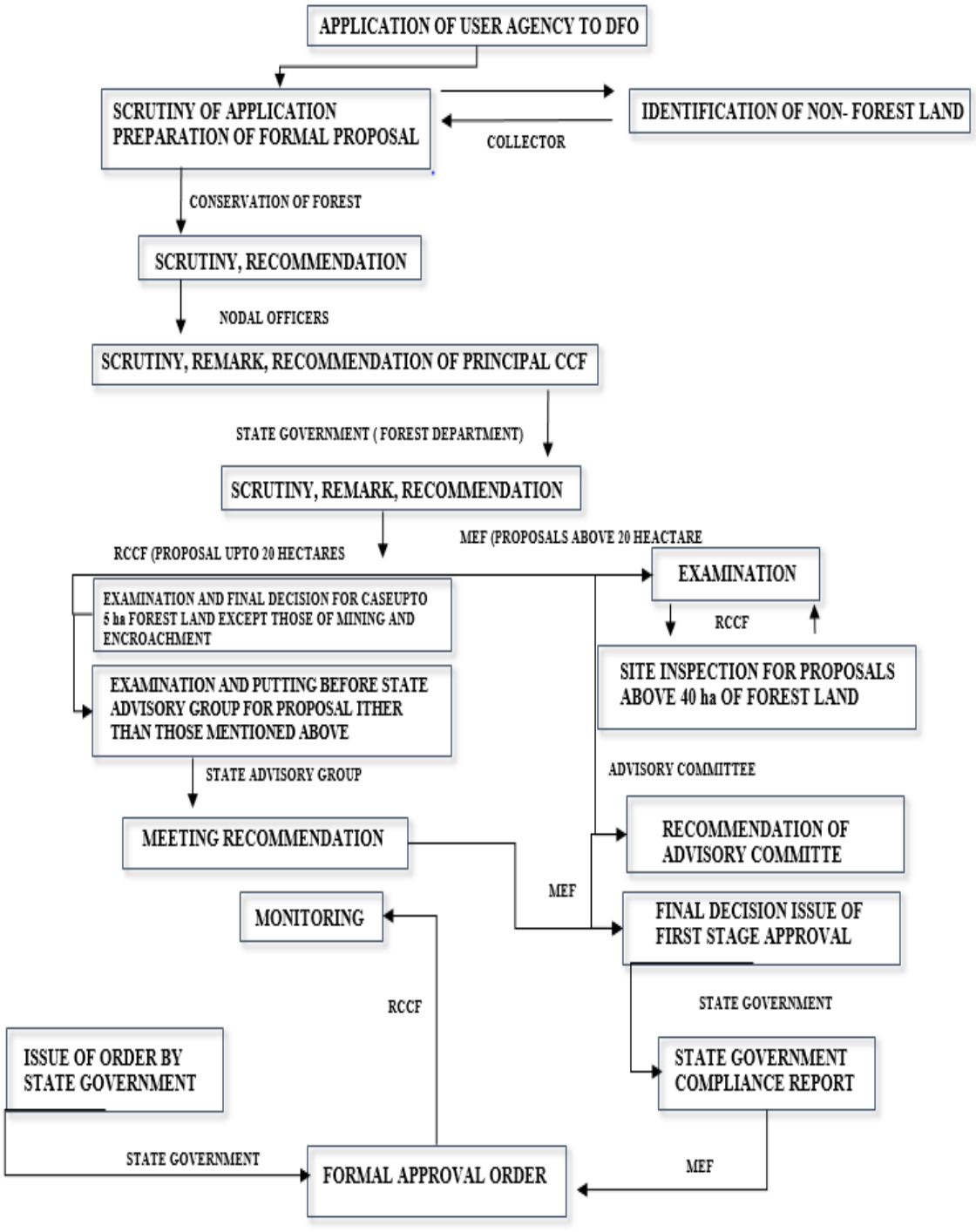


Figure 3-2 Forest Clearance Procedures

3.10 CRZ Clearance for Road Construction in Coastal Regulation Zone (CRZ) Area

Section 5 is starting from Singaperumalkoil to Mamallapuram which is not falling under CRZ area as per provision of CRZ notification 2011 hence it is not required any CRZ clearance or NOC from competent authority.

3.11 Permissions and Clearances Required for The Project

The following Table highlight the permission required for the project from various Statuary authorities.

Table 3-2 Permissions Required

Type of Clearance	Statutory Authority	Applicability	Project Stage	Responsibility
Environmental Clearances (EIA OBTAINED 2018)	MOEF State Board	As per EIA Notification	Construction Prior to work	Highways Department
Forest Clearances	MoEF	Trees Felling	Construction Prior to work	Highways Department e
Consent to Establish Under the Air (Prevention & Control of Pollution) Act, 1981 and The Water (Prevention & Control of Pollution) Act, 1974.	Tamil Nadu Pollution State Pollution Control Board	For operating hot mix plants, crushers and construction camps	Construction Prior to work	Concessionaire
Consent to Operate under the Air (Prevention & Control of Pollution) Act, 1981	Tamil Nadu Pollution State Pollution Control Board	For operating hot mix plants, crushers and construction camps	Construction Prior to work	Concessionaire
Permission to store Hazardous Materials under Hazardous Waste (Management, Handling and Trans- boundary Movement) Rules 2008.	Tamil Nadu Pollution State Pollution Control Board	Storage and Transportation of Hazardous Materials and Explosives	Construction Prior to work	Concessionaire
Explosive license under the Explosives Act 1884 and the revised rules 1983	Chief Controller of Explosives, petroleum and Explosive safety	Storage of explosives materials	Construction Prior to work	Concessionaire
PUC certificate for vehicles for construction under Central Motor and Vehicle Act , 1988	Motor Vehicle department of Tamil Nadu	For all construction vehicle	Construction Prior to work	Concessionaire
Quarry lease deeds and license under the Mines Act, 1958	Mining and Geology	Quarrying and borrowing operations	Construction Prior to work	Concessionaire

Type of Clearance	Statutory Authority	Applicability	Project Stage	Responsibility
	Department of Tamil Nadu			
Consent for ground water extraction	Tamil Nadu Ground Water Authority	Ground water extraction for construction and camps	Construction Prior to work	Concessionaire
Permission for labour camps	Labour Department of Tamil Nadu	Labour camps	Construction Prior to work	Concessionaire
NOC for Borrow area	Local Panchayat / Municipality	Borrow area	Construction Prior to work	Concessionaire
Consent to Operate under the Air (Prevention & Control of Pollution) Act, 1981	Tamil Nadu Pollution State Pollution Control Board	For establishing Hot mix plants, Crushers, construction camps and batching plants	Operation	Concessionaire
Consent to Operate under the Water (Prevention & Control of Pollution) Act, 1974	Tamil Nadu Pollution State Pollution Control Board	For discharging of domestic wastewater through soak pits	Operation	Concessionaire

3.12 Conclusion

Understanding of the legal provisions and policy framework enables the PIU to consider the statutory requirements for obtaining clearances, consents and permissions prior, during the project and shall promote the PIU team to complete the project on time. Missions prior, during the project and shall promote the PIU team to complete the project on time.

4 Environmental Profile of the Project Area

4.1 Introduction

Baseline environment involves collection of data on the existing status of the environment which helps in identification and assessment of impacts due to the proposed road and during various phases of project cycle. The environmental baseline includes investigation of physical, chemical, biological and socioeconomic parameters. This section deals with the description of existing environmental setting in the study area. The baseline data has been compiled for:

- Air Environment
- Noise Environment
- Land Environment
- Water Environment
- Ecological Environment
- Socio-Economic Environment

Data on baseline environment component were collected from various sources of government departments, literature and publications, websites etc. The information about the district was collected from district handbook and its official website.

Details regarding the ground water were obtained from the reports of Central Ground Water Board. Baseline environmental monitoring programmed for various environmental attributes will be conducted in near future. Baseline environmental monitoring shall be conducted as per the guidelines of CPCB. Primary data for ambient air quality, ambient noise levels, water quality (ground and surface) and soil quality will be carried out by a NABL accredited laboratory.

Baseline environmental monitoring shall be conducted as per the guidelines of CPCB. Primary data for ambient air quality, ambient noise levels, water quality (ground and surface) and soil quality shall be generated by a NABL accredited laboratory.

4.2 Study area

To study the baseline environmental profile of the project area, the project impact zone has been classified into two:

- **Direct Impact Zone and Indirect Impact Zone**
- **Direct Impact Zone (DIZ)**: This consists of the RoW and a strip of land within 50 m on either side of the RoW of the proposed alignment. Detailed inventory of environmental features has been carried out in this zone.
- **Indirect Impact Zone (IIZ):** This consists of a strip of land within 10 Km aerial distance on

either side of the proposed RoW.

- The samples shall be collected on an average of once in 7 to 8 km. The proposed sample locations were listed below.

Table 4-1 Sampling Locations for Baseline Measurement in Section 5

Parameters	Sampling location
Surface Water	Twin lotus lake
	Manampathy lake
	Nellikuppam lake
	Kondamangalm lake
Ground Water	Twin lotus lake area
	Manampathy lake
	Nellikuppam lake
	Kondamangalm lake
Air sample	Singaperumalkoil
	Kondamangalam
	Karumbakkam
	Kattur
	Poranthavakkam
	Poonjeri
	Junction
Noise sample	Poonjeri junction
	Poranthavakkam
	Kattur
	Karumbakkam
	Kondamangalm
	Sengundram
Soil sample	Kondamangalam
	Karumbakkam
	poranthavakkam
	paniyur

4.3 Air environment

4.3.1 Meteorology

Rainfall and Climate- Chengalpattu District

The district has normal weather during winter but very hot in the summer. Rainfall depends mainly on the Northeast Monsoon. The pre-monsoon rainfall is almost uniform throughout the district. The coastal taluks get more rains rather than the interior regions.

This district is mainly depending on the seasonal rains, the distress conditions prevail in the event of the failure of rains. Northeast and Southwest monsoon are the major donors with 54% and 36% contribution each to the total annual rainfall.

- Normal - 1213.3mm
- Maximum - 1133.0mm

The months between April and June are generally hot with temperatures going up to an average maximum of 36.6ºC. In winter (December - January) the average minimum temperature is 19.8ºC. The climate of the district shows a maximum of 36.6°C and a minimum of 19.8°C.

Table 4-2 Ambient Air Quality Monitoring Locations

Sample Code	Location	Coordinates
AAQ1	SINGAPERUMAL KOIL	12°45'57.16"N, 80° 0'19.80"E
AAQ2	KONDAMANGALAM	12°44'49.07"N, 80° 2'50.63"E
AAQ3	KARUMBAKKAM	12°42'59.67"N, 80° 5'39.89"E
AAQ4	KATTUR	12°40'16.04"N, 80° 5'44.81"E
AAQ5	PORANTHAVAKAM	12°38'27.83"N, 80° 7'50.00"E
AAQ6	POONJERI JUNCTION	12°36'53.42"N, 80°10'7.14"E

Table 4-3 NAAQ Standards of Air Quality

S.No	Parameters	Analytical method	NAAQ standards: 2009		Sampling Time
1	Sulphur Dioxide (SO2), µg/m3	IS 11255: (Part 2) / USEPA Method 6	50 (Annual)	80 (24 Hours)	24 Hours
2	Nitrogen Dioxide (NO2), µg/m3	IS: 5182 (Part – 6): 2006 /CPCB guidelines Volume1	40 (Annual)	80 (24 Hours)	24 Hours
3	Particulate Matter (PM2.5), µg/m3	In house method (Gravimetric method) based on CPCB guidelines Volume1	40(Annual)	60 (24hours)	24 Hours
4	Particulate Matter (PM10), µg/m3	IS:5182 (Part– 23): 2006 CPCB guidelines Volume1	60 (Annual)	100 (24 hours)	24 Hours
5	Carbon Monoxide, (CO), mg/m3	IS:5182(Part–10):1999 (Reaff:2006) CPCB guidelines Volume1	2 (8 hours)	4 (1hour)	8 Hours
6	Ozone, O3, µg/m3	In house method (Spectrophotometric method) based on CPCB guidelines Volume1	100 (8hours)	180 (1hour)	8 Hours

Figure 4-1 Ambient Air quality Monitoring

Table 4-4 Summary of Ambient Air Quality Results

Location	Statistics	PM2.5 (µg/m3)	PM10 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	CO (mg/m3)	O3 (µg/m3)
AAQ1	Minimum	25	52	8.9	16.3	0.29	12.9
	Maximum	33	67	12.2	23.6	0.52	16.9
	Average	28.79	60.29	10.37	19.28	0.42	14.78
	98th Percentile	32.54	66.54	11.924	11.924	0.52	16.462
AAQ2	Minimum	20	43	6.8	13.9	0.11	11.4
	Maximum	27	57	8.8	16.9	0.29	13.7
	Average	23.25	49.38	7.74	15.48	0.18	12.57
	98th Percentile	26.54	56.08	8.754	16.9	0.2624	13.654
AAQ3	Minimum	19	40	5.1	13.6	-	11.6
	Maximum	24	53	7.9	16.6	-	13.7
	Average	21.42	45.83	6.62	14.93	-	12.48
	98th Percentile	23.54	52.08	7.854	16.462	-	13.654
AAQ4	Minimum	17	36	-	12.8	-	10.1
	Maximum	23	48	-	15	-	12.9
	Average	19.71	41.83	-	13.89	-	11.44
	98th Percentile	23	47.54	-	15	-	12.716
AAQ5	Minimum	18	38	<5	13.2	-	10.7
	Maximum	24	51	8.5	15.8	-	13.3
	Average	20.92	44.54	-	14.37	-	12.17
	98th Percentile	24	51	-	15.708	-	13.208
AAQ6	Minimum	22	46	7.8	15.5	0.21	12.7
	Maximum	28	59	11.8	19.3	0.41	15.3
	Average	24.92	52.88	9.93	17.17	0.32	13.64
	98th Percentile	28	59	11.754	19.07	0.41	15.024

4.4
4.4 Land environment

The land environment primarily consists of physiography, geology, minerals, soils, land use pattern and seismicity. The components of land environment discussed in this section includes,

- Geography and Topography
- Geology
- Seismicity
- Soil Characteristics
- Land Use

4.4.1 Geography and topography

Geographical location of the Chengalpattu District

Chengalpattu district is situated on the Northern East Coast of Tamil Nadu and is bounded in the West by Vellore and Thiruvannamalai districts, in the North by Tiruvallur district and Chennai district, in the South by Villuppuram district and in the East by the Bay of Bengal. It lies between 11° 00' to 12° 00' North and 77° 28' to 78° 50' East. The district has a total geographical area of 4,393.37 sq.km and coastline of 57 km Chengalpattu, the temple town is the district headquarters. This district is flat and having small hills in Chengalpattu and Mathuranthagam Taluks.

4.4.2 Geology

Geology of Chengalpattu

Geology of Chengalpattu district is characterized by hard rock predominantly charnocites Gneiss with Gondwana formations. These are overlain by laterites and alluvium.

Mineral Resources - Chengalpattu District

Granite, stone quarry, Sand quarry, silica sand and clay are the minerals available in Chengalpattu district.

Table 4-5 Mineral distribution

Name of Mineral	Estimated Availability
Silica Sand	600,000
White Clay	500,000
Black Granite	375,000
Stone	7,500,000
Sand	4,500,000

4.4.3 Hydrology

Palar River is one of the major rivers in the state of Tamil Nadu traversing through Chengalpattu district for a length of 54 Kms. The river Palar enters the district at Palur village and confluxes with Bay of Bengal between Vayalur and Kadalur village. Moreover, the district is bounded by the river Adayar in the north and the Ongur river in the south. Besides the aforesaid rivers, Neenjal Maduvu, Pukkadurai Odai, and Kiliyar are other minor rivers flowing through Chengalpattu district. The district is home to 528 major irrigation tanks having ayacut of more than 100 Acres (or) 40 ha each.

Chengalpattu District has 5 major river basins namely Palar Basin, Adyar Basin, Cheyyar sub - basin, Ongur basin and Kiliyar sub - basin. Besides, there are numerous minor & major streams and channels criss- crossing the entire district. This district also has 57km of coastal line, which normally receives 30% higher rainfall than inland. The Buckingham canal drainage system is very sensitive and its fringe areas are always flood prone.

Chengalpattu District is nick named "Erikal Mavattam" due to the presence of large number of irrigation tanks spread throughout the district. There are 528 major irrigation tanks having Ayacat Area 52,762 ha. under the maintenance of PWD and rest of the tanks are vested with Panchayat union.

Government Canals	2
Private Canals	—
Major Irrigation Tanks (PWD)	528
Ayacatarea (Hecs)	52762
Minor Irrigation Tanks	549
MI Tanks Area (Hecs)	5451.17
Other Wells	1241
Other Sources	—

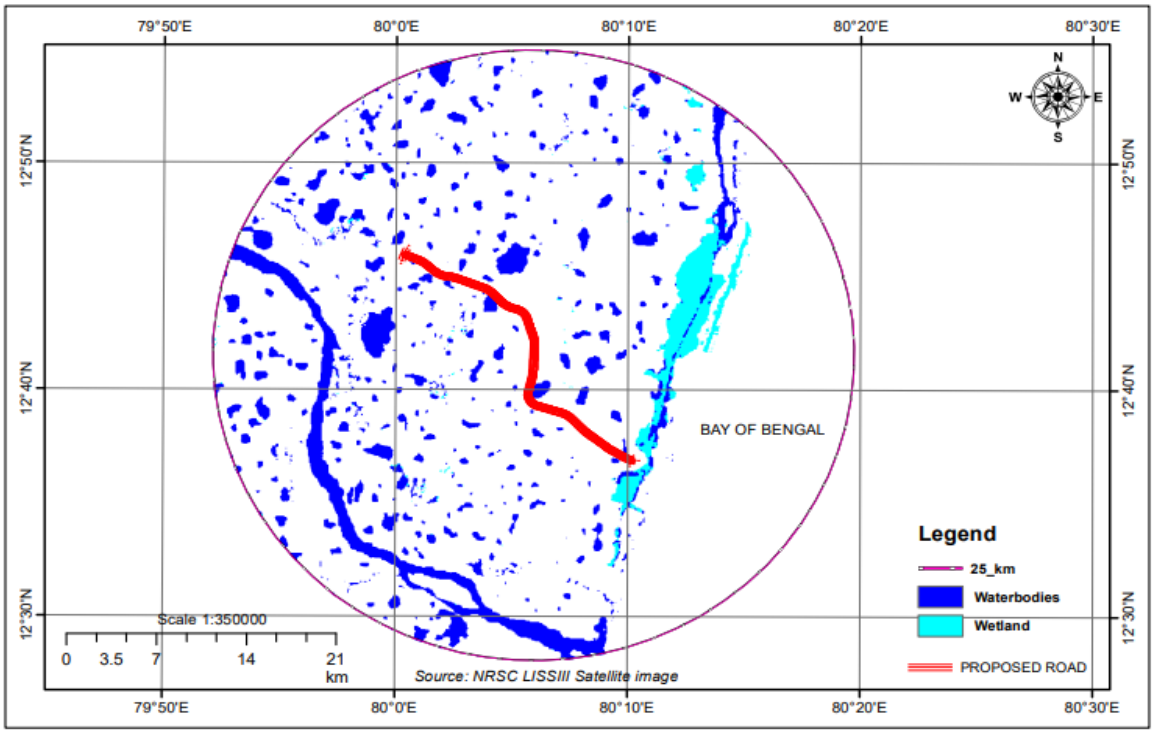


Figure 4-2 Water Bodies Map

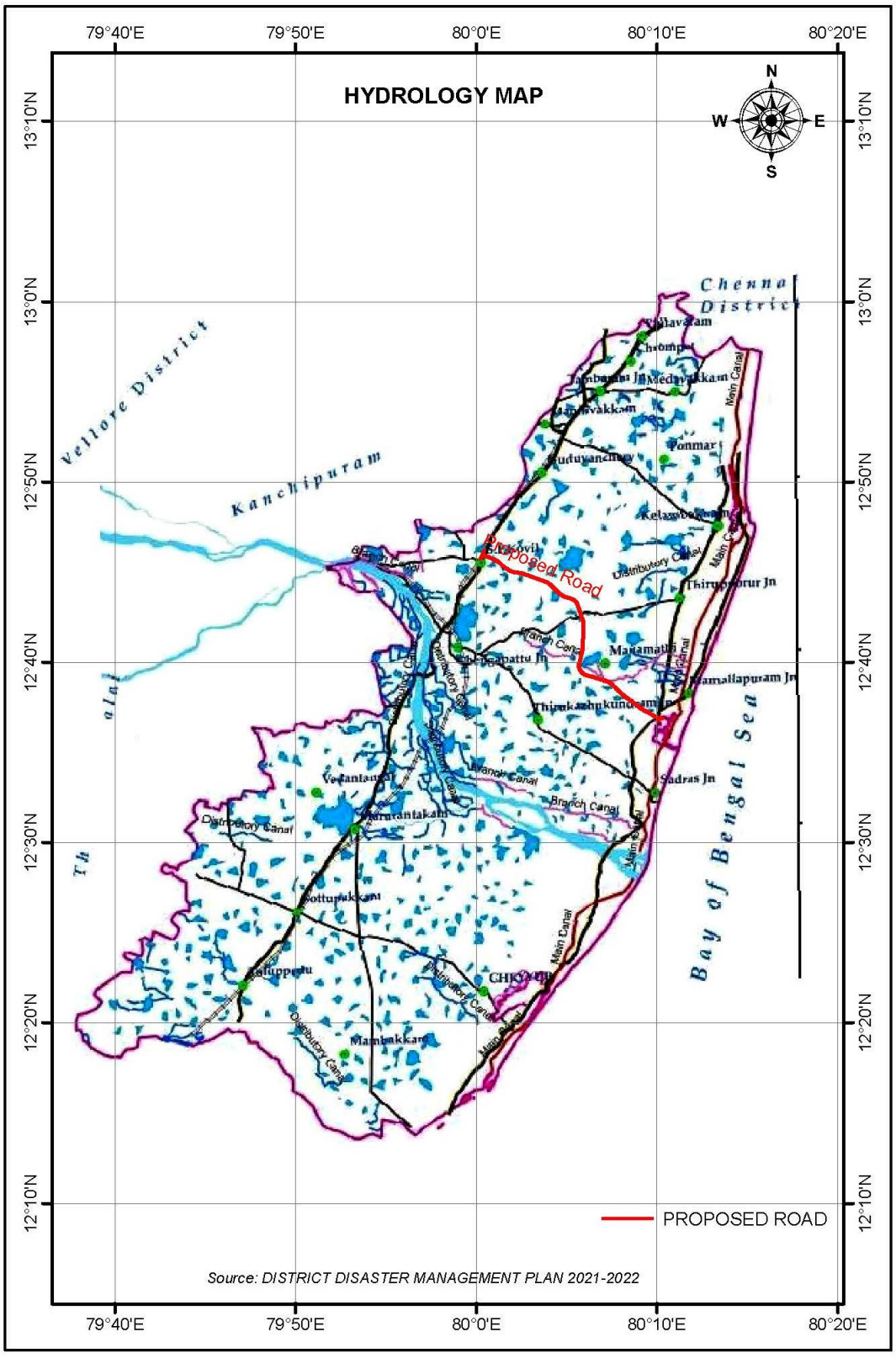


Figure 4.5 Hydrology Map of Chengalpattu District

4.4.4 Topography

Topography – Chengalpattu district

Palar River is the main river in the district, which is not perennial. Cheyyar and Vegavathy rivers are tributaries of Palar and join it at Thirumakkudal

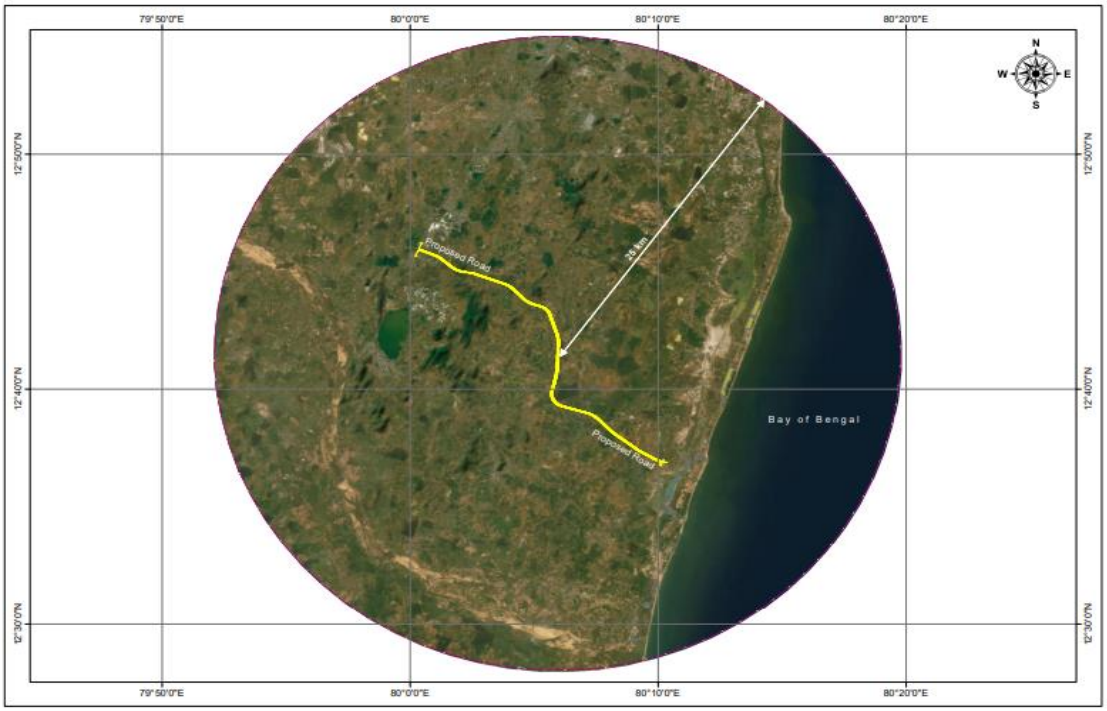


Figure 4-3 Satellite Image of Project Site

4.4.5 Seismicity and volcanic activity

Seismicity / Effect due to earthquake has been accounted for by considering the seismic load in longitudinal and transverse direction. For the purpose of determining the seismic forces the country is divided into four zones (Zone II to Zone V) based on the intensity of earthquakes that a particular area may be subjected to, with Zone V comprising of areas which have been subjected to severe earthquakes & Zone-II comprising areas least liable to earthquakes (source: http://www.imd.gov.in/section/seismo/static/seismo-zone.htm).

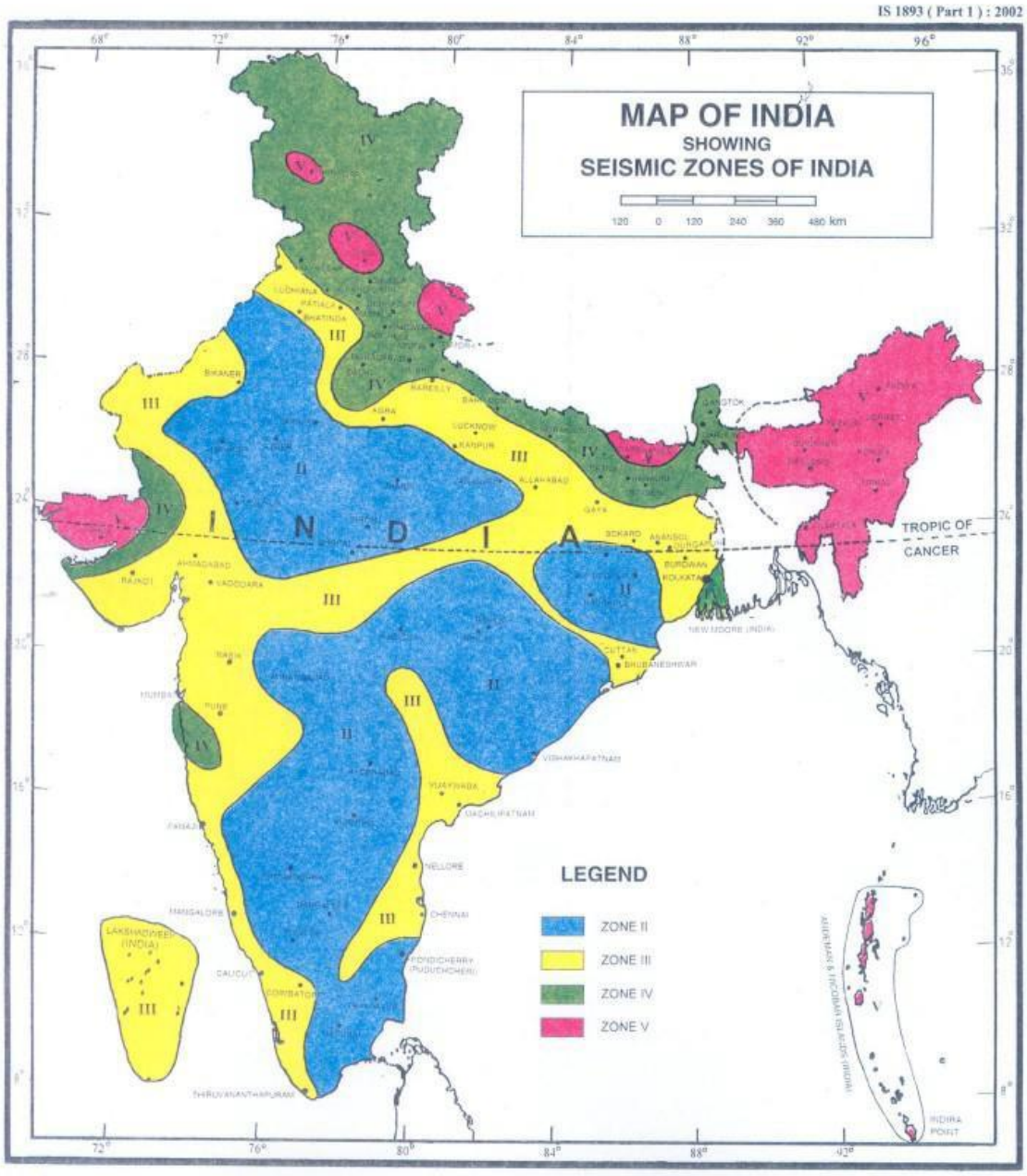


Figure 4-4 Map showing Seismic Zones of India

The seismic loads are calculated using Response Spectrum method as per Modified clause of IRC 6: 2010. The seismic force depends upon several factors like zone factor, Period of vibration, Soil type etc. The seismic load in longitudinal and transverse direction is found out separately. As per the seismic zone classification of India, the proposed road project falls within

Chengalpattu districts and fall in zone III of seismic map (Figure 4-4) and relevant provisions in IRC-6:2010 have been adopted in the design.

4.4.6 Soil characteristics

The physical and chemical characters of the parent rock, physiography, altitude, climatic condition and plants and animals of the surrounding region influence the process of soil formation. The major soil groups of Tamil Nadu are: Red soils, (62%), Black soils (12%), Laterite soils (3%) and Coastal soils (7%).

Soil Characteristics – Chengalpattu District

The soil in Chengalpattu district have been classified into 1) clayey soil, 2) red sandy or red loamy soil 3) Red sandy brown clayey soil and 4) Alluvial soil. Of the above soils brown clayey soil is the most predominant, covering more than 71 percent of the areal extent of Chengalpattu district. Alluvial soils are found on the banks of Palar, Cheyyar and other rivers. The river alluvium is transported and is seen in coastal area of this district. Sandy coastal alluvial (arenacious soil) occurs along the seacoast as a narrow belt.

Type of Soil	Places in District
Read Loam	Chengalpattu, Uthiramerur Blocks
Lateritic Soil	Pleatus in the district
Black Soil	Spread in all Blocks
Sandy Coastal Alluviam	Thirukazhukundram, Thiruporur, St.ThomasMount.
Red Sandy Soil	Chengalpattu, Urban Blocks

In order to establish the soil characteristics of the project area, soil samples will be taken and analysed for all important parameters at pre-selected locations.

4.4.7 Land use

Land Use – Chengalpattu District

The district has a spread of 4393.37 km^2, out of which 1364.89 km^2 was sown area, 1236.28 km^2 irrigated area and 426.57 km^2 contributes forest area. The district shows 1553.47 km^2 of Poromboke area and 82.57 km^2 of Town area.

Table 4-6 Area Distribution

Category	Area in km^2
Total Area	4393.37
Net Sown Area	1364.89
Net Irrigation Area	1236.28
Forest Area	426.57
Poromboke Area	1553.47
Town Area	82.57

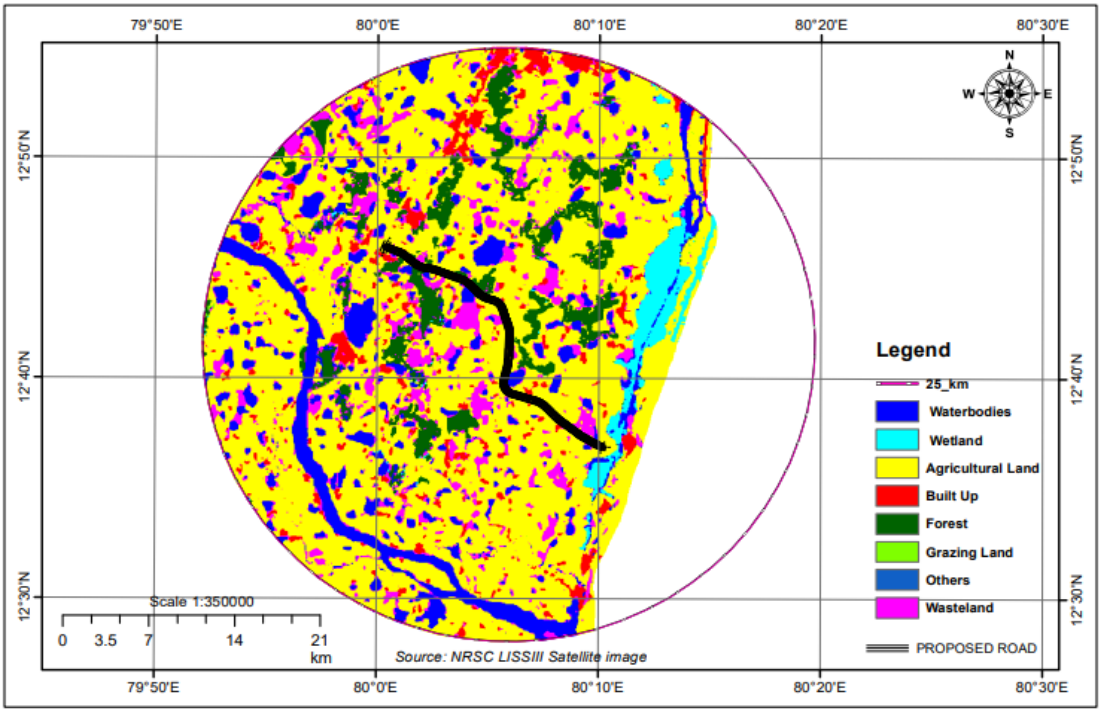


Figure 4-5 Land Use and Land Cover

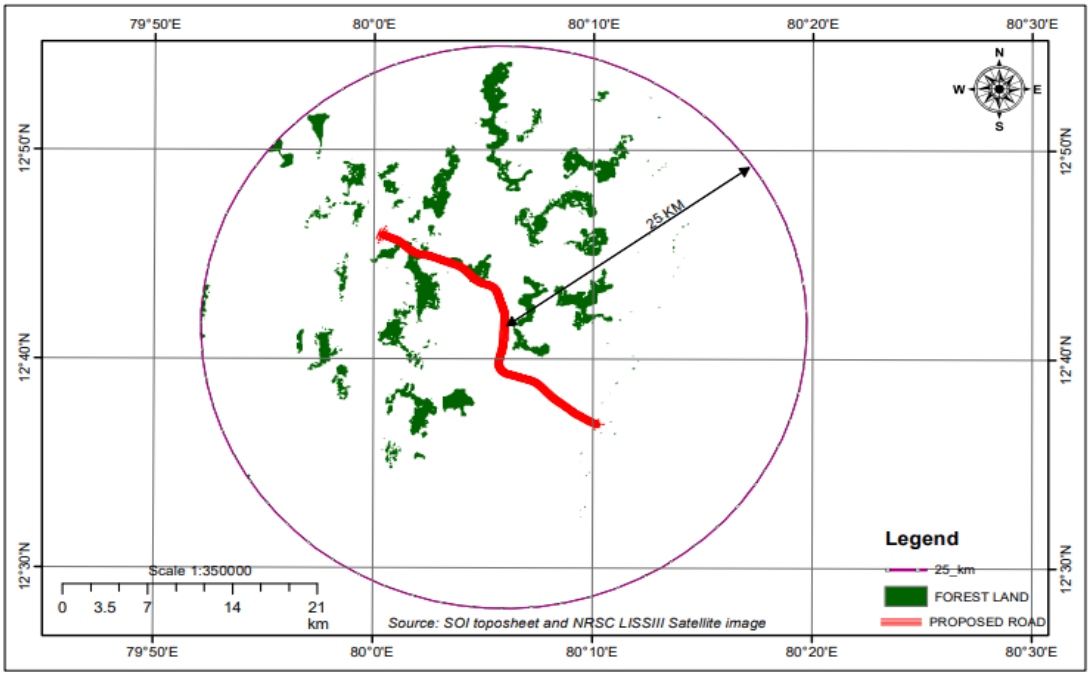


Figure 4-6 Forest Area

4.5 CRZ

Section is starting from Singaperumalkoil to Mamallapuram which is not falling under CRZ area as per provision of CRZ notification 2011 hence it is not required any CRZ clearance or NOC from competent authority.

Table 4-7 Surface Water Quality Monitoring Locations

Sample Code	Location	Coordinates
SW1	Twin lotus Lake	12°37'15.63"N, 80° 9'59.48"E
SW2	Manampathy Lake	12°39'45.20"N, 80° 6'21.95"E
SW3	Nellikuppam Lake	12°43'53.54"N, 80° 4'14.49"E
SW4	Kondamangalam	12°45'47.76"N, 80° 0'53.62"E

Figure 4-7 Surface Water Sampling

Table 4-8 Surface water Standards as per IS2296

S. No	Parameters	Unit	Test method	Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – C
1	Temperature	°C	APHA 23rd EDN – 2550B	Not Specified
2	Colour	Hazen	APHA 23rd EDN – 2120 C	300
3	Odour	-	APHA 23rd EDN – 2150 B	Not Specified
4	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2017)	1
5	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff:2017)	6.5 – 8.5
6	Electrical Conductivity,	µS/cm	IS : 3025 Part 10-1984 (Reaff: 2012)	Not Specified
7	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2017)	1500
8	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009 (Reaff: 2019)	Not Specified
9	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2019)	Not Specified
10	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2019)	600
11	Sulphate as SO_4	mg/l	APHA 23rd EDN -4500- SO42- E	400
12	Fluoride as F	mg/l	APHA 23rd EDN -4500-F B&D	1.5
13	Nitrate as NO_3	mg/l	APHA 23rd EDN -4500- NO3- B	50
14	Ammonia as NH_3	mg/l	APHA 23rd EDN -4500- NH3 B&C	Not Specified
15	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2019)	Not specified
16	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified

S. No	Parameters	Unit	Test method	Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – C
17	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
18	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2019)	Not Specified
19	Magnesium as Mg	mg/l	APHA 23rd EDN 3500 Mg B	Not Specified
20	Iron as Fe	mg/l	APHA 23rd EDN -3111 B	Not Specified
21	Manganese as Mn	mg/l	APHA 22nd EDN -3111 B	Not Specified
22	Phenolic compounds as C_6H_5OH	mg/l	APHA 22nd EDN 5530 B,C	0.005
23	Copper as Cu	mg/l	APHA 23rd EDN -3111 B	1.5
24	Mercury as Hg	mg/l	APHA 23rd EDN -3112B	0.005
25	Cadmium as Cd	mg/l	APHA 23rd EDN -3111 B	0.01
26	Selenium as Se	mg/l	APHA 23rd EDN -3113B	0.05
27	Total Arsenic as As	mg/l	APHA 23rd EDN -3113 B	0.2
28	Cyanide as CN	mg/l	APHA 23rd EDN -4500-CN E	0.02
29	Lead as Pb	mg/l	APHA 23rd EDN -3111 B	0.1
30	Zinc as Zn	mg/l	APHA 23rd EDN -3111 B	15
31	Total Chromium as Cr	mg/l	APHA 23rd EDN -3111 B	0.03
32	Nickel as Ni	mg/l	APHA 23rd EDN –3111 B	Not Specified
33	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2019)	Not Specified
34	Anionic Surfactants as MBAS	mg/l	APHA 23rd EDN -5540 C	1
35	Mineral oil	mg/l	FI- IR	Not Specified
36	Poly Chlorinated Biphenyls (PCBs)	mg/l	APHA 23rd EDN -6630 B	Not Specified
37	Poly Nuclear Aromatic Hydrocarbon as PAH	mg/l	APHA 23rd EDN -6440 B	Not Specified
38	Dissolved Oxygen as O_2	mg/l	IS:3025:Part-38:1989 (Reaff:2019)	4
39	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006 (Reaff:2019)	Not Specified
40	Bio-Chemical Oxygen Demand at 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2019)	3
41	Oil and Grease	mg/l	IS:3025:Part-39:1991 - Reaff:2019)	0.1
42	Total Coliforms	MPN/100ml	IS: 1622 -1981 (Reaff – 2014)	5000
43	E coli	MPN/100ml	IS: 1622-1981(Reaff – 2014)	Not Specified

Table 4-9 Summary of Surface Water Quality Results

S. No	Parameter	Unit	Results			
			SW1	SW2	SW3	SW4
1	Temperature	°C	26.6	27.5	28.4	29
2	Colour	Hazen	25	10	10	35
3	Odour	-	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
4	pH at 25°C	-	8.05	7.85	7.95	8.23
5	Electrical Conductivity	µS/cm	654	492	612	982
6	Turbidity	NTU	11.6	4.7	2.7	13.3
7	Total Dissolved Solids	mg/l	345	266	339	552
8	Total Hardness as CaCO3	mg/l	120	110	146	240
9	Total Alkalinity as CaCO3	mg/l	102	92	124	188
10	Chloride as Cl	mg/l	115	85	97	156
11	Sulphate as SO4	mg/l	28	14	30	58
12	Fluoride as F	mg/l	0.18	0.16	0.16	0.33
13	Nitrate as NO3	mg/l	8	5	9	21
14	Ammonia as NH3	mg/l	0.52	0.23	0.37	1.98
15	Phosphate as PO4	mg/l	0.68	0.34	0.52	1.13
16	Sodium as Na	mg/l	78	60	72	110
17	Potassium as K	mg/l	4.2	2.7	4.3	5.2
18	Calcium as Ca	mg/l	33	25	31	52
19	Magnesium as Mg	mg/l	9.1	11.5	12.7	26.7
20	Iron as Fe	mg/l	0.44	0.25	0.19	0.58
21	Manganese as Mn	mg/l	0.14	0.08	0.10	0.13
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)
23	Total Suspended Solids	mg/l	10	6	7	18
24	Dissolved Oxygen as O2	mg/l	5.3	5.5	5.7	4.5
25	Chemical Oxygen Demand	mg/l	30	18	16	38
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	3.2	2	2	6.3
27	Phenolic compounds as C6H5OH	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	0.11
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.01
35	Zinc as Zn	mg/l	0.14	0.11	0.13	0.27
36	Total Chromium as Cr	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
37	Nickel as Ni	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
38	Oil & Grease	mg/l	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)

39	Poly Chlorinated Biphenyls (PCBs)	mg/l	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)
40	Poly Nuclear Aromatic Hydrocarbon as PAH	mg/l	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)
41	Total Coliform	MPN/ 100ml	>1600	>1600	>1600	>1600
42	Faecal Coliform	MPN/ 100ml	>1600	>1600	>1600	>1600

Table 4-10 Ground Water Quality Monitoring Locations

Sample Code	Location	Coordinates
GW1	POONJERI	12°37'27.16"N, 80° 9'10.48"E
GW2	MANAPATHY	12°43'8.10"N, 80° 4'58.38"E
GW3	NELLIKUPPAM	12°40'54.60"N, 80° 6'3.21"E
GW4	KONDAMANGALAM	12°44'37.33"N, 80° 2'49.97"E

Figure 4-8: Ground Water Quality Monitoring

Table 4-11 Summary of Ground Water Quality Results

S. No.	Parameter	Unit	Results			
			GW3	GW4	GW3	GW4
1	Colour	Hazen	<1	1	<1	1
2	Odour	-	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
3	Turbidity	NTU	0.5	BDL(<0.5)	0.5	BDL(<0.5)
4	pH at 25 °C	-	7.33	7.55	7.33	7.55
5	Conductivity at 25 °C	µS/cm	1116	1445	1116	1445
6	Total dissolved solids	mg/l	635	837	635	837
7	Total Suspended solids	mg/l	<2	<2	<2	<2
8	Total Alkalinity as CaCO3	mg /l	270	330	270	330
9	Total Hardness as CaCO3	mg/l	316	460	316	460
10	Calcium as Ca	mg/l	86	108	86	108
11	Magnesium as Mg	mg/l	24.5	46	24.5	46
12	Chloride as Cl-	mg/l	166	207	166	207
13	Sulphate as SO4	mg/l	82	112	82	112
14	Nitrate as NO3	mg/l	3	11	3	11
15	Iron as Fe	mg/l	0.11	0.23	0.11	0.23
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
17	Fluoride as F	mg/l	0.29	0.41	0.29	0.41
18	Sodium as Na	mg/l	102	74	118	144
19	Potassium as K	mg/l	2.4	1.3	2.1	3.6
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
26	Zinc as Zn	mg/l	0.05	0.03	0.05	0.17
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
29	Cyanide as CN	mg/l	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
34	Pesticides	mg/l	Absent	Absent	Absent	Absent
35	Total Coliforms	MPN/ 100ml	<2	<2	<2	4
36	E.coli	MPN/ 100ml	<2	<2	<2	<2

Table 4-12 Ground Water standards as per IS10500

Parameters	Unit	Test Method	Limit as per IS 10500 : 2012
Colour	Hazen	IS 3025:1983 Part 4	5
Odour	-	IS 3025:1984 Part 5	Agreeable
pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff:2017)	6.5-8.5
Electrical Conductivity at 25°C	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2019)	Not Specified
Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2017)	1
Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2017)	500
Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2017)	Not Specified
Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23- 1986(Reaff:2019)	200
Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009 (Reaff: 2019)	200
Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2019)	250
Sulphate as SO_4	mg/l	APHA 23rd EDN -4500- SO_4^{2-} E	200
Fluoride as F	mg/l	APHA 23rd EDN -4500-F B&D	1.0
Nitrate as NO_3	mg/l	APHA 23rd EDN -4500- NO_3^- B	45
Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2019)	75
Magnesium as Mg	mg/l	APHA 23rd EDN Mg B	30
Iron as Fe	mg/l	APHA 23rd EDN -3111 B	1
Manganese as Mn	mg/l	APHA 23rd EDN -3111 B	0.1
Copper as Cu	mg/l	APHA 23rd EDN -3111 B	0.05
Mercury as Hg	mg/l	APHA 23rd EDN -3112B	0.001
Cadmium as Cd	mg/l	APHA 23rd EDN -3111 B	0.003
Selenium as Se	mg/l	APHA 23rd EDN -3113B	0.01
Total Arsenic as As	mg/l	APHA 23rd EDN -3113 B	0.01
Cyanide as CN	mg/l	APHA 23rd EDN -4500-CN E	0.05
Lead as Pb	mg/l	APHA 23rd EDN -3111 B	0.01
Zinc as Zn	mg/l	APHA 23rd EDN -3111 B	5
Total Chromium as Cr	mg/l	APHA 23rd EDN -3111 B	0.05
Aluminum as Al	mg/l	APHA 23rd EDN -3500-Al-B 2012	0.03
Barium as Ba	mg/l	APHA 23rd EDN -3111 D	0.7
Residual Free Chlorine	mg/l	APHA 23rd EDN -4500-Cl B	0.20
Anionic Surfactants as MBAS	mg/l	APHA 23rd EDN 5540 C	0.20
Phenolic Compounds as Phenol	mg/l	APHA 23rd EDN 5530 B,C	0.001
Pesticides	mg/l	APHA 23rd EDN - 6630 B, C	Absent
Total Coliforms	MPN / 100ml	IS 1622 (1981) (Reaff – 2019)	Absent/ 100ml
E coli	MPN / 100ml	IS 1622 (1981)(Reaff – 2019)	Absent/ 100ml

Table 4-13 Noise Quality Monitoring Locations

Sample Code	Location	Coordinates
N1	POONJERI JUNCTION	12°36'57.44"N, 80° 9'58.71"E
N2	PORANTHAVAKKAM	12°38'33.39"N, 80° 7'43.66"E
N3	KATTUR	12°40'38.81"N, 80° 5'51.37"E
N4	KARUMBAKKAM	12°43'20.20"N, 80° 5'33.70"E
N5	KONDAMANGALAM	12°44'57.15"N, 80° 2'21.93"E
N6	SENGUNDRAM	12°45'48.97"N, 80° 0'38.97"E

Table 4-14 Summary of Noise Quality Results

Location Code	Sample Location	Lday [dB(A)]	Lnight [dB(A)]	Leq [dB(A)]
N1	Poonjeri junction	54.7	44.6	53.1
N2	Poranthavakkam	48.9	41.9	47.6
N3	Kattur	47.8	43	46.7
N4	Karumbakkam	49.1	42.8	47.8
N5	Kondamangalam	48.7	42.4	47.4
N6	Sengundram	56.8	45.5	55.2

Table 4-15 Ambient Noise Standards

Zone Classification	Lday dB(A)	Lnight dB(A)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

Table 4-16 Soil Quality Monitoring Locations

Sample Code	Location	Coordinates
S1	POONJERI JUNCTION	12°37'7.67"N, 80° 9'22.61"E
S2	PORANTHAVAKKAM	12°38'11.22"N, 80° 7'53.17"E
S3	KATTUR	12°40'22.12"N, 80° 5'21.76"E
S4	KARUMBAKKAM	12°43'36.73"N, 80° 5'48.36"E
S5	KONDAMANGALAM	12°44'47.15"N, 80° 3'20.18"E
S6	SENGUNDRAM	12°45'38.66"N

Figure 4-9 Soil Sampling

Table 4-17 Soil Quality Standards

S.No	Parameters	Test Methods
1	pH (1:5 Soil Suspension)	IS - 2720(Part 26) 1987(RA 2011)
2	Bulk Density, g/cc	FAO Chapter 3, ABCTL/SOIL/SOP 1
3	Electrical conductivity, mS/cm (1:5 Soil Suspension)	IS -14767:2000 (RA 2010)
4	Total Nitrogen as N, kg/ha	IS -14684:1999, Reaff:2008
5	Available Phosphorous as P, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2
6	Available Potassium as K, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7
7	Exchangeable Calcium as Ca, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4
8	Exchangeable Magnesium as Mg, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5
9	Exchangeable Sodium as Na, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6
10	Organic matter (%)	IS 2720 (Part 22):1972, Reaff:2010
11	Texture Classification	Robinson Pipette Method
12	Sand (%)	
13	Clay (%)	
14	Silt (%)	

Table 4-18 Standard Soil Classification

S.No	Parameter	Acceptable Values
1.	pH	<4.5 Extremely acidic
		4.51-5.50 Very Strongly acidic
		5.51-6.0 Moderately acidic
		6.01-6.50 Slightly acidic
		6.51-7.30 Neutral
		7.31-7.80 slightly alkaline
		7.81-8.50 moderately alkaline
		8.51-9.0 strongly alkaline
		9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mS/cm) (640 ppm=1000 µS/cm)	Upto 1.00 Average
		1.01-2.00 harmful to germination
		2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon (%)	Upto 1.0 : Very less
		0.21-0.4 : less
		0.41-0.5 : medium
		0.51-0.8 : On an average sufficient
		0.81-1.00: Sufficient
		>1.0 more than sufficient
4	Nitrogen (Kg/ha)	Upto 50 very less
		51-100 less
		101-150 good
		151-300 better
		>300 sufficient
5	Phosphorus (Kg/ha)	Upto 15 Very less
		16-30 less
		31-50 medium
		51-65 on an average sufficient
		66-80 sufficient
		>80 more than sufficient
6	Potassium (Kg/ha)	0-120 very less
		120-180 less
		180-240 medium
		240-300 average
		300-360 better
		>360 more than sufficient

Table 4-19 Summary of Soil Quality Results

S. No.	Parameters	S1	S2	S3	S4	S5	S6
1	pH	8.22	7.87	8.36	7.56	7.92	8.28
2	Bulk Density, g/cc	1.27	1.22	1.24	1.37	1.35	1.24
3	Electrical Conductivity, mS/cm	0.174	0.137	0.275	0.114	0.142	0.211
4	Total Nitrogen, kg/ha	127	184	154	146	112	214
5	Available Phosphorous, kg/ha	38.8	47.3	29.3	28.7	33.9	50.9
6	Available Potassium, kg/ha	307	378	274	252	296	410
7	Exchangeable Calcium as Ca,m.eq/100g	17.7	20	19.7	15.7	14.2	21.3
8	Exchangeable Magnesium as Mg, m.eq/100g	5.36	6.14	5.54	4.36	4.97	6.22
9	Exchangeable Sodium as Na, m.eq/100g	1.69	1.33	1.71	1.17	1.02	1.69
10	Organic matter (%)	1.14	1.42	1.32	0.96	1.08	1.32
10	Texture Classification	Clay Loam	Clay	Clay	Loam	Loam	Clay
11	Sand (%)	41.5	30.2	27.5	38.8	41.2	28.7
12	Clay (%)	32.7	53.6	60.6	24.7	25.6	61.3
13	Silt (%)	25.8	16.2	11.9	36.5	33.2	10
14	Sodium Absorption Ratio	1.57	1.16	1.52	1.17	1.04	1.44
15	Copper as Cu	3.71	BDL(<2)	4.11	BDL(<2)	BDL(<2)	5.24
16	Zinc as Zn	18.9	22.3	15.3	31	24.1	18.1
17	Manganese as Mn	32.7	36.8	23.1	28.6	37.6	42.8
18	Lead as Pb, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
19	Nickel as Ni, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
20	Chromium as Cr, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
21	Cadmium as Cd, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
22	Arsenic as As, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
23	Mercury as Hg, mg/kg	BDL (<0.5)	BDL (<0.5)	BDL (<0.5)	BDL (<0.5)	BDL (<0.5)	BDL (<0.5)

A. Total Baseline Sample

- The Ambient Air quality is selected 5 km along the alignment with the interval of 5 km, total of 6 location were selected.
- For the Noise sample we have considered sensitive receptor location like residential, commercial, industrial and silent zone.
- Surface Water sample were collected in the available surface water present near the alignment with in 5 km, total of 4 surface water sample were collected.
- Ground Water sample is collected in the available ground water pipeline along the alignment, total of 4 ground water sample are collected with the interval of 6 km.

Figure 4-10 Ground Water and Surface Water Location

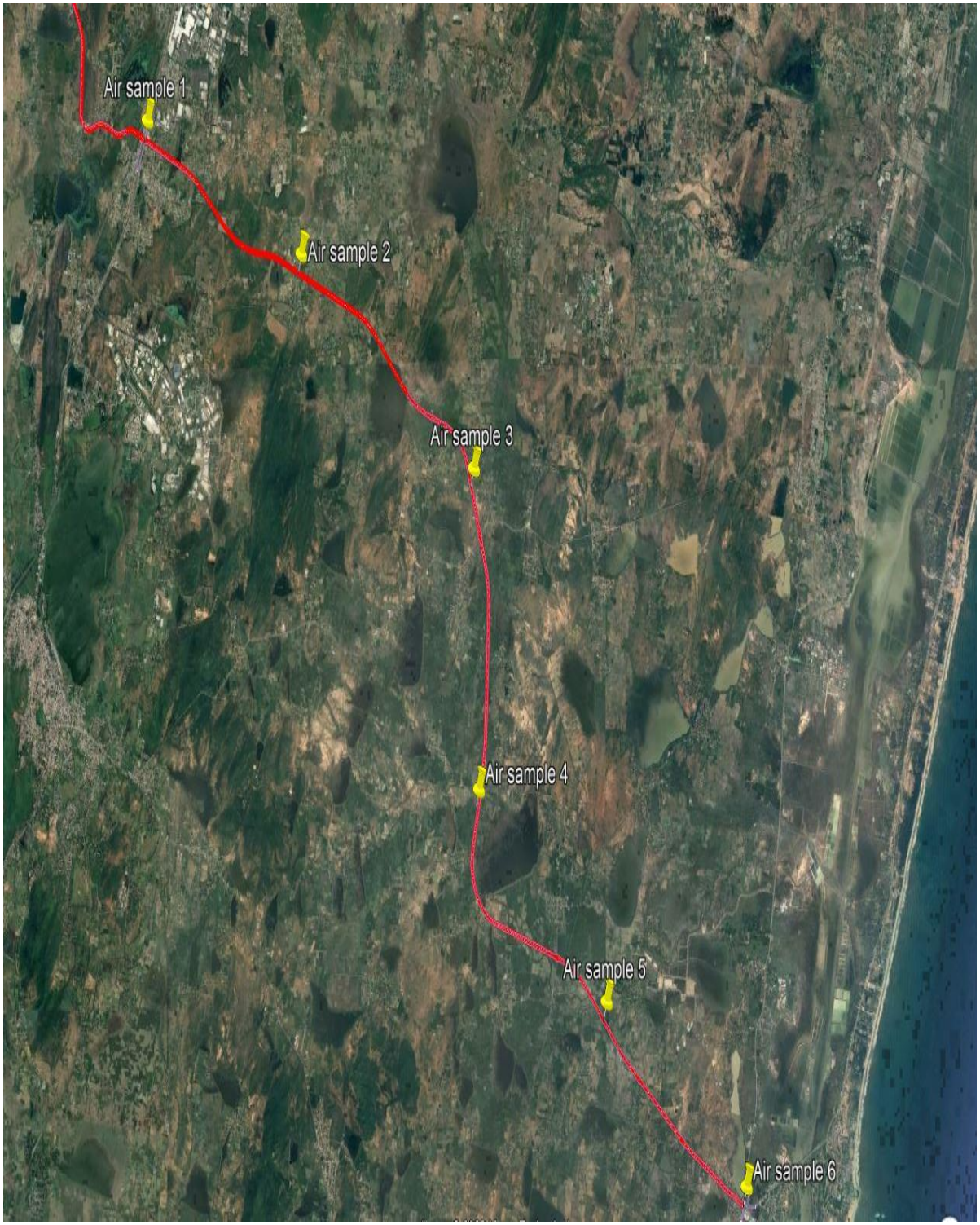


Figure 4-11 Ambient Air Quality Sampling Location

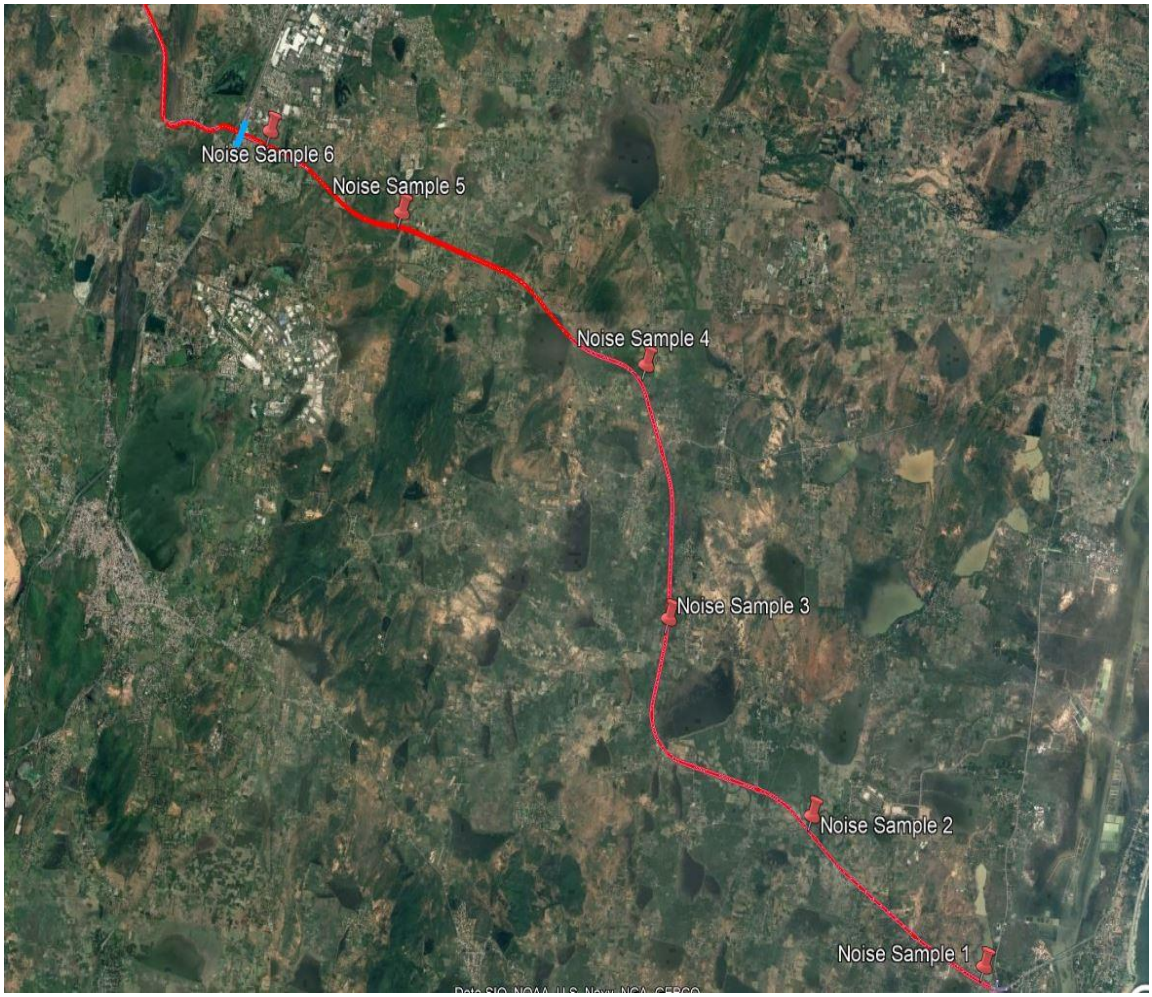


Figure 4-12 Ambient Noise Quality Sampling Location

4.6 Ecological Environment

4.6.1 Terrestrial Ecology

4.6.1.1 Introduction

An ecosystem is composed of plant and animal populations, and it differs from natural community designation in that it involves the total nutrient and energy economics of the system as well as the organisms involved. Ecosystems are self maintained and self contained. Natural ecosystems are invariably richer in species and more stable than those of artificially developed, due to their many inter-dependencies and inter-relationships.

Ecosystem shows complex inter-relationships between biotic and abiotic components leading to dependence, competition and mutualism. Biotic components comprise both plant and animal communities, interacting not only within and between themselves but also with the abiotic components of the environment. Generally, biological communities are good indicators of climatic and edaphic factors because of their strong relationships with them. The studies on the biological aspects of the ecosystem are important in Environment Impact Assessment studies for the suitability of natural flora and fauna. Information on the impact of environment stress on the community structure serves as an inexpensive and efficient early warning system to check the damage on a particular ecosystem. A change in the composition of biotic communities under stress is reflected through a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of fauna and flora existing in the ecosystem. These changes over a span of times can be quantified and related to the existing environment.

Chennai, the state capital of Tamil Nadu is one of the fastest-growing metro cities in India witnessed a significant increase in urban agglomeration over a decade. Due to increase in the population, there is a growing demand for infrastructure facilities, which includes Water supply, Underground sewerage, Electricity, and Roads. The major arterial road network in Chennai Metropolitan Area consists of National Highways (NH 16, NH 716, NH 48 and NH 32) as major radial roads and Inner Ring Road (IRR), Chennai Bypass and Outer Ring Road (ORR) as ring roads. However, the available road network observed to be limited concerning the growing population and hence to cater to the traffic congestion, Tamil Nadu Highways Department has chosen to develop Chennai Peripheral Ring Road (CPRR). The CPRR has 5 segments as follows.

Section	CPRR Break-up	Length (km)
1	Northern Port Access Road– Ennore port to Thatchur on NH 16	25.31
2	Thatchur on NH 16 to Start of Thiruvallur Bypass	26.10
3	Start of Thiruvallur Bypass to Sriperumbudur on NH 48	30.10
4	Sriperumbudur on NH 48 to Singaperumal Koil on NH 32	23.80
5	Singaperumal Koil on NH 32 to Mamallapuram	27.471
	Total	**132.781**

The proposed study location is at the Chennai Peripheral Ring Road Section V from Singaperumal Koil at NH 45 to Mamallapuram located in Chengalpattu District, Tamil Nadu.

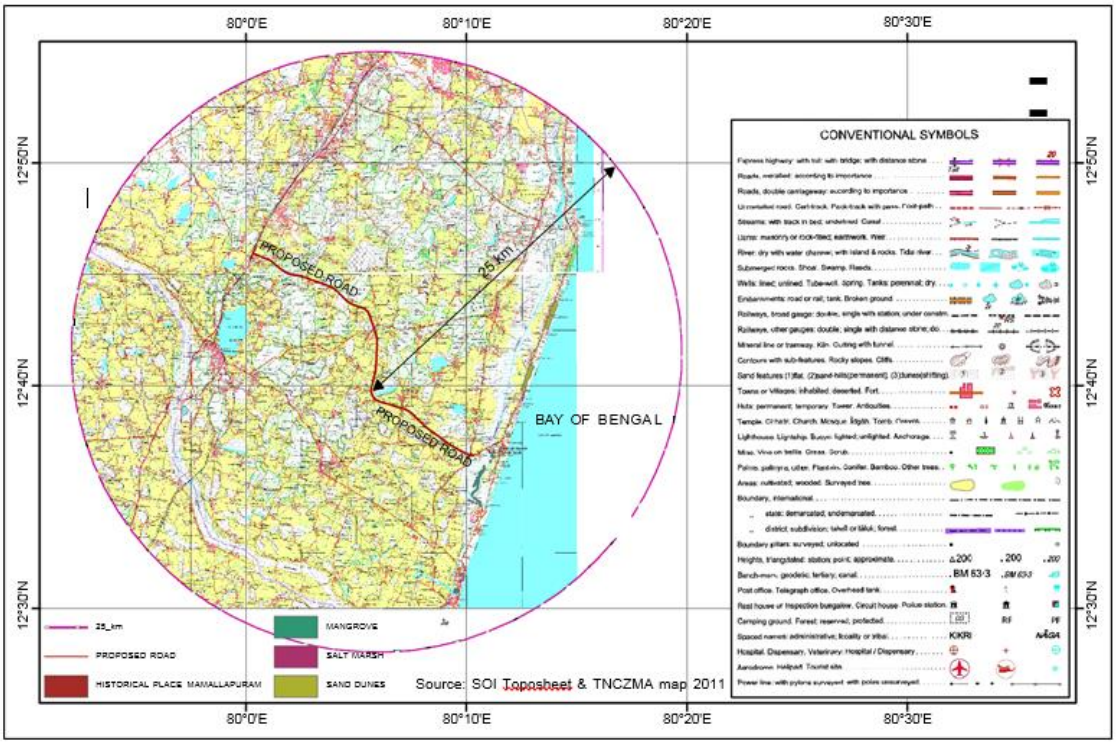


Figure 4-13 Topo Map of the Project Site

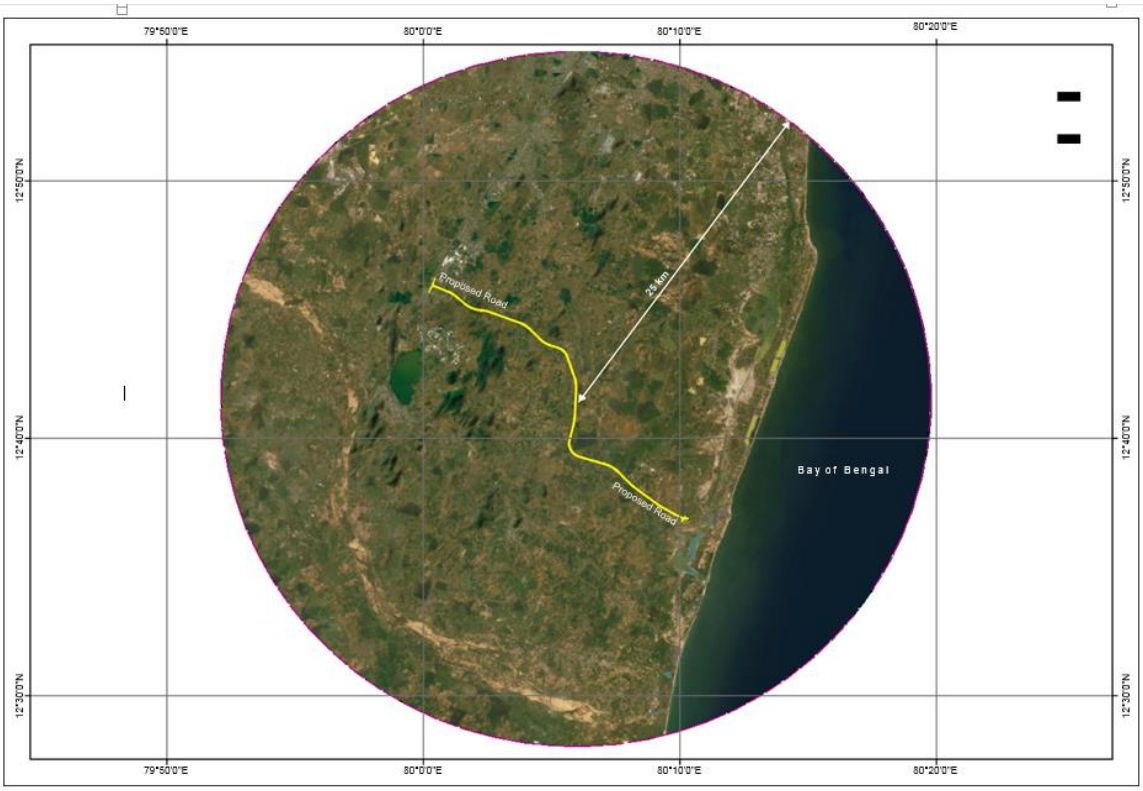


Figure 4-14 Satellite Image of the Project Site

4.6.1.2 Objectives

The objectives of ecological study during the study period of EIA study period may be outlined as follows:

- To characterize the environmental components like land, water, flora and fauna;
- To understand their present status;
- To understand carrying capacity of the ecosystem;
- To assess present bio-diversity; and
- To identify susceptible and sensitive areas.

4.6.1.3 Regional Biodiversity

Tamil Nadu has a total land area of 130,060 km² which constitute of about 3.96% of the total geographical area of the country. Physiographically, the State can be divided into four major regions viz Coastal Plains, Eastern Ghats, Central Plateau and Western Ghats. The main rivers of

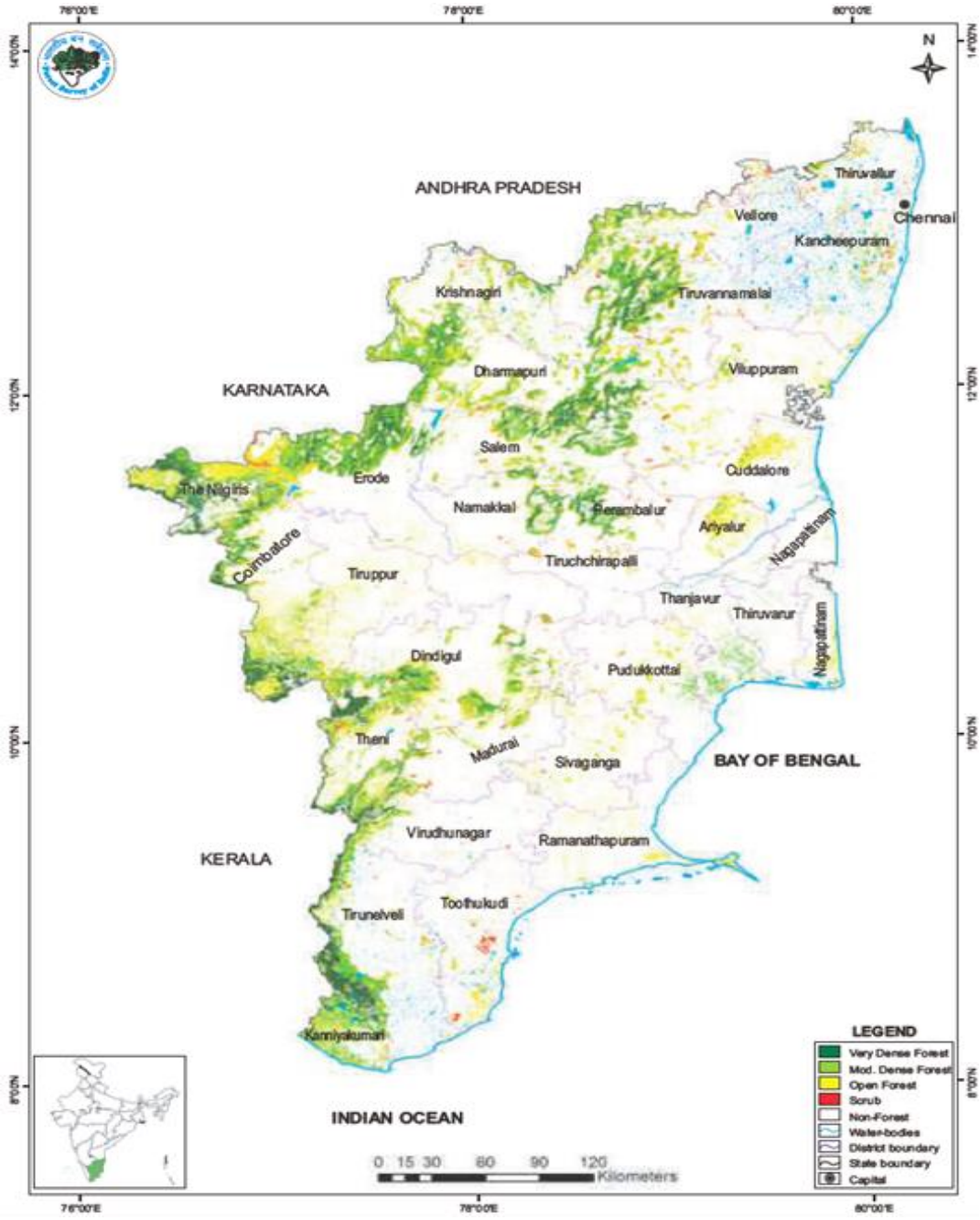
the State are Cauvery, Bhavani, Palar, Vaigai etc. which drain into the Bay of Bengal. Tamil Nadu has a Humid Tropical Climate.

Forest Biodiversity in the State is mainly confined to Western Ghats and Eastern Ghats. Forest Cover of the State is 21,570 km² which is 16.55% of the State's geographical area (GA). In terms of forest canopy density classes, the State has 3,593 km² (2.76% of GA) very dense forest, 11,034 km² (8.48% of GA) moderately dense forest and 11,729 km² (9.07% of GA) open forest respectively (Source: FSI, 2021; www.forests.tn.gov.in).

The mangrove cover in the State is 44.83 km², which is 0.035% of the State total geographical area. The Very Dense mangrove comprises 1.04 km² of the mangrove cover, Moderately Dense mangrove is 27.24 km² while open mangroves constitute an area of 16.55 km².

Recorded Forest Area (RFA) in the State is 22,877 km² which constitute of about 17.59% and 2.99% of the total geographical area of the State and Country respectively, of which 20,293 km² is Reserved Forest, 1,782 km² is Protected Forest and 802 km² is Unclassed Forests. The RFA covers 17.59% of geographical area of the State. The reserved, protected and unclassed forests are 88.70%, 7.79% and 3.51% of the recorded forest area in the State respectively.

Tropical dry Deciduous Forest covers an area of 12.23 lakh ha constituting 54.30%, Tropical Thorn Forest covers an area of 5 lakh ha constituting 22.10%, Tropical Moist Deciduous Forest covers an area of 2.60 lakh ha constituting a percentage of 11.10%. The Biodiversity rich forest types are the Tropical Wet Evergreen Forest covering an area of 0.60 lakh ha constituting 2.67%, Tropical Semi Evergreen Forest covering an area of 0.23 lakh ha constituting 1.01%, Subtropical Broad leaved Hill Forest covers an area of 1.14 lakh ha constituting 5.04%, the Tropical Dry Evergreen Forest which is a unique type of Tamil Nadu covers an area of 0.26 lakh ha constituting 1.16%, the mangrove forest covers an area of approximately 0.23 lakh ha constituting 1.01%.



Source: Forest Survey of India, 2021

Figure 4-15 Forest Map of Tamil Nadu

Habitat fragmentation is the process by which habitats which were once continuous become divided into separate fragments. This mainly happens due to human activities such as agriculture, rural development and urbanization. As cities and civilization grow in size, the fragmentation of

habitats causes extinction of many plant and animal species and is the largest threat to biodiversity on earth. Designing with nature can improve the quality of cities for people, plants and animals. In doing so, ecosystem services can be enhanced.

The state's rich biodiversity and the natural resources are facing a serious threat from the growing human encroachments, cattle grazing, collection of firewood, man-animal conflict, poaching, illicit felling, mass tourism and pilgrimage etc. and also from various developmental activities. Biodiversity Conservation has been structured covering the Ecosystem Diversity, Species Diversity and Genetic Diversity. Species Diversity has been structured separately for plants and animals. Wild plant diversity has been structured on the lines of Red-listed plants, Endemic plants, Medicinal plants, Wild relatives of cultivated plants, allied species of cultivated species and others.

Wild Animal diversity has been structured on the lines of Red listed animals, Endemic animals, Flagship species, Keystone species, Pollinators and others. Domesticated species diversity has been structured on the lines of Cultivated Plants and Domesticated animals.

Chengalpattu District

Chengalpattu District has a geographical area of 2,945 km². The district is situated on the northeast coast of Tamil Nadu and bounded on the north by the Chennai district, West by the Kancheepuram district and Thiruvanamalai Districts and on the south by the Vilupuram District. With a coastal length of 57 km, the district is bounded in the east by the Bay of Bengal.

Palar River is one of the major rivers in the state of Tamil Nadu traversing through Chengalpattu district for a length of 54 km. The river Palar enters the district at Palur Village and confluxes with Bay of Bengal between Vayalur and Kadalur Villages. Moreover, the district is bounded by the Adayar River in the north and the Ongur River in the south. Besides the aforesaid rivers, Neenjal Maduvu, Pukkadurai Odai, and Kiliyar are other minor rivers flowing through Chengalpattu District. The district is home to 528 major irrigation tanks having ayacut of more than 40 ha each.

Most of the agricultural activity is dominated by Paddy, Pulses, oil seeds, Tapiaco, Greengram, fruit crops and vegetables. Watermelons are cultivated in Kodur, Cheyyur and its surrounding areas during summer. The major cash crops are Coconut, Groundnut and Banana are also cultivated in considerable area.

4.6.1.4 Biogeographic zone, province and Forest type

This study has been carried out during the October 2022 of study period for the purpose of providing an independent and comprehensive baseline assessment of the flora, terrestrial vertebrate, aquatic fauna and associated habitat values of the site and around the project sites at the Chennai Peripheral Ring Road Section V from Singaperumal Koil at NH 45 to Mamallapuram

located in Chengalpattu District, Tamil Nadu and a subsequent assessment of potential ecological impacts.

The study area falls under semi-arid category as far as the Indian Biogeographical Zones *(Rodger, Panwar, and Mathur 2000)* are concerned. Under the biogeographical provinces, the study area falls under the category of **6E-Deccan Peninsula-Deccan South.**

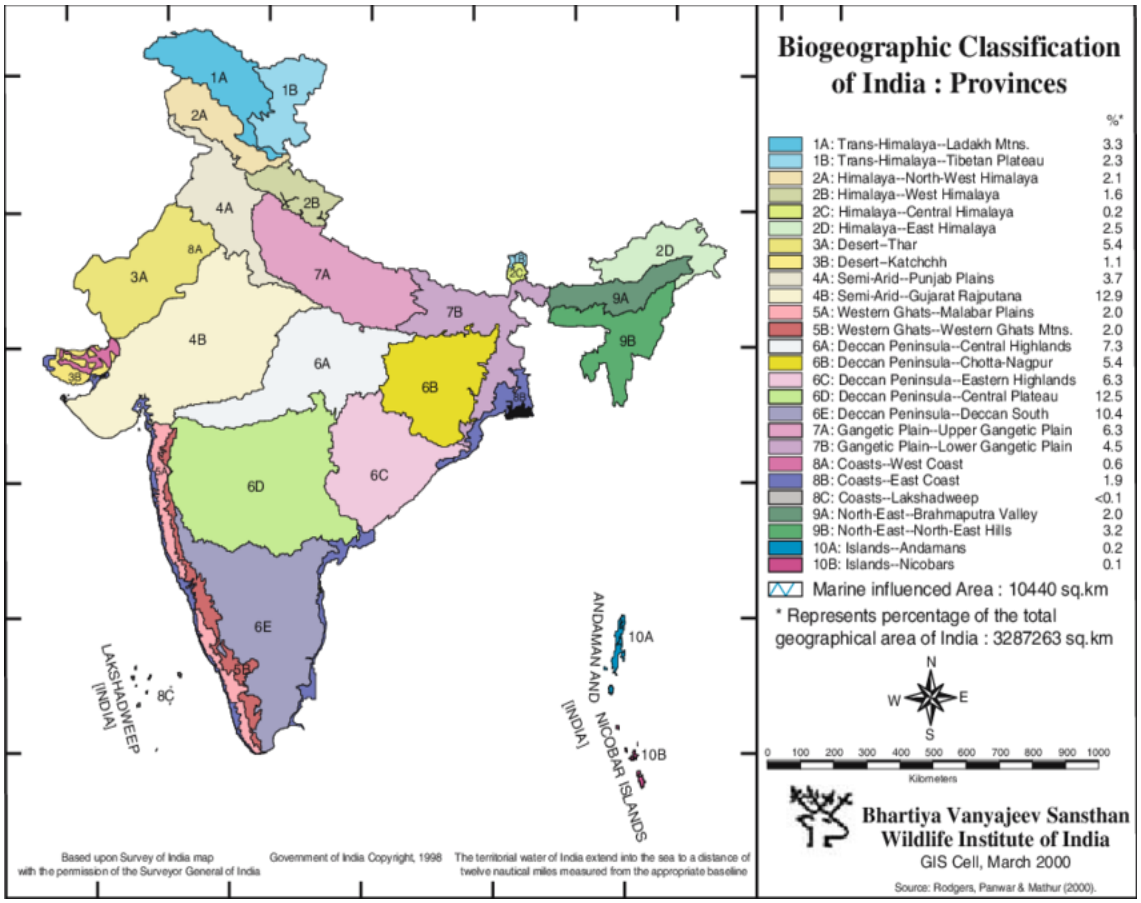


Figure 4-16 Map showing the Bio-geographic Provinces of India

The field investigation and satellite imagery data show that the study area is is a mixture of coastal region, agricultural and get irrigated by tanks and bore wells. The dry tropical vegetation is observed within the study area. The experimental finding of the pre-monsoon season shows the dominance of grasses like *Cyperus rotundus, Cynodon dactylon*. From the primary observations, the tree species recorded in the study area were *Borassus flabellifer, Acacia auriculiformis, Cocos nucifera, Azadirachta indica, Acacia nilotica, Phoenix sylvestris, Mangifera indica* etc. Some of the common shrub species are *Calotropis procera, Datura metel, Lantana camara, Nerium oleander, Sida cordifolia* etc. and *Amaranthus spinosus, Boerhavia diffusa, Acanthospermum hispidum,*

Achyranthes aspera, Euphorbia hirta, Cassia tora, Hyptis suaveolens, Sida acuta, Tridax procumbens etc. among herbaceous species.

The detailed ecological assessment of the study area has been carried out with the following objectives:

- To establish the present status of ecological conditions surrounding the project location;
- To study the existing anthropogenic stresses on the prevailing ecosystem.
- To identify and predict the likely impacts on the local ecosystem from the proposed activities;
- To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Act, 1972;
- To define ecological/conservation status of each species as per IUCN categories (Red Data List).
- To formulate migratory measures and a sustainable Environmental Management Plan (EMP) basing upon the likely impacts.

During survey, following aspects were considered for ecological studies:

- Assessment of present status of flora and fauna;
- Identification of rare and endangered species of plants and animals (if any);
- Identification of ecologically sensitive areas within the study area;
- Assessment of migratory route of wildlife (if any); and
- Assessment of Aquatic Ecology with specific reference to aquatic birds and fishery resources.

4.6.1.5 Methodology

A desktop review (published documents etc.) was conducted to determine the forest area through Satellite imagery, vegetation type *(Champion and Seth, 1962),* floral and faunal assemblage in the study area. Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out to collect information related to local biodiversity in and around the villages. The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area;

- Compilation of secondary information available in published literatures/ forest working plans etc.
- Site Verification and finalization in consultation with Project proponent, local inhabitants.

A. Floral Study

The assessment of the flora of the study area is done by an extensive field survey of the study area.

- Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature.
- Besides the identification of plant species, information was collected on the vernacular names and uses of plants made by local inhabitants.
- Qualitative analysis of vegetation is made by two different methods such as floristic (by simple studying various genera and species of various plant groups i.e. herbs, shrubs, trees, etc.).

B. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important animal groups such as birds, mammals and reptiles for sampling of animals through the following methods.

- For sampling birds/ avifauna 'point sampling' along the fixed transects (foot trails) were done to record all the species of birds with the help of binoculars; field guides and photography for more than 1 hour on each transect (n=4).
- For sampling mammals, 'direct count on open width (20 m) transect' were used on the same transects. Besides, information on recent sightings/records of mammals by the locals are also collected from the study areas.
- 'Reptiles' mainly lizards were sampled by 'direct count on open width transects'.
- Secondary information collected from local villagers, published government data etc.

❑ **List of the endangered and endemic species as per the schedule of The Wildlife Protection Act, 1972**

Emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife Protection Act 1972, as well as in Red List of IUCN. Various methods used for study animals are as follows:

A. **Point Survey Method:** Observations were made at each site for 15-20 min duration.

B. **Road Side Counts:** The observer travelled by motor vehicles from site to site and all sightings were recorded.

4.6.1.6 Floristic composition within the study area

The ecology and diversity survey was conducted in the study area. It is observed that human settlements present within the study area and many of areas have moderate ranges of plantations. Most of the vegetations are natural vegetation observed within the study area. During site assessment several floral species encountered within the study area.

The plants grown are mostly of economic importance. Among the fruit trees which are common are Coconut, Mango, lime, Banana, Papaya, etc. Among the non-fruit trees the common ones are Neem, Curry tree etc. Coconut and Betel nut palm is mostly planted in plantations. During site assessment several floral species encountered within the study area.

The study area does not have any forest land and permanent natural vegetation. From the primary observation, the tree species recorded in the study area in the plantation area were *Borassus flabellifer, Acacia auriculiformis, Cocos nucifera, Azadirachta indica, Acacia nilotica, Phoenix sylvestris, Mangifera indica* etc. The survey was conducted in the study area and its surroundings.

The study area reveals the presence of reserved forests such as Vallam reserved forest located about 9.45 km, Thirutheri Reserved Forest located about 0 km, Sengundram Reserved Forest located about 0 km, Sirugundram Reserved forest located about 0 km, Appur Reserved forest located about 4 km, Siruvanjur Reserved forest located about 4.6 km, Kattankulathur Reserved forest located about 3.1 km, Gudlur Reserved forest located about 3.8 km and Kumili Reserved forest located about 8.7 km. There are no other protected forests within the study area of 15 km radius. However, the vegetation within the study area is moderate density, with the existence of some weeds as per the survey conducted within the study area. The results of survey exhibited sparsy vegetation with the existence of 136 terrestrial flora. Since the project area is not a forest area and water scarcity is always a problem most of the area is covered with the invasive plant. However, coconut, Neem, Acacia trees are widely distributed away from the study area.

The following species were encountered from the study area during the field visits as given in Table 4-20.

Table 4-20 Floristic Diversity in the Study Area

S. No.	Scientific Name	Common Name	Family	IUCN Conservation Status	Status
Tree					
1	*Albizia lebbeck*	Siridam	Fabaceae	Not assessed	Common
2	*Cassia siamea*	Manjal konrai	Caesalpiniaceae	Not assessed	Common
3	*Acacia auriculiformis*	Katthisavukku	Mimosaceae	Not assessed	Common

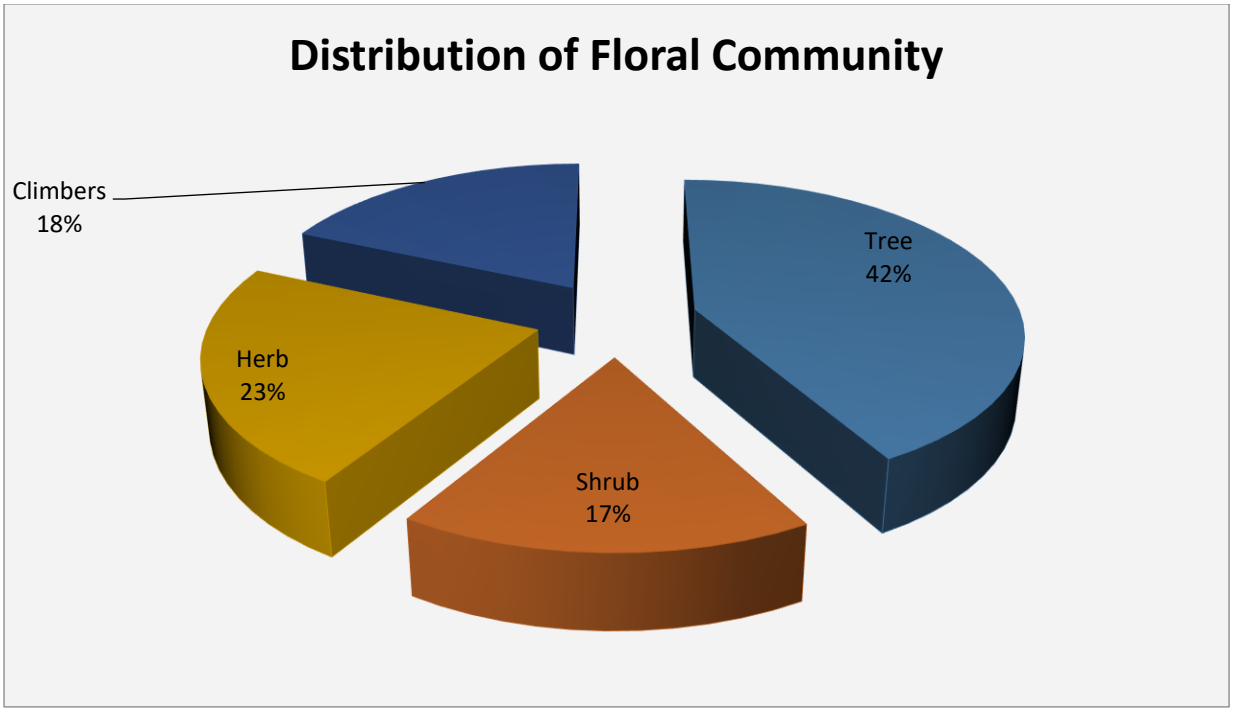
S. No.	Scientific Name	Common Name	Family	IUCN Conservation Status	Status
4	*Buchanania lanzan*	Charam	Anacardiaceae	Not assessed	Common
5	*Albizia saman*	Thoongumoonji maram	Fabaceae	Secure	Common
6	*Eucalyptus leptophylla*	Neelagiri thailam	Myrtaceae	Not assessed	Planted
7	*Cassia fistula*	Appai	Caesalpiniaceae	Least Concern	Very Common
8	*Bauhinia racemosa*	Atti	Fabaceae	Not assessed	Common
9	*Borassus flabellifer*	Nonkuppanai	Arecaceae	Endangered	Common
10	*Carica papaya*	Pappali	Caricaceae	Not assessed	Common
11	*Bridelia retusa*	Mullu-Vengai	Phyllanthaceae	Not assessed	Common
12	*Acacia nilotica*	Karuv Elai	Mimosaceae	Not assessed	Common
13	*Bambusa arundinacea*	Kulay-munkil	Poaceae	Not assessed	Common
14	*Diospyros melanoxylon*	Karundumbi	Ebenaceae	Not assessed	Planted
15	*Gardenia gummifera*	Sirukkambil	Rubiaceae	Least Concern	Planted
16	*Madhuca longifolia*	Illupei	Sapotaceae	Not assessed	Common
17	*Ficus racemosa*	Atthi	Moraceae	Least Concern	Common
18	*Gmelina arborea*	Kumalaamaram	Lamiaceae	Least Concern	Common
19	*Melia azedarach*	Kattu vembhu	Meliaceae	Not assessed	Common
20	*Ailanthus excelsa*	MahaNeem	Simaroubaceae	Not assessed	Common
21	*Manilkara zapota*	Sapota	Sapotaceae	Not assessed	Common
22	*Neolamarckia cadamba*	Vellaikkatampu	Rubiaceae	Not assessed	Common
23	*Phoenix acaulis*	Kaattu echam	Arecaceae	Not assessed	Very Common
24	*Phyllanthus emblica*	Nelli	Euphorbiaceae	Least Concern	Common
25	*Murraya koenigii*	Karivepillai	Rutaceae	Not assessed	Very Common
26	*Alstonia scholaris*	Elilaipalai	Apocynaceae	Least Concern	Common
27	*Butea monosperma*	Parasa	Fabaceae	Not assessed	Common
28	*Aegle marmelos*	Vilvam	Rutaceae	Not assessed	Very Common
29	*Casuarina equisetifolia*	Savukku	Fabaceae	Not assessed	Very Common
30	*Albizia amara*	Wunja	Mimosaceae	Not assessed	Common
31	*Cocos nucifera*	Tennai	Arecaceae	Not assessed	Very Common
32	*Artocarpus heterophyllus*	Palaa	Moraceae	Not assessed	Common
33	*Bombax ceiba*	Sittan	Bombacaceae	Not assessed	Very Common
34	*Terminalia arjuna*	Marutham	Combritaceae	Not assessed	Common
35	*Terminalia bellirica*	Thandri	Combritaceae	Not assessed	Common
36	*Wrightia tinctoria*	Paalai	Apocynaceae	Not assessed	Common
37	*Azadirachta indica*	Veppai	Meliaceae	Not assessed	Very Common
38	*Delonix regia*	Cemmayir-konrai	Fabaceae	Least Concern	Common
39	*Delonix elata*	Perungondrai	Fabaceae	Least Concern	Rare
40	*Dalbergia sissoo*	Shisham	Fabaceae	Not assessed	Common
41	*Ficus benghalensis*	Alai	Moraceae	Not assessed	Common
42	*Annona squamosa*	Sitapalam	Annonaceae	Not assessed	Planted
43	*Citrullus colocynthis*	Kumatti	Cucurbitaceae	Not assessed	Common
44	*Ficus religiosa*	Araca-maram	Moraceae	Not assessed	Common
45	*Polyalthia longifolia*	Nettilinkam	Annonaceae	Not assessed	Common
46	*Musa paradise*	Vaazha	Musaceae	Not assessed	Common
47	*Prosopis juliflora*	Vaelikaruvai	Fabaceae	Not assessed	Common

S. No.	Scientific Name	Common Name	Family	IUCN Conservation Status	Status
48	*Mangifera indica*	Mamaram	Anacardiaceae	Data Deficient	Common
49	*Terminalia catappa*	Nattuvadumai	Combretaceae	Not assessed	Rare
50	*Morinda citrifolia*	Nuna	Rubiaceae	Not assessed	Common
51	*Phoenix sylvestris*	Thangtup	Arecaceae	Not assessed	Common
52	*Tectona grandis*	Tekku	Verbenaceae	Not assessed	Common
53	*Tamarindus indica*	Puli	Caesalpiniacae	Not assessed	Very Common
54	*Syzygium cumini*	Naval	Myrtaceae	Not assessed	Common
55	*Psidium guajava*	Segapu	Myrtaceace	Not assessed	Common
56	*Ziziphus mauritiana*	Elandhai	Rhamnaceae	Not assessed	Common
57	*Citrus medica*	Elumiccai	Rutaceae	Not assessed	Common
Shrubs					
1	*Jasminum sessiliflorum*	Kuruvilaangkodi	Oleaceae	Not assessed	Common
2	*Agave tomentosa*	Malai-k-koyya	Agavaceae	Not assessed	Common
3	*Lantana camara*	Unnichedi	Verbenaceae	Not assessed	Very Common
4	*Balanites aegyptiaca*	Nanchundan	Zygophyllaceae	Not assessed	Common
5	*Bougainvillea spectabilis*	Bougainvillea	Nyctaginaceae	Not assessed	Planted
6	*Calotropis procera*	Vellai Erukku	Asclepiadaceae	Not assessed	Common
7	*Sida cordifolia*	Arivalmukku	Malvaceae	Not assessed	Common
8	*Tecoma stans*	Manjarali	Bignoniaceae	Not assessed	Common
9	*Nerium oleander*	Arali	Apocynaceae	Not assessed	Common
10	*Jatropha curcas*	Kattukkottai	Euphorbiaceae	Not assessed	Rare
11	*Calotropis gigantea*	Erukku	Asclepiadaceae	Not assessed	Common
12	*Datura metel*	Dhutura	Solanaceae	Not assessed	Common
13	*Euphorbia tirucalli*	Cakkalavi	Euphorbiaceae	Least Concern	Common
14	*Hibiscus rosa sinensis*	Ampurukam	Malvaceae	Not assessed	Common
15	*Tarenna asiatica*	Tharani	Rubiaceae	Not assessed	Common
16	*Oxalis corniculata*	Paliakiri	Oxalidaceae	Not assessed	Rare
17	*Euphorbia geniculata*	Amman-paccarici	Euphorbiaceae	Not assessed	Common
18	*Vitex negundo*	Nochi	Verbenaceae	Not assessed	Common
19	*Ziziphus nummularia*	Narielandai	Rhamnaceae	Not assessed	Common
20	*Xanthium strumarium*	Marul-umattai	Asteraceae	Not assessed	Common
21	*Dodonaea viscosa*	Virali	Sapindaceae	Not assessed	Common
22	*Woodfordia fruticosa*	Velakkai	Lythraceae	Least Concern	Common
23	*Morinda pubescens*	Mannanunai	Rubiaceae	Not assessed	Very Common
Herbs					
1	*Plumbago zeylanica*	Chittiramoolam	Plumbaginaceae	Not assessed	Common
2	*Abutilon indicum*	Akatam	Malvaceae	Not assessed	Common
3	*Achyranthes aspera*	Nayuruvi	Amaranthaceae	Not assessed	Very Common
4	*Cassia tora*	Taghrai	Caesalpiniaceae	Not assessed	Very Common
5	*Aloe vera*	Katrazhai	Liliaceae	Not assessed	Planted
6	*Chloris barbata*	Chevvarakupul	Poaceae	Not assessed	Common
7	*Cyperus rotundus*	Panni-korai	Cyperaceae	Not assessed	Common
8	*Amaranthus spinosus*	Mullukkeerai	Amaranthaceae	Not assessed	Common
9	*Commelina benghalensis*	Kanang-karai	Comllinaceae	Not assessed	Common

S. No.	Scientific Name	Common Name	Family	IUCN Conservation Status	Status
10	*Boerhavia diffusa*	Mukaratte kirai	Nyctaginaceae	Not assessed	Common
11	*Argemone mexicana*	Eliyotti	Papaveraceae	Not assessed	Common
12	*Digera muricata*	Thoyya keerai	Amaranthaceae	Not assessed	Common
13	*Eclipta prostrata*	Karisalanganni	Asteraceae	Not assessed	Common
14	*Indigofera oblongifolia*	Avuri	Fabaceae	Not assessed	Rare
15	*Ocimum basilicum*	Sweet basil	Lamiaceae	Not assessed	Common
16	*Ocimum sanctum*	Thulasi	Lamiaceae	Not assessed	Planted
17	*Mimosa pudica*	Thottaccurungi	Fabaceae	Least Concern	Common
18	*Phyllanthus amarus*	Keelanelli	Phyllanthaceae	Not assessed	Common
19	*Sida acuta*	Karuncaranai	Malvaceae	Not assessed	Very Common
20	*Solanum nigrum*	Manathakkali	Solanaceae	Not assessed	Common
21	*Phyla nodiflora*	Poduthalai	Verbenaceae	Least Concern	Rare
22	*Vernonia cinerea*	Puvamkuruntal	Asteraceae	Not assessed	Common
23	*Sida cordifolia*	Mayir-manikham	Malvaceae	Not assessed	Common
24	*Ipomoea dissecta*	Kakkattan	Convolvulaceae	Not assessed	Common
25	*Helicteres isora*	Valampuri	Sterculiaceae	Not assessed	Common
26	*Cynodon dactylon*	Arugu	Poaceae	Not assessed	Very Common
27	*Dinebra retroflexa*	Viper grass	Poaceae	Not assessed	Very Common
28	*Aerva lanata*	ciru-pulai	Amaranthaceae	Not assessed	Common
29	*Cymbopogon citratus*	Karppurappul	Poaceae	Not assessed	Common
30	*Euphorbia hirta*	Ammam Paccharisi	Euphorbiaceae	Not assessed	Common
31	*Tridax procumbens*	Vettukkaaya-thalai	Asteraceae	Not assessed	Common
Climbers					
1	*Abrus precatorius*	Kundumani	Fabaceae	Not assessed	Common
2	*Aristolochia bracteolata*	Aduthinnarppalai	Aristolochiaceae	Not assessed	Common
3	*Basella rubra*	Pasalakkirai	Basellaceae	Not assessed	Common
4	*Bougainvillea spectabilis*	Kakitha poo	Nyctaginaceae	Not assessed	Common
5	*Cissus quadrangularis*	Perandai	Vitaceae	Not assessed	Common
6	*Citrullus colocynthis*	Kumatti	Cucurbitaceae	Not assessed	Common
7	*Clitoria ternatea*	Sangu Poo	Fabaceae	Not assessed	Common
8	*Coccinia grandis*	Kovaikkaai	Cucurbitaceae	Not assessed	Common
9	*Cyclea peltata*	Pon-mucuttai	Menispermaceae	Not assessed	Common
10	*Gloriosa superba*	Sengandhal	Liliaceae	Not assessed	Common
11	*Hemidesmus indicus*	Nannari	Apocynaceae	Not assessed	Common
12	*Ichnocarpus frutescens*	Utar-koti	Apocynaceae	Not assessed	Common
13	*Ipomoea dissecta*	Kakkattan	Convolvulaceae	Not assessed	Common
14	*Ipomoea nil*	Kotikkakkattan	Convolvulaceae	Not assessed	Common
15	*Ipomoea obscura*	Siruthalai	Convolvulaceae	Not assessed	Common
16	*Ipomoea pes-caprae*	Attukkal	Convolvulaceae	Not assessed	Rare
17	*Ipomoea reptans*	Vallaikkirai	Convolvulaceae	Not assessed	Common
18	*Luffa cylindrica*	Peerkankai	Cucurbitaceae	Not assessed	Common
19	*Pergularia daemia*	Velipparuthi	Apocynaceae	Not assessed	Common
20	*Pueraria tuberosa*	Nilapoosani	Fabaceae	Not assessed	Common

S. No.	Scientific Name	Common Name	Family	IUCN Conservation Status	Status
21	*Solena amplexicaulis*	Pulivanci	Curcurbitaceae	Not assessed	Common
22	*Tragia involucrata*	Kanchori	Euphorbiaceae	Not assessed	Common
23	*Trichosanthes cucumerina*	Pudalankaai	Curcurbitaceae	Not assessed	Common
24	*Tylophora asthmatica*	Kalutai-p-palai	Asclepidaceae	Not assessed	Common
25	*Tylophora indica*	Nachchuruppam	Asclipedaceae	Not assessed	Common

The detailed study revealed dominance of *Borassus flabellifer, Acacia auriculiformis, Cocos nucifera, Azadirachta indica, Acacia nilotica, Phoenix sylvestris, Mangifera indica* among tree species. Totally 57 species of trees found in the study area along with 23 shrub species, 31 herb species and 25 climber species. *Calotropis procera, Datura metel, Lantana camara, Nerium oleander, Sida cordifolia* are found to be the predominant species among shrub. Among the herbaceous species *Amaranthus spinosus, Boerhavia diffusa, Acanthospermum hispidum, Achyranthes aspera, Euphorbia hirta, Cassia tora, Hyptis suaveolens, Sida acuta, Tridax procumbens* etc. found to be abundant.



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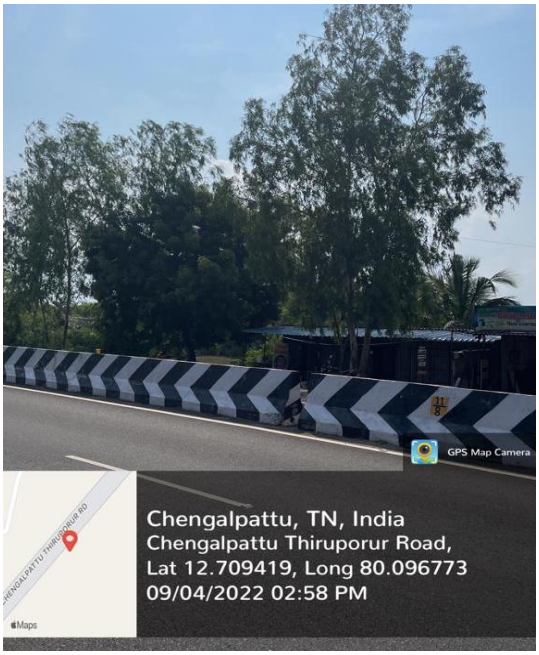
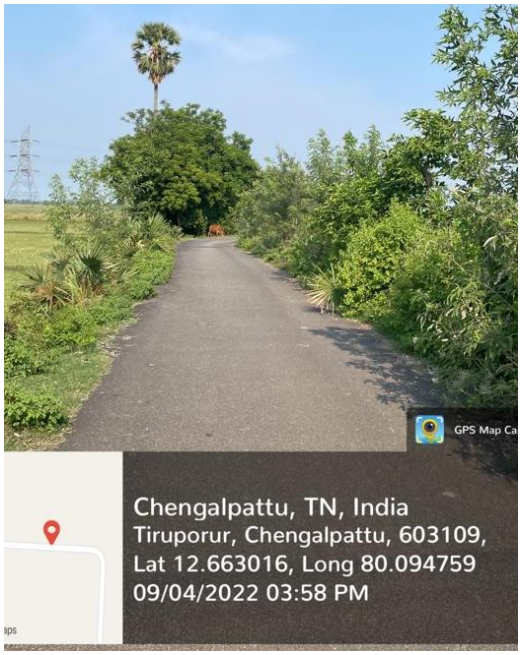




Source: ABC Techno Labs India Private Limited

4.6.1.7 Economically Important Flora of the Study Area

Agricultural crops: The major crops grown in study area are Paddy, groundnuts, sugarcane, cereals, millet and pulses. In canal fed areas paddy occupies the largest area of cultivation followed by green gram and black gram. Other crops grown in the region are cashew and coconut. Different fruits like banana, papaya, mangoes, sapota, guava and vegetables like brinjal, tomato, lady's finger, drumsticks, coriander and chilies also grown by the local people.

Medicinal plant species: The nearby area is also endowed with the several medicinal plants which are commonly available in the shrub forest and waste lands. The common medicinal plants of the region is *Azadirachta indica* (Neem).

Fuel wood plant species: Local villagers use to collect dry leaves, stems and log to fulfill their daily need for fuel wood requirement. *Azadirachta indica* (Neem), *Mangifera indica* etc. are the species used for fuel wood collection from the surrounding forest area.

Rare and endangered floral species: As per IUCN red list *Borassus flabellifer* (Nonkuppanai) categorized as endangered species. During the vegetation survey in the study area did not encounter any such species which are endangered or threatened under IUCN (International Union for Conservation of Nature and Natural resources) guidelines.

4.6.1.8 Faunal Communities

Both direct (sighting) and indirect (evidences) observation methods were used to survey the faunal species around the study area. Additionally, reference of relevant literatures (published/ unpublished) and conversations with local villagers were also carried out to consolidate the presence of faunal distribution in the area *(Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988).*

Mammals: No wild mammalian species was directly sighted during the field survey. Conversation with local villagers around the study area also could not confirm presence of any wild animal in that area. Palm-Squirrel, Jungle Cat, Little Indian field mouse, Rat, Short nosed fruit bat, Black rat, Indian mole rat, Three stripped Palm Squirrel, Common mongoose, Common Mouse, Indian Hare etc. were observed during primary survey.

Avifauna: Since birds are considered to be the indicators for monitoring and understanding human impacts on ecological systems *(Lawton, 1996*) attempt was made to gather quantitative data on the avifauna by walk through survey within the entire study area and surrounding areas. From the primary survey, a total of 54 species of avifauna were identified and recorded in the study area. The diversity of avifauna from this region was found to be quite high and encouraging. The list of avifauna species found in the study area is mentioned in Table 4-21.

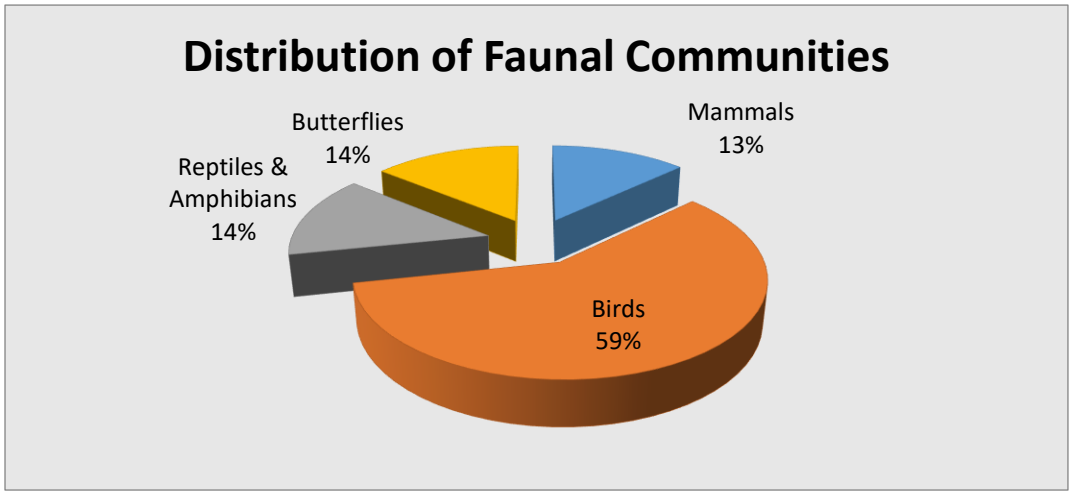
The Indian Chameleon, tree lizard, common garden lizards and common toads are also seen. Variety of butterflies (like Plain Tiger, Common Pierrot, Great Eggfly, Common bushbrown, Common sailor, Lime butterfly, Common Mormon, Indian Skipper, Southern birdwing, Common lime, Common crow, Common tiger, Small Grass Yellow) is spotted in abundance in the study zone.

Table 4-21 Fauna Recorded from the Primary Survey in the Study Area and their Conservation Status

S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status
Mammals				
1	*Funambulus pennanti*	Palm–Squirrel	IV	Not assessed
2	*Felis chaus*	Jungle Cat	II (Part I)	Least Concern
3	*Mus booduga*	Little Indian field mouse	IV	Least Concern
4	*Bandicota indica*	Rat	IV	Least Concern
5	*Cynopterus sphinx*	Short nosed fruit bat	IV	Least Concern
6	*Rattus rattus*	Black rat	IV	Not assessed
7	*Bandicota bengalensis*	Indian mole rat	IV	Least Concern
8	*Funambulus palmarum*	Three stripped Palm Squirrel	IV	Least Concern
9	*Herpestes edwardsii*	Common mongoose	IV	Least Concern
10	*Mus musculus*	Common Mouse	IV	Not assessed
11	*Lepus nigricollis*	Indian Hare	IV	Least Concern
12	*Felis catus*	Cat	--	Not assessed
Birds				
1	*Milvus migrans*	Black kite	IV	Least Concern

S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status
2	*Vanellus indicus*	Red-wattled lapwing	IV	Least Concern
3	*Acridotheres tristis*	Common myna	IV	Least Concern
4	*Accipiter badius*	Shikra	IV	Least Concern
5	*Egretta intermedia*	Intermediate egret	IV	Least Concern
6	*Ceryle rudis*	Pied Kingfisher	IV	Least Concern
7	*Alcedo atthis*	Small blue kingfisher	IV	Least Concern
8	*Coracias benghalensis*	South Indian roller	IV	Least Concern
9	*Anastomus oscitans*	Asian open billed stork	IV	Least Concern
10	*Corvus macrorhynchos*	Indian jungle crow	V	Least Concern
11	*Apus apus*	Common swift	IV	Least Concern
12	*Ardea alba*	Large egret	IV	Least Concern
13	*Charadrius leschenaultii*	Large sand plover	IV	Least Concern
14	*Athene brama*	Southern Spotted owlet	IV	Least Concern
15	*Dicrurus adsimilis*	Fork-tailed drongo	IV	Least Concern
16	*Dendrocitta leucogastra*	Southern tree pie	IV	Least Concern
17	*Gallinula chloropus*	Common Moorhen	IV	Least Concern
18	*Halcyon smyrnensis*	White-breasted kingfisher	IV	Least Concern
19	*Haliastur indus*	Brahminy kite	IV	Least Concern
20	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	IV	Least Concern
21	*Nectarinia asiatica*	Purple sunbird	IV	Least Concern
22	*Lanius schach*	Long-tailed Shrike	IV	Least Concern
23	*Oriolus oriolus*	Golden oriole	IV	Least Concern
24	*Nectarinia minima*	Small sunbird	IV	Least Concern
25	*Turdoides caudatus*	Common babbler	IV	Least Concern
26	*Tringa hypoleucos*	Common sandpiper	IV	Least Concern
27	*Nycticorax nycticorax*	Night heron	IV	Least Concern
28	*Pitta brachyura*	Indian pitta	IV	Least Concern
29	*Ploceus philippinus*	Baya weaver bird	IV	Least Concern
30	*Turdoides striatus*	Jungle Babbler	IV	Least Concern
31	*Saxicoloides fulicatus*	Indian Robin	IV	Least Concern
32	*Pycnonotus cafer*	Red vented Bulbul	IV	Least Concern
33	*Phragamaticola aedon*	Thick billed Warbler	IV	Least Concern
34	*Pericrocotus cinnamomeus*	Small Minivet	IV	Least Concern
35	*Pseudibis papillosa*	Black Ibis	IV	Least Concern
36	*Eudynamys scolopaceus*	Koel	IV	Least Concern
37	*Egretta garzetta*	Little Egret	IV	Least Concern
38	*Psittacula krameri*	Rose ringed parakeet	IV	Least Concern
39	*Bubulcus ibis*	Cattle Egret	IV	Least Concern
40	*Dicrurus macrocercus*	Black drongo	IV	Least Concern
41	*Streptopelia chinensis*	Spotted dove	IV	Not assessed
42	*Columba livia*	Rock pigeon	IV	Least Concern
43	*Corvus splendens*	House crow	V	Least Concern
44	*Cypsiurus balasiensis*	Asian palm swift	IV	Least Concern
45	*Ardeola grayii*	Pond Heron	IV	Least Concern
46	*Elanus caeruleus*	Black-winged Kite	IV	Least Concern
47	*Alcedo atthis*	Small Blue Kingfisher	IV	Least Concern
48	*Cuculus canorus*	Common cuckoo	IV	Least Concern
49	*Centropus sinensis*	Greater coucal	IV	Least Concern

S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status
50	*Phalacrocorax niger*	Little cormorant	IV	Least Concern
51	*Perdicula asiatica*	Bush Quail	IV	Least Concern
52	*Alauda gulgula*	Oriental Skylark	IV	Least Concern
53	*Passer domesticus*	House sparrow	IV	Least Concern
54	*Merops orientalis*	Green bee eater	IV	Least Concern
Reptiles & Amphibians				
1	*Chameleon zeylanicum*	Chameleon	IV	Not assessed
2	*Ahaetulla nasuta*	Green whip snake	II (Part II)	Least Concern
3	*Cnemaspis littoralis*	Coastal day gecko	--	Data Deficient
4	*Daboia russelii*	Russeles viper	II (Part II)	Not assessed
5	*Euphlyctis cyanophlyctis*	Skipper frog	IV	Least Concern
6	*Polypedates maculatus*	Tree frog	IV	Least Concern
7	*Naja naja*	Common cobra	II (Part II)	Not assessed
8	*Calotes versicolor*	Common Garden Lizard	II	Not assessed
9	*Bungarus caeruleus*	Common Krait	IV	Not assessed
10	*Ophisops leschenaultii*	Snake-eyed lizard	--	Not assessed
11	*Duttaphrynus melanostictus*	Common toads	IV	Least Concern
12	*Ptyas mucosa*	Rat snakes	IV	Least Concern
13	*Hemidactylus frenatus*	Common house gecko	--	Least Concern
Butterflies				
1	*Danaus chrysippus*	Plain Tiger	--	Not assessed
2	*Castalius rosimon*	Common Pierrot	--	Not assessed
3	*Hypolimnas bolina*	Great Eggfly	--	Not assessed
4	*Mycalesis perseus*	Common bushbrown	--	Not assessed
5	*Neptis hylas*	Common sailor	--	Not assessed
6	*Papilio demoleus*	Lime butterfly	--	Not assessed
7	*Papilio polytes*	Common mormon	--	Not assessed
8	*Spialia galba*	Indian Skipper	--	Not assessed
9	*Troides minos*	Southern birdwing	--	Least Concern
10	*Papilio demoleus*	Common lime	--	Not assessed
11	*Euploea core*	Common crow	--	Least Concern
12	*Danaus genutia*	Common tiger	--	Not assessed
13	*Eurema brigitta*	Small Grass Yellow	--	Least Concern

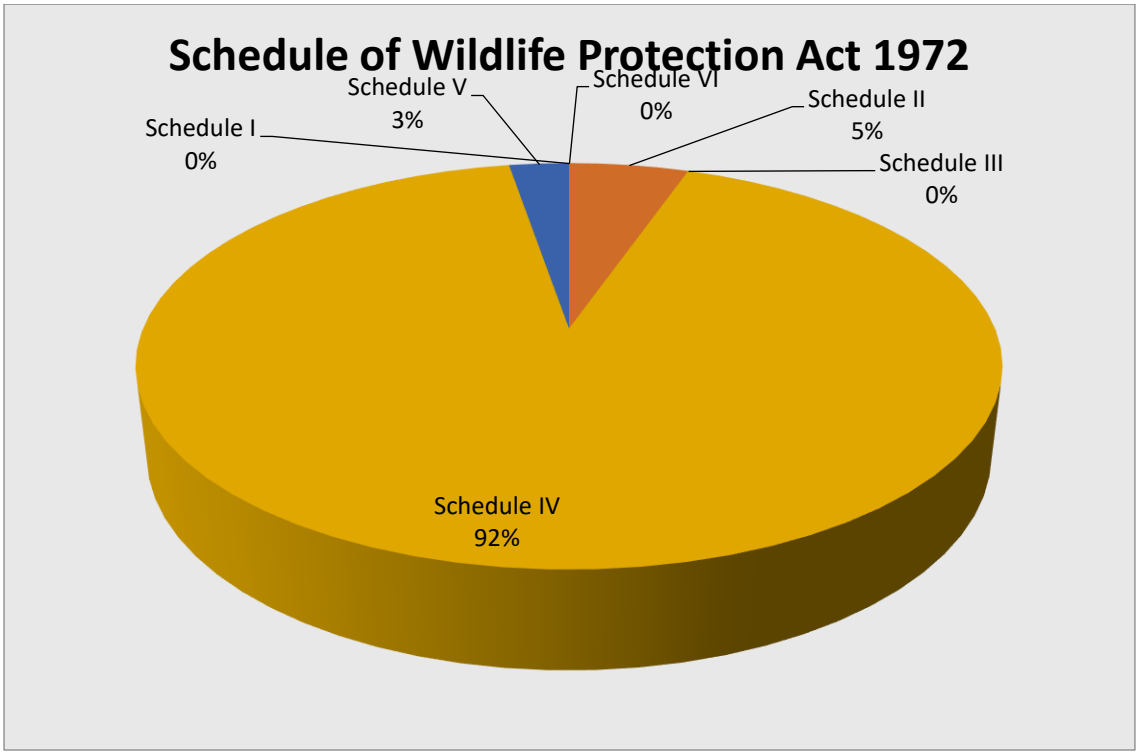


Livestock like cattle, buffalo, goat, poultry, duck and pig are reared for dairy products, meat, egg and for agriculture purpose. Majority of cattle and buffalo are of local variety. Backyard poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

The study area is marked with moderate population of flora and fauna. With reference to the Wildlife Protection Act 1972 total number of wildlife tabulated in this study can be characterized as given in Table 4-22.

Table 4-22 Characterization of Fauna In the Study Area (As Per W.P Act, 1972)

S. No.	Schedule of Wildlife Protection Act 1972	No. of species	Remark
1	Schedule I	0	-
2	Schedule II	4	-
3	Schedule III	0	-
4	Schedule IV	69	-
5	Schedule V	2	-
6	Schedule VI	0	-



The detailed interpretation of flora and fauna identified within the study area are tabulated in Table 4-23.

Table 4-23 Description of Flora and Fauna

S. No.	Type of Species	Scientific Name	Common Name
Flora			
1	Endangered species	*Borassus flabellifer*	Nonkuppanai
2	Threatened species	None	None
3	Near Threatened species	None	None
4	Vulnerable species	None	None
Fauna			
1	Endangered species	None	None
2	Threatened species	None	None
3	Near Threatened species	None	None
4	Vulnerable species	None	None
5	Migratory Corridors & Flight Paths	No corridors & flight paths	-
6	Breeding & Spawning grounds	None	-

A comprehensive Central Legislation namely Wild Life (Protection) Act was enforced in 1972 to provide protection to wild animals. Schedule-I of this act contains the list of rare and endangered species, which are completely protected throughout the country. The list of wild animals and their conservation status as per Wild Life Act (1972) are presented in Table 3 species recorded/reported

from study area, out of which 4 species belongs to schedule-II, 2 species belongs to schedule-V and rest of the species belongs to schedule-IV of Wildlife protection Act, 1972.

4.6.2 Aquatic Ecology

Evaluation of the biological impulses on study area is an integral part of an environmental impact assessment as the consequences of perturbations in the environment ultimately may affect the habitat. Project activity area devoid of any intense breeding/nursery grounds of economically important living resources. Though organisms have evolved to withstand the change within certain limits, they may not be well adapted to manmade stresses. Thus, the monitoring programme should sufficiently target the entire potential at risk.

An essential prerequisite for the successful solution to these problems is to evaluate ecological impacts from the baseline information and undertake effective management plan. So the objective of aquatic ecological study may be outlined as follows:

- To characterize water bodies like fresh waters;
- To understand their present biological status;
- To characterize water bodies with the help of biota;
- To understand the impact of industrial and urbanization activities; and
- To suggest recommendations to counter adverse impacts, if any on the ecosystem.

To meet these objectives following methods were followed:

- Generating data by actual field sampling and analysis in these areas through field visits during study period; and
- Discussion with local people to get the information for aquatic plants and aquatic animals.

A number of samples were investigated for enumeration of aquatic fauna. In order to study aquatic flora and faunal life one time survey was conducted during the summer season. Major component of the aquatic life under the study area are listed below.

- *Aquatic macrophytes*
- *Phytoplankton and zooplankton*
- *Other community.*

While considering assessment of aquatic pollution and its implications, it must be realized that, despite many changes in the physico-chemical properties of the water body, the ultimate consequences of pollutants may be reflected inevitably on the biological system. Hence, the

investigations of an ecosystem and particularly of its communities constitute an integral part of any ecological assessment. This can be achieved by selecting a few reliable parameters from a complex community structure. The parameters considered have phytoplankton, zooplankton and status of fishery. The first two reflect the productivity of a water column at the primary and secondary levels, respectively. Ultimate commercial interest being fisheries, the status of the exploitable fishery resources was assessed. Information on larval stages of fishes and decapods was used to evaluate probable occurrence of spawning and breeding grounds of economically important species.

To assess the planktonic profile of Phytoplankton and Zooplankton, 3 water samples from Manampathy Lake, Mamalla Lake, Chettipunyam Lake and Singaperumal koil Lake which are located about 0.47 km towards East-Northeast, 0.48 km towards Southwest, 1.78 km towards Northeast and 0 km respectively from the study were collected at sub surface level. The aquatic ecological study was conducted in different water bodies of the study area and the flora and fauna was recorded.

- **Macrophytes**

The macrophytes observed within the study area are tabulated in Table 5.

Table 4-24 Description of Macrophytes

S. No.	Scientific Name	Common Name	Type
1	*Azolla pinnata*	Mosquito Fern	Free floating pterophyte
2	*Cyperus articulates*	Jointed flatsedge	Emergent Hydrophytes
3	*Eichhornia crassipes*	Common water hyacinth	Free floating hydrophytes
4	*Enhydra fluctuans*	Water Cress	Marshy amphibious hydrophytes
5	*Hydrilla verticillata*	Hydrilla	Submerged hydrophytes
6	*Ipomea aquatica*	Water Morning Glory	Marshy amphibious hydrophytes
7	*Ipomoea carnea*	Bush Morning Glory	Marginal Hydrophytes
8	*Najas indica*	Waternymph	Submerged hydrophytes
9	*Nelumbo nucifera*	Lotus	Floating hydrophytes
10	*Nymphaea nouchali*	Star lotus	Floating Hydrophytes
11	*Nymphoides cristata*	Crested Floatingheart	Floating Hydrophytes
12	*Pistia stratiotes*	Water lettuce	Free floating hydrophytes
13	*Polygonum barbatum*	Knot gras	Marshy amphibious hydrophytes
14	*Trapa natans*	Water caltrop	Floating Hydrophytes
15	*Typha angustifolia*	Lesser Bulrush	Emergent hydrophytes
16	*Vallisneria spiralis*	Tapegrass	Submerged hydrophytes

Source: ABC Techno Labs India Pvt. Ltd.

4.6.2.1 Phytoplankton and Zooplankton

Planktons can be broadly grouped into two categories those with plant origin are called 'Phytoplankton' and those with animal origin are called 'Zooplankton'.

A. Phytoplankton

Phytoplankton is the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Phytoplankton samples were collected without filtering the water. To preserve, 0.3 mL lugol's solution was added to 100 ml sample. Subsequently, phytoplankton were concentrated by centrifugation and analysed microscopically in laboratory. Identification of phytoplankton was done using standard taxonomic keys.

The Lackey Drop (microtransect) method (Lackey 1938) is a simple method for obtaining counts of considerable accuracy (APHA 2017).

Chemicals/reagents used: Lugol's iodine

Equipment used: Centrifuge tubes of 15ml capacity, cover slips, glass slides, dropper, plastic bottles (100 ml capacity)

Instruments used: Centrifuge and Microscope.

Table 4-25 Phytoplankton Species

S. No.	Species	Family
1	*Synedra* sp.	Bacillareophyceae
2	*Cyclotella* sp.	Bacillareophyceae
3	*Lyngbya* sp.	Cyanophyceae
4	*Anabaena* sp.	Cyanophyceae
5	*Gloetrichia* sp.	Cyanophyceae
6	*Bacillaria paxillifer*	Bacillariaceae
7	*Navicula* sp.	Naviculaceae
8	*Nitzschia* sp.	Bacillariaceae
9	*Chlorococcum* sp.	Chlorococcaceae
10	*Cylindrospermum* sp.	Cyanophyceae
11	*Anacystis* sp.	Cyanophyceae
12	*Clostrium* sp.	Chlorophyceae
13	*Oocystis* sp.	Chlorophyceae
14	*Volvox* sp.	Chlorophyceae
15	*Pediastrum simplex*	Hydrodictyaceae
16	*Rhizosolenia* sp.	Rhizosoleniaceae
17	*Triceratium* sp.	Triceratiaceae
18	*Ulothrix* sp.	Chlorophyceae
19	*Chlamydomonas* sp.	Chlorophyceae
20	*Zygnema* sp.	Chlorophyceae
21	*Azolla* sp.	Spermatophyta
22	*Achnanthes* sp.	Chrysophyta

Source: ABC Techno Labs India Pvt. Ltd.

B. Zooplankton

The significance of zooplanktons is found in their role in transferring biological production from phytoplankton to larger organisms in the food web. Sample collection was carried out in the similar method as that of phytoplankton. The result of the zooplankton analysis is tabulated in Table 4-26.

Table 4-26 Zooplankton Species

S. No.	Species	Family
1	*Daphnia* sp.	Cladocera
2	*Microsetella* sp.	Ectinosomatidae
3	*Acartia spinicauda*	Acartiidae
4	*Aspidisca* sp.	Aspidiscidae
5	*Oithona* sp.	Oithonidae
6	*Philodina* sp.	Philodinidae
7	*Sagitta* sp.	Sagittidae
8	*Chydorus sphaericus*	Chydoridae
9	*Moina* sp.	Cladocera
10	*Cyclops* sp.	Copepoda
11	*Brachinus* sp.	Rotifera
12	*Diaptomus* sp.	Rotifera
13	*Eucalanus* sp.	Eucalanidae
14	*Euglena* sp.	Phytomastigophora
15	*Trichocerca* sp.	Trichocercidae
16	*Monostyla* sp.	Lecanidae
17	*Naegleria* sp.	Protozoa

Source: ABC Techno Labs India Pvt. Ltd.

4.6.2.2 Fish Community

The fish species reported from the study area are tabulated in Table 4-27.

Table 4-27 List of Fish Species Reported

S. No.	Scientific Name	Common Name	Family
1	*Channa gachua*	Dwarf snakehead	Channidae
2	*Channa marulius*	Great snakehead	Channidae
3	*Channa punctata*	Green snakehead	Channidae
4	*Etroplus maculatus*	Orange chromide	Cichlidae
5	*Euthynnus affinis*	Mackerel tuna	Scombridae
6	*Heteropneustes fossilis*	Stinging catfish	Heteropneustidae
7	*Lepidocephalichthys guntea*	Guntea loach	Cobitidae
8	*Megalaspis cordyla*	Torpedo scad	Carangidae
9	*Mugil* sp.	Flathead mullet	Mugilidae
10	*Mystus bleekeri*	Day's mystus	Bagaridae
11	*Mystus vittatus*	Striped Dwarf Catfish	Bagaridae
12	*Nemipterus* sp.	Threadfin bream	Nemipteridae

S. No.	Scientific Name	Common Name	Family
13	*Notopterus notopterus*	Asiatic knifefish	Notopteridae
14	*Oreochromis mossambicus*	Mozambique tilapia	Cichlidae
15	*Platycephalus biomacula*	Flat head fish	Platycephalidae
16	*Puntius amphibius*	Scarlet-banded barb	Cyprinidae
17	*Puntius arenatus*	Arenatus barb	Cyprinidae
18	*Salmostoma bacaila*	Large razorbelly minnow	Cyprinidae
19	*Sardinella* sp.	Ray-finned fish	Clupeidae

Source: ABC Techno Labs India Pvt. Ltd.

Conclusion:

Dominant tree species in the project area was dominated by *Borassus flabellifer, Acacia auriculiformis, Cocos nucifera, Azadirachta indica, Acacia nilotica, Phoenix sylvestris, Mangifera indica* etc. From primary data it is observed that tree community has highest diversity. While the shrub community shows less diversity. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole. There is no National Park or wildlife sanctuary within study area.

There is no schedule I species recorded within the study area. Total 12 mammalian species observed and recorded within the entire study area and 54 species of avifauna were identified and recorded from the entire study area and surrounding area. The diversity of avifauna from this region was found to be quite high and encouraging.

There is no record of endangered, rare or endemic aquatic plants and animal species in the study area.

Overall, the plankton diversity and density observed at all the sampling locations was good. Since, the proposed project is not involved with any kind of toxic effluents to be discharged in the natural water bodies, plankton herein would be unaffected and hence the higher trophic levels shall remain safe.

4.7 Social environment

4.7.1 Chengalpattu district demographic profile

Demography: According to 2011 census, the District had population of 39.90 lakh, which is about 5.53% of the total State population. The total population of the District was 3,990,897, in which 2,010,309 were Male and 19, 80,588 were Female. In rural 14, m53, 072 & in Urban it was 2,537,825.

Table 4-28 Demography

Category	Total
Total Population	39,90,897
Rural Population	14,53,072
Urban Population	25,37,825
Male Population	20,10,309
Female Population	19,80,588

Scheduled Caste Population: According to 2011 census, the schedule caste and schedule tribe population shows 231,254 and 10,163 of the population is scheduled tribe.

Table 4-29 Scheduled Caste Population

Category	Rural	Urban	Total
Scheduled Caste	134,451	96,803	231,254
Scheduled Tribe	6,707	3,456	10,163

Density of Population: According to 2011 census, the density of population is 927/ km^2.

Workers Classification: The total main workers of the District was 1,673,814 persons forming 41.9% of total population in the District. Of this, 1,181,308 were male workers & 4,92,506 were Female workers & 678,251 were from rural & 9,95,563 were from Urban & 89,343 were of cultivators & 2,72,514 of Agricultural laborers & 54,732 of Household industry and rest in other activities ie 12,57,225. Percentage of workers to the total population is 41.9%.

Growth Rate: The growth rate shows the decadal population growth shows growth rate of 38.69% from 2001 to 2011.

Literacy Rate: The Literacy rate shows that 85% of the population of Chengalpattu is Literate. The details given in following table; Literacy rate is calculated excluding children in the age group of 0-6.

Table 4-30 Literacy Rate

Description	Numbers	Percentage
Literacy	3,013,382	85.29%
Male Literacy	1,611,461	90.34%
Female Literacy	1,401,921	80.17%

Education

The district provides education to the entire population through the following channels:

Table 4-31 Education Facilities

Description	Numbers
Primary School	68
Middle School	300
Secondary & Senior Secondary School	638
Arts and Science College	34
Engineering College	52
Technical University	4

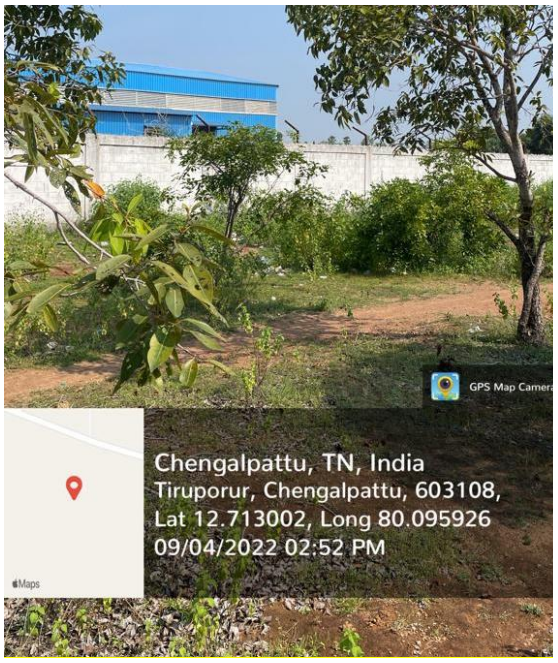
4.8 Social impacts

Table 4-32 Social Impacts of Chennai Peripheral Road

Total Assets Affected	Nos.of Public utilities Affected
1,613	

- **Community properties**

The impact on the common property resources (CPRs) shows that 73 CPRs are likely to be affected. The details of the impact is given below;



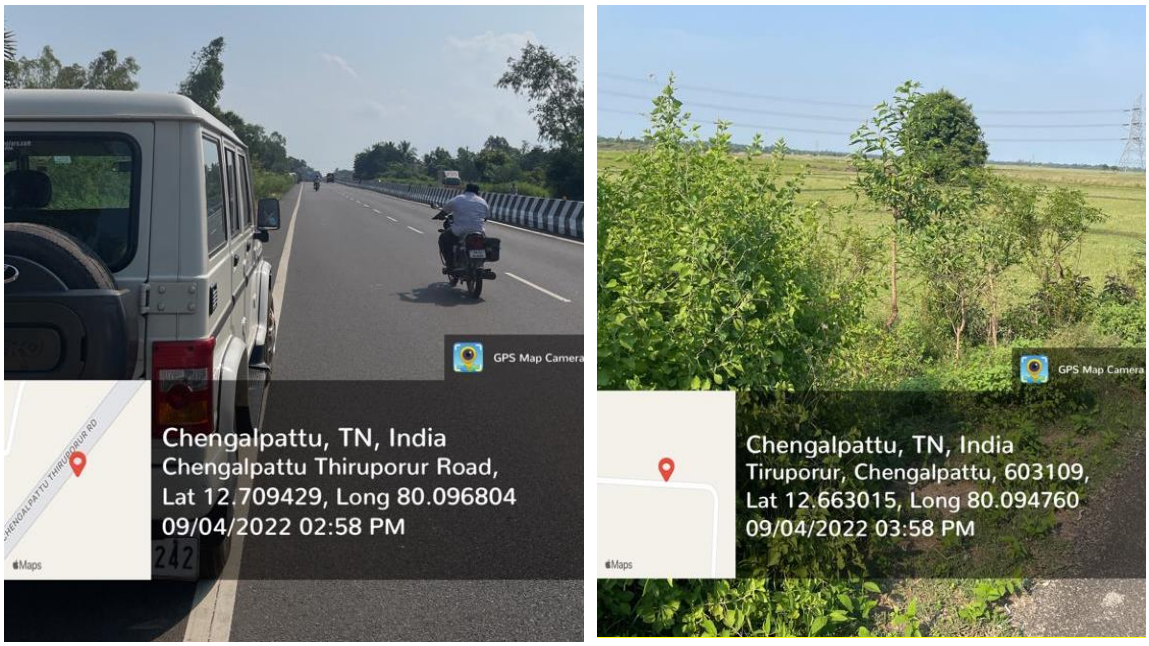


Figure 4-17 Photos from the Project Alignment

Table 4-33 Abstract of Affected Common Property Resources (CPRs)

S. No.	Description	Nos.
1	Burial Ground	
2	Bus Stop	
3	Church	
4	Govt / Inst. Building	
5	Pump House	
6	School	
7	Temples	
8	Water Tank	
9	Well	
10	OHT	
	Total	

Source: Census and Baseline Socio- Economic Survey, June 2016

Table 4-34 Details of affected Common Property Resources (CPRs) in Section 5

Sl. No.	R /L	Village	Taluk	Type of CPR	Description of Loss	Impact	Remarks
1	L	Pooncheri Juction	Tirukalukundram	TNRDC Shed	TNRDC Ambulance shed	Major	Replace
2	L	Pooncheri Juction	Tirukalukundram	Toll Plaza	TNRDC Tool Plaza	Major	Replace
3	L	Ambal Nagar	Tirukalukundram	Bus Stop	Ambal Nagar Bus stop	Major	Replace
4	L	Ambal Nagar	Tirukalukundram	Temple	Temple at present not in use	Major	No
5	L	Ambal Nagar	Tirukalukundram	Temple	Temple at present not in use	Major	No
6	L	Perumal Eri	Tirukalukundram	Training center	Sri M V Arunachalam Technology	Minor	Replace
7	L	Melakannagapattu	Tirukalukundram	Bus Stop	Bus Stop - Melakannagapattu	Major	Replace
8	L	Melakannagapattu	Tirukalukundram	Church	Prayer Hall Tiru sabai	Major	Replace
9	R	Ambal Nagar	Tirukalukundram	Temple	Nagathamman temple	Major	Replace
10	R	Karanai	Tirukalukundram	Pump House	Pump House, Karanai Village	Major	Replace
11	R	Melakannagapattu	Tirukalukundram	O.H.Tank	Over Head Tank	Major	Replace

4.9 Public consultation meeting

Thus, after the submission of the Screening Report, a public consultation was conducted to disseminate the course of the study. This will allow the study team to incorporate the suggestions made in the project and continue with the drafting of the project. The dissemination process consisted in holding several meetings with the public, where the proposals of the project were presented as well as the impacts by the study team. As per the ToR, the consultation meetings addressed to local public were conducted on 21st to 31st July 2014 at 5 locations. The number of meeting points, outcomes and affected PAHs perceptions were captured and detailed in coming chapter's related to public consultation

4.10 Conclusion

Understanding of the environmental profile and status of the project corridor enable the PIU/implementing agencies to ascertain the standards to be provided and baseline for monitoring progress.

5 Implementation Mechanism

5.1 Introduction

The Environmental Management Plan identified for the construction will be included in the bid documents for ensuring implementation of the environmental safeguards. The management measures identified for the operation phase will be taken up by the highways department, upon completion of construction activities.

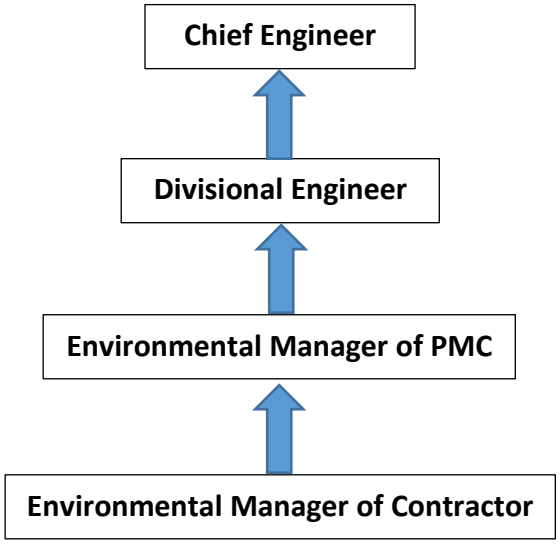


Figure 5-1 Flow Chart showing Reporting Structure for EMAP

5.2 Project Management Consultant (PMC) – Environmental Safeguard Specialist

The HD has proposed to appoint Environmental and Social Safeguards Specialists, for overseeing environmental and social safeguards compliance, in all the projects of the department. The E&S Safeguard specialists will directly report to the Chief Engineers (HD) or authorized official. The Environmental specialist shall submit monthly reports to the reporting authority (HD), on the status of compliance with the Environmental requirements.

The roles and responsibilities of the Environmental Officer / Manager (EO/EM) is given below;

a) All matters related to environmental and social activities within the ROW such as latest EIA, SIA, RAP and other related documents should be available to the EO immediately after mobilization. The Forest, environmental clearance, Tamil Nadu Pollution Control Board's clearance conditions and other approval status should be specified. A status report prepared by HD would be required for the EO to start the work.
b) The Environmental Officer (EO) should be mobilized during the early stages of Construction. This is to help the Contractor in identifying environmentally sound locations for Construction

camps, hot mix plant, WMM plant and all other issues according to the Environmental Management Action Plan (EMAP).

c) The important role of EO during construction is to ensure the smooth implementation of EMAP and to address direct and indirect social issues arising out of implementation of the RAP.

d) The EO should visit incomplete construction work sites where there are no contractor's current activities, active construction work sites and completed areas of the work sites and conduct regular meetings with the contractor in identifying gaps pertaining to both environment and construction safety. The EO will also visit the hot mix plant; quarries and crushers, borrow areas and others as per the necessity. EO has to ensure appropriate corrective and preventive action to the identified gaps in construction site in environmental aspects. Conduct regular meeting on environmental aspects.

e) The EO will assist the Engineer to ensure environmentally sound engineering practices. In addition, other specialists of the engineers' team may also act and report on road safety related issues.

f) The EO will carry out consultation with the Contractor, contractor's men, local Project Affected People (PAPs) and interest groups. The EO will also consult with NGOs to consider any problems (e.g. access problem to school, buildings, houses and business establishments) arising from construction activities.

g) The EO will assist in the compliance with various labour laws including the payment of minimum wages to the individual contract laborer's especially 'unskilled illiterate migrant laborers'. This has a direct bearing on the health and safety of the workers.

h) The EO will assist the Contractor, and the Highway Department in all matters related to public contacts including consultation, training and public relations.

i) The EO will prepare standard formats (if available they may be obtained from other projects that are being implemented or are completed recently) for the compliance of the environmental and social requirements.

j) The EO will ensure the procurement of materials that are included in the Bill of Quantities relating to environmental and social mitigation costs.

k) The EO will assist the HD and the Contractor in all training activities during construction period.

l) The EO will prepare and submit regular reports to the CE of HD.

m) The EO will assist the various Environmental monitoring activities of the Contractor.

n) The EO will be responsible to confirm whether the contractor has received all Certifications in different sectors from the concerned authority to precede the work.

o) The EO in co-operation with the EO of Contractor and Superintending Engineer will make sure the issuing of timely Work order for the Nurseries to be raised according to the 'Landscaping, Tree planting and Environmental Enhancement Plan'. This will allow one year for the plants to attain the required size.

5.3 Roles and Responsibility of Line Departments and Stakeholders

The role and responsibility of the organizations are mentioned below.

State Pollution Control Board (SPCB): The State Pollution Control Board will be responsible for any matters related to air, water and noise pollution during construction and operational stages. Any matters related to this may be brought under their notice for solution.

Forest Department: Any matters related to social forestry, forests, wildlife and trees, etc. should be consulted with the local DFO or Forest Range Officer, Forest Department depending upon the advice required.

HD: HD is responsible for implementation and supervision of the Road works.

Final Design Consultant: Preparation of final road designs and contract documentation based on the preliminary road designs, and formulation of the Environmental Management Plan and Environmental Management Action Plan recommendations.

Environmental Specialist of HD: ES will be responsible for all matters of environmental monitoring and inter-Governmental co-ordination.

Traffic Police and State Police: Any matters related to traffic and violation of traffic and other law and order issues may be taken up with the traffic police and State Police.

Tamil Nadu Water Supply and Drainage Board (TWAD): TWAD will be responsible for any matters relating to water supply, water taps, bore wells and tube wells along the sides of the roads.

Local Bodies (Municipal Authorities/ Village Administration): Village Administration/ Municipal authorities will be responsible for local bus waiting sheds, Panchayat and municipal public wells etc.

Motor Vehicle Department: The motor vehicle department will be responsible for issue and matters relating to Pollution under Control Certificates, driving licenses etc.

Fire Force and Fire Station: The matters relating to safety especially relating to fire safety may be taken up with the Fire force.

Archaeological Department: All matters relating to ancient archaeological structures and historical monuments that may encounter during construction works or identified during preconstruction stage.

Mining and Geology Department: All matters relating to quarry and sand materials may be referred to State Mining and Geology Department.

5.4 Grievance Redressal Mechanism

The set up GRC shall have the system of records keeping, contact details of complainant, date of the complaint received, nature of grievance etc. for the project road and shall take necessary action against the complaint. The GRC will determine the merit of each grievance, and resolve grievances within an outer time limit of three months of receiving the complaint.

Complaints register with Contractor:

The contractor shall keep and maintain a complaint register report at his site office along the project road as well as project facilities like construction camp, labour camp etc., for public to register their complaints. The Contractor, after taking necessary action based on the complaint, will also incorporate the same in the complaint register. This report will also be part of the monthly report, for HD to monitor and take necessary action, if needed. It has to be noted that, inaction upon the complaint of the public will be considered as a major lapse from the side of the contractor, leading to invoking of penalty clause which is given in bid document/ EMP. The HD will have the following mechanism to address the grievances of the persons affected by the project:

Appellate Level Grievance Redressal Committee, (ALGRC)

ALGRC with the following members, will function effectively, to redress the grievances of the affected persons:

Chief Engineer (HD)

Superintend Engineer (SE)

Project Level Grievance Redressal Committee, (PLGRC)

A Project Level Grievance Redressal Committee will be set up, and the members are as follows (preferably one of them as woman):

- The Divisional Engineer
- One Elected representative
- A person who is publicly known in the local area
- Superintending Engineer (Convener)

5.5 Capacity Building and Training on Environmental Aspects

Training is an investment made on the human resource of the organization to provide and tone the competencies, required to do an existing job well and also to perform for future needs. The general awareness on environment and safety will be imparted to the educational institutes that are present in the project corridor by the contractor.

Table 5-2 Training Programme to the Contractor's Staff

Programme	Particulars	Duration	Participants
Orientation Programme	Contactor's Responsibility as per bid document Reporting System in EMAP	One day each	Engineers including ESE
Awareness programme	General Awareness on Environment	One day each	NGOs / Schools / Residential Welfare Associations

5.6 Conclusion

The Environmental Management Action Plan (EMAP), which is an integral part of the Environmental Management Plan, identify the detailed impacts, propose the mitigation actions and mention the implementing organization and monitoring organization. Until the responsibility for the implementation of EMP is assigned to a number of parties, each with specific responsibilities the implementation shall not be made scientific and accountable. Hence the above description on the institutional arrangements enable the HD official and contractors to implement the project with ease. The cost for these arrangements is budgeted for each components and included in the EMP cost.

6 Environmental Impact and Mitigation Enhancement

6.1 Introduction

Baseline environmental status of the proposed project stretch of Section 5 has been generated. Baseline environment involves collection of data on the existing status of the environment which helps in identification and assessment of impacts due to the proposed road and during various phases of project cycle. The environmental likely impacts on various environmental components due to the road project have been identified, assessed and presented in this chapter.

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural components along the project corridor. The assessment of impacts as discussed in Chapter 5 is based on the information from primary and secondary data collection, previous EA document and supplemented by field surveys collected for the purpose.

6.1.1 Direct and Indirect Impacts

The environmental impacts could be direct as well as indirect. The direct area of influence includes the Corridor of Impact and the construction sites for the project. The indirect area of influence includes areas with potential indirect impacts, for example areas impacted from sediment-loaded runoff or areas impacted due to location of labour camps. The impacts on various environmental components can occur at any of the following stages of the project planning and implementation:

i. Planning and design stage
ii. Construction stage
iii. Operation stage.

The description and magnitude of impacts for the various environmental components of the project are presented in the following sections. Major factors influencing the environmental factors are:

i. Settlement Pattern
ii. Topography / terrain
iii. Land use pattern – agricultural, built-up (residential, commercial, industrial) etc.
iv. Other physical features

Tables given below presents the general environmental impacts expected due to the proposed road. Impacts have been assessed based on the information collected from the screening and scoping of environmental attributes. The quanta of all the impacts on Natural Environment are discussed in detail in subsequent paragraphs.

Table 6-1 General Impacts on Natural Environment

Project Activity	Planning and Design Phase	Pre-construction Phase		Construction Phase					Road Operation	Indirect effects of operation or Induced development
Env. Component Affected	Land acquisition	Removal of Structures	Removal of trees and vegetation	Earth works, including quarrying	Laying of pavement	Vehicle & Machine operation & maintenance	Asphalt & crusher plants	Sanitation & Waste (labour campus)	Vehicle operation	
Air	-	Dust generation during dis-mantling	Reduced buffering of air and noise pollution, Hotter, drier microclimate	Dust generation	Asphalt odour	Noise, dust, pollution	Noise, odour, dust, pollution	Odour / smoke	Noise, dust, pollution	other pollution
Land	Loss of productive Land	Generation of debris	Erosion and loss of top soil	Erosion and loss of top soil	-	Contamination by fuel and lubricants Compaction	Contamination Compaction of soil	Contamination from wastes	Spill from accidents	Change in Land use pattern
Water	Loss of water sources	Siltation due to lose earth	Siltation due to lose earth	Drainage alteration Break in continuity of ditches, Siltation, Stagnant Water pools in quarries.	Reduction of ground water re- charge area	Contamination by fuel and lubricants	Contamination by asphalt leakage or fuel	Contamination from wastes Overuse	Spill Contamination by fuel, lubricants and washing of vehicles	Increased contamination of ground water
Noise	-	Noise Pollution	Noise Pollution due to machinery	Noise Pollution	--	Noise pollution	Noise Pollution	-	Noise Pollution	Noise pollution
Flora	-	Loss of Biomass		Lowered productivity Loss of Ground for vegetation	-	Removal of vegetation	Lower productivity Use as fuel wood	Felling trees for fuel	Impact of Pollution on vegetation Lowered productivity Toxicity of vegetation.	-
Fauna			Disturbance Habitat loss	Disturbance		Disturbance	Disturbance	Poaching	Collision with traffic	Distorted habitat

Table 6-2 General Impact on Social and Cultural Environment

Project Activity	Planning and Design Phase	Pre-Construction Phase			Construction Phase					Operation	
										Direct	Indirect Induced development
Component Affected	Design decisions & Implementation policies	Land acquisition	Removal of Structures	Removal of trees & vegetation	Earth works, including quarrying	Laying of pavement	Vehicle & machine operation & maintenance	Asphalt and crusher plants	Labour Camps	Vehicle operation	-
Agricultural land	-	Change in land prices	Loss of land economic value	Loss of standing crops	Loss of productive land	-	-	Dust on agricultural land reduce productivity	-	-	Conversion of Agricultural Land
Buildings and built structures	-	-	Loss of structures, Debris generation, Noise and Air pollution	-	Noise, vibration may cause damage to structures	-	Noise, vibration may cause damage to structures	Dust accumulation on building and structure	-	Vibration and noise	Change in building use and characteristics
People and Community	Anxiety and fear among community	-	Displacement of people Psychological impact on people loss of livelihood	Loss of shade & community trees, Loss of fuel wood and fodder, Loss of income	Noise and Air pollution	Odour and dust	Noise and Air pollution, Collision with pedestrians Livestock and vehicles	Air and noise pollution and discomfort	Community clashes with migrant labour	Noise pollution, Risk of accident	Induced pollution
Cultural Assets	-	-	Displacement loss of structure from RoW	Loss of sacred trees.	Noise, vibration may cause dam-age to structure	-	Damage from vibration & air pollution	Dust accumulation	-	Damage from vibration & air pollution	-
Utilities and Amenities	-	-	Interruption in supply	-	-	-	Damage to utility and amenities	Dust accumulation on water bodies	Pressure on existing amenities		-

6.2 Air Environment

6.2.1 Meteorology

The various stages of the proposed road project such as planning, construction or operation do not involve major or long term impacts on the macro climate and meteorology of the area. This may be due to the construction of road. However, temporary changes during the project operation would mostly be attributed to micro climatic changes due to addition of hard surfaces and related induced development. This would contribute to marginal rise in temperatures in the vicinity of the project corridor and is a permanent impact, but it is localized. The project will have a comprehensive plantation programme and avenue plantation. This could provide shade and canopy to larger areas. This could reverse if any minor or negligible impacts do exists due to the proposed road corridor.

6.2.2 Ambient air quality

The ambient air quality of the project influence area will be affected during pre- construction, construction and operation phases. Pre-Construction and construction phase impacts will be intermittent in nature and will change from location to location as construction progress continues.

Preconstruction Phase

The preconstruction stage activities include site clearance, shifting of utilities, removal of trees present in the corridor of impact (CoI), transportation of man and material, construction of accommodations, construction of stock yards, installation of construction plants, and construction of office buildings. Dust generating activities would be predominant during pre-construction stage particularly if preconstruction tasks are performed during dry weather.

The impacts due to the preconstruction are temporary and localized and the corridor of impact is limited. Quantification of impacts at the preconstruction stage is very difficult as these are very temporary and localized.

Construction Phase

Vehicular emissions are one of the major sources of impact on air quality during the construction phase of the project.

Impact on air quality during the construction phase of the project will be considerable as the phase involves number of activities, but the possible impacts will be short term only. However, provision of adequate air pollution control equipment, like dust filters and measures like dust suppression by water sprinkling and planting of green belt may further help to significantly reduce the impact.

Emission of CO_2 and NOx due to the combustion of diesel will be a principal cause of air pollution during the construction phase. However, being a short duration, the impact will be less.

Various construction activities would result in increase of SPM levels during construction phase. But it has been observed that the air quality in the region found to be well within the ambient air quality standards. However, the operation of the construction machineries will be planned in such a manner to make least numbers working at the same time to ensure the background SPM levels.

But the project will have beneficial impact on air quality of the region during its operation phase as the proposed project is to provide road corridor which will ensure smooth and fast traffic flow.

The road stretch pass through various sensitive receptors places like schools, hospitals and religious places as listed in the sensitive receptors section. These will be the potential receptors of air pollution during the operational phase of the project.

6.3 Noise Environment

The major sources of noise pollution during the construction phase of the project would be the piling activities, vehicular movement and mixing, casting and material movement.

These activities will last for the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A).

The high noise levels arising from these activities can affect the personnel operating the machines. Use of proper Personal Protective Equipment (PPE) such as earmuffs will mitigate any adverse impact of the noise generated by such activities/machineries.

The activities such as excavation, loading and transportation of material would generate noise in the range of 90 to 105 dB (A) and this can occur only when all the equipment operate together and simultaneously. This is however, is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB

in an 8-hour shift, for which all statutory precautions should be taken into consideration. However, careful planning of machinery selection, operations and scheduling of operations can reduce these levels.

The operation of the proposed project would result in uninterrupted movement of heavy and light vehicles at high speed and this may cause increase in ambient noise levels along the project corridor. It may have negative environmental impact on the sensitive receptors close to the project road.

6.4 Impact on Water Environment

Due to the proposed project, there will be some direct and indirect long-term impacts on the water resources. Table below presents the major adverse impacts on the water resources and the indicators chosen to assess the impacts for the study.

Table 6-1 Impacts on Water Resources due to Construction Activities

Impacts Due To Construction	Indicators
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of Ground Water recharge	Area rendered impervious
Use of Water Supply for Construction	Quantum of water used
Contamination from fuel and lubricants	Nature and quantum of contaminators
Contamination from improper sanitation and Waste Disposal in Construction Camps	Area of camp / disposal site and, proximity to water bodies / channels

6.4.1 Impact on Surface Water Resources

During the construction phase of the project, some impacts are anticipated on the water quality of the water bodies located along the corridor. During the construction, stockpiles pollute the nearby water bodies. The impact will be direct, low significance, site-specific to local and short term in nature. Disposal of other construction debris and soil erosion from the embankments may contaminate the nearby water bodies. Spillage of petroleum and other hazardous materials used during construction may pollute the nearby water bodies. Lack of adequate sanitary facilities, drainage and appropriate refuse collection and disposal system in the camps of the construction workers during construction may pollute the nearby water bodies.

Table 6-2 Showing water bodies along the Section 5

Sl. No.	Water Body Name	Village Name	Remarks
1	Poonjeri Lake	Poonjeri	Nearest one
2	Mammalla Lake	Poonjeri	Nearest one
3	Perumal Eri	Perumal Eri	Nearest one
4	Manampathy Lake	Manampathy	Nearest one
5	Sirukundram Lake	Sirukundram	Crossing the one
6	Senkundram Lake	Senkundram	Crossing the one
7	Dasarikuppam Lake	Dasarikuppam	Crossing the one
8	Hanumanthapuram Pond	Hanumanthapuram	Nearest one
CROSSING RIVER			
	Kunnappattu River	Kunnappattu	Nearest one

6.4.2 Impact on Ground Water Resources

The impacts due to the construction phase of the project will be over exploitation of the ground water. A number of groundwater sources such as open wells, bore wells and hand pumps are located along the proposed project route. The proposed road will not affect any of the ground water sources. Therefore, eventual impact of the proposed project may only be marginal.

Water requirements for the project will be sourced from surface water bodies. In these water bodies, pumping will be allowed only from the surface without boring of any tube wells within surface water bodies. In the absence of availability of surface water for construction, ground water will be used after obtaining the necessary clearances from the Ground water department. The extraction will not be permitted within the grey, dark and over-exploited blocks.

6.4.3 Impact on Surface Water Quality

No permanent impact is anticipated on water quality due to the highway project. Construction activities will temporarily deteriorate surface water quality near the alignment in terms of its turbidity.

Increase in Run off

The proposed construction of road will result in increased surface run off. The addition of concrete surface, which essentially increase paved impervious surface, will cause increased surface runoff along the roadsides. Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow of water into the ground.

Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, as the proposed project has been designed with drains to take care of runoff, surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which shall take care of the increased runoff.

6.5 Impact on Soil

6.5.1 Loss of Land

One of the major local impacts due to highway project is upon the local land resources required for the proposed road project. Land acquisition for the project is to extent possible is minimized as it is constructed over the agriculture land. While loss of productive land is the most direct negative impact, other significant indirect negative impacts can also occur.

6.5.2 Soil Erosion

Erosion of top-soil can be considered a moderate, direct and long-term negative impact resulting from the construction of roads. The potential for soil erosion is high and pervasive during the construction stage. Starting with clearing and grubbing of trees vegetation is stripped away, exposing raw soil. The construction of new fill slopes for grading and bridge-end fills also exposes large areas to erosion, if protection methods are not implemented. Finally, during the operation or maintenance phase of highway development, erosion can continue to occur in areas not vegetated. Fills are exposed to long-term exposure to water and wind. Although soil erosion occurs sporadically on highway corridors, the sites most affected are generally bridge end fills and over-steep banks. As this project is on the plain terrain, no soil erosion is anticipated.

6.5.3 Road slopes and spoils

Erosion problems may occur on newly constructed slopes and fills depending on soil type, angle of slope, height of slope and climatic factors like wind (direction, speed and frequency) and rain (intensity and duration). Since slope protection methods (re-vegetation or stone pitching) form part of good engineering practice, and have been incorporated into the detailed design for the roads, erosion concerns should be minimized. However, failure to maintain soil erosion protection can reduce the security of high road embankments and add siltation to the rivers during the monsoon season.

6.5.4 Improvement and construction of bridges and culverts

Construction of road corridor involves excavation of river bed and banks for the construction of the foundation and piers at crossing locations. If the residual spoil is not properly disposed of, increased sedimentation downstream of the bridge may take place during the monsoon. Also, the bridge-end fills require armoring to ensure gullying and slumping are minimized.

6.5.5 Quarries and borrow areas

The excavation of quarries and borrow pits used for obtaining soil and aggregate materials for road construction can cause direct, and indirect long-term major adverse impacts on the environment. While loss of productive soil is the most direct negative impact, other significant indirect negative impacts can also occur.

Since most of the construction materials would be available from existing quarries nearby, relatively few new borrow areas will be required.

One of the long-term residual adverse impacts of borrow pits not reclaimed is the spread of malaria. Mosquitoes breeding and multiplying in stagnant water that collects in these pits can affect humans in villages and towns close to the features.

6.6 Soil Contamination Construction Phase

Soil contamination would take place to a small extent due to spillage of construction material, oil, fuel, grease and asphalt around the construction yards. Especially at vehicle & DG sets fueling areas, where soil contamination occurs predominantly. Dumping of scarified materials to the adjacent agricultural land may lead to contamination of top soil.

6.6.1 Operational Phase

During the operation stage, soil may get contaminated with similar reasons, as mentioned above, during routine and periodical maintenance of the project road. The implications of accidental discharge are potentially disastrous. But, it must be emphasized that the probability of such an accident is quite low, as one of the objectives of the design is the enhancement of road safety.

Geology

As the proposed road passes through flat plain terrain, no significant impact on geology is anticipated from activities involved in construction of proposed road. However, road construction from activities will require supply of road building materials, which should be collected from approved quarry sites.

Likely impact on the geology is due to the uncontrolled blasting in the quarries supplying aggregates for construction at these sites. As these quarries are licensed, the prevalent rules on blasting will be adhered to. Hence, the impact on general geology of the region is insignificant. At the construction sites, no blasting is envisaged.

6.7 Seismology

The project corridor traverses through Seismic Zone II as defined by the vulnerability zoning system, i.e., Low Damage Risk Zone (i.e. areas with a probable seismic intensity of VI on the Modified Mercalli Intensity Scale). Thus, the project does not have any significant impact on the seismic stability of the area.

6.8 Biological Environment

6.8.1 Loss of Trees

It is estimated to be a total of 2995 Nos. of trees will be affected during to the project. About 1,580 number trees will be felled during the development of this project. Other trees will be transplanted.

6.8.2 Forest Area

The proposed construction of proposed road is passing through three reserve forests and involves forest land bound to get forest clearances.

Table 6-3 Forest Area covered under the proposed project

Sl. No	Forest	Type of Forest	Length (km)	District
1	Thirutteri	Reserve	0.5	Chengalpattu
2	Sirukundram	Reserve	1.26	Chengalpattu
3	Sengunram	Reserve		

Mannur Reserved Forest

Coconut Groves – Sengadu

Mango Groves – Sengadu

Eucalyptus Tree Groves

	
Kelanur Village - Casuarinas Tree Groves	Kelanur Village - Eucalyptus Tree Groves

6.8.3 Wild Life

No wild life crossing is found along the project corridor. Though the proposed road is not located within 10 km radius of ecological sensitive area, recommendation from NBWL is not mandatory as the project does not require environmental clearance under EIA notification and it is located away from the ecological sensitive area.

6.8.4 Social Environment

Impact of the proposed project on the socio-economic environment is expected to be overwhelmingly beneficial and is also one of the major objectives of undertaking these project initiatives. However, there are certain negative impacts on the socio-economic situation of the project area each of which are discussed in detail in the following sections.

6.9 Loss of Utilities and Amenities

Site clearances involves removal of various assets, utilities and amenities that are,

- Natural (trees, bushes, and grass lands), and
- Physical structures (public or private assets and utilities)
- Relocation of service utilities

For people dependent on the above, this constitutes economic loss for some time before these are restored to their previous status.

Table 6-4 Affected Public Utilities in Section 5

Sl. No.	Description	Quantity
1	Telephone poles	
2	Low Tension Electric line poles	
3	Transformers	
4	OFC Cable Stones	
5	Electric Box	
6	Lamp Pole	
7	Hand Pump/Water tap	
8	Well	
9	Over Head Tank	
10	High Tension Towers	

6.9.1 Public Health and Safety

Impacts on Public health and safety may arise during the phases of pre-construction, construction and operation phases. During the pre-construction and construction phases, dismantling of the structures for CoI clearance and road construction activities may result in the following health hazards:

Dismantling of properties has psychological impacts on their owners and others associated with them

Debris generated on account of the above-mentioned activities. Labour Camps during construction period can bring the following problems.

In the case of non-local labour, labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries. These labours hired from outside can have clashes with the local population on account of cultural and religious differences. The influx of a large work force to an area can impose additional stress on facilities such as medical services, power, water supply, etc.

If alternative fuels are not made available to the workforce, there is a likelihood that trees will be cut down for cooking or heating purposes.

Insanitary conditions in the labour camps might also result in impact on health of labours as well as the local population. Transmission of diseases is also facilitated by the migration of people.

Allied activities during construction period may cause local disruption.

- Allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas.
- Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities.

- Traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.
- There will be some impact on land during construction, limited mainly to temporary acquisition to cater to road diversion or traffic detours and establishment of labour camps.

6.9.2 Removal of Cultural Property

Potential impacts on religious and historic sites during the construction stage relate to the possibility for physical damage to occur to structures located close to the road works. However, it is required to relocate some cultural properties that are within the CoI. A total of 18 cultural properties is affected out of the 73 community structures. The CPRs which were completely affected will be relocated in consultation with the users and the community.

6.9.3 Removal of Protected Monuments

There are no monuments of historical or archeological significance within the influence area of the project corridor as per the Archaeological Protection Act. Hence, no impacts on these properties are anticipated due to the project.

Table 6-5 Showing Impacted Cultural Properties in Section 5

Sl. No.	R or L	Village	Taluk	Type of CPR	Description of Loss
	L	Ambal Nagar	Tirukalukundram	Temple	Temple at present not in use
	L	Ambal Nagar	Tirukalukundram	Temple	Temple at present not in use
	L	Melakannagapattu	Tirukalukundram	Church	Penteshgo Tiru sabai
	R	Ambal Nagar	Tirukalukundram	Temple	Nagathamman temple

6.9.4 Removal of Bus Shelters

2 bus bays will be affected in Section 5 The same shall be replaced in original locations by the main contractors. These have been further discussed in RAP.

7 Environmental Mitigation Measures

7.1 Introduction

Prevention or avoidance of impact is better than mitigation of impact. Hence avoidance and reduction of adverse impacts approaches were adopted during the design stage through continued interaction between the design and environmental teams. This is reflected in the designs of the horizontal & vertical alignment, cross sections adopted, construction methods and construction materials. In-depth site investigations have been carried out so that sensitive environmental resources are effectively avoided, leading to the environmentally best-fit alignment option. As a result many of the trees, cultural properties, water bodies etc. have been avoided at the design stage itself.

7.2 Air Environment

Motor vehicles have emerged as one of the major sources of air pollution especially in urban areas. As the proposed road is aimed at enhancing the efficiency of road transport system, the number of vehicles plying on this road will be increased overtime.

Summary of potential impact and mitigation measures proposed is mentioned below.

Figure 7-1 Potential Impacts and Mitigation measures

S. No.	Item	Intensity of Impact	Reason for Impact	Mitigation/Enhancement
1	Meteorological factors and climate	Marginal impact	Due to production and laying of hot bituminous mix.	Avenue plantation Plantation in realignment sections
2a	Air quality emissions Pre- construction stage	Temporary and location specific (Dust Generation)	Shifting of utilities, removal of trees & vegetation, transportation of material installation of construction plants	Sprinkling of Water Fine materials to be completely covered, during transport & stocking. Plant to be installed in downwind direction from nearby settlement.
2b	Air quality - emissions Construction Stage	Moderate impact (Gaseous pollutants & Dust generation)	Clearing and grubbing materials dumping brushing of the surface access roads to borrow areas Hot mix plants, Crushers paving of asphalt layers Labour Camps	Air pollution Norms will be enforced, Laborers will be provided mask. Local people will be educated on safety and precaution on access roads, newly constructed embankment etc.
2c	Air quality - emissions Operation	Moderate impact	air pollutants from traffic dust emission from tires	compliance with future statuary regulatory requirements auto-

S. No.	Item	Intensity of Impact	Reason for Impact	Mitigation/Enhancement
	Stage	(Gaseous pollutants)		technology, vehicular fuel quality-improvement
3	Air quality monitoring	---	Effectiveness / shortfall (if any) Any unforeseen impact.	Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

7.3 Meteorological Factors and Climate Construction Phase

Felling of trees, laying of pavement and other construction activity may cause temporary impact on micro climate of the project influence area. No other significant impacts are envisaged in climatic parameters.

7.3.1 Operation Phase

The objective of the present project is only to widen and strengthen the existing road. Hence, no changes in climatic conditions are anticipated. If any minor impacts do exist due to the proposed project, it will be mitigated by compensatory and additional afforestation and avenue plantation.

7.4 Ambient Air Quality

7.4.1 Construction Phase

During construction stage, the asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up including:

a) Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads
b) Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.
c) The hot mix plant will be fitted with dust extraction units.
d) It shall be ensured that the dust emissions from the crusher and vibrating screen from the stone quarries do not exceed the standards.

To ensure the control of exhaust gas emissions from various construction activities, the contractor shall take up the following mitigation measures:

a) An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided in the event of the emissions exceeding the SPCB norms.
b) To ensure the efficiency of the mitigation measures suggested, air quality monitoring shall be carried out at least once every season during the period for which the plant is in operation.
c) All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. A vehicle management schedule prepared by the contractor and approved by the Engineer shall be adhered to.

7.4.2 Operation Phase

Development of landscape along the road can reduce concentration of pollutants. It is, therefore, recommended that the area available on both sides of the road be used to develop a green belt with dense canopy to minimize the air quality impacts in the downwind regions. Such development will also improve the general aesthetics in the region.

The periodic monitoring of the ambient air quality at pre-designated locations will be conducted to ensure further improvement /modification in the design methodology.

7.5 Noise Environment

7.5.1 Construction Phase

Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. The following mitigation measures need to be worked out by the contractor for the noise impacts associated with the various construction activities:

a) Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery to avoid and minimize excessive noise and vibration and ensure environmental safety of workers. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB (A).
b) To avoid and minimize excessive vibration and deformations, it is recommended to use alternative methods of drilling.
c) Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum. Workers in the vicinity of high noise levels must wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
d) Construction camps shall not be located 1000 m from settlement areas. No hot mix, batching and aggregate crushing plants shall be located within 1000 m of sensitive land uses as schools, hospitals etc.

e) The main noise producing sources such as the concrete mixers, generators, grader etc. should be provided with noise shields around them. The noise shields can be any physical barriers, which is effective in adequate attenuation of noise levels. A 3 m high enclosure made up of brick and mud with internal plastering of a non-reflecting surface will be very effective in this regard.
f) For protection of construction workers, earplugs should be provided to those working very close to the noise generating machinery.
g) To avoid significant impacts on human health, it is being recommended to avoid construction work at certain sections during night times and ensure that only minimum required machinery is deployed on the site. At construction sites within 150 m of human settlements, noisy construction should be stopped during nights
h) Noise level monitoring should be conducted as per Environmental Monitoring Plan given in EMP.

7.5.2 Operation Phase

Mitigation of the noise effects during the operation of the project can be effected by the following options:

a) Development of greenbelt with high canopy along the project road for attenuation of noise.
b) Noise barriers: The impacts due to high noise levels will be critical at various urban locations and due to the larger number of receptors and their continuous exposure to high noise levels from the traffic.
c) Noise monitoring should be conducted as per Environmental Monitoring Plan

7.6 Water Environment

7.6.1 Water Resources

Necessary measures will be taken not to dispose the slurry in to the water bodies by providing barrier with sand bags constructed around the piling location and the slurry can be stored in it so that the clear supernatant will flow out and the sludge will be settled at bottom. The sludge can be removed periodically and disposed at sites identified for debris disposal. The contractor will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.

Wastage of water during the construction will be minimized. While working across or close to perennial water bodies, the Contractor will not impede or block any flow of water. If for any bridgework, containment of flow is required, the Contractor will seek Approval of the Engineer.

Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals will be undertaken with permission with the Department of

Irrigation. Care should be taken to minimize any disruption to the flows and to ensure that a high quality of water is maintained.

The Contractor may use the natural sources of water subject to the provision that any claim arising out of conflicts with other users of the said natural sources will be his responsibility.

7.6.2 Water Quality

- The Contractor will take all precautionary measures to prevent the waste water generated during construction from entering into streams, water bodies.
- Oil interceptor will be provided at plant site and truck parking.
- All wastes arising from the project will be disposed of, as per SPCB norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and transported to the approved disposal sites.
- Construction work close to the streams or water bodies will be avoided during monsoon.
- Construction laborers camps will be located at least 1000m away from the nearest habitation.
- Construction of temporary or permanent devices to prevent water pollution due to increased siltation and turbidity shall be ensured.
- It will be ensured that no sanitary wastes from the labour camps are discharged into the nearby watercourses. Wastewater arising from domestic use in labour camps will be sent to septic tank and soak pit.
- The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body. In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided.
- The slopes of embankments leading to water bodies will be modified and rechanneled to prevent entry of contaminants into the water body.
- During the construction stage periodical water sampling and laboratory analysis shall be implemented to examine possible pollution of surface and underground flows.

7.7 Drainage

Proper drainage measures will be taken along the road corridor like:

- Drainage arrangements to be in tune with the site condition and include forming of drainage layer, longitudinal and cross drains, etc.
- Wherever required, suitable sub surface drains shall be provided for full width of formation
- During construction period, suitable barrier will be used to protect the adjoining water

bodies from the falling earth materials and dust raised to avoid sedimentation.

- The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during construction. In sections along water courses, and close to cross-drainage channels, earth, stone or any other construction materials must be properly disposed off so as not to block the flow of water.
- All necessary measures will be taken to prevent earthwork, stonework and other debris from impeding cross-drainage at rivers, streams and water canals.
- Project road has drains on both sides which should be maintained well from collection to dispose of runoff.

7.8 Land Environment

7.8.1 Topography And Geology

Care shall be taken during embankment construction and cutting process, so that the natural drainage pattern in the areas will not be affected and adjacent flora should not be affected.

- Rehabilitation of borrow area and quarry area shall be carried out in order to control the water logging problem and to avoid the soil erosion and landslides of the adjacent area.
- Existing licensed quarry will be used as source of coarse and fine aggregates.
- It will be ensured that the aggregates procured during construction stage will be from the authorized or licensed suppliers only.

7.8.2 Soil Contamination

Soil contamination is likely due to the possible leakage of fuel/lubricants and dumping of construction wastes during construction stage. The contractor will be required to initiate measures to reduce/prevent waste generation from all activities. The measures would include

- Identifying landfill sites for disposal of debris and a plan for disposal needs to be prepared by the contractor with approval of Construction Supervision Consultant
- Undertake measures for minimization of waste and recycling of surplus materials for use by local communities
- Follow established procedures for storage of hazardous goods and chemicals
- Prepare plans for cleanup of any accidental spillage
- Checks for ensuring erosion control structures are in place before earthworks are started

All arrangement for transportation during construction including provision, maintenance, and clearing debris, where necessary will be considered incidental to the work and should be

planned and implemented by the contractor as approved and directed by the Engineer. Disposal of all waste materials is responsibility of the contractor.

At various construction sites, the vehicles and equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refueling sites are kept away from drainage channels and important water bodies. At the wash down and refueling areas, "oil interceptors" shall be provided. All spills and petroleum products shall be disposed off in accordance with the SPCB guidelines. Fuel storage and fueling areas will be located at least 300m from all cross drainage structures and significant water bodies. In all fuel storage and refueling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

To minimize the dumping of construction wastes from the project, the debris generated due excavation and site preparation shall be suitably reused in the proposed construction, subject to the suitability of the material and the approval of the Engineer.

Unusable debris material shall be suitably disposed off by the contractor at pre- designated disposal locations, subject to the approval of the Engineer. The bituminous wastes shall be dumped in secure landfill sites only. At such locations dumping will be carried out over a 60 mm thick layer of rammed clay so as to eliminate any chances of leaching. The identification of such landfill sites shall be carried out by the Contractor (before start of construction activity) and duly approved by the concerned department and the PIU.

Impacts are anticipated only in case of accidents involving large spillover of hazardous materials or petroleum products. Monitoring shall be done at the locations where these have occurred and further course of action to reduce the pollution shall be worked out.

7.8.3 Productive Agriculture Lands

Efforts have been made to minimize the intake of productive lands. The borrow areas; construction camp locations; traffic detours and other construction sites shall be selected carefully in consultation with the Engineer to minimize the agricultural land acquisition. To conserve the productive topsoil of all areas affected due to project, the following measures have been proposed:

- The topsoil from all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil
- The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile will be restricted to 2 m

- Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum and shall be covered with gunny bags or tarpaulin
- It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to CoI
- The stored topsoil will be utilized for:
- Covering all disturbed areas including for the redevelopment of borrow areas
- Filling up of tree pits, proposed as part of compensatory plantation

The contractor shall be responsible for working out haul roads with the minimal loss of productive soils, in consultation with the Engineer.

7.8.4 Borrowing and Quarrying

Specific locations of borrow areas to be used will be identified by contractor. The selection and recommendations for borrow areas will be based on environmental as well as civil engineering considerations. Location and source of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, MoRTH and as specified in IRC: 10-1961. Redevelopment of the borrow areas to mitigate the impacts will be the responsibility of the contractor. The contractor shall evolve site- specific redevelopment plan for each borrow area location, which shall be implemented after the approval of the Engineer.

Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. The haul roads and borrow areas will be managed and maintained by the contractor. Since dust rising is the only impact along the haul roads sprinkling of water will be carried out twice a day along such roads during their period of use.

Borrowing of earth shall be avoided on productive lands and within 1 km of settlement areas. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than

30 cm after stripping the 15 cm top soil aside. At locations where private owners desire their fields to be leveled, the borrowing shall be done to a depth of not more than 2 m or up to the level of surrounding fields.

Though no major impacts on geological profile of the project area are anticipated, requirement of construction material from quarries will induce pressure on the local geological

deposits. The contractor is to ensure procurement of the construction material from licensed quarries only. It is envisaged that no new quarries will be proposed.

The quarries that would be used for procuring construction material should be established under "The Tamil Nadu Mines and Mineral Concession Rules, 1959". The act lays down guidelines for establishing quarries and obtaining quarry lease. It also specifies the conditions to be maintained for operating the quarry or for obtaining renewal of quarry lease. In respect of quarrying in environmentally sensitive areas certain restrictions have been imposed to avoid any detrimental impact due to irresponsible quarrying. The rules lay down various precautionary measures during blasting, safety of workers, management measures within quarries, approval of the village heads prior to material leaving the village, precautionary measures to avoid spillage during transport of quarry materials.

The contractor should obtain material from quarries which are already operational with the relevant clearances and compliance to environmental requirements. In case the whole quarry is taken up by the contractor then the contractor will be responsible for closure of the quarry. A quarry area rehabilitation plan is to be submitted by the contactor to the engineer for its approval prior to acquiring material from the quarry.

7.9 Biological Environment

7.9.1 Loss of Trees

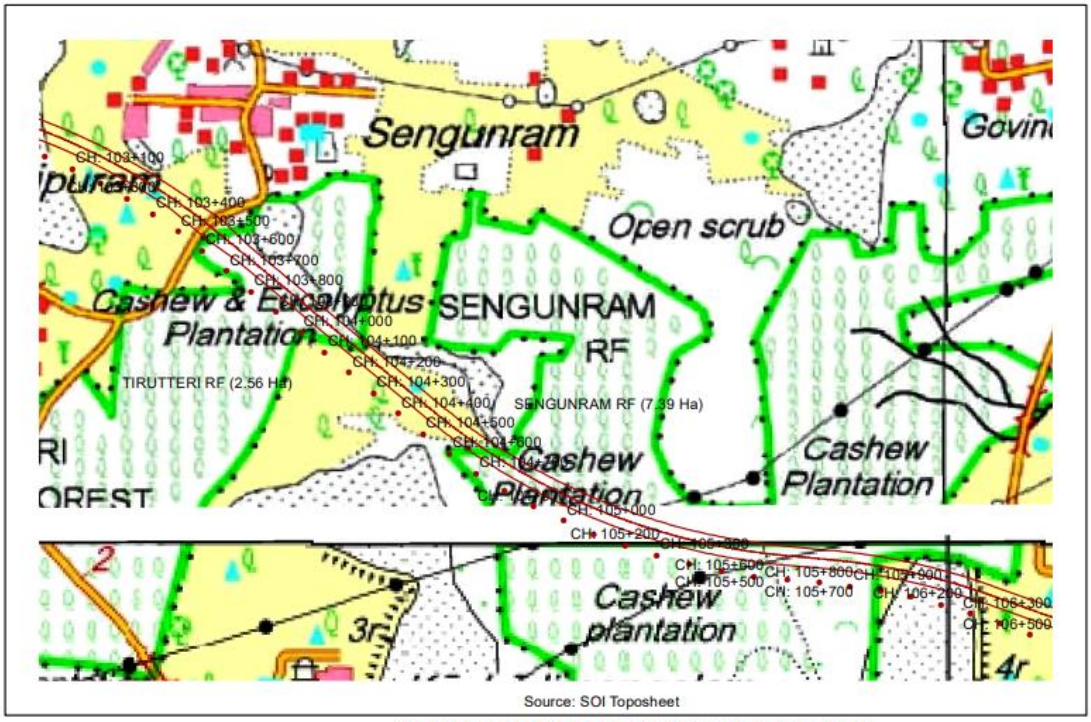
The tree felling will be compensated by planting trees at 1:10 ratio in the existing road in the available space. Moreover, out of the 4210 identified trees likely to be removed. It has been considered to save and protect 3585 trees below 900 mm girth size shall be transplanted along the same corridor along the PRoW. (Out of the 3585 trees below 900 mm, 1519 of them were less than 600 mm girth size and hence the chance for survival rate shall be more). Only 625 trees need to fell down due to the proposed roads which shall be compensated for 10 times of new saplings in around the project corridors.

Plantation at Enhancement Sites

A number of Government offices, schools, hospitals, and cultural properties exist along the project corridor. Trees such as Nettilingam, Neem is proposed for planting sensitive receptor's premises,

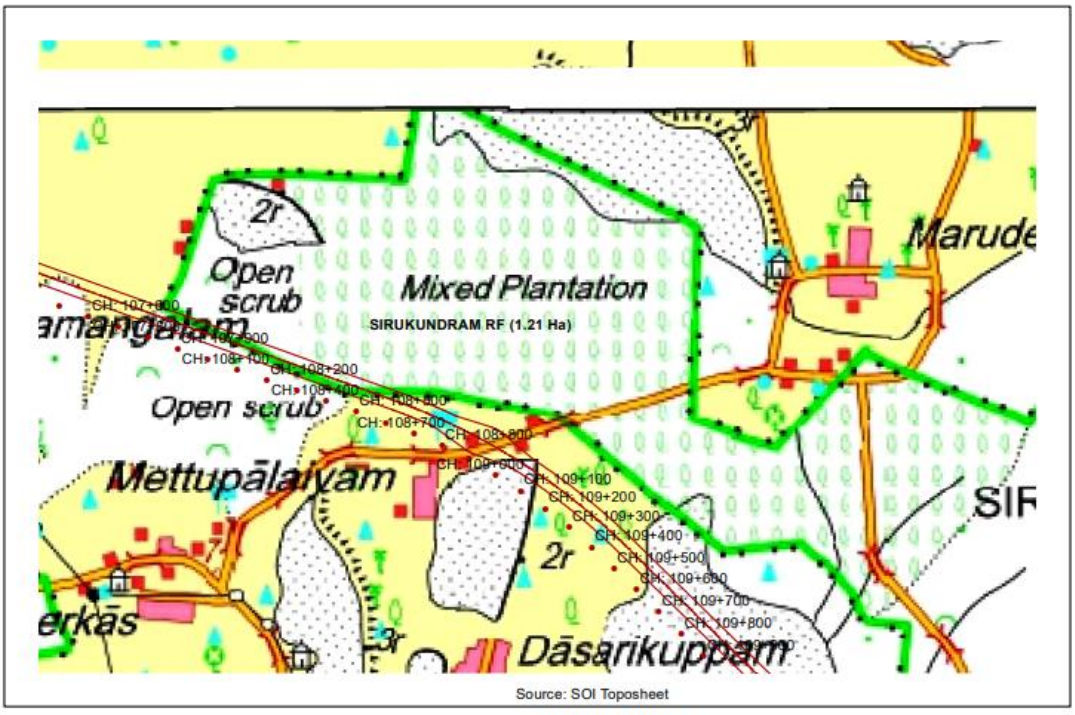
7.9.2 Forest Area

There is a requirement for forest land diversion as proposed road is passing through and adjacent to the reserved/protected/revenue forest, hence mitigation measures are warranted.



TIRUTTERI RESERVE FOREST AND SENGUNDRAM RF

Figure 7-2 Tirutteri and Sengundram RFs, and Proposed Road Alignment



SIRUKUNRAM RF

Figure 7-3 Sirukunram RF and Proposed Road Alignment

7.9.3 Wild Life

No wild life habitat/wild life crossing has been observed along the proposed road corridor. Signboards depicting name and distance of reserve forest shall be displayed at start of the forest zones.

7.9.4 Fauna

The construction and operation phase of the project doesn't possess threat to the fauna population available in the project area. There are no endangered species reported in the site and hence, no impacts are anticipated and mitigation measures are not required.

7.10 Social Environment

7.10.1 Loss of Access

The contractor shall provide safe and convenient passage for vehicles and pedestrians to and from side roads and property accesses connecting the project road. The construction activities that affect the side roads and existing access to individual properties shall not be undertaken without providing adequate provisions.

The construction works will not interfere with the convenience of the public or the access to use and occupation of public or private roads, railways and any other access footpaths to or of properties, whether public or private.

7.10.2 Safety Aspects

The Contractor will take all necessary measures for safety of traffic during construction. He shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the road under improvement.

Safety measures during construction phase

- Safety measures for construction workers
- Safety measures for road users
- Safety measures for the public

Safety measures during Operation Stage

Traffic safety measures are inbuilt into the project design and specifications. These would take care of the safety aspects in the operation stage. Following components are provided with safety aspects in view.

- Foot paths are provided throughout the cross section
- Non-motorized vehicles are stream lined to travel in a separate lane
- Local traffic will be stream lined to travel in service road
- Specify Speed Limit and De-restriction Signs (RS12 & RS13) at the entry and exit to each urban or village area, which has street lighting. These signs will be shown on the road plans and will be subject to local agreement or modification prior to erection.
- Provide cattle crossings where there is a need for a cattle crossing.

7.10.3 Construction Workers Camp

Layout of Construction Camp

The contractor based on the following guidelines shall identify the location of the construction site. The construction site shall be located

- A minimum of 1 km away from any major settlement or village
- A minimum of 300m of any major surface water course or body
- A minimum of 500-m away from any Reserve Forest/Wild life Sanctuary/Ecologically sensitive areas
- On nonagricultural lands, as far as possible

Facilities at Workers Camps

- Accommodation
- Sanitation Facilities
- Shelter at Workplace
- Canteen Facilities
- Health Care Facilities
- Day Crèche Facilities
- (Detailed Guideline for workers camps).

7.11 Cultural Environment

7.11.1 Religious and Cultural Places with Local Importance

Out of the 73 CPRs identified, 18 cultural properties like Worship places and shrines were identified need to be relocated. The contractor and the PIU should consult the community and finalize a suitable location for relocation. The relocated structure should be equivalent to or bigger in size and precincts to the structure that is being acquired. Necessary facilities as were present in the original structure should be provided in the relocated site as well.

7.11.2 Protected Monuments

As none of the monuments of historical or archeological significance within the influence area of the project corridor as per the Archaeological Protection Act are getting impacted no mitigation measures are suggested.

7.12 Conclusion

The identified mitigation strategies shall ensure the environmental safety and safeguards the impacts related to environment and public.

8 Environmental Management Plan

8.1 Introduction

To mitigate the identified impacts an Environmental Management Plan and Environmental Management Cost has been prepared. The likely adverse impacts on various environmental components, viz., Land, Air, Water, Biodiversity and Social & Aesthetic have been assessed. Based on the identified impact's potential, the management practice to be followed for minimizing and mitigating the impacts on the surround environment, the activity wise Environment Management Plan is drawn.

In summary, the expected impacts are of small scale, temporary and site specific depending on the implementation of the project and will not exceed the construction and major environmental norms. The EMP will be form part of the contract document.

8.2 Environmental Management Plan

Effective implementation of the environmental measures suggested based on the baseline environmental conditions and environmental impact assessment requires robust procedures. Implementation could be ensured only when a pragmatic approach for environmental management is adopted. There are two stages for which the implementation arrangement is required i.e during project construction phase and operation phase. Some of the environmental tools which are applicable for this project for effective implementation of environmental measures are discussed in this chapter.

Environmental Management Plan (EMP) is aimed at mitigating the possible adverse impact of a project and for ensuring to maintain the existing environmental quality. The EMP converses all aspects of planning, construction and operation of the project, which are relevant to environment. It is essential to implement the EMP right from the planning stage and then continuing it throughout the construction and operation stage. Therefore, the main objective of the EMP is to identify the project specific activities that would have to be considered for investigation of the significant adverse impacts and the mitigation measures required.

8.3 Traffic Management Measures

During the construction stage of various components, traffic diversion or management is required. Temporary traffic diversion plan shall be prepared by the contractor prior to construction phase, which can be modified during construction to avoid/minimize the impact on road users and environment. The construction of project will be taken up in phased manner. Accordingly, the project stretch will be closed during construction. Only local traffic will be allowed on the stretch by providing barricading to separate the construction area and necessary road safety

furniture like sign boards, reflectors lightings, etc. The access to the adjoining properties and cross streets should be ensured during construction of project components.

During construction, the through traffic will be diverted through parallel roads and adjacent roads. This de-touring length will be planned to ensure the level best minimum distance than existing route.

8.3.1 Planning the works

The complexity of traffic diversion or management differs from scheme to scheme but the main objective is to maximize the safety of work force, publics living nearby and the travelling public and the second objective is to keep traffic flowing as freely as possible. So the traffic management should be a safe system of work for both operatives and road users. During the planning stage of works the following points should be noted.

a) Intimation to the public living or shops available adjoining the construction site.
b) Attention must be paid to the needs of pedestrians. This applies especially in the vicinity of bus stops, shops, where larger numbers of people with physical/mental impairments may be expected.
c) Construction works should be undertaken in the minimum time, taking up the minimum of road space, but without compromising safety. Where practicable, additional resources or time- reducing techniques should be considered.
d) There must always be liaison with the Authority concerned to avoid concurrent works in close proximity.
e) Transport authorities to be informed to plan their stops and routes if diverted
f) There should be always liaison with traffic police and other emergency services

8.3.2 Designing Traffic Management

a) Before execution minimum lateral (sideways) clearance should be given between moving traffic and workspace
b) Outer boundary of workspace should be provided with barricading as specified in the SoR of TNHD.
c) Barricading should be visible in day and night and also adjacent to running traffic lane should be lined with traffic cones.
d) Access to the adjoining properties should be ensured through temporary arrangements.
e) Adequate working space should be provided around the work place to allow temporary works
f) Proper diversion board indicating the "Road ahead is closed" the nature of work going ahead with authority name should be placed before the entrance of road with advance

warning of diversion should be placed before 100m of diversion with arrow sign for diversion.

8.4 Sensitive Receptors Management Plan

The project needs to develop measures for the rehabilitation of cultural properties that will be affected by the road improvement program. This could be made a part of the broad R&R Principle and Policy Framework. The Environmental Budget within the EMP will undertake the environmental enhancement where as any land acquisition and rehabilitation will be part of the Resettlement Action Plan

8.4.1 Direct Impacts:

The direct impacts to the cultural properties are of the following category.

a) Only Compound wall affected
b) Compound wall and part of the compound affected
c) Part of structure affected
d) Complete cultural property affected
e) Loss of access/entrance, if the existing access is from the project roadside.

8.4.2 Project Approach:

In all cases, the mitigation actions are framed unique to that particular situation with respect to the available space, the unique characteristics of the religious structure affected and the local public and religious judgment. In other words, the project policy is unique to consider the widely varying situations for each cultural property.

8.4.3 Impact Mitigation:

The loss of land and assets of the cultural properties will be treated on par with the loss of other land and assets for the purpose of compensation and assistance. However, the project will, in addition, strive to enhance benefits to the affected cultural properties in consultation with their respective management/ Owners.

8.4.4 Measure for restoration, reconstruction and relocation of cultural properties

Measures on reconstruction and relocation of cultural properties are shown in the following table.

Table 8-1 Reconstruction and Relocation of Cultural Properties

Sl. No	Description of loss	Mitigation Measures
1	Only Compound wall and land beneath affected	Reconstruction of wall parallel to the present compound wall. Loss of land compensated. Access/entrance provided through one of the Side

Sl. No	Description of loss	Mitigation Measures
2	Compound wall and part of compound affected	Reconstruction of wall parallel to the existing wall. Loss of land compensated. If land is available adjacent to the property, will be purchased.
3	Structure affected	Alternate structure constructed and all pre-status restored.
4	Statue affected	Complete structure reconstructed and all pre-status restored.
5	Only land affected	Compensation for land and if possible alternate land provided.
6	Complete cultural property affected	Relocation of site identified by the cultural property authorities and rebuilding of the property.
7	Schools	No Horn Zone Tree plantation serve as noise barriers Loss of compound walls shall be reconstructed.
8	Hospital	Silent Zone Loss of building shall be relocated with new building in the same place or alternate site shall be identified for relocation. Tree plantations
9	Water bodies	Tree plantation along the bunds. Desilting or deepening of the area proportionate to the area acquired for road works.

8.4.5 Design changes made to save cultural properties:

Accordingly, some of the cultural properties have been saved.

Relocation necessary: In few cases some land acquisition will also be necessary.

Environmental Enhancement and landscaping: At least in many cases cultural property enhancement measures are necessary.

8.5 Tree Cutting and Compensatory Plantation

a) The vulnerable trees to be felled during construction activity are estimated as 2,995 trees. It is proposed to cut 9 trees only which have girth size more than 900 mm and 1,571 No. of trees having girth size from 600 mm to 900 mm will also be removed. Remaining 1,085 trees of girth size 300 to 600 can be transplanted within available land.

b) Adequate precaution shall be taken during implementation to keep the tree cutting at minimum.

c) However, for cutting of affected trees, note with necessary details on the project and trees & species with girth and justification for tree cutting shall be submitted by the Highways Department to the respective Forest department for obtaining permission.

d) Tree cutting shall be carried out by the Forest Department of the GoTN prior to start of work.

8.5.1 Compensatory Plantation:

a) Provision has been made in the cost estimate for plantation at ten times the number of vulnerable trees.
b) HD has proposed to carryout compensatory plantation after completion of the road construction, through its nursery wing which will also carry out the maintenance activities of the plantation.
c) Around 15,800 trees shall be planted along the roads and open land in the project areas and in the school ground and parks nearby, if any.
d) Suggested species of trees for the compensatory plantation are honey suckle, yellow gulmohar, netilingam, neem, etc.
e) Tree guards will be provided for saplings, and the recommended height of the saplings will be more than 2 m.

8.5.2 Trees Transplantation:

a) Provision has been made for transplanting 2,995 trees likely to be affected due to the project.
b) The trees below 600 mm girth size has been identified for transplanting.
c) The transplanting of trees shall enable the PIU to save endangered species and speedy growth of the same.
d) The aesthetic landscape appearance of the project road shall also remaining the same with scenic beauty and green cover

8.5.3 Installation of the animal underpass

Seven animal underpasses (7 m x 4 m) with some 250 m intervals will be provided along the proposed road alignment where pass through the reserve forest areas as follows. Adequate locations of the animal locations have been confirmed and determined by wildlife expert of the Forest Department.

Table 8-2 Locations of the Animal Underpasses

Sl No	Chainage
1	103+825
2	104+075
3	104+800
4	105+050
5	105+300
6	105+550
7	105+800

Table 8-3 Environmental Management Plan

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
Pre – Construction Phase					
1.	Land Acquisition	The land will be acquired following the provisions of Tamil Nadu Highway Act, 2001 and the compensation will be determined following India's new Land Acquisition and Rehabilitation and Resettlement Act, (RFCTLARR Act, 2013)	Corridor of Impact.	PIU, Revenue Dept., and NGOs,	PMU(CPRR)
2.	Obtaining Clearance, Permission and Consents	Consultation and coordination with relevant authorities to prepare the documents to obtain clearance, permission and consents Conditions set in CRZ clearance, Environmental clearance and other permission and consents are to strictly adhere to	Project clearance/ NoC/ Permissions	Contractor	PIU and PMC
3.	Baseline collection	A full set of baselines of air, water, soil and noise will be collected by contractor prior to the mobilization	As specified in the environmental monitoring plan	Contractor	PIU and PMC
4.	Tree Felling and Transplantation. The total number of trees to be affected for the project is 2995.	As far as possible maximum efforts shall be made to minimize the number of trees proposed to be felled by adopting suitable on the spot adjustment of engineering designs. Trees shall be removed from the Corridor of Impact (CoI) and construction sites before the commencement of construction. Prior Permission shall be obtained from the Revenue Department for the avenue trees and the Forest Department for the trees located within the Forest areas The trees cut shall be disposed of through auction (inclusive of tree stumps). This disposal shall be done immediately to ensure that the traffic movement is not disrupted. Progress of tree cutting shall be reported to the PIU.	Corridor of Impact.	PIU, Revenue Department, and Forest Department. Tree Felling Contractor	PMU(CPRR)
5.	Utility Relocation and Common Property Resources (CPRs)	All community utilities and common property resources such as stand posts bore wells, wells, water supply lines, toilets, sewage lines, drainage systems, optical fibre cables, electric power supply lines, transformers, irrigation pump houses, telephone and television cables shall be relocated and restored before the commencement of the road improvement activity. While relocating these utilities and facilities, all concerned agencies including PIU shall take necessary precautions and shall provide barricades/delineation of such sites to prevent accidents including accidental fall into boreholes, pits, drains both during demolition and construction/ relocation of such facilities. Standard safety practices shall be adopted for all such works.	Corridor of Impact	PIU, Concerned Agencies/ Departments, Contractor	PMU(CPRR)

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		Early completion of works for schools, colleges and health centers including shifting of gates and construction of boundary walls shall be planned during holidays so that the risk of accidents and disturbance to the day-to-day activity of such institutions are minimized. Proper placement (as per codes) of passenger shelters/bus stops shall be ensured to prevent distress to the commuters and passengers. Access to the Common Property Resources (CPR's) shall be maintained. Relocation sites for all CPRs shall be selected in consultation with concerned communities, local administrative authorities/departments.			
6.	Relocation of Cultural and Religious Properties	All cultural properties within the CoI, whose structure is getting affected fully, shall be relocated at suitable locations, as desired by the community; and for partially impacted structures enhancement measures shall be applied at the same sites before construction begins, depending on the availability of space, the requirement of the communities and fund availability. No cultural properties or religious structures shall be removed or relocated without the knowledge and written consent of the concerned parties or communities and local administration as the case may be. Sites for the relocation of these religious structures shall be identified following the choice of the community. As far as possible, the architectural elements of the structure should be conserved/reflected/translated into the design of new structures following the wishes of the community Proper drainage and garbage disposal at such sites shall be ensured to prevent unhygienic conditions, blocking of drains, etc. at/near relocated structures. Garbage collection bins, soak pits or other appropriate measures shall be provided apart from the simple enhancement of such sites.	Corridor of Impact. 11 Temples, 3 churches, 2 burial grounds, and one school	PIU, NGOs, Contractor, Concerned Community	PMU(CPRR)
7.	Onsite Training	The PIU shall organize orientation sessions during all stages of the project. This shall include on-site training (general as well as specific to the context of this subproject) as well. These sessions shall involve the concerned division-level staff of the CPRR involved in the project, Staff of the Site Engineer/ Supervision Consultant and the Contractor.		PIU, Site Engineer/ Supervision Consultant	PMU(CPRR)
8.	Joint Field Verification	The Engineer - In charge of Supervision Consultant and the Contractor shall carry out joint field verification to ascertain the necessity of saving trees, environmental and community resources wherever such representations or suggestions in writing have been received and forwarded by the project authority or by the site engineer following the local situations (in consultation with the local authority/ interest of community representation).	Project Corridor	Contractor and Environmental Officer of SC	PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		The complaints/suggestions together with the observations and expert opinion of the joint verification team containing the need for additional protection measures or changes in design/scale/nature of protection measures including the efficacy of enhancement measures suggested in the EMP shall be summarized in a written document containing all the details with date, time, place, and signature of the individuals involved and this shall be sent to PIU/CPRR for approval. The PIU shall maintain proper documentation and justifications/reasons in all such cases where deviation from the original EMP is proposed.			
9.	Assessment of Impacts due to Changes/ Revisions in the Project Work	The Engineer - In charge of Supervision Consultant shall assess the anticipated impacts and revise/modify the EMP in consultation with the PIU/CPRR in accordance to the recommendation made by the field survey party in the event of changes /revisions (including addition or deletion) in the project's scope of work	Project Corridor	Contractor and Environmental Officer of SC	PIU
10.	COVID-19 response	Taking cognizance of situation at time of mobilization, the Contractor shall undertake a COVID-19 risk assessment of project area and prepare a COVID-19 Response and Management Plan (C-R&MP) and submit to PIU and Supervision Consultant for approval. The preparation of C-R&MP shall consider guidance of Government of India, World Health Organization, International Labour Organization, International Financial Corporation and World Bank's interim guidance note etc. The key points include but not limited to, Consider ways to minimize/control movement in and out of construction areas/site. If workers are accommodated on site require them to minimize contact with people outside the construction area/site or prohibit them from leaving the area/site for the duration of their contract. Implement procedures to confirm workers are fit for work before they start work, paying special to workers with underlying health issues or who may be otherwise at risk. Check and record temperatures of workers and other people entering the construction area/site or require self-reporting prior to or on entering. Provide daily briefings to workers prior to commencing work, focusing on COVID-19 specific considerations including cough etiquette, hand hygiene and distancing measures. Require workers to self-monitor for possible symptoms (fever, cough) and to report to their supervisor if they have symptoms or are feeling unwell. Prevent a worker from an affected area or who has been in contact with an infected person from entering the construction area/site for 14 days. Preventing a sick worker from entering the construction area/site, referring them to local health facilities if necessary or requiring them to quarantine at home for 14 days.	All locations	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		The contractor shall submit a weekly monitoring and progress report to PIU and Supervision Consultant.			
11.	Crushers, Hot-mix Plants & Batching Plants	Crushers, hot mix plants, and batching plants shall comply with the requirements and specifications of the relevant current emission control legislation. Hot-mix and batching plants shall be located 1000m (1km) away from residential/ settlements, forests, wildlife movement areas, and commercial establishments, preferably in the downwind direction. The Contractor shall submit a detailed layout plan for all such sites and seek prior approval of Engineer - In charge of Supervision Consultant before entering into a formal agreement with a landowner for setting-up such sites. Actions by Supervision Consultant and PIU/CPRR against any non- compliance shall be borne by the Contractor at his own cost. Arrangements to minimize dust pollution through the provision of windscreens, mist spray units, and dust encapsulation shall have to be provided at all such sites. Specifications of crushers, hot mix plants, and batching plants shall comply with the requirements of the relevant current emission control legislation and Consent / NOC for all such plants shall be submitted to the Supervision Consultant and PIU/ CPRR. No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority and the same is submitted to the PIU/ CPRR and the Supervision Consultant. Environmental Monitoring (dust and emission) have to be conducted to demonstrate compliance	Project Corridor All construction machineries (Crushers, Hot-mix Plants & Batching Plants) should be kept/ stationed 1000 m away from settlements (refer to Annexure 4)	Contractor	Environmental Officer of SC and PIU
12.	Other Construction Vehicles, Equipment and Machinery	The discharge standards promulgated under the Environment Protection Act, 1986 shall be strictly adhered to. All vehicles, equipment, and machinery to be procured for construction shall conform to the relevant Bureau of Indian Standard (BIS) norms. Noise limits for construction plant equipment are to be procured such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A), when measured at one-meter distance from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986. Efficient and environmentally friendly equipment confirming to the latest noise and effluent emission control measures available in the market shall be used in the project. The Contractor shall maintain a record of Pollution under Control (PUC) certificate for all vehicles and machinery used during the contract period, which shall be produced to the PIU/ CPRR and the Supervision Consultant for verification whenever required.	Project Corridor	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
13.	Borrow Areas	Arrangement for locating the source of supply of material for embankment and subgrade as well as compliance with environmental requirements, as applicable, shall be the sole responsibility of the Contractor. The environmental personnel shall be required to inspect every borrow area location before approval. Format for reporting shall be as per the Reporting Format enclosed in the EMP for Borrow Area. The Engineer - In charge of the Supervision Consultant shall be required to inspect every borrow area location and evaluate such proposals following environmental requirements before issuing approval for use of such sites. No borrow areas shall be opened within 500m of wildlife movement zones and forest areas. The borrow areas shall be at least 300m from schools and village access roads. Borrow area should be located at a minimum distance of 300m from the residential/ settlement area. Proper fencing should be provided and access to the borrow areas should be restricted for the locals The Contractor shall not borrow the earth from the selected borrow area until a formal agreement is signed between landowner and Contractor and a copy of the agreement is to be submitted to the Engineer – In-charge of the Supervision Consultant. The Supervision Consultant shall report these facts to the PIU/ CPRR along with the remarks in the prescribed format with documentary proofs. Planning of haul roads for accessing borrows materials shall be undertaken during this stage. The haul roads shall be routed to avoid agricultural areas. In case agricultural land is disturbed, the Contractor shall rehabilitate it as per Borrow Area guideline given in the Environmental Management Framework (EMF) or as approved by the Engineer – In-charge of Supervision Consultant. Haul roads shall be maintained throughout the operation period of the borrow areas by undertaking the required maintenance and repair works, which may include strengthening, pothole repairing, and diversions. Improvements shall be done to reduce inconvenience to users of these roads, residents living along the haul roads and minimize air and water pollution. Such measures shall include, but not limited to, frequent sprinkling of water, repairing of the road, road safety provisions (warning and informatory signage, flagmen, etc.), and ensuring covering of loaded vehicles by waterproof tarpaulin; consultation with public and special precautions are required when measures are implemented near schools, health centers, and settlement areas.	Ecologically sensitive area (Mannur RF)	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
14.	Quarries	The Contractor shall identify materials from existing licensed quarries with suitable materials for construction. Apart from approval of the quality of the quarry materials, the Engineer's representative shall verify the legal status of the quarry operation, as to whether approval from the Department of Geology and Mining, GoTN is obtained. No quarry and/or crusher units shall be selected or used, which is within 1000m from the forest boundary, wildlife movement path, breeding and nesting habitats, and national parks/sanctuaries. No quarry plants can be set-up within 1000m from the residential/ settlement locations Contractor shall also work out haul road network used for quarry transport and report to Engineer - In charge of Supervision Consultant who shall inspect and in turn report to PIU/ CPRR on the suitability of such haul roads from the safety of residents, biodiversity and other environment points of views.	Quarry area Should be located 1000m from the settlement locations (refer to Annexure 4)	Contractor	Environmental Officer of SC and PIU
15.	Arrangement for Construction Water	The Contractor shall source the requirement of water preferentially from surface water bodies, as rivers and tanks in the project area. The Contractor shall be allowed to pump only from the surface water bodies. Boring of any tube wells shall be prohibited. To avoid disruption/disturbance to other water users, the Contractor shall extract water from fixed locations. The Contractor shall consult the local people before finalizing the locations. Only at locations where surface water sources are not available, the Contractor can contemplate the extraction of groundwater. Consent from the Engineer that "no surface water resource is available in the immediate area for the project" is a pre-requisite before extraction of groundwater. The Contractor shall need to comply with the requirements of the PWD – Water Resources Department. Go TN and seek their approval for doing so.	All rivers/ surface water bodies that can be used in the project	Contractor	Environmental Officer of SC and PIU
16.	Sand (all river and stream beds used directly or indirectly for the project)	The Contractor shall identify sand quarries with requisite approvals for the extraction of sand. In case of selection of new sites for sand quarrying, the Contractor shall obtain prior approval and concurrence from Competent District Authority and the Engineer – In charge of the Supervision Consultant keeping in view the objections and convenience of the local population, who may restrain such activities for their security and safety. Where the supplier of sand is another party, the authentic copy of the lease agreement that has been executed between the local Tahasildar and the supplier has to be submitted to Supervision Consultant and PIU/ CPRR of the project, before any procurement is made from such a site. To avoid accidents and caving in of sandbanks at quarry sites, and shall be removed layer by layer. Digging deeper than the permissible limit has to be completely avoided by the	All riverbeds recommended for sand extraction for the project	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		Contractor. Such quarry shall be barricaded 10m away from the periphery on all sides except the entry point, to prevent the accidental fall of domestic cattle, wildlife, and human beings.			
17.	Labour Requirements	The Contractor shall use unskilled labor drawn from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply, etc.)	Along the project corridor at construction sites	Contractor	Environmental Officer of SC and PIU
18.	Construction Camp Locations – Selection, Design & Layout	Construction camps shall not be proposed: Within 1000m of Ecologically sensitive areas/ zones Within 1000m from the nearest habitation to avoid conflicts and stress over the infrastructure facilities, with the local community. The layout of construction camps has to be prepared and approved by the Engineer – In charge of the Supervision Consultant. The location for the stockyard for construction materials shall be identified at least 1000 m from watercourses. The waste disposal and sewage system for the camp shall be designed, built and operated such that there will no contamination to the soil, groundwater and also ensure that there is no odor generation. Unless otherwise arranged by the ULB's, arrangements for disposal of excreta suitably approved by the local medical health or municipal authorities or as directed by Engineer shall be provided by the Contractor.	All Construction Workers Camps including areas in the immediate vicinity	Contractor	Environmental Officer of SC and PIU
19.	Arrangements for Temporary Land Requirement	The Contractor as per prevalent rules shall carry out negotiations with the landowners for obtaining their consent for temporary use of lands for construction sites/ hot mix plants /traffic detours /borrow areas etc. The Engineer shall ensure that the site is cleared before handing over to the owner (after construction or completion of the activity) and it is included in the contract.	Areas temporarily acquired for construction sites / hot mix plants / borrow areas / diversions / detours	Contractor	Environmental Officer of SC and PIU
II.	**CONSTRUCTION STAGE**				
Site Clearance					
20.	Clearing and Grubbing	Site clearance including clearance of marked trees for felling and removal has to be carried out much before the actual road construction takes place. Structures and utilities (cabins, commercial properties, hoardings, overhead power transmission lines, cable connections, telephone lines, bore wells, stand posts, wells, statues, temples, etc.) shall be compensated/relocated as per RAP and EMP provisions before tree felling; clearing or grubbing activities are to be undertaken as these activities may damage structures (private and govt.) and essential facilities/utilities of public use.	Corridor of Impact	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		All works shall be carried out in a manner such that the damage or disruption to flora is minimum. Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works shall be removed with prior approval from Engineer - In charge of Supervision Consultant. The Contractor, under any circumstances, shall not cut or damage trees. Vegetation above 30 cm girth shall be considered as trees and shall be compensated.			
21.	Dismantling of Bridgework / Culverts	All necessary measures shall be taken especially while working close to cross drainage channels to prevent earthwork, stonework, materials, and appendage as well as the method of operation from impeding cross-drainage at rivers, streams, water canals, and existing irrigation and drainage systems or causing flooding	At locations were bridge works and culverts are proposed.	Contractor	Environmental Officer of SC and PIU
22.	Generation & disposal of Debris	Debris generated due to the dismantling of the existing road shall be suitably reused in the proposed construction as follows: Eighty percent (80%) of the sub-grade excavated from the existing road surface, excluding the scarified layer of bitumen, shall be reused in the civil works after improving the soil below the subgrade through the addition of sand and suitable cementing material for qualitative up-gradation. The dismantled scraps of bitumen shall be utilized for the paving of crossroads, access roads and paving works in construction sites and campus, temporary traffic diversions, haulage routes, parking areas along the corridor or in any other manner approved by the Engineer - In charge of Supervision Consultant. At locations identified for disposal of residual bituminous wastes, the disposal shall be carried out over a 60 mm thick layer of rammed clay to eliminate the possibility of leaching of wastes into the groundwater. The Contractor shall suitably dispose of unutilized non-toxic debris either through filling up of borrows areas located in the wasteland or at pre-designated disposal sites, subject to the approval of the Engineer - In charge of Supervision Consultant. Debris generated from pile driving or other construction activities along the rivers and streams drainage channels shall be carefully disposed of in such a manner that it does not flow into the surface water bodies or form puddles in the area. The pre-designated disposal locations shall be part of the Comprehensive Solid Waste Management Plan to be prepared by the Contractor in consultation and with approval of Engineer - In charge of Supervision Consultant and approval local competent authority.	Throughout Project Corridor	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
23.	Non-bituminous construction wastes disposal	The location of disposal sites shall be finalized before completion of the earthworks on any particular section of the road. The Engineer shall approve these disposal sites conforming to the following These are not located within the designated forest area The dumping does not impact natural drainage courses No endangered/rare flora is impacted by such dumping. Settlements are located at least 1000 m away from the site.	Disposal site locations	Contractor	Environmental Officer of SC and PIU
24.	Bituminous wastes disposal	The disposal of residual bituminous wastes shall be done by the Contractor at secure landfill sites, with the requisite approvals for the same from the concerned government agencies.	Throughout Project Corridor	Contractor	Environmental Officer of SC and PIU
25.	Stripping, stacking and preservation of topsoil	The topsoil from all sites including roadside widening and working area, cutting areas, quarry sites, borrows areas, construction camps, haul roads in agricultural fields (if any) and areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles for reuse. A portion of the temporarily acquired area and/or RoW edges shall be earmarked for storing topsoil. The locations for stacking shall be pre-identified in consultation and with approval of Engineer - In charge of Supervision Consultant. The following precautionary measures shall be taken by the Contractor to preserve the stockpiles until they are re-used: Stockpile shall be arranged such that the slope does not exceed 1:2 (vertical to horizontal), and height is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile shall be protected by silt fencing. Multiple handling is to be kept to a minimum to ensure that no compaction occurs. Such stockpiles shall be covered with empty gunny bags or shall be planted with grasses to prevent loss during rains. Such stockpiled topsoil shall be utilized for Covering reclamation sites or other disturbed areas including borrow areas (not those in barren areas) Topdressing of road embankment and fill slopes Filling up of tree pits and in the agricultural fields of farmers, acquired temporarily that need to be restored. Residual topsoil, if there is any, shall be utilized for the plantation works along the road corridor.	Throughout Project Corridor	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		The utilization as far as possible shall be in the same area/close to the same area from where the topsoil was removed. The stripping, preservation, and reuse shall be carefully inspected, closely supervised and properly recorded by the Supervision Consultant.			
26.	Accessibility	The Contractor shall provide a safe and convenient passage for vehicles, pedestrians, and livestock to and from roadsides and property access connecting the project road by providing temporary connecting road and footpath, as necessary. Construction activities that shall affect the use of side roads and existing accesses to individual properties, access to works, whether public or private, shall not be undertaken without providing adequate provision approved by the Supervision Consultant. The Contractor shall take care that the crossroads are constructed in such a sequence that construction work over the adjacent crossroads are taken up in a manner that traffic movement in any given area does not get affected.	All along the project corridor, all access roads.	Contractor	Environmental Officer of SC and PIU
27.	Planning for Traffic Diversions and Detours	Detailed traffic control plans shall be prepared by the Contractor and the same shall be submitted to the Engineer - In charge of Supervision Consultant for approval. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements including night time safety measures, details of traffic arrangement after cessation of work each day, safety measures are undertaken for the transport of hazardous materials and arrangement of flagmen, etc. to regulate traffic congestion. The Contractor shall provide specific measures for the safety of pedestrians and workers as a part of traffic control plans. The Contractor shall ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. The Contractor shall also inform the local community of changes in traffic routes and pedestrian access arrangements with assistance from the Supervision Consultant and PIU/ CPRR.	All along the project corridor, all access roads	Contractor	Environmental Officer of SC and PIU
Construction Materials					
28.	Earth from Borrow Areas for Construction	No borrow area shall be opened without permission of the Engineer – In charge of Supervision Consultant. Borrow pits shall not be dug continuously in a stretch. The location, shape, and size of the designated borrow areas shall be as approved by the Engineer and following the IRC recommended the practice for borrow pits for road embankments (IRC 10: 1961).	All along the project corridor, all access roads sites temporarily acquired & all borrow areas	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		The borrowing operations shall be carried out as specified in the guidelines for siting and operation of borrow areas The unpaved surfaces used for the haulage of borrow materials shall be maintained dust-free by the Contractor. Since dust rising is the most significant impact along the hauled roads, a sprinkling of water shall be carried out twice a day along such roads during their period of use.			
29.	Quarries	The Contractor shall obtain materials for quarries only after the approval of the Department of Geology and Mining, GoTN. A copy of this consent must be submitted to PIU/ CPRR through Engineer –In charge of Supervision Consultant. The Contractor shall develop a Comprehensive Quarry Redevelopment Plan, as per the Mining Rules of the State and submit a copy to PIU/ CPRR and Supervision Consultant before the opening of the quarry site. The quarry operations shall be undertaken within the rules and regulations in vogue.	All along the project corridor and all haul roads	Contractor	Environmental Officer of SC and PIU
30.	Blasting	Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor will not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of MoRTH 302 besides the law of the land, as applicable. The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives. The Contractor shall at all times when engaged in blasting operations, post sufficient warning flagmen, to the satisfaction of the Engineer. The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whomsoever concerned or affected or likely to be concerned or affected by blasting operations. Blasting shall be carried out only with the permission of the Engineer. All the statutory laws, regulations, rules, etc., about the acquisition, transport, storage, handling and use of explosives shall be strictly followed. Blasting shall be carried out during fixed hours (preferably during mid-day) or as permitted by the Engineer. The timing shall be made known to all the people within 1000m (200m for pre-splitting) from the blasting site in all directions. Blast Management Plan shall be prepared by the Contractor, and it needs to be approved by the Engineer – in charge of Supervision Consultant	All blasting And Pre- splitting Sites.	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
31.	Water Extraction	Procurement of water is to be carried out as per "Arrangement for Construction Water". The Contractor shall minimize the wastage of water during construction.	All water bodies recommended being used in the project	Contractor	Environmental Officer of SC and PIU
32.	Transporting Construction Materials	All vehicles delivering materials to the site shall be covered to avoid spillage of materials. All existing highways and roads used by vehicles of the Contractor, or any of his sub-Contractor or suppliers of materials and similarly roads which are part of the works shall be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles The unloading of materials at construction sites close to settlements shall be restricted to daytime only. Transportation vehicles shall be cleaned before leaving the site	All along the Project corridor and all haul roads	Contractor	Environmental Officer of SC and PIU
Construction work					
33.	Disruption to other users of Water	While working across or close to any perennial water bodies, the Contractor shall not obstruct/ prevent the flow of water. Construction over and close to the non-perennial streams shall be undertaken in the dry season and if such activity is likely to disrupt, constrain or impact the community use of the water body, adequate prior information (at least two weeks in advance) shall be provided to such community. Such water bodies may be limited to ponds, water harvesting structures (WHS), feeder channels to the pond, irrigation sources, etc. If the supply of water or access to a source is being completely cut off, then the Contractor shall make necessary arrangements to provide water in the interim period. A water quality test shall be done before providing/supplying water. Wherever excavation results in diversion of water flow shall be required as per the engineering designs, the Contractor shall ensure that such diversion channels have no stepper slopes than 1:2 (V to H). Proper slope protection measures have to be taken as approved by the Engineer - In charge of Supervision Consultant and PIU/ CPRR. The Contractor shall take prior approval from PWD –Water Resource Department, GoTN and Supervision Consultant for any such activity. The PIU/CPRR shall ensure that Contractor has served the notice to the downstream users of water well in advance where such diversion of the flow is likely to affect the downstream population subject to the condition that under no circumstances the downstream flow shall be stopped putting the wildlife, the aquatic fauna, and the shoreline settlement under distress.	Water withdrawal locations	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
34.	Drainage and Flood Control	The Contractor shall ensure that any construction materials like earth, stone, ash or appendage are disposed off such that it does not block the flow of water of any watercourse and cross drainage channels. Where necessary adequate mechanical devices to bailout accumulated water from construction sites, campsites, storage yard, excavation areas are to be pre-settled and arranged well in advance of the rainy season besides providing temporary cross drainage systems. The Contractor shall take all adequate precautions to ensure that construction materials and excavated materials are enclosed in such a manner that erosion or run-off of sediments is controlled. Silt fencing shall be installed before the onset of the monsoon at all the required locations, as directed by Engineer - In charge of Supervision Consultant and PIU/ CPRR. The Contractor shall also ensure that no material blocks the natural flow of water in any watercourse or cross drainage channel. Before monsoon, the Contractor shall provide either permanent or temporary drains to prevent water accumulation or flooding in surrounding residential, commercial and agricultural areas.	Surface water sources/ drains/ Nalahs/ Ponds etc	Contractor	Environmental Officer of SC and PIU
35.	Siltation of Water Bodies and Degradation of Water Quality	The contractor shall construct silt fencing at the base of the embankment construction near all water bodies (including wells) and around the stockpiles at the construction sites. Silt fencing shall be provided before the commencement of earthwork and shall continue till the stabilization of the embankment slopes is complete on the particular sub-section of the road. The Contractor shall also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay byes and bus bays which are ultimately entering into any surface water bodies/water channels with a fall exceeding 1.5 m.	Surface water sources/ drains/ Nalahs/ Ponds etc.	Contractor	Environmental Officer of SC and PIU
36.	Slope Protection and Control of Soil Erosion	The Contractor shall construct slope protection works as per design, or as directed by the Engineer - In charge of Supervision Consultant to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fiber mats, mulches, grasses, slope drains and other devices as required under specific local conditions. Contractor shall ensure the following: After construction of road embankment, the side slopes of all cut and fill areas shall be graded and covered with stone pitching, grass and shrub as per design specifications. Turfing works shall be taken up as soon as possible provided the season is favorable for the establishment of grass sods.	High raise embankment and surface water bodies locations	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		Other measures of slope stabilization shall include mulching netting and seeding of batters and drain immediately on completion of earthworks with the sowing of seeds of grass, shrub and bushes 30cm interval from line to line across the slope and sprinkling of water on such slopes after completion of the earthwork. In borrow pits, the depth shall be regulated so that the sides of the excavation shall not be steeper than 1 vertical to 2 horizontal, from the edge of the bank. Stabilization of the embankment with appropriate technique/s shall commence soon after the embankment formation.			
Pollution Control					
Water Pollution					
37.	Water Pollution from Construction Wastes	The Contractor shall take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. The contractor shall avoid construction works close to the streams or water bodies during monsoon. All waste arising from the project is to be disposed of in the manner that is acceptable to the Tamil Nadu State Pollution Control Board (TNPCB) or as directed by Engineer – In charge of Supervision Consultant. The Engineer – In charge shall certify that all liquid wastes disposed of from the sites meet the discharge standards.	Surface water sources/ drains/ Nalahs/ Ponds etc.	Contractor	Environmental Officer of SC and PIU
38.	Water Pollution from Fuel, Lubricants, and Chemicals	The contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors shall be provided for vehicle parking, wash down and refueling areas as per the design provided. In all, fuel storage and refueling areas are located on agricultural land or areas supporting vegetation, the topsoil shall be stripped, stockpiled and returned after cessation of such storage. The contractor shall arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites approved by the Engineer – In charge. All spills and collected petroleum products shall be disposed of following MoEF&CC and TNPCB guidelines. Engineer – In charge shall certify that all arrangements comply with the guidelines of TNPCB/ MoEF&CC.	Surface water sources/ drains/ Nalahs/ Ponds etc.	Contractor	Environmental Officer of SC and PIU
Air Pollution					
39.	Dust Pollution	The Contractor shall take every precaution to reduce the level of dust (PM10 and PM 2.5) from crushers, material storage yards, haul roads and construction sites (including earthwork,	Construction area/ site, Construction	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		dismantling, scarification and material mixing sites) by sprinkling of water, mist spray, encapsulation of dust source and erection of screen /barriers. Hot mix plant and batch mix plant shall be fitted with dust extraction units and mist spray to keep down the dust emission levels. The PM10 value at a distance of 40m from a unit located in such a cluster should be less than 500 µg/m3. The Contractor shall provide necessary certificates to confirm that all crushers used in the project conform to relevant dust emission control legislation. Air pollution monitoring shall be conducted as per the Environmental Monitoring Plan and results shall be used to strengthen/rectify problematic areas. If other existing crushers are used, such units need to have a valid license from the TNPCB.	camps, Materials Loading/ unloading facilities		
40.	Emission from Construction Vehicles, Equipment and Machineries	The contractor shall ensure that all vehicles, equipment, and machinery used for construction are regularly maintained and conform to the emission standards specified by the TNPCB. Certification issued for such contrivances obtained from designated/approved authority shall be submitted along with the specified reporting format. The contractor shall maintain a separate file and submit Pollution under Control (PUC) certificates for all vehicles/equipment/machinery used for the project. Monitoring results shall also be submitted to Supervision Consultant and PIU/ CPRR as per the Environmental Monitoring Plan in the specified format.	Construction camps, Materials Loading/ unloading facilities	Contractor	Environmental Officer of SC and PIU
Noise Pollution					
41.	Noise Pollution: Noise from Vehicles, Plants and Equipment's	The Contractor shall confirm the following: All plants and equipment used in construction shall strictly conform to the MoEF&CC/ TNPCB noise standards. All vehicles and equipment used in construction shall be fitted with exhaust silencers. Servicing of all construction vehicles and machinery shall be done regularly and during routine servicing operations, the effectiveness of exhaust silencers shall be checked and if found defective shall `be replaced. Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one-meter distance from the edge of equipment in the free field), as specified in the Environment (Protection) Rules, 1986. Maintenance of vehicles, equipment, and machinery shall be regular and up to the satisfaction of the Engineer to keep noise levels at the minimum. Idling of temporary trucks or other equipment shall not be permitted during periods of unloading or when they are not in active use. (MoRTH - Section: 201.2)	Sensitive locations including Schools, Hospitals, and Temples	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		At the construction sites within 150m of the nearest habitation, noisy construction work such as crushing, concrete mixing, batching shall `be stopped during the night time between 9.00 pm to 6.00 am. No noisy construction activities shall be permitted around educational institutes/health centers (silence zones) up to a distance of 100 m from the sensitive receptors. The contractor shall provide noise barriers to the suggested locations of select schools/ Temples/health centers. Monitoring shall be carried out at the construction sites as per the monitoring schedule and results shall be submitted to Engineer-In charge of Supervision Consultant. The engineer shall be required to inspect regularly to ensure the compliance of EMP. (Refer MoRTH - Section 111.3)			
Health and Safety					
42.	Personal Safety Measures for Labour, Material handling, Painting, etc.	The contractor shall provide all necessary safety appliances such as safety goggles (high visibility), helmets, safety belts, earplugs, masks, vests, boots, etc. to workers and staff. Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete, etc. Welder's protective eye-shields to workers engaged in welding works Protective goggles and clothing to workers engaged in stone breaking activities and workers shall be seated at sufficiently safe intervals Earplugs to workers exposed to loud noise (above 75dB (A)), and workers working in crushing compaction, or concrete mixing operation. Adequate safety measures for workers during the handling of materials at the site are taken up. The Contractor shall comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. The Contractor shall not employ any person below the age of 14 years for any work and no woman shall be employed for the work of painting with products containing lead in any form. The Contractor shall also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. The contractor shall provide facemasks to the workers when the paint is applied in the form of a spray or a surface having dry lead paint is rubbed and scrapped. The Contractor shall mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance. These shall be reflected in the Construction	Construction sites	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		Safety Plan to be prepared by the Contractor during mobilization and shall be approved by Engineer.			
43.	Traffic and Safety & Pedestrian Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan/Drawings and as required by the Engineer – In charge for the information and protection of traffic approaching or passing through the section of any existing crossroads. The Contractor shall ensure that all signs, barricades, pavement markings are provided as per the MoRTH specifications. Pedestrian Safety shall be ensured. Pedestrian circulation shall be demarcated before start & unsafe areas shall be cordoned off	All along the project corridor and all haul roads	Contractor	Environmental Officer of SC and PIU
44.	The risk from Electrical Equipment(s)	The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that - No material shall be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights shall be provided to protect the public in construction zones. All machines to be used in the construction shall conform to the relevant Indian Standards (IS) codes, shall be free from patent defect, shall be kept in good working order, shall be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer Incharge. Precautionary measures shall be taken when working close to the underground or overhead cables	All construction equipment	Contractor	Environmental Officer of SC and PIU
45.	First Aid	The contractor shall arrange for - A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone Availability of suitable transport at all times to take an injured or sick person(s) to the nearest hospital Equipment and trained nursing staff at the construction camp.	All construction equipment	Contractor	Environmental Officer of SC and PIU
Cultural Property					
46.	Chance Found Archaeological Property	All fossils, coins, articles of the value of antiquity, structures, and other remains or things of geological or archaeological interest discovered on the site are the property of the Government and shall be dealt with as per provisions of the relevant legislation. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He shall, immediately upon	Along the project road.	Contractor	Environmental Officer of SC, , State Archaeological Department and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		discovery thereof and before removal acquaint the Engineer-Incharge of such discovery and carry out the Supervision Consultant instructions for dealing with the same, waiting which all work shall be stopped. The Engineer shall seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.			
Labour Camp Management					
47.	Location of Construction labor camps: Accommodation	The Contractor shall provide, if required, erect and maintain necessary (temporary) living accommodation and ancillary facilities during the progress of work for labor to standards and scales approved by the Engineer- In charge. The contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building & other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction & maintenance of labor camp. Construction camps shall not be proposed within 1000m from the nearest habitation to avoid conflicts and stress over the infrastructure facilities, with the local community. The location, layout and basic facility provision of each labor camp shall be submitted to Engineer before their construction. The construction shall commence only upon the written approval of the Engineer - In charge.	Along the project corridor at the location of construction labor camps	Contractor	Environmental Officer of SC and PIU
48.	Potable Water	The Contractor shall construct and maintain all labor accommodation in such a fashion that uncontaminated water is available for drinking, cooking, and washing. within the precincts of every workplace in an accessible place, as per standards set by the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996). The contractor shall also guarantee the following: Supply of sufficient quantity of potable water (as per IS) in every workplace/labor campsite at suitable and easily accessible places and regular maintenance of such facilities. If any water storage tank is provided that shall be kept such that the bottom of the tank is at least 1m from the surrounding ground level. If water is drawn from any existing well, which is within 30m. the proximity of any toilet, drain or other sources of pollution, the well shall be disinfected before water is used for drinking. All such wells shall be entirely covered and provided with a trap door, which will be dustproof and waterproof. A reliable pump shall be fitted to each covered well. The trap door shall be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. Testing of water shall be done every month as per the parameters prescribed in IS 10500:1991.	Construction labor camps	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		Compliance with EMP shall be reported to Engineer - In charge every week. Engineer - In charge shall inspect the labor camp periodically, to ensure compliance of the EMP.			
49.	Sanitation and Sewage System	The Contractor shall ensure that - The sewage system for the camp are designed, built and operated in such a fashion that no health hazards occur and no pollution to the air, groundwater or adjacent watercourses take place Separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women Adequate water supply is to be provided in all toilets and urinals All toilets in workplaces are with the dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition Night soil is to be disposed of by putting a layer of it at the bottom of a permanent tank prepared for the purpose and covered with 15 cm. layer of waste or refuse and then covered with a layer of earth for a fortnight. Adequate health care is to be provided for the workforce during the entire phase.	Construction labor camps	Contractor	Environmental Officer of SC and PIU
50.	Waste Disposal	The contractor shall provide garbage bins in the camps and ensure that these are regularly emptied and disposed of hygienically as per the Comprehensive Solid Waste Management Plan approved by the Engineer - In charge. Unless otherwise arranged by ULB's, the Contractor has to make arrangements for disposal of night soils (human excreta) either by suitably approved by the local medical health or municipal authorities or as directed by Engineer - In charge as provided by the Contractor.	Construction labor camps	Contractor	Environmental Officer of SC and PIU
51.	Stock-yards	Location for stockyards for construction materials shall be identified at least 1000 m from the watercourse and separated and sufficiently away from the labor camps. Separate enclosures shall be planned for storing construction materials containing fine particles such that sediment-laden water does not drain into nearby storm water drain & underground sewerage pipes.	Construction labor camps	Contractor	Environmental Officer of SC and PIU
52.	Fuel storage and refueling areas	The Contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance, and refueling sites are located at least 500 m from rivers and irrigation canal/ponds All location and lay-out plans of such sites shall be submitted by the Contractor before their establishment and shall be approved by the Engineer. In all fuel storage and refueling areas, if located on agriculture land or areas supporting vegetation, the topsoil shall be stripped, stockpiled and returned after completion of such storage and refueling activities. Fuel storage shall be provided with bunds.	Construction labor camps	Contractor	Environmental Officer of SC and PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		The plan for the construction campsite shall also include the process of collection and disposal of spent oil and grease. The collection and disposal methods for the spent oil and grease submitted as part of the construction camp plan should be duly approved by the Engineer - In charge.			
Contractor Demobilization					
53.	Clearing of Construction of Camps & Restoration	Contractor to prepare site restoration plans for approval by the Engineer. The plan has to be implemented by the contractor before demobilization. On completion of the works, all temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer. Residual topsoil shall be distributed on adjoining/proximate barren/rocky areas as identified by the Engineer in a layer of a thickness of 75mm - 150mm.	All Construction Workers' Camps	Contractor and Environment Officer of SC	PIU
54.	Redevelopment of Borrow Areas	Redevelopment of borrow areas shall be taken up following the plans approved by the Engineer.	At all borrow area locations suggested for the project.	Contractor and Environment Officer of SC	PIU
55.	Ambient Environmental Data Collection	To collect a full set of post-construction data to be compared with the pre-construction baseline and analyze the impacts due to the project construction	As specified in the environmental monitoring plan	Contractor	PIU and PMC
Environmental Enhancement and Special Issues					
56.	Enhancement Measures	Enhancement of all incidental spaces shall be planned and carried out before completion of construction, along the project road. Some of the enhancement measures to be considered along the project roads include avenue tree plantation, restoration of water bodies, providing public amenities, planting of shrubs in medians, rainwater harvesting, adequate storm water drainage, Landscaping at junctions to improve aesthetics, etc.	At suitable locations along the project road	Contractor and Environment Officer of SC	PIU
57.	Roadside Plantation Strategy, Tree Planting & Protection	The Contractor/identified agency (were specifically identified) shall do the plantation at the median and/or turfing at embankment slopes as per the tree plantation strategy prepared for the project. The Contractor/ identified agency shall plant Indigenous plant varieties to the extent possible, guidance from the forest department shall be taken for the same. Minimum 80 percent survival rate of the saplings shall be acceptable otherwise the Contractor shall replace dead plants at his own cost (Refer Annexure 7). The Contractor shall maintain the plantation until they handover the project site to CPRR. Giving due protection to the trees that fall in the shoulders	All tree plantation/ greenery areas of the project	Contractor / Forest Department and Environment Officer of SC	PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		/corridor of impact/ trees planted outside clear zone shall be the prime focus during Construction/post-construction. Re-plantation of at least ten times the number of trees (1:10) cut should be carried out along the project road. Since the major portion of the project road may pass through open lands, planting of trees along the entire stretch of the road is recommended as an enhancement measure, which would also serve as a mechanism to delineate ROW and prevent future encroachments/squatters into the right of way, wherever possible. Growth and survival of trees planted shall be ensured and monitoring is done at least for 3 years. Survival status shall be reported every month to Engineer – In charge. The Engineer – In charge shall inspect regularly the survival rate of the plants and compliance of tree plantation guidelines.			
58.	Transplantation	All trees up to 30 cm girth at breast height and naturally occurring medicinal shrubs/bushes/grass clumps within the RoW shall be uprooted mechanically with ball of earth intact for relocation and transplantation at various pre-identified locations such as degraded sites, embankments of road-side water bodies, temples, near-by market places, religious properties, schools and along road corridors for preventing loss of diverse vegetative cover and for reducing growth period.	Along the project road	Contractor / Forest Department and Environment Officer of SC	PIU
59.	Flora and Chance found Fauna	The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any wild animal is found near the construction site at any point in time, the Contractor shall immediately upon discovery thereof acquaint the Engineer – In charge and execute the Engineer's instructions for dealing with the same. The Engineer-In charge shall report to the nearby forest office (range office or divisional office) and shall take appropriate steps/ measures if required in consultation with the forest officials.	Along the project road	Contractor / Forest Department and Environment Officer of SC	PIU
60.	Sensitive Areas	The sensitive areas like schools, hospitals are provided with permanent noise barriers before the start of work to minimize the dust and noise impacts due to vehicle movement (during / post-construction). Their effectiveness to be checked during the operation phase. Construction activities shall be confined within the present available RoW, regularly strict monitoring/supervision should be done to minimize/control air-noise pollution and abatement of dust particles at the minimum level possible using well maintain modern machineries. Crushers, Hot-mix Plants and Batching Plants should be placed at least 10km aerial distance away from	Concerned locations	Contractor / Forest Department and Environment Officer of SC	PIU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
		the sanctuary boundary.			
III.	**OPERATION STAGE (Activities to be Carried Out by the Contractor (till the DLP) and then CPRR /Forest Department, GoTN)**				
61.	Monitoring and Evaluation of Environmental Mitigation Measures provided in the Project	The PIU/CPRR shall monitor the operational performance of the various mitigation/ enhancement measures carried out as a part of the project.	All along the project corridor	Contractor (DLP) and PIU	PMU
62.	Maintenance of Drainage	PIU/CPRR shall ensure that all drains (side drains and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding without damaging the land, properties, spurs and check dams erected to stabilize the course and flow of all such drainage channels. PIU/CPRR shall ensure that all the sediment/oil and grease traps set up at the truck and bus lay bye are cleared once in every three months.	All along the project corridor	Contractor (DLP) and PIU	PMU
63.	Road Maintenance	Establishment of work zones to separate workers on foot from traffic and equipment by: Provide barricades, adequate lighting, warning signs or signals where person on foot must work or travel through or near heavy equipment operations or congested travel areas Provide turn-around and lay out for internal traffic control patterns to eliminate congestion Provide high visibility safety apparel of proper classification to all workers Ensure worksite vehicles have working adjustable side mirrors Prohibit equipment operators from backing up long distances, and work to minimize the distance trucks need to back up to access the work area Each worker should have a designated back-up person or spotter to signal when it is safe for operators to back equipment into work areas and to make sure everyone keeps clear of the moving equipment. Educate workers on the concept of teamwork along with safety Establish a policy to prohibit use of wireless devices and cell phones while walking or working around moving equipment	All along the project corridor	Contractor (DLP) and PIU	PMU
64.	Pollution Monitoring	The frequency of monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination are to be continued at pre-designated locations as identified in the Environmental Monitoring Plan and if necessary, at additional locations for comparative study of pre and post-operation data to ensure further improvement/modification in similar future works. PIU/CPRR shall appoint a specific pollution monitoring agency for this purpose.	All along the project corridor	Contractor (DLP) and PIU	PMU

Sl.No.	Project Activities	Management Measure	Location	Responsibility	
				Planning and Execution	Supervision and Monitoring
65.	Atmospheric Pollution	Ambient air concentrations of various pollutants shall be monitored as envisaged in the Environmental Monitoring Plan at pre-designated locations to compare the levels with the pre- construction data. Additional data at other locations may be collected as per any site-specific requirement.	All along the project corridor	Contractor (DLP) and PIU	PMU
66.	Noise Pollution	Noise pollution shall be monitored as per the Environmental Monitoring Plan at sensitive locations where pre-construction noise data was collected. The functioning of the noise barriers has to be specifically supervised and monitored for further improvement/replication at other affected points if necessary. Signage indicating 'no horn zones' near sensitive locations shall be maintained and kept clean. Monitoring the effectiveness of the pollution attenuation barriers shall be taken up thrice in the operation period.	All along the project corridor	Contractor (DLP) and PIU	PMU
67.	Soil Erosion and Monitoring of Borrow Areas	Visual monitoring and inspection of soil erosion at borrow areas, quarries (if closed and rehabilitated), embankments and other places expected to be affected, shall be carried out before monsoon, during monsoon, and after winter rains to record and monitor the effectiveness of such structures after the completion of project, to evaluate the beneficial effects of each type of activity together with the cost involved.	Borrow areas	Contractor (DLP) and PIU	PMU
68.	Avenue Trees	The PIU/CPRR with the assistance from Forest Department, GoTN shall do survival monitoring of avenue trees for every Quarter.	All along the project corridor	PIU and Forest Department	PMU
69.	Road Safety and Maintenance of Assets	No advertisement/hoardings shall be allowed within the Right of Way limits of the project road. Regular maintenance and cleaning of assets such as signboards, bus stops, drains, etc. shall be undertaken. OHS measures	All along the project corridor	Contractor (DLP) and PIU	PMU

8.6 Use Of Sustainable Green Materials Management Plan

GO GREEN Strategies

The following arrangements have been included in the preparation of environment management plan schemes, in order to make road projects as a sustainable system.

Sustainable/"Green" Materials

All paving materials, should be finished as anti-skid, non - slip, unglazed material. Since most road projects are redevelopment projects, reusing /recycling existing the road materials removed during construction (debris) materials. This practice is preferable and advisable. Materials which have some recycled content or that can be recycled after use should be preferred. Example:

- Recycled Asphalt, Recycled Rubber, Recycled stone or other miscellaneous construction materials, Recycled components in Concrete.

Permeable Pavement

Permeable pavement is a paving system which allows the rainfall to percolate into an underlying soil or aggregate storage reservoir, where storm water is stored and infiltrated to underlying sub grade, or removed by an overflow drainage system.

Permeable pavements are helpful for encouraging ground water recharge, and will help reducing pollution load in storm water runoff.

8.7 Environmental Monitoring

The monitoring programme is devised to ensure that the envisaged purpose of the project is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP
- To suggest improvements in the management plans, if required
- To satisfy the statutory and community obligations
- To provide feedback on adequacy of Environmental Impact Assessment

The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Physical, biological and environmental management components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators (PIs). The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution;
- Environmental management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed and utility of the mitigation/enhancement designs proposed.

Table 8-4 Environmental Monitoring Indicators

Sl. No	Indicator	Details	Stage	Responsibility
A	**Environmental Condition Indicators and Monitoring Plan**			
1	Air Quality	The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the Monitoring Plan given in the Environmental Management Plan	Construction	Contractor through approved monitoring agency
2	Noise Levels		Construction	Contractor through approved monitoring agency
			Operation	TNHD through approved monitoring agency
3	Water Quality		Construction	Contractor through approved monitoring agency
B	**Environmental Management Indicators and Monitoring Plan**			
1	Disposal Locations	Locations for dumping have to be identified and parameters indicative of environment in the area has to be reported	Pre-Construction Stage	Contractor
2	Construction Camps	Location of construction camps have to be identified and parameters indicative of environment in the area has to be reported	Pre-construction	Contractor
3	Borrow Areas	Location of borrow areas have to be identified and parameters indicative of environment in the area has to be reported	Pre-construction	Contractor
4	Tree Cutting	Progress of tree removal marked for cutting is to be reported	Pre-construction	Foresters to PIU
5	Tree Plantation	Progress of measures suggested as part of the Tree Plantation Strategy is to be reported	Construction	Foresters to PIU
6	Top soil	Implementation of the measures suggested for top soil preservation	Construction	Contractor

Sl. No	Indicator	Details	Stage	Responsibility
		shall be reported by Contractor to the Engineer		
C	**Management & Operational Performance Indicators**			
1	Survival Rate of Trees	The number of trees surviving during each visit will be compared with the number of saplings planted	Operation	The Engineer will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Forest wing of the PIU will be responsible for monitoring over a period of 5 years.
2	Status Regarding Rehabilitation of Borrow Areas	The PIU will undertake site visits to determine how many borrow areas have been rehabilitated in line with the landowners request and to their full satisfaction.	Operation	The Engineer will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Environmental Cell of the PIU will be responsible for monitoring over a period of 5 years

8.8 Reporting System

Reporting system for the suggested monitoring program operates at two levels as:

- Reporting for environmental condition indicators and environmental management indicators (except tree cutting indicator)
- Reporting for operational performance indicators at the PIU level

Contractor and Engineer operate the reporting system for environmental condition and environmental management indicators (except tree cutting). The Environmental Cell of PIU will operate the reporting system for environmental management tree cutting indicator and operation performance indicators. The PIU will set the targets for each activity envisaged in the EMP beforehand and all reports will be against these targets. Contractor will report to the Engineer on the progress of the implementation of environmental conditions and management measures as per the monitoring plans. The Engineer will in turn report to the PIU on a quarterly basis which will be reviewed. Along with these reports, forestry wing of the PIU shall report progress of tree cutting, compensatory plantation, landscaping and survival rate as per the monitoring plan. The PIU will also send periodical compliance report to the concerned authority as per the conditions of clearance granted for the project after receiving the report from the contractor and duly verified by the Engineer. Reporting formats have been prepared, which will form the basis of monitoring, by the Engineer and/or the Environmental Cell as required and

presented as part of the EMP. The details of reporting formats prepared for the project is presented in Table 8.4.

Table 8-5 Summary Details of Reporting Formats

Sl. No.	Item	Stage	Contractor	Forest Wing	Supervision Consultant (SC) / Concessionaire		Project Implementation Unit (PIU)
			Implementation & Reporting to SC	Implementation & Reporting to PIU	Supervision	Reporting to PIU	Oversee / Field Compliance Monitoring
1	Identification of Dumping Locations	Pre-Construction	One Time	-	One Time	One Time	One Time
2	Setting up of Construction Camp	Pre-Construction	One Time	-	One Time	One Time	One Time
3	Borrow Area Identification	Pre-Construction	One Time	-	One Time	One Time	One Time
4	Tree Cutting	Pre-Construction	-	Monthly	-	-	Quarterly
5	Tree Plantation	Construction		Monthly			Quarterly
6	Topsoil Monitoring	Construction	Quarterly		Continuous	Quarterly	Quarterly
7	Pollution Monitoring	Pre Construction / Construction / Operation	As Per Monitoring Plan	-	Quarterly	Quarterly	Quarterly
8	Pollution Monitoring	Operation	-	-	-	-	As Per Monitoring Plan
9	Survival Rate of Trees	Operation	-	Quarterly	-	-	Quarterly
10	Status Regarding Rehabilitation of Borrow Areas	Operation	-	-	-	-	Half Yearly

In addition to these formats, to ensure the environmental provisions are included at every activity of the implementation by the contractor, it is suggested that the approval of the environmental personnel of the engineer is required in the Request for application to proceed or other similar reporting formats used by the contractor. These will not only ensure that the environmental provisions are addressed but also link the satisfactory compliance to environmental procedures prior to approval of the Interim Payment Certificate (IPC) by the Engineer. The activities by the contractor that can impact the environment will be identified based on discussions between the Environmental Specialist of the PIU,

Team Leader of the Engineer and the Environmental personnel of the Engineer. The decisions will be communicated to the contractor prior to the start of the construction activities.

8.9 Environmental Budget

Mitigation measures proposed in the EMAP will be implemented by the Concessionaire. The works to be undertaken by the Concessionaire have been quantified and the quantities included in the respective BOQ items such as earth works, slope protection, road safety features and tree plantation.

More general environmental management measures to be followed by the Concessionaire have been included in the specifications and this EMAP. The budgetary provisions for the implementation of the environmental management plan and enhancement measures for the Project road are presented in the following Table. The EMP budget has been incorporated as BOQ in the total project cost estimates (DPR).

Budgetary estimates for environmental management in the project include all items envisaged as part of the EMP. The environment budget shown in Table 8.5 includes provisions for various environmental management measures (other than measures considered under good engineering practices) and the environmental monitoring costs. The EMP budget accounts for Rs 1,400 Lakhs.

Table 8-6 Budgetary Provision for Environmental Management Measures

S.NO	ITEM	UNITS	RATE (in INR)	QUANTITY	COST (INR)
	Construction Phase				
	Site clearance				
1.	Disposal of unserviceable as well as serviceable material with all leads and lifts beyond the ROW	Cum	Bill no, item no 2.02		
2.	The top layer of disposal pit shall be provided with good earth suitable for development of vegetation/plantation. All work shall be carried out as per specification of MoRTH and approval of the Engineer in charge	Cum	Provision shall be made by the contractor		

S.NO	ITEM	UNITS	RATE (in INR)	QUANTITY	COST (INR)
3.	Regular water sprinkling (at least 4 times)per day all construction sites for suppression of visible dust level	km	Provision shall be made bu the contractor		
	Construction near water bodies				
4.	Construction of silt taps at the discharge points of channels into fresh water bodies across the project road as indicated in the clause 111.4 and 111.8	M	Provision shall be made by the contactor		
5.	Providing oil interceptors at the fuel/oil storage camps or construction camps	Nos	Provision shall be made by the contactor		
6.	Providing and construction of rain water harvesting complete as per drawing and technical specification section 300,1300,1500,1700 or as directed by the engineer	nos	Bill no 8.25		
	Worker safety				
7.	Providing personal protective equipment to labour during the construction phase of the project	Nos	Provision shall be made by the contractor		
	Monitoring of environment attributes during construction activity				
	Air quality				
8.	Monitoring of air quality near hat mix plant	No of sample	7,500	18	13,500
9.	Monitoring of air quality at critical location	No of sample	7,500	18	135,000
	Noise level				
10.	Monitoring of noise level at equipment yards	No of sample	3,000	18	54,000

S.NO	ITEM	UNITS	RATE (in INR)	QUANTITY	COST (INR)
11.	Monitoring of noise level at critical	No of sample	3,000	18	54,000
12.	Water quality	No of sample	6,000	42	252,000
13.	Soil quality	No of sample	6,000	10	60,000
	Enhancement measures				
14.	Enhancement measure				1,326,432
	HIV/AIDS prevention measures				
15.	IEC materials printing publishing		3,000	24	72,000
16.	Healthcare clinic		30,000	8	240,000
17.	Condom vending machine		15,000	3	45,000
18.	Condom supplies		5,000	24	120,000
19.	Testing		1,500	500	750,000
20.	Signage's and hoarding		15,000	15	225,000
	Environmental budget during construction phase				3,468,432
21.	Operation phase				
22.	Monitoring of air quality at critical location	No of sample	7,500	18	135,000
23.	Monitoring of noise level at critical location	No of sample	3,000	18	54,000
	Environmental budget during construction phase				189,000
	Subtotal				3,657,432
	Grand Total INR (Environmental Budget + 3% contingency)				3,767,155

Table 8-7 Budget for Implementation of Environmental Management Plan

S.no	Component	Item	Unit cost	Quantity	Total cost
A. Construction Stage					
1.	Tress cutting	Cutting of road side tress for construction of road	Cost to be part of DPR		
2.	Environmental monitoring	Ambient air quality noise and surface and ground water monitoring as per monitoring plan	Lump sum		400,000
3.	Topsoil management		Cost to be part of DPR		
4.	Air	Dust suppression measures	Cost to be part of DPR		
5.	Labour camp and ancillary facilities	Labour camp and all associated facilities as per EMP	Cost to be part of DPR		

S.no	Component	Item	Unit cost	Quantity	Total cost
6.	Personal protective equipment (PPE's)	Personal protective equipment like vest, helmet, safety shoe, hand gloves, gumboots, earplug, harness belt, welding glass etc	Cost to be part of DPR		
7.	First Aid Kits	First aid kit at the construction site camp and ancillary sites	Cost to be part of DPR		
8.	Compensatory plantation	Replantation of tress (3:1)	1,500	5,396	14,094,000
9.	Oil interceptor	Oil interceptor at workshop at camp site	50,000	2	400,000
10.	Borrow area rehabilitation and quarry management	Rehabilitation and restoration	Cost to be part of DPR		
11.	Debris and waste disposal	Solid waste, demolition waste, hazardous waste	Cost to be part of DPR		
12.	Display of safety signage's and work zone safety	Sign board, retro reflective tape, cones, barriers	Cost to be part of DPR		
	Project Enhancement				
13.	Embankment strengthening (by way of plantation)	Grass engraining with indigenous shrubs	Cost to be part of DPR		
14.	Protection on bridges, culvert and on high embankment	Slope protection measure	Cost to be part of DPR		
15.	Shifting of community property resources	Shifting and relocation	Cost to be part of DPR		
16.	Capacity building	Lump sum budget for capacity building			200,000
	Contingency cost @ 5%				**754,700**
	Total budget cost				**15,848,700**

Tree Felling Cost

Tree felling permission will be obtained for 806 trees from District Collector. The cost for the same has been included in project costs.

Utility Shifting

The cost of existing utility shifting is taken under separate Head.

Mitigation measures other than Good Engineering Practices

This section includes the costs for the mitigation measures during the construction other than those included in the Engineering Budget. It covers the following items:

Oil Interceptors

The unit cost of Oil & Grease Interceptors (Influent handling capacity 20 L/hr) has been considered as per prevalent market rates.

Recharge pits for urban drains

The unit cost of Recharging Pits for roadside drains (2 m below the bottom of the catch pit) has been worked out as per prevalent market rates.

Soak pits for hand pumps

The unit cost of soak pit made of brick masonry/concrete rings, filled with brick bats and pebbles, as per market rate. Cost for this item has been considered under utility shifting of water sources.

Tree Plantation and Protection

Compensatory plantation

This item includes costs for the tree plantation, protection and maintenance for 5 years as a part of compensatory plantation, road side avenue plantation and plantation in space available between EROW & PROW.

For tree plantation, the unit cost of 1.5 m height saplings is estimated as Rs 1500 per 10 sapling. It includes the cost of the seedling, manuring, plantation and maintenance for 5 years; cost of replacing of casualties is also included. Tree fencing will be provided for the saplings. The plantation will be done by PIU through Concessionaire.

Transplantation

This item includes costs for the transplanting the trees with less than 900 mm girth size, the, the unit cost of transplanting each tree is estimated as Rs 6000 per tree. (The cost is derived from the successful case study of Gujarat State Road Project with 50% additional provision). It includes the cost of the digging, transplanting, manuring and maintenance for 5 years. The transplanting shall be chosen by the contractor based on the species and its survival rates.

Monitoring Environmental Attributes during Pre -Construction Phase Air Quality

The cost for continuous 24 hour monitoring for PM10, PM2.5, SO2, NOx & CO as per prevalent market rates. (For 25 locations and for one time will be carried out by the DPR consultant during baseline monitoring for EIA report).

Noise Level

The cost for noise level monitoring on dB(A) scale (readings to be taken at 15 second interval for 15 minutes every hour for a total period of 24 hours) as per prevalent market rates.

(For 25 locations and for one time will be carried out by the DPR consultant during baseline monitoring for EIA report).

Water Quality

Water quality will be monitored for the following parameters:

- Surface water: pH, BOD, TDS, Pb, Oil & Grease and Detergents
- Ground water: pH, TDS, Total Hardness, Sulphate, Chloride, Fe, Pb, and Coliform, count

Cost for one time monitoring of water quality as per prevalent market rates.

(For 25 locations and for one time will be carried out by the DPR consultant during baseline monitoring for EIA report).

Soil Quality

Cost for one time monitoring of soil quality for Pb, Sodium Absorption Ratio & Oil & Grease as per prevalent market rates. Provisions have also been included in the budget to monitor the soil quality in event of any major accident/spillage during bulk transport of hazardous material. Costs are incorporated for monitoring at such locations. (For 25 locations and for one time will be carried out by the DPR consultant during baseline monitoring for EIA report).

Monitoring Environmental Attributes during Construction Phase

Air Quality

The cost for continuous 24 hour monitoring for PM10, PM2.5, SO2, NOx & CO as per prevalent market rates. (For 25 locations and for four times for 3 years will be carried out by the contractor during construction stage). (For hot mix plants and additional monitoring location during construction, samples will be collected at 10 locations for four seasons for 2 years)

Noise Level

The cost for noise level monitoring on dB(A) scale (readings to be taken at 15 second interval for 15 minutes every hour for a total period of 24 hours) as per prevalent market rates.

(For 25 locations and for four times for 3 years will be carried out by the contractor during construction stage). (For hot mix plants and additional monitoring location during construction, samples will be collected at 10 locations for four seasons for 2 years)

Water Quality

Water quality will be monitored for the following parameters:

- Surface water: pH, BOD, TDS, Pb, Oil & Grease and Detergents
- Ground water: pH, TDS, Total Hardness, Sulphate, Chloride, Fe, Pb, and Coliform, count

Cost for one time monitoring of water quality as per prevalent market rates.

(For 25 locations and for four times for 3 years will be carried out by the contractor during construction stage). (For hot mix plants and additional monitoring location during construction, samples will be collected at 10 locations for four seasons for 2 years)

Soil Quality

Cost for one time monitoring of soil quality for Pb, Sodium Absorption Ratio & Oil & Grease as per prevalent market rates. (For 25 locations and for four times for 3 years will be carried out by the contractor during construction stage). (For hot mix plants and additional monitoring location during construction, samples will be collected at 10 locations for four seasons for 2 years)

Monitoring Environmental Attributes during Operation / Post-Construction Phase Air Quality

The cost for continuous 24-hour monitoring for PM10, PM2.5, SO2, NOx & CO as per prevalent market rates. (For 25 locations and for four times for one year will be carried out by the contractor during post -construction stage on BOT basis).

Noise Level

The cost for noise level monitoring on dB(A) scale (readings to be taken at 15 second interval for 15 minutes every hour for a total period of 24 hours) as per prevalent market rates.

(For 25 locations and for four times for one year will be carried out by the contractor during post - construction stage on BOT basis).

Water Quality

Water quality will be monitored for the following parameters:

- pH, BOD, COD, TDS, Pb, Oil Grease and DETERGENT for surface water
- pH, TDS, Total Hardness, Sulphate, Chloride, Fe,pb and Coliform count for ground

Soil Quality

Cost for one time monitoring of soil quality for Pb, Sodium Absorption Ratio & Oil & Grease as per prevalent market rates. (For 25 locations and for four times for one year will be carried out by the contractor during post -construction stage on BOT basis).

8.10 Enhancement Proposal

Enhancement measures for Temples/Churches/Schools

Enhancement or replacement of 73 identified Common Property Resources (CPR) will be covered under RAP.

8.11 Enhancement/Mitigation Measures for Water Bodies

Water bodies have been identified along the project road for enhancement which covers the following enhancement;

- RCC retaining wall to protect the bund along the road
- Provision of 2 m high and on average of 120m long stone wall
- Grass sodding along road slope for average of 80m length

8.12 Waste Bins

It is proposed to provide waste collection bin at every bus bay/shelter these dimensions and cost shall be included in bus shelter replacement cost.

8.13 Signboards for the Reserve Forest

It is proposed to provide informatory sign board regarding the location of Reserve forests (If the buffer zone is located at about 5km distance from project road). Signboards shall be displayed at the start of identified forest zones of project road's stretch falling within 5 km. The cost shall be included under the cost for display boards and highways sign boards.

8.13.1 Monitoring and Management Measures

The monitoring cost for the inspection of Trees plantation and survival, Borrow land areas, labor camps, waste/ debris removal and other components has been derived based on the prevailing rates

8.13.2 Monitoring and Evaluation Specialist and PMC Expert

The cost towards the appointment of Environmental expert for the PIU and the PMC environmental specialist has been made based on the remuneration fixed by multilateral funding agencies for EMP implementation in road projects. (Rs 100,000 for 10 months for each sub projects).**Training and Capacity Building**

The cost towards the training and capacity building component has been derived at the rate of one lakh for a training programme.

Programme	Particulars	Duration	Participants
Orientation Programme	Concessionaire's Responsibility as per bid document / Reporting System in EMAP	One day	Engineer including ESE
Awareness programme	General Awareness on Environment General Awareness on Safety aspects	One day	Skilled and unskilled laborers
Orientation Programme	Concessionaire's Responsibility as per bid document Reporting System in EMAP	One day	Engineers and staff of the contractor office and PMC staff

8.14 Information Dissemination and Awareness Creation

The cost towards sensitivity and information dissemination of environmental issues to the public shall be delivered through any consulting firms or NGOs during the implementation stage. Four workshops, campaigns shall be planned at the cost of one lakh each for three sub projects.

8.15 Penalty Clause for Non-Conformity to the EMP

The Concessionaire shall implement all mitigation measures for which responsibility is assigned to him as stipulated in the EMP Report. Any lapse in implementing the same shall attract the penalty clause as detailed below:

All lapse in obtaining clearances / permissions under statutory regulations and violations of any regulations with regard to eco-sensitive areas shall be treated as a major lapse.

Any complaints of public, within the scope of the Concessionaire, formally registered with the IE, or with the TNHD complaint cell and communicated to the Concessionaire, which is not properly addressed within the time period intimated by the IE / PIU shall be treated as a major lapse.

Non-conformity any of the mitigation measures stipulated in the EMP Report (other than stated above) shall be considered as a minor lapse.

On observing any lapses, IE shall issue a notice to the Concessionaire, to rectify the same.

Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after one month from the original notice date and first reminder date respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.

If a major lapse is not rectified upon receiving the notice, IE shall invoke the penalty clause, in the subsequent interim payment certificate.

Penalty for major lapses shall be with-holding of 10% of the interim payment certificate, subject to a maximum limit of Rs. 30 lakhs.

If the lapse is not rectified within three months after withholding the payment, the amount withheld shall be forfeited.

8.16 Occupational Health and Safety in Construction

8.16.1 Policy on Occupational Health and Safety (OHS)

The Contractor shall have an OHS policy in particular to the Project. It shall include the following:

a) Nature of work, duration, number of people employed (both skilled and unskilled).
b) It shall be precise, clearly written and signed with date by a most Senior officer of the Company, who will be accountable for the construction activity.
c) It shall be communicated and readily accessible to all persons.
d) The policy shall cover the following:
e) Comply with national and international regulations and policies regarding health and safety.
f) Follows all safety standards formulated by the state.
g) Protect its workers health and safety during the activity by providing all safety measures.
h) Voluntary programmes for the well-being of its workers.

Workers participation

a) Ensure workers representatives in OHS Management system.
b) Workers shall be provided with adequate training on all aspects of OHS.
c) Workers and their representatives shall be adequately represented in implementing OHS policy, evaluation and its review for betterment.
d) The Contractor shall form a Health and Safety Committee for the better implementation of OHS.

Policies/ Statutory Regulations

International guidelines such as JICA Standard Safety Specification (JSSS), World Bank ESS4: Community Health and Safety and IFC 2.0 Occupational Health and Safety, shall be referred while preparing the Construction OHS Plan. The following national regulations and standards are applicable to the project:

Indian Regulations

- The Fatal Accidents Act, 1885
- The Workmen's Compensation Act, 1923
- The Factories Act, 1948
- The Employees State Insurance Act, 1948
- Indian Electricity Act 2003 and Rules 1956

- The Mines & Minerals Act, 1957
- The Central Labor (Regulation & Abolition) Act, 1970
- The Water (Prevention & control of pollution) Act, 1974
- Petroleum Rules, 1976 (Petroleum & Explosive Department)
- The Air (Prevention & control of pollution) Act, 1984
- Batteries Act, 1989
- Building and other construction workers (Regulation of Employment and Condition of Services) Act, 1996 (BoCW)
- National Building Code 2016
- The Noise Pollution (Regulation & Control) Rules, 2000
- Recycled use of Plastic Use
- The Hazardous Waste (Management & Handling) Rules, 2000
- Construction and Demolition Waste Management Rules, 2016

Indian Standards

- IS 3696-1 (1987): Scaffolds and Ladders - Code of Safety, Part 1: Scaffolds
- IS 3696-2 (1987): Scaffolds and Ladders - Code of Safety, Part 2: Ladders
- IS 13416-1 (1992): Recommendations for preventive measures against hazards at workplaces, Part 1: Falling material hazards prevention
- IS 13416-2 (1992): Recommendations for preventive measures against hazards at workplaces, Part 2: Fall prevention
- IS 13416-3 (1994): Recommendations for preventive measures against hazards at workplaces, Part 3: Disposal of debris
- IS 13416-4 (1994): Recommendations for preventive measures against hazards at workplaces, Part 4: Timber structures
- IS 13416-5 (1994): Recommendations for preventive measures against hazards at workplaces, Part 5: Fire protection

Responsibility and accountability

(1) Health and Safety Officer (HSO)

The Contractor shall have a HS Officer, who will be responsible for all safety measures during the construction. The Manager/ officer shall be a graduate from any Science / Engineering streams. He shall have Diploma in Industrial Safety or Diploma in Health, Safety and Environment from a recognized Institute or shall undergone 30-hour OHSE/ Safety Course.

It shall be ensured by the Contractor/ Employer that no work will be performed on site without a safety representative permission. The cost for the OHS shall be included in the BoQ as a separate item under Environment, Social, Health and Safety Specifications.

(2) Health, Safety and Environment Supervisor/s

A dedicated, full time safety supervisor shall made available at site. He shall not be given any other duties. This person shall not have any other assigned duties. He shall have a diploma / post graduate diploma in Construction Safety/ Industrial Safety/ Health, Safety and Environment. He shall be trained in First Aid/ CPR immediately after his induction to the Project.

(3) Safety Committee

A safety committee shall be formed with the most senior officer / Project Manager as Chairman of the committee and the HSO as the Convenor of the Committee. They shall prepare and review the safety arrangements at site frequently. Minutes of Meeting (MoM) shall be kept in office for review of Employer. The Committee members details along with contact details shall be prepared at prominent locations of the construction activity and office premises.

(4) Communication

The Contractor shall display the communication mechanism in each site under construction and at all premises of people assembling locations. It shall be precise with to whom they contact in case of an accident / emergency. Details of ambulance services, first aid facility, first aider etc. shall be included in the display.

(5) Notice Board/ Safety Awareness Board

It shall include general construction safety posters, manpower numbers, date of last incident occurred, total number of injuries, incidences and near-miss case reporting, man-hours injury free recorded; and details of contact persons in case of emergency.

(6) Reporting

Monthly report shall include incident reporting, near miss reporting, and first aid analysis reports.

The Construction Health and Safety Report of Contractor shall include the following, but not limited to:

a) General terms in Safety
b) Legal provisions in Construction Safety in India
c) Roles and Responsibilities
d) Method Statement of Activities
e) Hazard and Risk Assessment Matrix
f) Risk Assessment of Activities

g) Emergency Preparedness Plan
h) Accident Response Plan
i) Fire Control Measures
j) Vehicles and Machinery Details along with their Manufacturing Year
k) Construction Safety Barricades and Signs – in relation to IRC Standards
l) Temporary Diversion – Safety Precautions
m) Temporary fuel station Details
n) Brief on Waste management, Hazardous Waste Management
o) First Aid and Ambulance facilities
p) Welfare facilities for Workers
q) First Aider Details
r) Training Mechanism
s) Monthly Reporting Formats

(7) Monthly Safety Report

The Safety manager shall submit a monthly report before 2nd week of every month in a prescribed format (Appendix I) shared by Employer / Supervision Consultant with a covering letter. The report shall be signed by Project Director/ Project Manager of the Contractor.

The HSO shall also submit the Near Miss report along with Monthly Report.

Table 8-8 Format for Safety Specifications in the BoQ

Sl No.	Item	Specifications	Requirement
ESHS 1	Health and Safety Officer (HSO)	1. A graduate from any Science / Engineering streams. 2. He shall have undergone 30-hour OSHA Safety Course / Diploma in Industrial Safety or Diploma in Health, Safety and Environment from a recognized Institute Preferable: Certificate of First Aid/ CPR certification.	Throughout the project period. Emoluments in monthly basis
ESHS 2	Personal Safety	Provide and maintenance of personal protective equipment including nosal mask for prohibition of spread of Covid-10, as required, to all personnel, visitors or third parties entering a Project Area are equipped with Personal Protection Equipment (PPE) pursuant to the practices and standards specified in Clause A2 (13) of Additional Technical Specification.	Monthly
ESHS 3	Medical Check up	The Contractor shall organise medical check-ups carried out by a doctor or an appropriately qualified nurse for all Contractor's Personnel prior to the initial mobilisation to the Project Area to check aptitude for the work. Hearing tests are conducted for the Contractor's personnel exposed to noise levels above 80 dB(A) in	Quarterly

Sl No.	Item	Specifications	Requirement
		order to establish initial audiograms. Annual test shall be carried out as per advise of the Engineer. Covid-19 test to the Contractor's personal as and when required.	
ESHS 4	First Aid provision	Provide and maintain first-aid provisions on any work site, including: suitably stocked first-aid kits; a person, respectively an adequate number of staff appointed and trained to take charge of first-aid arrangements and ensure that staff and workers are informed about first-aid arrangements.	Monthly
ESHS 5	Safe Drinking Water	Contractor shall provide to his personnel safe drinking water at all project work areas throughout the construction period as per the Clause 6.14 of CC and Clause A1 (16) of Additional Technical Specification. The quantity and quality of this water complies with the Indian standards.	Monthly
ESHS 6	Accommodation	Provide and maintain accommodation for non-resident Personnel in a camp or an alternative structure outside of the Project Areas, such as a hotel or rented house, will comply with the conditions of the present ESHS Sub-Clause in pursuance of Sub-Clause 6.6 of the CC.	Lump Sum
ESHS 7	Meals	Contractor provides meals at a reasonable cost or free of charge to its Contractor's Personnel per shift in a canteen area and according to a procurement system which complies with the provisions of this ESHS Specifications Sub-Clause 6.13	Lump Sum
ESHS 8	Training Programme	Contractor shall organize training sessions for his personnel in two-folds: introductory sessions for starting work at the Project Area, and technical training as required in relation to the execution of the works.	Quarterly

Appendix I: HSE MONTHLY PROGRESS REPORT

Project Name		Client	
Supervision Consultant		Contractor	
Financing Agreement No.		Financing	
Project Region		Reporting Period	Month & Year

No. of Personnel in the Field		
No. of Machineries (Provide item wise List)		
Principal Activities		
Progress of Works		
HSE Incidents	Reporting Month:	Last Month:
First Aid Incidence	Reporting Month:	Last Month:
Near Miss Incidence	Reporting Month:	Last Month:
Safe Man Hours Worked	Reporting Month:	Cumulative:
No. of Lost Work Days	Reporting Month:	Cumulative:
Safety Audit	Internal:	External:
Problems Encountered		
Suggested Solutions		
Status of Previous Problems/ Issues		
Activities Conducted Reporting Month		
Activities Planned for the Current Month		
Remarks		

Table – 1: Contractor's Establishment

Sl No	Type of Establishment	Chainage/ Village	Area	Land use	E&S receptors in and around site	Approval Reference
1	Project Office					
2	Construction Camp(s)					
3	Labour Camp					
4	Material Stockyard(s)					
5	Crushers					
6	Borrow Area(s)					
7	Quarry(s)					
8	First Aid Facility					

Table – 2: Environmental – Social – Health Aspects

Sl No	Particular Points	CPRR Section 5	Remarks
1	**Environmental**		
i	**Camp Site Area Particulars:** Location: Extent in Acres: Type of Soil: Nature of Present land Use Land Ownership: Lead: Village: Borrow area reclamation process:		
ii	**Quarry Particulars :** Environmental Clearance Certificate Details 1. Q1 Location 2.Q2 Location 3. Q3 Location	1. EC No. 2. EC No. 3. EC No.	
iii	**Equipment & Machinery Information** Type of Equipment engaged at the site		
iv	Information on water bodies & local streams existing and present condition improvement plans if any	No. and Chainage River: Canal: Streams: Water Tanks: Open Well: Groundwater Pumps:	
v	Information on Tree cuttings: No of Trees exists in the ROW No of Trees planned to cut or remove.		

<table>
<tr><th>Sl No</th><th>Particular Points</th><th>CPRR Section 5</th><th>Remarks</th></tr>
<tr><td>vi</td><td>Information on Plantation
Avenue Plantation,
Location, Extent, type of plants age plants, watering, weeding practices, survival percentage and replacement</td><td></td><td></td></tr>
<tr><td>vii</td><td>EQM Test Reports
(a) Air quality Samples tested (nos)
(b) Surface Water quality Samples tested (nos.)
(c) Ground Water quality tested (nos.)
(d) Noise Samples tested (nos)
(e) Soil quality Samples tested (nos)
(f) Vibration (nos.)</td><td></td><td></td></tr>
<tr><td>2</td><td colspan="3">SOCIAL ASPECTS</td></tr>
<tr><td>i</td><td>Labour Camp Information
• Type of Structure
• Water facility
• Drinking Water Quality
• Toilets
• Washing Areas
• Drainage System</td><td></td><td></td></tr>
<tr><td>ii</td><td>Camp Location particulars
• Location
• Extent
• Ownership
• Distance from the nearest Chainage: .</td><td></td><td></td></tr>
<tr><td>iii</td><td colspan="3">Training
<table>
<tr><th>Item</th><th>Details</th><th>Remarks</th></tr>
<tr><td>• Numbers of training organized</td><td></td><td></td></tr>
<tr><td>• Nos. of participants</td><td></td><td></td></tr>
<tr><td>• Topics</td><td></td><td></td></tr>
<tr><td>• Type of participants</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>iv</td><td>Others

Recreation Facilities</td><td></td><td></td></tr>
<tr><td>3</td><td colspan="3">HEALTH ASPECTS</td></tr>
<tr><td>i</td><td>1. Availability of Doctor
2. Nurse
3. Number of Health Check up camp organized
4. Camp site Health Facility
5. First Aid boxes Availability</td><td>1. Name & Contact Details
2.
3.
4.
5.</td><td></td></tr>
<tr><td>ii</td><td>Distribution of Medicines
Types
Frequency
Number</td><td>-</td><td>-</td></tr>
<tr><td>iii</td><td>Details of Ambulance
Facilities as per CA</td><td></td><td></td></tr>
</table>

A. First Aid Analysis and Report

Table – 3: Applicable Permits Status

Sl No	Description	Quantity	Location	Details of Clearance/ Permits	Validity	Remarks
1	HMP					
2	RMC					
3	WMM					
4	DG Set					
5	Fuel station					
6	Borrow Area					
7	Aggregate Quarry					
8	Sand quarry					
9	Tree Cutting					
10	Labour License					
11	Labour Camp					
12	Water use (KLD)					

Table – 4: HSE Site Instructions /Observation/NCR Details

Sl No	Description of Site Instructions /Memo	Date	Compliance Status with Date
1			
2			

Table – 5 : Key Issues /Public Complaints

Sl No	Details of Public Complaints / Grievances / Key Issues	Date of Issue with Letter reference	Compliance Status with Date
1	Location: Issue: Complainant: Contact Details:	-	-
2	Location: Issue: Complainant: Contact Details:		

Table – 6 : HSE Related Correspondences

Incoming

Sl No	Letter Description	Date of Issue with Letter Reference	Status with Date
1			
Outgoing			
1			
2			

HSE Related Photographs

Photo with Description	

Labour Camp Facilities

Photo with Description	

Training Programmes

Photo with Description	

Awareness Programmes

Photo with Description	

Good Practice Programmes

Photo with Description

Appendix II Near miss Report Format

Contractor:					Near Miss: 00		
Incident Type (Mark √ at selected category)	**Incidents**	**Environment Incidents**	**Non Reportable Injury (<3) days**	Dangerous Occurrences	>*3day	*Major	*Fatal
	Near Miss	Property Damage	First Aid	Medical Treatment			

Incident Date:		Time:		Place of Incident	
Reported by		Time:		Contact No	

Description of the Incident/Accident (attach photograph, sketch, etc. if required)

If personal injury involved, complete the details of Inured Person (IP) and other details below:					
Name of IP: -		Male / Female (M/F)	-	Employment No	-
Occupation: -		Insurance name and no	-		
Contact no of IP: -		Next of Kin and Tel no:	-		
DoB & Age: -		Accompanied by & Tel no:	-		
Employer: -		Supervisor name & Tel no:	-		
IP sent to Hospital? Y/N	-	Name of Hospital and Tel no:	-		
First Aid was given? Y/N	-	Witnesses Names	Employer	Contact No.	
IP sent to Rest (R)/Work (W)	-	1. -	-	-	
IP had PPE?	-	2. -	-	-	
JSA/Tool Box Talk was given?	-	Extra Pages & Photos Attached? Yes/No			

What were the immediate actions are taken:

-

What were the underlying causes :

-

What measures are needed to stop it happening again?

Corrective/Preventive Actions Taken by Manager and his/her Comments

Person completing report	Position	Signature	Date
Reviewed By:			

Note:

- For all types of Incident, inform EHS department immediately and submit the Initial Incident/Accident Report
- For all types of **reportable** incidents/accidents the investigation shall be carried out and Incident/Accident Investigation report must be submitted within 7 days

9

9 Public Consultation and Disclosure

9.1 Public Consultation Meeting at Manamathi Village in 2014

9.1.1 Organising the Meeting

Public consultation meeting was organized at the Thirupadalambigai Thirumanamandabam, Manamathi Village on 3.00 pm of 21st July 2014. A notice inviting for the meeting was issued to the local people residing in the project area, the commuters on the project area, NGOs, Government departments and general public three days prior to the meeting. The MLA of Thiruporur Constituency and the Village Panchayat Presidents of villages along/adjacent to the proposed alignment from Mahabalipuram to Singaperumalkoil were also invited for the meeting. The information on the meeting was published in the local news papers. The information regarding the consultation meeting was displayed at entrance of the venue in a flex banner.

9.1.2 Consultation Meeting

The public consultation meeting was convened by the Divisional Engineer (H), C&M, Chengalpattu Division and Government of Tamil Nadu. The Assistant Divisional Engineer (H), C&M, Chengalpattu, The Assistant Divisional Engineer (H), C&M, Thirukazhukundram, representatives from NGOs and Government Departments and the General Public were attended the meeting.

The meeting was attended by representatives from the following 19 villages/ hamlets: Sirungundram, Manamathi, Kulipanthandalam, Amayampattu, Santhaimedu, Kottivakkam, Viraspalayam, Vengoor, Karumpakkam, Mullipakkam, Kankulam, Agaram, Siruthavur, Thasarikuppam, Rayamangalam, Karanai, Sengalunirodai, Mailai and Singaperumalkoil.

9.1.3 Presentation of the Project

The Alignment Map, Typical Cross Section drawings and salient features of the project were displayed in the hall. Brief note on the tasks performed during the meeting is listed below:

- The project background, alignment, project features and facilities, benefits like travel time savings, safety, etc and impacts like land acquisition, environmental/social impacts, etc were explained by the Consultants in the meeting in local language (Tamil).
- After presentation, an interaction session was carried out, in which attendees have given their suggestions and raised few questions regarding the project.
- Participant's attendance were recorded and given in the Annexure.
- A feedback form was distributed to the audience of the meeting to give their suggestions and comments on the project. The format of feedback form was finalized in consultation with Highways Department. The questionnaire was formulated in a view to provide full freedom for the stakeholders to register their comments/suggestions.

The entire consultation meeting was video documented and photographs were taken.

Figure 9-1 Photos of the 9.1 Public Consultation Meeting at Manamathi Village in 2014

9.1.4 Proceedings of the Meeting

The Divisional Engineer welcomed the participants and introduced the study team, thereby commencing the dissemination meeting.

- Senior Social Development Specialist from the study team addressed the participants and informed them about the purpose of the dissemination meeting and also provided snap shot of proposed project and invited Divisional Engineer to explain in detail about the proposed alignment and project specific information's.
- The Divisional Engineer, explained the participants about the proposed alignment, villages passing through, proposed RoW and facilities proposed under this project.
- On completion of briefing of the project, the participants were invited to ask their clarifications and suggestion on the proposed project. Feedbacks from the participants were recorded in a feedback form and videography was also done for the entire dissemination meeting.

- Around 70 public representatives from various villages were participated and about 57 participants were recorded their feedback in the form circulated during the meeting.
- The dissemination meeting end with a thanking note and the Divisional Engineer appreciated the contributions of participants and assured that comments/ feedback received during the meeting will be duly considered during finalization of the project.
- In general, public opinioned that the proposed project will improve the connectivity in the neighboring villages.

Following Table highlights the key suggestion/ comments raised during the meeting:

Sl.No.	Suggestions/Comments	Reply to Comments
1	ENGINEERING ASPECTS	
2	Whether the project is a Toll road.	The proposals on tolls will be finalised at the subsequent stages by the government.
3	Whether the proposed Sub-way across railway line at Singaperumalkoil will be affected by this project.	No. It is proposed to modify the geometry of ROB under construction at Singaperumalkoil.
	SOCIAL ASPECTS	
1	Representative wanted to know the number of villages is proposed to be passing through the project road.	Study team listed the name of villages through which the project road is passing through in this section.
2	Representatives enquired about the compensation for affected agricultural lands in the project.	Compensation will be determined as per latest LA & RR act '2013.
3	People also enquired about the compensation for affected wells in the agricultural lands.	Compensation will be determined as per latest LA & RR act '2013.
4	Representative wanted to know the strategies going to be adopted for payment of compensation to the losses.	The compensation package matrix for the losses will be prepared as per the latest LA & RR act '2013 and disclosed by the project authority.
5	Entire cultivation land is likely to be affected due to this project which has been the only source for livelihood. Hence requested the team to mitigate LA over cultivable lands.	Project alignment is finalised in view of minimising social and environmental impacts. Compensation will be paid for the affected land as per latest LA & RR act '2013.
6	Representative wanted to know whether the project affects the commercial stretches at Karanai and wanted the RS Nos. of all the likely affected areas.	It is replied that, no commercial stretches would be affected. Land plan schedule is under preparation. Affected RS Nos. will be disseminated after completion of LPS
7	Wanted to know is there a provision for alternate cultivable land for the loss of same.	Possibilities of providing alternate land will be evaluated and compensation packages will be determined as per latest LA & RR act '2013

9.1.5 Feedback from the Stakeholders

- After the meeting, the attendees were requested to fill in the feedback forms delivered in the dissemination session. All the forms received from the participants are documented.
- Totally 57 feedback forms were received and analyzed from the meeting. Every query, suggestion or concern of the participants from the meeting and feedback form shall be considered in the subsequent stages of the assignment.

The comments collected from the feedback forms are summarized in the following table:

Sl.No.	Suggestions/Comments	Reply to Comments
	ENGINEERING ASPEC	
1	Revenue survey numbers along the proposed alignment	Land plan schedule is under preparation. Affected RS Nos. will be disseminated after completion of LPS.
2	Details about the proposed alignment and request a copy of alignment plan for the public.	The alignment plan is displayed in the hall. The same will be available at Highways Division/Sub-division offices for reference.
3	Necessity of the project.	Provide connectivity around Chennai and access to Ennore Port from all radial roads.
4	Are there any future development potentials for the nearby villages?	Proposed project provide connectivity and accessibility for the nearby villages.
5	Is there any alternate alignments evaluated for this proposal?	Final alignment is selected after evaluating various alternate alignments based on techno, economic, environmental and social point of view.
6	Is there any provision for cross roads in the project?	Underpasses proposed for the cross roads.
7	Are there any possibilities for by-pass to avoid impacts to our area?	Final alignment is selected after evaluating various alternate alignments based on techno, economic, environmental and social point of view. Modification will cause major impact on other areas.
8	Widening of existing road to avoid land acquisition.	Project road will be developed with 60m right of way. Widening of existing roads requires land acquisition on both sides which will cause major social impacts on the adjoining villages.
9	Project should not affect the existing rural link roads, water resources, channels & other irrigation system	Service road is proposed on both sides to provide access and underpasses are proposed for crossing the project road. Necessary cross drainage structures are proposed waterway crossings.

Sl.No.	Suggestions/Comments	Reply to Comments
10	Provide address of government departments involved in the process of implementation of the project to obtain clarity before buying any lands along the project area.	The alignment plan is available at the Highways Divisional/Sub-division offices for reference.
11	Provision for cross roads and link roads	Service road is proposed on both sides to provide access and underpasses are proposed for crossing the project road.
12	Thiruporur and neighbouring villages should be linked with the proposed road	These areas can be accessible from the project road through existing roads like OMR, Thiruporur-Chengalpattu Road, Thiruporur-Thirukazhukundram Road, etc
13	Tolls should not be proposed in this project	Proposals on tolls will be finalised at the subsequent stages by the government.
14	Requested to upload the proposed alignment in the website for public viewing.	The alignment plan is available at the Highways Divisional/Sub-division offices for reference.
15	Families living at Sirukundram want to propose the road on the southern part of the hill so that agricultural based activities and livelihood will not be affected.	The proposed alignment is on the southern part of the hill only.
16	Poromboke land in the Vengoor village should not be affected.	Final alignment is selected after evaluating various alternate alignments based on techno, economic, environmental and social point of view. Modification will cause major impact on other areas.
17	In Karani village, the alignment should be planned to pass through poromboke lands so as to avoid impact to patta lands	Final alignment is selected after evaluating various alternate alignments based on techno, economic, environmental and social point of view. Modification will cause major impact on other areas.
18	Bus stands/ bus stops should be provided under this project	Bus bays with shelter proposed on the service road near villages and important road crossings.
	ENVIRONMENTAL ASPECTS	
1	How about trees affected along the alignment	Tree cutting is unavoidable. New tress will be planted at a ratio of 1:10. Wherever possible trees will be replanted.
2	Road alignment should not affect the water bodies such as lakes, pond, etc.	Adequate care has been taken to avoid impacts to water courses.
	SOCIAL ASPECTS	
1	Is there any Government job for the PAFs?	At present, there is no provision made by the authority

Sl.No.	Suggestions/Comments	Reply to Comments
2	Requested to implement the project without affecting the houses and properties.	The alignment is finalized in view of minimising social impact. Utmost care will be taken to minimising the impact on the house and properties duringimplementation.
3	Requested to provide higher compensation to the patta lands	Compensation for the PAFs will be made as per latest LA & RR act '2013.
4	Requested to provide compensation more than the government fixed rate for the lands.	Compensation for the PAFs will be made as per latest LA & RR act '2013.
5	Project shall be implemented without affecting properties in the Manamathi village	The alignment is finalized in view of minimising social impact. Care will be taken to minimise the impact in Manamathi village during implementation.
6	Compensation should be more than the current market value	Compensation for the PAFs will be made as per latest LA & RR act '2013.
7	Whether any alternate land for the affected agricultural land will be given?	Possibilities of providing alternate land will be evaluated and compensation packages will be determined as per latest LA & RR act '2013
8	Whether direct employment opportunities will be given to the PAFs?	Job opportunities would be given to the PAFs during construction of the project.
9	Requested to enhance compensation packages.	Compensation for the PAFs will be made as per latest LA&RR act '2013.
10	It is opinion that proposed project will affect small farmer's livelihood.	Adequate care will be taken to minimise the impact.

Source: EIA Report, 2017

9.2 Public Consultation Meeting at Manamathi Village in November 2022

(This section will be added after the consultation meetings finish.)

10 Conclusion and Recommendations

Based on the environmental impact assessment, the proposed CPRR alignment at Section 5 do not have any major impact on the environmental as well as social aspects. The anticipated impacts are found to be common for construction of any highways/ road projects. The modelling study performed for the air quality and noise levels also predicts the same. The proposed CPRR shall have traffic safety measures for safeguarding the road users. Climate risk adaptation measures like providing adequate culverts, bridges and use of anticorrosivematerials shall extend the life of the proposed structures and the pavement from flooding or other natural disasters.

Being a Greenfield corridor, the presence of the receptors are almost negligible and hence during the project construction and operation significant impacts are not envisaged.However, the given EMP will be implemented by the Contractor for which the EMP has beenincluded in the Bid Document to make it mandatory for implementation. For the loss of landand structures, adequate compensation has been worked out and given in the RAP. The suggested enhancement measures including the compensatory afforestation, deepening of water bodies shall add positive environmental benefits.

The Contractor should prepare site specific Construction EMPs based on final designand locations of construction camps, quarries and borrow areas etc. The assessment outcomes shall have limitations, however it shall be managed through appropriate action asgiven in the following table.

EIA Limitation	Actions to be taken	Responsibility
Changes in the proposed alignment	The assessment has to be conducted tocapture the major impacts and accordingly the EMP has to be updated	Supervision Consultants and the PIU
Amendment in the rules, regulations andpolicies	The EIA has to be updated as per the amended rules, regulation and policy and accordingly the assessment has to be revised (including the EMP)	Supervision Consultants and the PIU
Availability of limited secondary information for theproject area	During the project implementation, primary information has to be collected and compared with the baseline information and accordingly the monitoring approach has to be revised	Supervision Consultants and the PIU
Meaningful consultations	Consultation with the local/public and the stakeholders should be conductedthroughout the construction period torecord and to sort the likely issues from the project site	Supervision Consultants and the PIU

ANNEX: REPORTING FORMATS
Contents

REPORTING FORMAT – 1: IDENTIFICATION OFCONSTRUCTION CAMP SITE

A	Project Details		Date of reporting:	
1.	Name of project stretch and link			
2.	Name and address of the Contractor			
3.	Contract date and duration			
4.	Status of completion of the project			
B	**Site Details**			
1.	Place Name		Landmark	
2.	Name of Panchayath / Municipality		Revenue Village	
3.	Taluk		District	
4.	Nearest Chainage (km)		Location	LHS/ RHS
5.	Area of site		Current Land use	
6.	Ownership of the land	Owned / leased	Survey no.	
7.	If leased / rented, Name and Address of owner			
8.	Distance* from any major settlement or village			
9.	Distance from any major surface water course			
10.	Distance from ecologically sensitive areas and distance from road			
11.	No of Trees and Girth size			
12.	No of Trees to be felled			

All distances are to be measured from the boundary of the site.

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

REPORTING FORMAT – 2: IDENTIFICATION OF SOURCES OF WATER

A	Project Details		Date of Reporting:	
1.	Name of project stretch and link no			
2.	Name and address of the Contractor			
3.	Contract date and duration			
4.	Status of completion of the project			
B	**Site Details**			
1.	Place Name		Landmark	
2.	Name of Panchayath / Municipality		Revenue Village	
3.	Taluk		District	
4.	Nearest Chainage (km) of the project road		location	LHS/ RHS
5.	Type of water body (River / Canal / lake)			
6.	Existing users			
7.	Ownership of the water body			
8.	Authority responsible for giving permission			
9.	If private, details of owner contact address and name			
10.	Distance from project road			
11.	Width and type of access road			
12	List of enclosure:	Location map		
		Photographs of the site		

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 3: IDENTIFICATION OF QUARRY AND STONE CRUSHER SITE

A	Project Details	Date of reporting:		
1.	Name of project stretch and link no			
2.	Name and address of the Contractor			
3.	Contract date and duration			
4.	Status of completion of the project			
B	**Site Details**			
1.	Place Name		Landmark	
2.	Name of Panchayath / Municipality		Revenue	
3.	Taluk		District	
4.	Nearest Chainage (km) of the project road		location	LHS/ RHS
5.	Area of site		Current land	
6.	Ownership of the land	Owned / leased	Survey no.	
7.	If leased, name, address of the owner			
8.	Type of material available and its quantity			
9.	Distance* of the site from:			
	(i) any major settlement or village			
	(ii) any major surface water course or body			
	(iii) any bridge, water supply system, infiltration well or pumping installation			
	(iv) any public road			
	(v) ecologically sensitive areas			
	(vi) nearest quarry / stone crusher			
10.	Distance from project road			

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 4: IDENTIFICATION OF BORROW AREAS

A	Project Details		Date of reporting:		
1.	Name of project stretch and link no				
2.	Name and address of the Contractor				
3.	Contract date and duration				
4.	Status of completion of the project				
B	**Site Details**				
1.	Place Name		Landmark		
2.	Name of Panchayath		Revenue village		
3.	Taluk		District		
4.	Nearest Chainage (km)		Location		LHS/ RHS
5.	Area of site		Current land use		
6.	Ownership of the land	Owned / leased		Survey no.	
7.	If leased, name, address and contact details of owner				
8.	Distance* from any major settlement or village				
9.	Distance from any major surface water course or body				
10.	Distance from ecologically sensitive areas				
11	Distance from the Project road				
12	Width and type of access road				
13	No of trees with girth> 0.3m				
14	No of trees to be cut				
15	Is top soil conservation required (Yes/ No)				
	Location Map				
	Layout Plan				
	Photographs of the site				

** All distances are to be measured from the boundary of the site.*

Note: Contractor has to fill and submit this format to the CSC upon identification of each borrow area. Subsequently, the Environmental Specialist of CSC has to visit the site and approve / reject the site with reasons. The Environmental Specialist of CSC has to give a copy of this format to the Contractor after his approval / rejection with remarks. On approval of a site, the Contractor has to prepare the Management and Redevelopment Plan for this site as per the Guidelines given in EMP and submit to CSC for approval.

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 5: REPORTING FORMAT FOR IDENTIFICATION OF DEBRIS DISPOSAL SITE

A	Project Details		Date of Reporting:	
1.	Name of project stretch and link no			
2.	Name and address of the Contractor			
B	**Site Details**			
1.	Place Name		Landmark	
2.	Name of Panchayath / Municipality		Revenue Village	
3.	Taluk		District	
4.	Nearest Chainage (km)		Location	LHS/ RHS
5.	Area of site		Current land use	
6.	Ownership of the land	Owned / leased	Survey no.	
7.	If leased, name, address and contact details of owner			
8.	Distance* from any major settlement or village			
9.	Distance from any major surface water course or body			
10.	Distance from ecologically sensitive areas			
11.	No. of trees to be cut			
12.	Is top soil conservation required (Yes/ No)			
List of enclosure:	Location map	Layout Plan/ Layout Plan		

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 6: FORMAT FOR REGISTER OF COMPLAINTS AND IT'S REPORTING

A. Project Details Information					
1	Name and Address of the Contractor				
	Contract date and duration				
	Details of Complaint Received		**Site Name**		
Sl. No	**Date of Complaint**	**Name and address of person with contact details**	**Complaint**	**Action taken with date**	**Signature of ESM of Contractor**

A register in this format shall be maintained at each site office of the Contractor. This same format shall be used to compile and report the details of complaints received at all sites to the CSC along with the Monthly Report of the Contractor. The Environmental Specialist of CSC has to give instruction to the Contractor, if any further action has to be taken on any complaint.

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 7: FORMAT FOR REGISTER OF SITES OPENED AND CLOSED AND IT'S REPORTING

A.	Project Details	Information
1.	Name of project stretchand link no.	
2.	Name and address of theContractor	
3.	Contract date andduration	

B. Site Details

Sl. No		Name and Address of the Owner	List of Clearances Required	Issue Date of each Clearance	Expiry date of each Clearance	Site Closing date	Redevelopment Status	Remarks	Signature of of ESM Contractor
1									
2									

* Construction Camp / Labour camp / Quarry Area and Stone Crusher Unit / Borrow Area / Debris Disposal Site / Water Source.

A site should be opened only after submitting the Management and Redevelopment Plan prepared as perthe Guidelines given in EMP and got it approved by the Environmental Specialist of the CSC. A register in this format (preferably in A3 size paper) should be maintained by the Contractor for each road. This same format shall be used to report the details of sites opened and closed to the CSC.

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 8: WORK FORCE MANAGEMENT

A	Project Details		Date of Reporting:	
1.	Name of project stretchand link no.			
2.	Name and address ofthe Contractor			
3.	Contract date andduration			
4.	Status of completion ofthe project			
5.	Name of Work Site with sl. no. in registerof sites			

B.	Status of work force				
Sl. No.	**Category of work force**	**Work force in the previous Month (No.)**	**Work force added in the reporting month (No.)**	**Work Force left in the reporting month (No.)**	**Total work force in the reporting month (No.)**
1.	UnskilledLabourers				
2.	Skilled labourers				
3.	Supervisors				
4.	Engineers				
5.	Office Staff				
	Sub Total				
	Grand Total				

No. of children (0 – 6 yrs.)			**No. of children (7-18yrs.)**			**No. of adults**		
Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**

C.	Categorization of work force										
Sl. No	**Category of work force**	**Male**		**Female**		**Employment Status**		**Residential Status**		**Accommodation**	
		< 18 yrs.	**> 18 yrs.**	**< 18 yrs.**	**> 18 yrs.**	**Regular**	**Temporary**	**Migrant**	**Local**	**Staying in**	**Others**
1.	Unskilled Labourers										
2.	Skilled labourers										
3.	Supervisors										
4.	Engineers										
5.	Office Staff										
	Sub Total										
	Grand Total										

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 9: REPORTING FORMAT FOR OCCUPATIONAL HEALTH AND SAFETY MEASURES

A	Project Details	Date of Reporting:	
1.	Name of project stretch and link no.		
2.	Name and address of the Contractor		
3.	Contract date and duration		
4.	Status of completion of the project		

B Implementation Status of Health and Safety Measures

Sl. No.	Health and Safety Measures	Implementation Status (Yes / No)	Remarks
1	Appointment of qualified Environment and Safety Manager		
2	Approval for Construction Safety Management Plan by the Engineer.		
3	Provision for flags and warning lights for potential hazards		
4	Provision of adequate staging, form work and access (ladders withhandrail) for		
5	Provision of adequate shoring / bracing / barricading / lightingfor all deep excavations of more than 3.0 m depth.		
6	Provision for sufficient lighting especially for night time work		
7	Construction Workers safety - Provision of personnel protective equipments		
	A. Helmets		
	B. Safety Shoe		
	C. Dust masks		
	D. Hand Gloves		
	E. Safety Belts		
	F. Reflective Jackets		
	G. Earplugs for labour		
8	Workers engaged in welding work shall be provided with welderprotective shields		
9	All vehicles are provided with reverse horns.		
10	All scaffolds, ladders and other safety devices shall be maintained inas safe and sound		
11	Regular health checkup for labour/ Contractor's personnel		
12	Sanitary conditions and all waste disposal procedures & methods in the camps		
13	Insurance coverage		

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

Note: Contractor has to fill and submit this format to the CSC along with the Monthly Report. The CSC has to visit site if required and the mitigation measures can be suggested by the CSC. The Environmental Specialist of CSC has to give back a copy of this format to the Concessionaire after his approval with remarks.

REPORTING FORMAT – 10: REPORTING FORMAT FOR TOPSOIL CONSERVATION

A	Project Details	Date of Reporting:		
1.	Name of project stretch and link no.			
2.	Name and address of the Contractor			
3.	Contract date and duration			
4.	Status of completion of the project			
5.	Name of Site with sl. no. in register of sites			
B	**Top Soil Conservation Details**			
Sl.	**List of Activities**	**Status**		**Remarks**
1.	Whether the location was pre-identified?			
2.	Whether the slope is < 1:2 ?			
3.	Whether height is less than 2 mts ?			
4.	Whether edges of pile are protected by silt fencing ?			
5.	Whether multiple handling is kept to a minimum			
6.	Whether measures are taken to prevent the loss during rains.?			
7.	Whether any other measure are provided? If yes, What is it?			

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 11: REPORTING FORMAT FOR WATER SPRINKLING

A	**Project Details**	
1.	Name of project stretch and link no.	
2.	Name and address of the Contractor	
3.	Contract date and duration	
5.	Location of water sprinkling	
B	**Water Sprinkling Details**	

Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of trips															
Quantity of Water SprinkledKLD															
If not, Reasons															
Days	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
No. of trips															
Quantity of Water SprinkledKLD															
If not, Reasons															

Submitted by

Environment Manager ofContractor

Signature & Date

Approved by

Environmental Specialist of CSC

Remarks by CSC

REPORTING FORMAT – 12: ROAD SAFETY MEASURES DURING CONSTRUCTION

A	**Project Details**	Date of Reporting:	
1.	Name of project stretch and link no.		
2.	Name and address of the		
3.	Contract date and duration		
4.	Status of completion of the project		
B	**Details of Safety Measures**		
S.No	**Safety Measures**	**Compliance Status (Yes / No)**	
a.	**General**		
1	A qualified Environment and Safety Engineershould be appointed		
2	A Traffic Management Plan should be prepared in accordance with IRC: SP: 55-2001 and got approved by the Engineer		
3	Maintenance of existing road stretches handed over to the Contractor should be carried out		
b.	**Details of Construction Zone**		
1	Length of transition sub zone should be min 50 mfor a speed of 50km/hr		
2	Length of work sub zone in urban stretch shouldbe<2 km		
3	Length of work sub zone in rural stretch should be5-10 km		

Signage's in construction zones

1. Sign saying **Men at Work** should be kept 500m ahead of Transition sub zone
2. Supplementary sign saying **Diversion Ahead** shall be kept 500m before the Actual diversion
3. Sign saying **Road Closed ahead** should be provided
4. **Compulsory Tum Right/ Left** sign should be provided
5. **Detour** sign should be placed
6. **Sharp Deviation sign** should be placed at end of advance warning sub zone
7. Signage should be provided in Transition Sub Work Zone
8. Signage saying **Keep Right/Left** should be provided
9. Signage should be placed in work sub zone
10. Hazard Marker should be placed where railing for CD structure on diversion starts
11. Barricade should be provided on either side of work sub zone
12. Flag persons should be provided for traffic control
13. Flags and warning lights should be provided at Construction zones
14. Metal drum /empty bitumen drum delineator, painted in circumferential strips of alternate black and white

Safety Arrangements

- Arrangements should be made for controlled access and entry to Construction zones
- Plastic crash barriers should be provided
- Demarcations (fencing, guarding and watching) should be provided at bridge / culvert construction sites
- Regular Inspection of Work Zone Traffic Control Devices should be carried out by authorized Contractor personnel
- All vehicles should be provided with reverse horns
- Speed of construction vehicles should be controlled through road safety training of drivers

Signage in Termination sub zone

- Sign for indication of end of work zone should be placed 120m from end of termination sub zone

Road Delineators

1 Roadway indicators should be provided
2 Hazard markers should be provided
3 Object markers should be provided

Submitted by	**Approved by**
Environment Manager ofContractor	**Environmental Specialist of CSC**
Signature & Date	

Remarks by CSC

REPORTING FORMAT -13: REPORTING FORMAT FOR ACCIDENTS

A	**Project Details**	
1.	Name of project stretch and link no.	
2.	Name and address of the Contractor	
3.	Contract date and duration	
4.	Status of completion of the project	
B	**Details of Accident and People Involved in Accident**	
	Name of site where accident occurred	
	Name and address of people involved in accident	
	Whether Contractor's personnel or	
	General public	
	Details of Injury	
	Details of treatment given	
	Details of compensation given	
C	**Type of Accident (√)**	
	Fall of person from a height	
	Slip, trip or fall on same level	Fire
	Struck against fixed objects	Contact with hot or corrosive substance
	Struck by flying or falling objects	Contact with poisonous gas or toxic
	Struck by moving objects	Contact with poisonous gas or toxic
	Struck / caught by cable	Hand tool accident
	Stepping on hail etc.	Vehicle / Mobile plant accident
	Handling without machinery	Machinery operation accident
	Crushing / burying	Other (please specify)
	Drowning or asphyxiation	
D	**Details of Machinery**	
	Machinery	
	Portable power appliance	
	Vehicle or associated equipment /machinery	
	Material being handled, used or stored	
	Gas, vapor, dust, fume or oxygen	
	Hand tools	
	Floor edge	
	Floor opening/ Left shaft	
E	**Reason of Incident**	
	Operating without authority	
	Failure to secure objects	
	Making safety devices	
	Working on moving or hazard tools	
	Using un-safety equipment	
	Adopting unsafe position or posture	
	Operating or working at unsafe speed	
	Unsafe loading, Placing, mixing	
	Failure to use helmet	
F	**Lack of Safety Measures Relevant**	
	No protective gear	
	Defective protective gear	
	Improper dress / footwear	
	Improper guarding	
	Improper ventilation/ illumination	

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

REPORTING FORMAT – 14: REPORTING FORMAT FOR ENVIRONMENTAL QUALITY MONITORING

A	Project Details	Date of Reporting:	
1.	Name of project stretch and link no.		
2.	Name and address of theContractor		
3.	Contract date andduration		
4.	Status of completion of the project		

Construction phase: Air Quality [Frequency: Quarterly]

Item	Unit	Measured value (Mean)	Measured value (Maximum)	Baseline value	CPCB Standards	Measurement Point	Sampling Date
PM_{10}	$\mu g/m^3$						
$PM_{2.5}$	$\mu g/m^3$						
SO_2	$\mu g/m^3$						
NOx	$\mu g/m^3$						
CO	ppm						

Construction phase: Water Quality [Frequency: Quarterly]

Item	Unit	Measured value (Mean)	Measured value (Max)	Baseline value	Country's Standards	Measurement Point	Sampling Date
[Surface Water]							
pH	-						
Turbidity	NTU						
DO	mg/L						
BOD	mg/L						
COD	mg/L						
TDS	ppm						
SS	mg/L						
Total hardness as $CaCO_3$	mg/L						
Nitrate as NO_3	mg/L						
Fluoride as F	mg/L						
Chloride (Cl-)	mg/L						
Pb	mg/L						

Item	Unit	Measured value (Mean)	Measured value (Max)	Baseline value	Country's Standards	Measurement Point	Sampling Date
Total Iron as Fe	mg/L						
Oil & Grease	mg/L						
Sodium absorption Ratio							
Detergents	mg/L						
[Ground Water]							
pH	-			-			
DO	mg/L						
BOD	mg/L						
TDS	ppm			-			
Total Hardness	mg/L			-			
Sulphate	mg/L			-			
Chloride	mg/L			-			
Fe	mg/L			-			
Pb	mg/L			-			
Sodium absorption Ratio							
Total Coliform	MPN/100ml			-			

Add lines when necessary

** BIS:2490, PART-I-1981*

***BIS: IS 10500 : 2012 Drinking Water standard*

Construction phase: Noise & Vibration Levels [Frequency: Quarterly]

Item	Unit	Measured value (Mean)	Measured value (Max)	Baseline value	Country's Standards	Measurement Point	Sampling Date
Noise (DAY)	dB(A)						
Vibration (DAY)	m/s						
Noise (Night)	dB(A)						
Vibration (Night)	m/s						

Construction phase: Soil Quality [Frequency: Quarterly]

Item	Unit	Measured value (Mean)	Measured value (Maximum)	Baseline value	Referred International Standards	Measurement Point	Sampling Date
pH							
Texture		Clay : Silt : Sand :	Clay : Silt : Sand :	N/A			
Grain Size	-	Retained in 10 mm : Retained in 4.75 mm : Retained in 2 mm : Retained in 425 µ : Retained in 75 µ:	Retained in 10 mm : Retained in 4.75 mm : Retained in 2 mm : Retained in 425 µ : Retained in 75 µ:	N/A			
Conductivity	S/m			N/A			
Calcium	mg/L			N/A			
Magnesium	mg/L			N/A			
Sodium	mg/L			N/A			
Nitrogen	mg/L			N/A			
Pb	mg/L						
Sodium Absorption Ratio	-			N/A			
Oil & Grease	mg/L			N/A			

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

Note: The Contractor has to conduct Environmental Monitoring through a NABL approved Laboratory as per the Environmental Monitoring Plan given in the EMP, fill this format and submitto the CSC along with the Monthly Report, if monitoring was due in that month.

REPORTING FORMAT – 15: REPORTING FORMAT FOR ENHANCEMENT AND MITIGATION OF CULTURAL PROPERTIES

A	**Project Details**		**Date of reporting:**
1.	Name of project stretch and link no.		
2.	Name and address of the Contractor		
3.	Contract date and duration		
4.	Status of completion of the project		
B	**Details of Enhancement and Mitigation of Cultural Properties**		
Sl. No.	**Location with chainage**	**% work completed**	**Remarks and reasons for delay, if any.**

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

Note: The Contractor has to fill the details of cultural properties for which enhancementand mitigation measures were carried out during the reporting month in this format and submit to the CSC along with the Monthly Report. Overall progress in this activity for the entire project road is to be included in the Monthly Report. The CSC has to visit the sites and verify the details. Additional mitigation measures, if required, can be suggested by the CSC. The Environmental Specialist of CSC has togive back a copy of this format to the Contractor after his approval with remarks.

REPORTING FORMAT – 16: REPORTING FORMAT FOR NOISE BARRIER CONSTRUCTION

A	**Project Details**		Date of reporting:
1. Name of project stretch and link no. 2. Name and address of the Contractor 3. Contract date and duration 4. Status of completion of the project			
B	**Details of Noise Barriers Constructed**		
Sl.	**Location with chainage**	**% work**	**Remarks and reasons for delay, if any.**

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

Note: The Contractor has to fill the details of Noise Barriers constructed during thereporting month in this format and submit to the CSC along with the Monthly Report. Overall progress in this activity for the entire project road is to be included in the Monthly Report. The CSC has to visit the sites and verify the details. The Environmental Specialist of CSC has to give back a copy of this formatto the Contractor after his approval with remarks.

REPORTING FORMAT – 17: ENHANCEMENT MEASURES OTHER THAN CULTURAL PROPERTIES

A	**Project Details**		Date of reporting:
1.	Name of project stretch and link no.		
2.	Name and address of the Contractor		
3.	Contract date and duration		
4.	Status of completion of the project		
B	**Details of Enhancement Measures**		
Sl. No.	**Location with**	**% work completed**	**Remarks and reasons for delay, if any.**
a	Raising embankment height		
b	Public water sources		
c	Bus stops and bus bays		
d	Water Bodies		
e	Hand pumps/ Syntax Tanks/OHT		
f	Sign Boards/ KM Stones		

Note: The Contractor has to fill the details of enhancement measures carried out for amenities / facilities other than cultural properties during the reporting month in this format and submit to the CSC along with the Monthly Report. Overall progress in this activity for the entire project road is to be included in the Monthly Report.

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

REPORTING FORMAT – 18: REPORTING FORMAT FOR TREE PLANTATION

A	**Project Details**			Date of reporting:
1.	Name of project stretch and link no.			
2.	Name and address of the			
3.	Contract date and duration			
4.	Status of completion of the project			
B	**Details of Trees Planted**			
Sl. No.	**Location with Chainage**	**No. of Trees Planted**	**% work completed**	**Remarks and reasons for delay, ifany**

Submitted by
Environment Manager ofContractor

Approved by
Environmental Specialist of CSC

Signature & Date

Remarks by CSC

Note: The Contractor has to fill the details of Trees planted during the reporting month in this format and submit to the CSC along with the Monthly Report. Overall progress in this activityfor the entire project road is to be included in the Monthly Report. The CSC has to visit the sites and verify the details. The Environmental Specialist of CSC has to give back a copy of this format to the Contractor after his approval with remarks.

REPORTING FORMAT – 19: OVERALL MONTHLY REPORTING FORMAT FROM CONTRACTOR TO CSC

A	**Project Details**	**Period of Reporting:**
1.	Name of project stretch and link	
2.	Name and address of the Contract date and duration	
3.	Status of completion of the Project	
B.	**Physical Progress Report**	

Sl. No.	**Enhancement Measures**	**Physical Target**	**Units carried over from Previous month**	**Units started in**	**Units completed**	**Units carried to next month**	**Cumulative**	**% target**	**Remarks**
1.	Noise barrier								
2.	Hand pumps								
3.	Bus Shelter								
4.	Sign Boards								
5.	cultural properties								
6	Trees Planted								
7	Others Utilities								

C.	Details of Sites for Project Ancillary facilities					
Sl. No.	**Type of camp / site**	**Cumulative No opened sites**	**No of sites operational**		**Cumulative No of sites redeveloped**	**Cumulative no. of sites closed**
1.	Construction camp					
2.	Labour camp					
3.	Quarry & stonecrusher					
4.	Borrow Area					
5.	Debris disposal site					
6.	Water sources				NA	
** A site will be considered closed after redeveloping and obtaining closure certificate from CSC*						

D.	Summary of machinery and equipment available		
Sl. No.	**Type of equipment / machinery /vehicles**	**Nos. available**	**Validity of PUC certificate (as applicable)**
1.			

E.	Details of lapses for which notices were issued during the previous report					
Sl. No.	**Details of notices issued by CSC**	**Date of notice**	**Type of lapse**	**Notice No.**	**Corrective actions**	**Remarks**
**In case of minor lapse, specify whether original notice, first reminder or second reminder*						

F.	Details of major lapses for which notices were issued during the current month		
Sl. No.	List of majorlapses	Date of issuing notice	Whether invoking penalty cla from next interim payment certificate is recommended?
1			
2			

G.	Details of minor lapses for which notices were issued during the current reporting month				
Sl. No.	List of minor lapses	Date of issuing notice			Whether invoking penalty clause from next interim payment certificate is recommended?
		Original notice	First Reminder	Second Reminder	

REPORTING FORMAT – 20: REPORTING/ MONITORING FORMATS TO BE ANNEXED WITH MONTHLY REPORT BY THE CONTRACTOR

Sl. No.	Reporting/ Monitoring format	Yes/ No	Sl. No	Reporting/ Monitoring format	Yes/ No
1	Format for Register of sites opened and closed and its reporting		13	Reporting Format for Environmental Quality Monitoring	
2	Format for Register of complaints and its reporting		14	Checklist for Monitoring of Construction Camp Management	
3	Reporting Format for Work Force Management		15	Checklist for Monitoring of Labour Camp Management	
4	Reporting Format for Occupational Health and Safety Measures		16	Checklist for Monitoring of Quarry and Stone Crusher Management	
5	Reporting Format for Topsoil Conservation		17	Checklist for Monitoring of Borrow Area Management	
6	Reporting Format for Water Sprinkling for Dust Suppression		18	Checklist for the Monitoring of Debris Disposal Site Management	
7	Reporting Format for Road Safety Measures DuringConstruction		19	Check List for Monitoring of Redevelopment of Construction Camp Site	
8	Reporting Format for Register of Accidents and it‘s Reporting		20	Check List for Monitoring of Redevelopment of Labour Camp Site	
9	Reporting Format for Enhancement and Mitigation of CulturalProperties		21	Check List for Monitoring of Redevelopment of Quarry And Stone Crusher Site	
10	Reporting Format for Noise Barrier Construction		22	Check List for Monitoring of Redevelopment of Borrow Areas	
11	Reporting Format for Enhancement Measures Other than CulturalProperties		23	Check List for Monitoring of Redevelopment of Debris Disposal Site	
12	Reporting Format for Tree Plantation				