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Environmental Impact Assessment Report

PROJECT PREPARATION AND CONSULTANCY SERVICESFORPREPARATION OF DETAILED PROJECT REPORT (DPR) FORVARIOUS ROAD IMPROVEMENT WORKS UNDER TAMIL NADUROAD SECTOR PROJECT – II (TNRSP II)

CONTRACT - PPC02

Phase – I Roads

2 Laning of Madapattu- Thirukovilur Section of SH-09 and Construction of a New Link Road between SH 09 and SH 137

&

2/4 Laning of Vridhachalam- Bhuvanagiri Section of SH-70





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EXECUTIVE SUMMARY

BACKGROUND

The Government of Tamil Nadu through Tamil Nadu Road Sector Project II (TNRSP II) is planning to improve about 2000 km road length of State Highways spread all over the State. The improvement is planned with the financial assistance from the World Bank. The road length planned to be improved has been divided into five packages designated as PPC-01 to PPC-05. The selected state highways will be improved to 2 /4 lane configuration with paved shoulders. The current project (TNRSP II Phase I Roads) comprises of two roads of PPC-02 package, namely Madapattu- Thirukovilur road (part of SH-09) and Vridhachalam- Bhuvanagiri road (part of SH-70). The Environmental Impact Assessment (EIA) study has been undertaken as part of Detailed Project Report (DPR) preparation.

OBJECTIVES OF THE ASSIGNMENT

The main objective of the project is to provide road user a safe and congestion free road through a set of interventions. The objective of EIA is to establish baseline conditions in project region, identify impacts (positive and adverse) and to formulate mitigation measures for adverse impacts. The other objective of EIA study is to meet World Bank safeguard requirements. The EIA has been carried out to comply with the Government of India notified Environmental (Protection) Rules 1986. Under these rules EIA Notification 2006 has been issued.

SCOPE OF ENVIRONMENTAL ASSESSMENT (EA)

The environmental assessment scope includes screening and scoping, environmental assessment and environmental management plans for the individual project roads as required. The EIA scope was also specified in the Terms of Reference (ToR) of Consultants. The coverage of EIA has also been finalized after discussion with TNRSP and the World Bank environmental experts.

DESCRIPTION OF PROJECT ROADS

There are two project roads in the scope of current EIA. These corridors are (a) Madapattu-Thirukovilur road and (b) Vridhachalam- Bhuvanagiri road. The road length of Vridhachalam-Bhuvanagiri road is 35.8 km. This road starts at Vridhachalam at km 0+000 of SH-70 and ends at Bhuvanagiri at km 35+000 of SH-70. The Madapattu- Thirukovilur road starts at km 41+700 of SH-09 at Madapattu and ends at km 66+200 of SH-09. On this road a link road connecting between SH-09 and SH-137 has also been proposed. This link road is a new alignment and ends at km 124+460 of SH-137. The design chainages for this link road have been finalised as km 66+190 to km 71+147.Total length of this road is 29.60 km.

Based on traffic demand Madapattu - Thirukovilur road is planned to be widened to 2 lanes with paved shoulders. The Vridhachalam- Bhuvanagiri road is planned to be widened to 4 lane configuration from km 0+000 to 2+000 (within Vridhachalam town) and in balance length 2 lane; with paved shoulders.

In order to improve road geometric; curves will be improved at 2 locations in Madapattu-Thirukovilur road and at 10 locations on Vridhachalam Bhuvanagiri road. The existing major junctions proposed to be improved are 2 in Madapattu- Thirukovilur road and 4 on Vridhachalam- Bhuvanagiri road.

There are no major bridges in any of the project roads. The Madapattu- Thirukovilur road has 1 minor bridge and 34 culverts and Vridhachalam- Bhuvanagiri road has 4 minor bridges and 52 culverts. In order to improve the cross drainage additional culverts planned are 21 are planned on Madapattu- Thirukovilur road and 64 in Vridhachalam- Bhuvanagiri road.

KEY ENVIRONMENTAL LAWS AND REGULATIONS

Table 1 presents the environmental regulations and legislations relevant to the improvement of both project roads.

Table 1: Environmental Regulations, Legislations and Applicability

S. No.	Act / Rules	Purpose	Applicability to Proposed Corridors for Widening	Authority
1	Environment Protection Act-1986	To protect and improve overall environment	Yes, applicable for construction & operation phases.	MoEFCC. Gol; DoE, State Govt. CPCB; SPCB
2	Notification for use of fly ash, 2003	Reuse large quantity of fly ash discharged from thermal power plants to minimize land use for disposal	Yes, subject to meeting the specifications.	MoEFCC
3	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013	Set out rule for acquisition of land by government	Yes, Applicable	DM offices, Villupuram, and Cuddalore
4	The Air (Prevention and Control of Pollution) Act, 1981	To control air pollution pollutants	Yes	TNPCB
5	The Water (Prevention and Control of Pollution) Act1974	To control water pollution by controlling the discharge of pollutants as per the prescribed standards	Yes	TNPCB
6	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEFCC for various land uses.	Yes (applicable during construction phase)	TNPCB
7	Public Liability and Insurance Act, 1991	Protection from hazardous materials and accidents.	Yes (applicable during construction stage)	TNPCB
8	Minor Mineral and Concession Rules	For opening a new quarry.	Yes, (Quarry Licenses shall be obtained by Contractors.)	District Collectors-Villupuram and Cuddalore
9	The Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules1989	To check vehicular air and noise pollution.	Yes, (applicable during construction stage)	Department of Transport
10	The Mining Act	The mining act has been notified for safe and sound mining activity.	Yes (Quarry Licenses shall be obtained by Contractors).	Department of mining, GoTN
11	Municipal Solid Waste (Management & Handling) Rules, 2000 (MSW Rules)	Segregation, Handling & safe disposal of domestic solid waste	Yes	Urban Local Body
12	Hazardous Wastes (Management, Handling and Transboundary	Safe handling, storage, transportation &	Yes (Applicable during construction as there will be a	TNPCB

S. No.	Act / Rules	Purpose	Applicability to Proposed Corridors for Widening	Authority
	Movement) Rules, 2008.	disposal of hazardous wastes	generation of discarded fuel & lubricants at construction camps)	
13	Batteries (Management and Handling) Rules, 2001	Safe recycling of lead acid batteries	Yes (Applicable during construction as there will be uses of lead acid batteries at construction camp	MoEFCC

CATEGORISATION OF PROJECT

On the basis of data and information collected during field survey and discussion with local expert and visualise potential associated impacts, consultant has categorised this project as **Category A (as per World Bank categorisation)**, which requires a full scale Environmental Assessment.

BASE LINE ENVIRONMENT

In order to establish baseline environmental conditions, in respect of various components of the environment, in project region a study area of 15 km aerial distance has been delineated on either side of project roads RoW. Primary and secondary baseline data has been collected in the study area, through reconnaissance survey, published data, TN Government Departments and on-site measurements and surveys. The environmental monitoring for the project was carried out in the months of April and May 2014 for Vridhachalam- Bhuvanagiri road and June 2014 for Madapattu- Thirukovilur road. Both the project roads are in plain terrain and elevation ranges from 10-50 m (for both the roads). The physiography of study area in both the project roads forms a flat country overlain by alluvium. The soil in the surrounding of Madapattu-Thirukovilur road are red loamy while the soil in the surrounding of Vridhachalam- Bhuvanagiri road is younger alluvium, coastal alluvium, deltaic alluvium and Red Loamy. The soils in the vicinity of both the project roads is slightly alkaline in nature, but are not contaminated with pollutants. Both the project roads are located in Seismic Zone II. There are no mineral resources in the project influence area of Madapattu- Thirukovilur road but Neyveli Lignite Mines within the 10 km aerial distance of Vridhachalam- Bhuvanagiri road. Eleven borrow areas have been identified in Madapattu-Thirukovilur road and thirteen borrow areas have been identified in Vridhachalam- Bhuvanagiri Road. The predominant land use pattern on either side of both the project roads is agriculture.

The climate of the study area of both the project roads is hot tropical. The temperature ranges from 22°C in January to 38°C in May and June. The annual rainfall in the study area of Madapattu-Thirukovilur road ranges from 898.4 to 1361.70 mm and 1050 to 1400 mm in the study area of Vridhachalam- Bhuvanagiri road. The minimum average relative humidity recorded during the study period was 41% and 32% in February and March 2014 respectively. The maximum relative humidity recorded was 97%, and 91% in February and March 2014 respectively. The dominant wind direction in the project region is NE and daily averaged wind speed is 4.9 ±1 kmph. The ambient air quality has been measured along both the project roads at the identified monitoring locations and measured ambient air quality data indicates that air quality is well within stipulated limits for SO_2, NOx, PM_{10} and $PM_{2.5}$ for both the project roads. The major rivers draining the study area are Ponnaiyar, Malatar and Gadilam in Madapattu-Thirukovilur road and Manimukhta and Coleroon in Vridhachalam- Bhuvanagiri road. The ground water resources in the project region include wells, tube wells and hand pumps. The ground water table in the surroundings of both project roads is 3-5 m. The ground water and surface water samples, from the sources present in the study area have been drawn to establish baseline water quality in the project region. The ground water quality results of both the corridors indicate that all water quality parameters are well within the specified limits for drinking water in IS: 10500. The surface water results indicate that surface water quality is well within limits specified in IS: 2296 except for one sample in each road. In Madapattu-Thirukovilur road BOD level is higher than specified limit and in case of Vridhachalam-Bhuvanagiri road, chloride level is exceeding the limits specified in IS: 2296. There are no wetlands in the study area on both the roads. The hydrology of the project influence area is governed by the Ponnaiyar River in case of Madapattu- Thirukovilur road and Vellar River in case of Vridhachalam- Bhuvanagiri road.

The noise levels have been measured to establish a baseline scenario in the project influence area of both the projects. The measured values indicate that noise levels are well within the ambient noise level standards for both the project roads.

Both the project roads do not pass through reserved or protected forests. There is also no presence of any notified Wild Life Park, National Park or Bird sanctuary within 15 km aerial distance from both the project roads. Predominant tree species that generally occur within the proposed RoW of both roads are *Acacia Arabica, Albizia Lebbek, Borassus flabelifer, Ficus religiosa, Lannea coromandalica, Morinda tnctiria, Moringa Sp, Pongamia pinnata, Prosopis juliflora, Tamarindus indicus, Vitex negundo,* etc. The shrubs seen in project influence area are *Ipomeas gossypiolides, Bambusa aryndinacea, Zizyphus juluba, etc.* The number of trees has been enumerated within the proposed RoW of both the project roads. The number of trees within the proposed RoW of Madapattu- Thirukovilur and Vridhachalam - Bhuvanagiri road is 2,267 and 5,011 respectively. The fauna in the surroundings of both project roads are domesticated.

The Madapattu- Thirukovilur road passes through Villupuram district of Tamil Nadu and Vridhachalam- Bhuvanagiri road passes through the Cuddalore district of the Tamil Nadu state. There is no archaeological monument within 500 m distance of either of the project roads. There are 8 education institutes along Madapattu- Thirukovilur road and 10 educational institutes along Vridhachalam- Bhuvanagiri road. The number of religious structures along Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road is 27 and 39 respectively.

STAKEHOLDER CONSULTATIONS AND INFORMATION DISSEMINATION

Stakeholder Consultations are an ongoing process till project is completely constructed. The consultations have been carried out with the locals in Focus group discussion at Sarvanapakkam (km 46+600) and Kolapakkam (km 65+000) in Madapattu- Thirukovilur road and at Gopalapuram (km 8+500) and Erambur (km 22+000) at Vridhachalam- Bhuvanagiri road. During these consultations the consultants have disseminated information about the project road widening. The institutional level consultations have been carried out by the consultant with Tamil Nadu Pollution Control Board and the local Highway Department at Vridhachalam. In the consultations at all locations, people suggested for effective drainage in the built up sections, equal and fair treatment for community residing on both sides, minimum tree cutting, minimum acquisition of land and property and safety of community from the traffic. They also suggested that there should be a minimum disturbance to the public due to construction, dust and noise. People have no opposition for link road between SH-09 and SH-137. Most of the suggestions of the public have been incorporated in project design and environmental management plan. Further, the locals inquired about compensation and most of the queries related to compensation were replied by the social expert. The details related to these have been covered in Resettlement Action plan report.

ANALYSIS OF ALTERNATIVES

The analysis of alternatives for both the project roads was carried out for “With Project Scenario” and “Without Project Scenario”. It is found that ‘Project Scenario’ with minor adverse impacts is an acceptable scenario. The minor adverse impacts in ‘Project scenario’ will be within acceptable range with Environmental Management Plan implementation.

On Madapattu- Thirukovilur road a 5.000km long new alignment for linking SH09 with SH137 is part of the proposed improvement. The area of proposed link road was studied extensively and four alternative alignments were considered for the finalization of this link road, out of which 'Option 4' was found as most suitable option for proposed link road due to less damage to irrigation wells, deviation from settlement areas, avoiding major CD Structures (by adjusting the alignment away from water bodies), minimum acquisition of agriculture land and minimum cutting of trees.

The project road widening schedule was finalised considering minimum acquisition of land and follows a TNRSP policy of maximum utilisation of existing RoW. The alignment of both the project roads has been adjusted to save the trees and road side water bodies.

POTENTIAL IMPACTS

The major impact associated with Design or Pre – construction phase are loss of land, properties and livelihood due to the acquisition of properties. The widening schedule of both roads has been finalised to minimize the acquisition of structures, dislocation and resettlement of people, cutting of trees and impact on water bodies. In most portions of project roads concentric widening is adopted to make maximum use of available RoW. The affected people will be adequately compensated as per Resettlement and Rehabilitation Action Plan.

Loss of topsoil is likely to occur because of excavation activities for bed preparation as well at borrow area if proper care is not taken.

Impact during Construction Phase

The impacts on topography during the construction phase will be at locations of minor bridges, new culverts and at locations of raising. The impacts on topography will also be visible at locations of intersections as these are planned to be improved. There is a proposal for 21 new culverts on the Madapattu - Thirukovilur road and 64 new culverts in Vridhachalam-Bhuvanagiri road. The intersections planned for improvement are 2 in Madapattu-Thirukovilur road and 03 in Vridhachalam- Bhuvanagiri road.

Low level of impacts is anticipated on geology because of removal of stone aggregates (202701 m^3 for Madapattu- Thirukovilur road and 311532 m^3 for Vridhachalam Bhuvanagiri road) and sand (7133 m^3 for Madapattu- Thirukovilur road and 20785 for Vridhachalam-Bhuvanagiri road) from identified and licensed quarries.

The impacts on climate have been identified as low, spatially restricted and of short term duration. Significant amount of dust is generated due to site clearance and excavation activities, stone crushing process, transportation of earth materials and dumping of extra fills and the spoils which have the potential of deterioration of air quality during the process. Gaseous and particulate matter emissions will also take place due to operation of hot mix plant for pre mix preparation. Bitumen production also releases volatile toxic gases through the heating process. These are likely to deteriorate the air quality in general and also cause occupational exposure in particular. These problems related to the deterioration of air quality, however, will be temporal in nature till the construction phase only. Further, the activities will not be confined to any one place rather, it will progressively move along the RoW, so prolonged deterioration in air quality will not occur at any one site.

Slight increase in ambient noise levels is anticipated during the construction period due to operations of plants and equipment as well as movement of construction vehicles however the rise may not be continuous. Proper scheduling of works and sitting of noise generating equipment away from settled areas can be effective in managing noise due to construction activities.

Minor bridges and culvert construction works may result into generation of some quantity of debris materials due to excavation and drilling works. These wastes may cause a temporary increase in turbidity and thereby contaminating the water, but such situation may occur only for short duration. Moreover, surface water may get contaminated due to stacking of construction materials near or disposal of construction waste near water bodies. However, these problems associated with foundation works can be managed through the proposed mitigation measures.

The impact on ground water sources due to widening of project roads include Hand Pumps (24), irrigation tank (1), Public taps (47) and water tanks (2) on Madapattu- Thirukovilur road and Hand pumps (7), Overhead Tank (2) on Vridhachalam- Bhuvanagiri road. The ground water resources, shall also be impacted if construction water is taken from the local water supply source. The widening of project roads shall also result in increased paved surface and this will reduce ground water recharge potential in the immediate surroundings.

Dust and gaseous emissions from different construction activities may lead to deterioration of health of workers as well as of the people living in close proximity of construction or plant sites. Although the emission effect is only for short term, till the construction work is over, but the effect may be significant from the point of view that the workers are directly exposed to these emissions. The construction workers migration to the project roads and surroundings may lead to sanitation problems creating congenial conditions for disease vectors. The public residing along the project road will also be exposed to accident risks due to construction activities if adequate safety measures are not adopted.

It has been estimated that about 2,267 numbers of trees on Madapattu- Thirukovilur and about 5,011 on Vridhachalam-Bhuvanagiri road will need to be felled for the widening and improvements. There will be removal of vegetation also during the site clearance. There is no requirement of cutting of any endangered species of flora on both the project roads.

There is an insignificant faunal population located in the project influence area of both the roads, thus no impact of fauna is envisaged. The fauna in the study area of both the roads are domesticated.

The impacts on the socio-economic environment include displacement of people, demolition of structures, and loss of land under agriculture and Influx of construction workers. The other impacts identified are employment and business opportunities to the local public. There is no impact on archeological monuments or archaeologically protected buildings as none of these exist within project influence area.

Impact during Operation Phase

The operation phase impacts include increased traffic and increased vehicular emissions and noise levels due to vehicular movement. The increased vehicular noise will have an adverse impact on noise sensitive receptors (educational institutes and health facilities) along the RoW. The increased air pollution will have a deleterious impact on the health of the road side population. Air quality predictions through mathematical modelling have been carried out using the CALINE-3 model and predicted air quality levels have been found to be well within the stipulated air quality standards till the project life. Noise level predictions have also been carried out using the FHWA model and it has been found that predicted noise levels are exceeding the stipulated limits at noise sensitive receptors since beginning. Due to increased traffic and better quality of the road there will be an increase in vehicular accidents if proper safety features are not planned as part of the design.

Avenue plantation in available clear space in RoW and landscaping at intersections and at identified locations shall enhance not only the overall aesthetics along the roads but will also improve the environmental condition of adjacent areas. The project plans to beautify 3 roadside ponds on Madapattu- Thirukovilur road and 5 roadside ponds on Vridhachalam- Parangipettai road with an aim of better and effective utilization of these ponds by the community. This will help in better acceptability of the project with the community.

AVOIDANCE, MITIGATION & ENHANCEMENTS

Prevention or avoidance of impact is better than mitigation of impact. Hence avoidance and reduction of adverse impact 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, as presented in **Table 2** below. The roadside ponds will be beautified for effective use by the community.

Table 2: Environmental Features saved through Avoidance Measure at Design Stage

Environmental Features	Potential Impact		Under Direct Impact		Saved through Widening Schedule	
	1*	2*	1*	2*	1	2
Trees (nos.)	2427	5121	2267	**5011**	**160**	**110**
Surface Water source	5	6	3	**3**	**2**	**3**
Ground Water source	35	17	23	**17**	**12**	**0**
Schools and Hospitals	3	11	3	**5**	**0**	**6**
Sensitive Community Properties	27	39	18	**34**	**9**	**5**
Bus Shelters	19	34	18	**34**	**1**	**0**

*1**-** Madapattu- Thirukovilur Road, 2**-** Vridhachalam –Bhuvanagiri Road

For each identified impact mitigation measures have been formulated and the cost of these has also been estimated. The details of all mitigations have been provided in standalone EMPs prepared for each corridor.

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Environmental Management Action Plan (EMAP) has been prepared for each corridor separately. It deals with the implementation procedure of the guidelines and measures recommended to avoid, minimize and mitigate adverse environmental impacts of the project. It also includes management of measures suggested for enhancement of the environmental quality along the highways. The above is part of stand alone EMPs.

The institutional arrangement made under the project will look into the implementation of projects as well as EMAP and the various legal settings applicable to the project are briefly stated in chapter 3. Socio-economic environmental elements have been separately dealt in a separate volume, namely, Resettlement and Rehabilitation Action Plan (RAP).

A standalone EMAP has been prepared for each corridor.

COST ESTIMATES FOR ENVIRONMENTAL MANAGEMENT

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

Provisional quantities have also been included for additional measures that may be identified during construction and for silt fencing which will depend on the Contractors work methods and site locations. Items and quantities have also been included in enhancement measures.

More general environmental management measures to be followed by the contractor have been included in the specifications and this EMAP. The EMP budget for Madapattu-Thirukovilur road and the Vridhachalm Bhuvanagiri road has been estimated at INR 39.15 millions and INR 85.95 millions respectively.

PROJECT IMPLEMENTATION ARRANGEMENT

The project will be implemented by the TNRSP through its Divisional Office. There will be one Construction Supervision Consultant (CSC) having a multidisciplinary team including an environmental specialist. The contractor will also appoint one Safety cum environmental expert. At site, environment related mitigations will be implemented by safety and environmental expert of the contractor under the supervision of Environmental Specialist of CSC. Detailed implementation arrangement of the project has been discussed in section 4.1 of the EMP.

CHAPTER 1 : INTRODUCTION

1.1 BACKGROUND

Road transport plays an important role both from the point of view of enhancing employment potential and all-round economic development of a State. Besides providing safe and efficient transport system, construction of a well-planned road can open up the entire area through which it passes, to myriad development opportunities. Tamil Nadu is a fast developing state with large coastal length. In order to utilize the full potential of the state for economic development a good road network is a primary requirement. The Government of Tamil Nadu has taken up road sector development with the financial assistance of the World Bank. The project has been named as TNRSP II. The first phase of the project (TNRSP I) has already been implemented. In TNRSP II, about 1800 km of road length is being taken up for upgradation and strengthening. The project works have been divided into five packages with about 400 km road length each. The project environmental assessment is being taken up to meet World Bank safeguard requirements and to meet country environmental framework requirements. The work of DPR preparation for package -2 has been entrusted to M/s Sheladia Associates Inc., USA. The Tamil Nadu Highway Department is the Executing Agency and TNRSP PIU at local level is the Implementing Agency (IA). The Environmental Assessment is being taken up as per the Terms of Reference (ToR) of the consultants, The ToR specifies environmental assessment to be taken up in two stages namely Environmental Screening and Scoping and Environmental Impact Assessment. In Package-02 of TNRSP II, two roads as mentioned below will be taken up for implementation as Phase I Roads.

(a) Vridhachalam (km 0+000) - Bhuvanagiri road (km 35+800) part of SH-70 and

(b) Madapattu (km 41+700) to km 66+190 plus link road between SH-09 and SH-137 (link road chainages km 66+190 to km 71+147). The link road starts at km 66+260 of SH-09 and ends at km 124+460 of SH-137. The entire improved road will be part of SH-09.

This report covers Environmental Impact Assessment of both the above road corridors.

1.2 THE PROJECT

The project roads Madapattu to Thirukovilur and Vridhachalam to Bhuvanagiri are part of State Highway-09 (SH-09) and State Highway-70 (SH-70) respectively. Both the roads at present are of two lane configuration and in good motorable condition. However, they suffer from geometric deficiencies at few locations. In addition, Madapattu- Thirukovilur road passes through the congested settlements of Pennavallam, Thirukovilur and Sarvanapakkam where as Vridhachalam- Bhuvanagiri road passes through the congested settlements of Bhuvanagiri, and Kammapuram. The proposed link road between SH-09 and SH-137 is a new alignment. No bypass has been proposed as part of widening and improvement of the project roads.

1.2.1 Project Description

Location of project road

The project roads Madapattu- Thirukovilur and Vridhachalam- Bhuvanagiri are located in Villupuram district and the Cuddalore district of Tamil Nadu respectively. The locations of both the project roads are shown in **Figures 1.1 (a)** and **Figure 1.1 (b)**. The latitude and longitude of the start point and end points of the road corridors are as follows:

(a) Corridor No.1 (Madapattu- Thirukovilur Road)

- Start Point - Latitude 11°47' 49.00“N and Longitude 79°24'17.18" E
- Endpoint (km 124+460 of SH-137) - Latitude 11°55'44.44"”N, and longitude 79°11’28.90"E respectively.

Figure 1.1 (a): Key Map Showing Madapattu- Thirukovilur Road

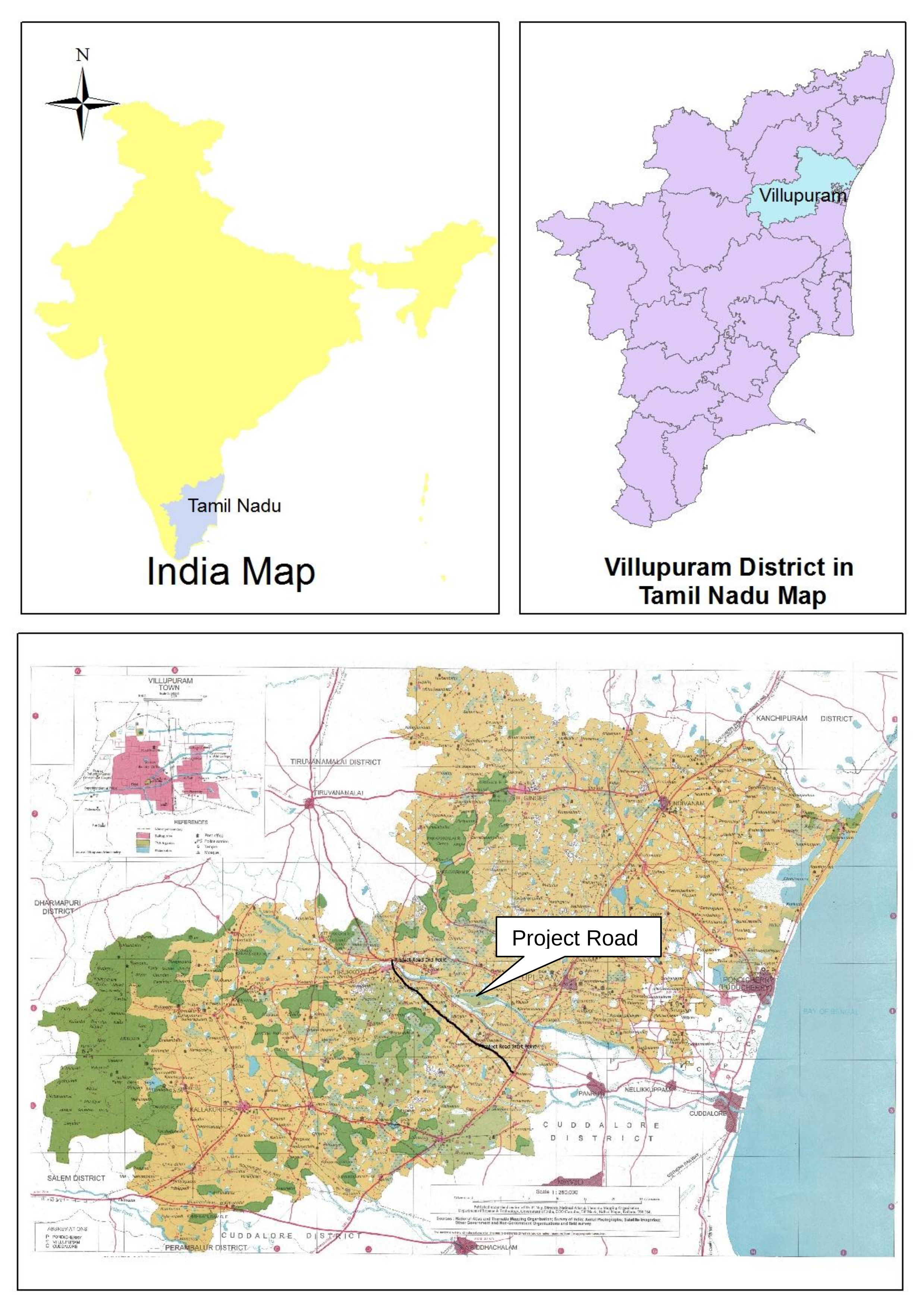
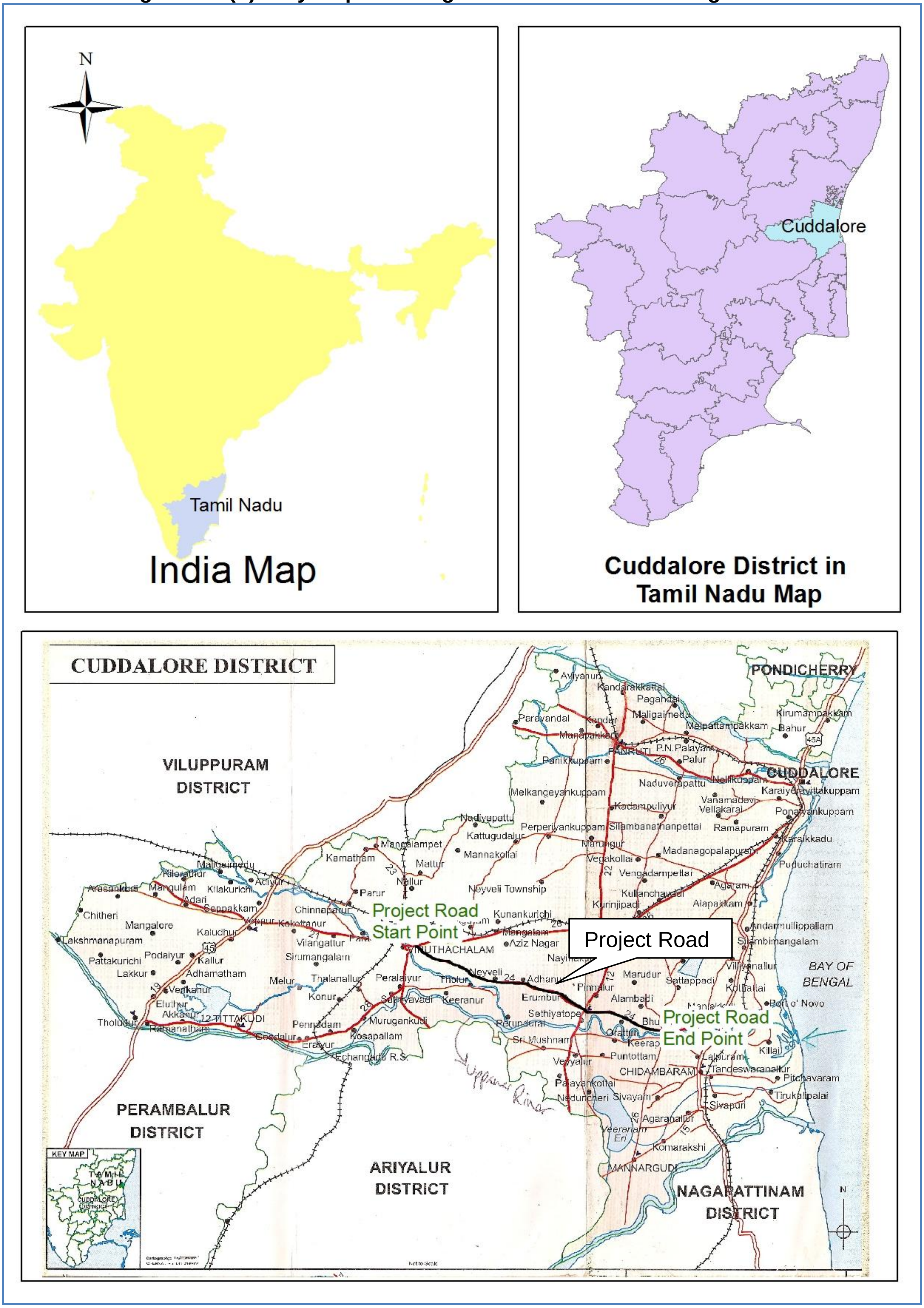


Figure 1.1 (b): Key Map Showing Vridhachalam- Bhuvanagiri Road



(b) Corridor No.5 (Vridhachalam- Bhuvanagiri Road)

- Start Point - Latitude 11° 30' 57.34“N and Longitude-79° 19' 52.21" E.
- End Point - Latitude 11°36’28”N, and Longitude 79°38’22”E

Right-of-Way Details

The consultants have collected existing Right-of-Way (RoW) information from the Highway Department. The existing RoW varies from 12-31 m for Madapattu- Thirukovilur road and 10-35 m for Vridhachalam- Bhuvanagiri road. The details of RoW at various locations of project roads have been given in subsequent chapters.

Details of Common Property Resources

Common property resources such as ponds, hand pumps, wells, schools, places of worship, etc. exist within and adjacent to RoW. Information on these has been collected for both the project roads and details are covered in subsequent chapters.

1.2.2 Objective of the Assignment

In order to accelerate economic growth to match with the country's growth, a modest design speed for the safe and efficient movement of people and goods is seen as the objective. The project will aim to provide congestion free, safe and smooth road to the population residing along both the project roads and other users travelling through these roads. The other objective of widening and strengthening of both the roads is for achieving sustainable development of the region, state and ultimately of the country.

1.2.3 Scope of Environmental Assessment (EA)

a. Objectives and Need of Environmental (EA) Assessment

The objective of the Environmental Assessment is the characterization of the existing status of the environment, to identify the probable adverse and positive impacts on the environment and the community due to the planned project and to delineate various measures to mitigate the adverse impacts and finally to assess the acceptability of overall residual impacts. The EA provides tools for decision-making as well as it also helps in ensuring the sustainable development with the least environmental damage by providing an agreed Environmental Management Plan. In order to achieve these objectives, detailed surveys and other studies have been carried out along the project roads to identify Valued Ecosystem Components (VEC) and corridor specific Significant Environmental Issues.

b. Scope of Environmental Assessment (EA)

The scope of the Environmental Assessment is the Terms of Reference (ToR) provided by TNRSP and past experience of the consultants on similar projects. The scope has been kept so as to meet the host country‘s statutory requirements and the World Bank safeguard policy requirements.

c. Environmental Screening and Scoping

The environmental screening exercise of both the project roads was undertaken to facilitate inputs on environmental considerations, apart from social, economic, and traffic & transport considerations. Further, the screening helped in determining the major environmental issues and the scope of work for conducting environmental assessment. As per the recommendations of the Environmental Screening report, detailed Environmental Assessment has been taken up. The scoping exercise defines geographical boundaries for the project road for impact assessment as well as defining each project influence area to assess the impacts due to project interventions during construction and operation phases.

d. Environmental Assessment

The EA for the selected project road for Phase I implementation includes establishing an environmental baseline in the study area, 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 (EMP) with necessary budget and institutional roles for its effective implementation. The EMP for project road will be included in project implementation agreements, including construction contract agreement. Basic approach & methodology for conducting an Environmental Assessment and the steps followed, source of secondary data, primary data generated during the EIA study, etc has been presented in **Annexure 1.1**.

e. Environmental Management Framework

The environmental management framework approved during Phase I of the project (TNRSP I) will be adopted in the current project also.

1.2.4 Project Benefits

Implementation of the project will have the following direct benefits:

- Improved quality of life for the population in the project influence area of both the corridors. Economic boost to the local population by facilitating easy transportation of materials and having better connectivity for the commercial and industrial centers;
- Employment opportunities to the locals during construction;
- Business opportunities to the local establishments during the construction phase
- Reduced travel time due to improved conditions of roads, smooth traffic flow by removing all bottlenecks at various locations and junctions, improved road geometry, etc.;
- Improved connectivity between commercial centers;
- Decrease in the environmental pollution by vehicle due to improvement in road surface and width;
- Reduced maintenance costs and savings in vehicle operating costs; and
- Increase the carrying capacity of the existing traffic volume and enable it to cater to the future traffic.

1.2.5 Structure of the Report

Environmental Assessment is conducted as per the Environmental Impact Assessment Notification of MoEFCC dated 14th September 2006 & its subsequent amendments. Apart from this, World Bank technical paper number 376: Roads and the Environment: A handbook is also referred in the preparation of this EA. Structure of EA volume is according to World Bank requirements and Terms of Reference (ToR). The structure has been described below.

Executive Summary: The Executive Summary covers the findings of EA for both the corridors and provides EMP budgets, project cost and requirements of clearances and permissions for the project implementation.

Chapter 1: Introduction - This chapter covers introduction to the project, location of project roads, environmental assessment process and coverage of the EIA report.

Chapter 2: Description of the Project - In this chapter a brief description of the project road covering various proposed improvements, costs and other considerations have been given.

Chapter 3: Environment Regulatory Framework - This chapter presents the statutory and administrative framework of the World Bank, Government of India and Environmental Legislation framework of Tamil Nadu State. This chapter also highlights the various environmental & other statutory clearances required for the project road during pre construction, construction and operational phases.

Chapter 4: Baseline Environment - This chapter presents an overview of various aspects of project area such as land, water, air, noise, biological and socio-economic environment. The major heading of the statement of baseline conditions and the section that follows have been devised on the basis of the Ministry of Environment, Forests and Climate Change's (MoEFCC's) suggested outline and review procedures and supplemented to address World Bank concerns in specific sections.

Chapter 5: Stakeholders Consultations – This chapter covers a description of consultation activities in the preparation of the EA including coordination with government agencies, actions undertaken to obtain the views of local non-government organization, affected groups and other relevant stakeholders. The chapter also covers how the project design takes care of suggestions of stakeholders in project development.

Chapter 6: Analysis of Alternatives – This chapter covers comparative description of various alignments, design and technical alternatives considered in the evolution of the project.

Chapter 7: Project Impacts and Issues – This chapter covers an examination and assessment of potential impacts related to various activities during various stages of project implementation (pre-construction, construction and operation phases).

Chapter 8: Impact Mitigation and Enhancement – This chapter covers mitigation measures for the identified adverse impacts. The chapter also covers budget estimation for the implementation of mitigation measures.

CHAPTER 2 : DESCRIPTION OF THE PROJECT

2.1 GENERAL

The Madapattu- Thirukovilur (including connecting link between SH-09 and SH-137) is located in Villupuram district of Tamil Nadu, whereas Vridhachalam- Bhuvanagiri road is located in the Cuddalore district of Tamil Nadu. The Madapattu- Thirukovilur road is part of existing Cuddalore- Chittoor Road (SH-9) covering a length of 24.600 km and 5.000 km of road linking SH-9 and SH-137.

The main project activities encompass widening, resurfacing, restoration, and rehabilitation of both the project roads. The improvement of the project roads will take into consideration aspects like lane configuration, widening schemes, speed, embankment height and the urban or rural setting along the roads. The project is linear in nature and road length to be taken up for improvement is 29.600 km in case of Madapattu- Thirukovilur road and 35.800 km in case of Vridhachalam- Bhuvanagiri road.

2.2 PRESENT CHARACTERISTICS

Both the roads selected for Phase I implementation traverses in plain terrain passing through rural areas as well as few intermittent semi-urban and urban settlements. In rural areas the land use on both sides is agricultural land/open spaces interspersed with small structures. The abutting land use in the built-up areas is predominantly residential and commercial. Few Educational institutions and worship places exist along the roads in some of the villages and town sections. It is observed that the vertical alignment of the road is quite flat except at few culvert locations.

Traffic signs are missing at many locations on both the project roads. No warning signs exist before the approach of the junction and approach of curves. Directional signs exist at few locations.

2.2.1 Right of Way (RoW)

There was a substantial difference in the data/information collected from site and from the Highway Department. During discussion with the officials, It came to light that the reference pillars at the site are being moved by the land owners. It can be noticed from **Table 2.1** that the existing right of way of the Madapattu - Thirukovilur road varies between 12 to 31 m at various locations. Similarly, **Table 2.2** reveals that the existing RoW for Vridhachalam- Bhuvanagiri road varies from 10 to 35 m.

Table 2.1: Existing Right of Way Details for Madapattu- Thirukovilur Road

Sl.No	Chainage(km)		ROW (m)
	From	To	
1	0+000	9+200	20.00
2	9+200	20+000	20.00
3	20+000	24+900	25.75
4	24+900	32+000	31.00
5	32+000	38+200	28.67
6	38+200	52+000	25.00
7	52+000	66+300	12.00

Source: Highways Department, Govt. of Tamilnadu

Table 2.2: Existing Right of Way Details for Vridhachalam- Bhuvanagiri Road

S.No	Indicative Location		Chainage		ROW (m)
	Cuddalore District	Village / Hamlet	From	To	
1	Vridhachalam (Virudhachalam) Taluk	Virudhachalam	0+000	1+800	30.0
2		Mavidandal	1+800	2+000	30.0
3			2+000	3+000	32.0
4			3+000	4+600	33.0
5		Ko.Adhanur	4+600	6+000	33.0
6		Kumaramangalam	6+000	6+600	33.0
7			6+600	6+800	30.0
8		Kumaramangalam	6+800	7+000	28.0
9			7+000	7+800	27.0
10		Gopalapuram	7+800	9+000	27.0
11		Keeranur	9+000	9+200	26.0
12			9+200	9+600	25.0
13			9+600	9+800	24.0
14			9+800	10+400	25.0
15		Kammapuram	10+400	12+200	25.0
16			12+200	14+000	20.0
17		Siruvarappur	14+000	14+600	20.0
18		Sattapadi	14+600	15+000	18.0
19			15+000	15+600	15.0
20		U.Adhanur	15+600	15+800	15.0
21			15+800	18+000	12.0
22	Chidambaram Taluk	Valayamadevi	18+000	19+000	12.0
23			19+000	20+000	10.0
24		Ammankuppam	20+000	21+000	10.0
25		Erumbur	21+000	21+400	12.0
26			21+400	21+600	13.0
27			21+600	22+000	14.0
28			22+000	23+000	15.0
29			23+000	23+800	12.0
30			23+800	24+000	13.0
31			24+000	24+200	14.0
32			24+200	24+400	15.0
33			24+400	24+800	14.0
34		Sethiathoppu	24+800	25+200	15.0
35			25+200	25+290	20.0
36			25+290	25+350	35.0
37			25+350	25+380	17.0
38			25+380	25+400	14.0
39			25+400	26+000	22.0
40			26+000	27+000	21.0
41		Miralur	27+000	28+000	21.0

S.No	Indicative Location		Chainage		ROW (m)
	Cuddalore District	Village / Hamlet	From	To	
42		Manjakkollai	28+000	30+000	22.0
43		Siyappadi			
44		Kilavadinatham	30+000	33+000	21.0
45		B.Udaiyur			
46		Vandarayampattu			
47		B.Adhivaraganallur	33+000	33+200	21.0
48			33+200	34+000	23.0
49		Perumathur	34+000	35+600	20.0
50		Bhuvanagiri	35+600	35+800	14.0

Source: Highways Department, Govt. of Tamilnadu

The existing carriageway of both the project roads is two lanes with paved shoulders. The Madapattu-Thirukovilur road has a flexible pavement with 7 m carriageway width between existing chainage km 41+890 to km 66+131. In case of the Vridhachalam-Bhuvanagiri road carriageway width is 7m with 0.50 m earthen shoulders on both sides. The cross drainage structure details for both the roads are given below:

(a) Madapattu- Thirukovilur Road

There are no major bridges; rail over-bridges (ROB)/ rail under-bridges (RUB) and grade separator on the project road. There is only one minor bridge at chainage km 47+369 with a single span length of 7.4 m. The project road has 36 culverts which include 2 numbers of cut stone and slab type culverts, 14 numbers of pipe culverts and 20 numbers of RCC slab type culverts.

(b) Vridhachalam- Bhuvanagiri Road

The project road has 4 minor bridges and 52 (2 cut stone and slab culverts, 24 RCC slab culverts and 26 pipe culverts) culverts that are planned for widening (between km 0+000 to 35+800).

2.2.2 Traffic Scenario

The Consultants conducted 7-day 24-hour directional classified Traffic Volume Count (TVC) at three different locations on Madapattu- Thirukovilur road and 2 locations on Vridhachalam-Bhuvanagiri road. The average daily traffic volumes are given below in **Tables 2.3 and 2.4**.

Table 2.3: Traffic Volume Count in Madapattu-Thirukovilur Road (SH- 09)

Sl.N	Section	Location Chainage (km)	ADT		
			Vehicles	PCU's	Commercial Vehicles
1	Cuddalore - Panrutti	13+400	14,819	15,355	1,762
2	Panrutti - Madapattu	36+000	9,873	11,814	2,756
3	Madapattu-Thirukkovilur	55+500	4,631	4,223	504

Source: Traffic volume Survey by the Consultants

Table 2.4: Traffic Volume Count in Vridhachalam – Bhuvanagiri Road (SH 70)

S.No.	Section	Location Chainage (km)	ADT		
			Vehicles	PCU's	Commercial Vehicles
1	Vridhachalam - Sethiathoppu	7.400	3,693	3,655	579

2	Sethiathoppu - Bhuvanagiri	32.300	3,749	3,703	438

Source: Traffic volume Survey by the Consultants

2.2.3 Road Width

The existing carriageway of the Madapattu- Thirukovilur road is Two Lane (7.0 m wide). The type of the existing pavement is flexible while carriageway of the Virudhachalam -Bhuvanagiri road is Two Lane/Two Lane with Paved Shoulder. The type of the existing pavement is flexible. The width of bituminous paved surface (carriageway with/without pave shoulder) is given **Table 2.5** below.

Table 2.5: Chainage wise Length Distribution of Road Width

Sl. No.	Existing Chainage (km)		Width of Carriageway with/without Paved Shoulder Width (m)
	From	To	
1	0+000	6+100	7
2	6+100	8+700	9
3	8+700	13+600	7
4	13+600	13+900	9
5	13+900	35+888	7

2.2.4 Villages and Urban-Built Up Sections

The Madapattu- Thirukovilur road is well connected to important places and economic centers of the State, namely Madapattu, Irundhai, Arumpattu, Madhampattu, Gopalapuram, Saravanapakkam, Pennaivalam, Ammavasappayam, T. Kunnathur, Edapalayam, Mudhalur and Thirukovilur. The Virudhachalam -Bhuvanagiri road covering a length of 35.800 km is part SH-70. This road project is well connected to important places and economic centers of the State, namely Virudhachalam, Gopalapuram, Kammapuram, Erumbur and Bhuvanagiri. The chainage of these villages and urban-built up sections are given in **Tables 2.1** and **2.2** while views at the start and end points of the project roads are given below in **Figures 2.1** and **2.2** for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road respectively.

Figure 2.1: Photographs of Project Start and End Point of Madapattu - Thirukovilur road

Start Point at 41+700 near Madapattu **End Point (Proposed Jn. of SH-9 with SH-137)**

Figure 2.2: Photographs of Start and End Point of Vridhachalam- Bhuvanagiri Road

End Point at Ch. 35+800

Start Point at 0+000

2.3 PROPOSED IMPROVEMENT

2.3.1 Definition of Terms Used in the Project

Project Influence Area (PIA): Fifteen km on either side (30 km corridor) in the plane area according to guideline of MoEFCC (Chapter 3). Since the GoI has only one definition for all landform throughout India, the same terminology is being used in all cases without any discrimination[1]. In reality the PIA should have been the ridge line (water divide) to ridge line on both sides. This distance is generally within five kms from the center line of the project road. However, for some parameters this is not sufficient and hence much bigger areas such as district (transport accessibility by air, road or rail) in certain cases and the state (population, literacy etc.) as a whole in certain other cases were considered.

Project influenced district: In general, it is the district through which the road passes. In the current case project influenced district is Villupuram for Madapattu- Thirukovilur road and Cuddalore district for Vridhachalam- Bhuvanagiri road.

Direct Influence Area: The direct project influence area has been considered the Right of Way (RoW) of respective project roads plus 500m corridor on either side of the road. The existing RoW in the project section is varying from 12 to 31 m in Madapattu- Thirukovilur road and 10 to 31 m in Vridhachalam- Bhuvanagiri road. In the direct project influence area, prominent land use is agricultural land/open spaces interspersed with small thatched roof/semi-permanent structures.

Environmental Impact Assessment (EIA): For convenience and clear understanding, in this project the relationship of EMP to EIA is taken as EIA=EA+EMP. In this case, both EA and EMP are two separately bound volumes.

Right of Way (RoW): It is the actual government land area legally available to state government i.e. Highway Department. Information about existing right of way has been provided in section 2.2.

[1] EIA Guidance Manual- Highway, Ministry of Environment, Forest and Climate Change, Government of India

Realignment: It is referred to increase in the horizontal curve radius, but may be generally applied to any change in the vertical or horizontal alignment of a road. No realignment is proposed in 2 nos. Madapattu- Thirukovilur road while 4 nos. Realignments are proposed in Vridhachalam- Bhuvanagiri road.

Private tree: These are trees situated in the private property within the proposed RoW, which will have to be compensated for in monetary terms according to the RAP. This is also to be compensated in the tree planting scheme of the project.

Public tree and avenue trees: Public trees are those that are located within the available RoW of Highway Department land.

Impact corridor (IC): The environmental strip plan has considered approximately 22.5m on either side of road centerline in the area where four lane has been considered while 11.5 m on either side from road centerline where two lane with paved shoulder has been proposed. In Madapattu- Thirukovilur no portion of project road is proposed to be widened to 4 lanes. In Vridhachalam- Bhuvanagiri road portion from km 0.000 to km 2.000 in Vridhachalam town is proposed to be widened to 4 lanes.

Bypasses: A bypass is the term usually applied to a road, which provides an alternate route around a congested area. This normally helps to divert through traffic away from using the urban center. There is no bypass planned in either of the project roads. But a link road of 5.0 km length is planned to connect SH-09 and SH-137 in Madapattu- Thirukovilur road.

2.3.2 Proposed CW Configuration and Cross Sections

Depending on the present condition of the selected roads, different levels of improvement/ up gradation measures will be required for different road stretches. The improvement works mainly consist of:

- Rehabilitation and upgrading to 2 lane with paved shoulders configuration and in some stretches 4 laning of the road.
- Upgrading/improving road geometrics
- Pavement design and strengthening shall be carried out in accordance with Section 5 of the Manual. On the existing carriage way portion, the pavement shall be designed as per IRC-37-2012 considering scarification of existing bituminous surfacing and starting pavement from GSB course.
- The road stretches crossing urban areas may also require alternative new alignments or realignments or provision for drains, sidewalks, bus bays and parking along existing road.
- Improving cross drainage structure and construction of a new CD structure where they are required.
- Improvement of the longitudinal drainage system, including surface and subsurface drains for the Project Highway shall be provided as per Section 6 of the Manual.

Replacement of culverts and construction of new culverts

The replacement/rehabilitation of culverts will accommodate two full lanes for the full formation width. Out of 36 culverts on the Madapattu - Thirukovilur road 5 Hume pipe, 1 RCC slab type and 2 CS slab type culvert will be upgraded to box size culverts. Apart from this, all existing culverts which are not to be reconstructed shall be widened to the roadway width of the Project Highway as per the typical cross section given in section 7 of the Manual. Repairs and strengthening of existing structures where required shall be carried out in19 RCC box type culverts.

On the Vridhachalam - Bhuvanagiri road there is retaining & widening of one existing cross drainage structure, reconstruction of 53 cross drainage structures which includes cut stone & slab culverts, RCC slab culverts, pipe culverts, minor bridge and construction of 92 new culverts.

The general repairs and rehabilitation works of culverts besides general cleaning will also include restoration of slopes and protective works, repair and replacement of drainage spouts where required, construction/repair of damaged parapets and repair and rehabilitation of damaged concrete/masonry of any component, etc. All the repair and rehabilitation works shall be carried out as per the Manual and Specifications.

Proposed Right of Way

Proposed RoW for various sections of the Madapattu- Thirukovilur road has been provided in **Table 2.6** and for Vridhachalam- Bhuvanagiri road RoW has been given in **Table 2.7**.

Table 2.6: Proposed Right of Way of Madapattu- Thirukovilur Road

S N	Design Chainage		Length (m)	RoW (m)
	From	To		
1	48+000	48+800	800	16
2.	41+700	48+000	6300	23.0
3.	48+800	49+150	350	23.0
4.	50+000	66+066	16066	23.0
5.	49+150	50+000	850	28.7

Table 2.7: Proposed Right of Way of Vridhachalam- Bhuvanagiri Road

S N	Design Chainage		Length (m)	RoW (m)
	From	To		
1	0+000	2+000	2000	26.3
2.	2+000	12+000	12000	23
3.	12+000	12+850	850	16
4.	12+850	21+900	9050	23
5.	21+900	22+500	600	16
6.	22+500	25+100	2600	23
7.	25+100	25+600	500	16
8.	25+600	27+300	1700	23
9.	27+300	27+600	300	17.5
10.	27+600	33+300	5700	17.5
11.	33+300	24+800	1500	23
12.	34+800	35+800	1000	16

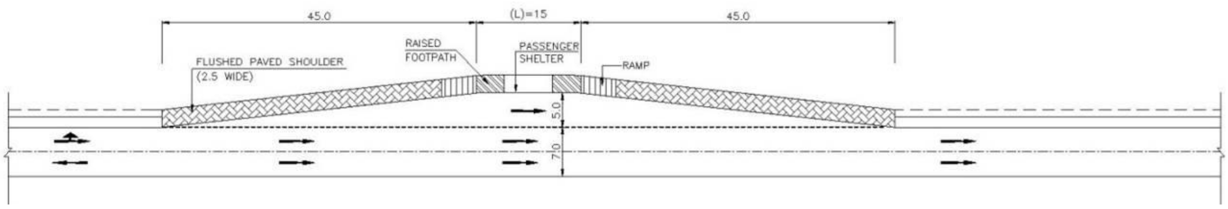
Embankment Height

- As per IRC the Embankment Height shall be 1.0m from HFL to the Top of sub grade
- Keeping in view of local person's suggestion the Proposed FRL is kept as 1.0m from the top of existing FRL

Bus Bays

With various road improvement works, 20 numbers of new bus bays and passenger shelters have been proposed on the Madapattu- Thirukovilur road. These bus bays are located on the LHS and RHS along the project road at habitations/villages such as Madapattu, Kothanur, Periyasevalai, Pavandhur, Pennaivalam, Ammavasai palayam, T.Kunnattur, Edapalyam, Muthalur and Kolapakkam. On the Vridhachalam- Bhuvanagiri road 39 bus bays and bus shelters have been proposed. Typical layout of bus bay is presented in **Figure 2.2** while chainage wise locations of the bus bays have been presented in **Annexure 2.1**.

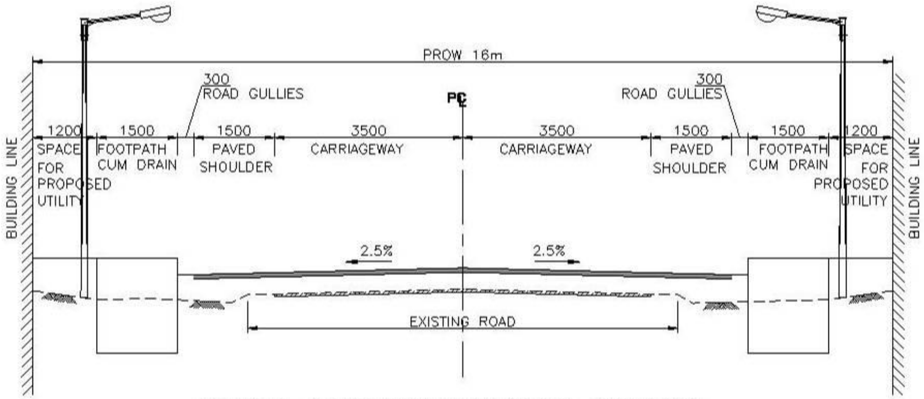
Figure 2.2: Typical Layout of Bus Bay



Design Cross Section

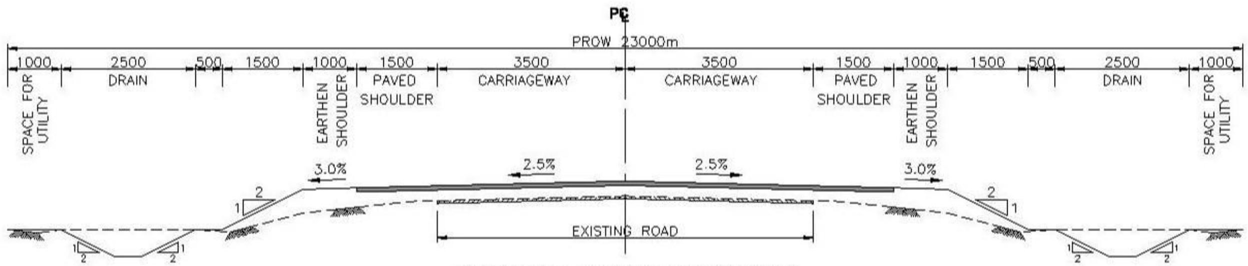
Widening is proposed on the side (LHS/RHS) mentioned above based on existing site conditions and technical requirements. Proposed options for widening have been shown in typical cross section drawings for built up section & rural locations in **Figure 2.3**. The road cross section at approach cross to junction with SH-69 is shown in **Figure 2.4** for Madapattu Thirukovilur road. The design cross sections for Vridhachalam-Bhuvanagiri road have been shown in **Figure 2.5** and **Figure 2.6** respectively, for 4 lane and 2 lane paved shoulders.

Figure 2.3: Typical Road Cross Section in Built up and Rural Section for Madapattu- Thirukovilur Road



TCS No.1 : 2-LANE BUILT-UP SECTION - 16m PROW

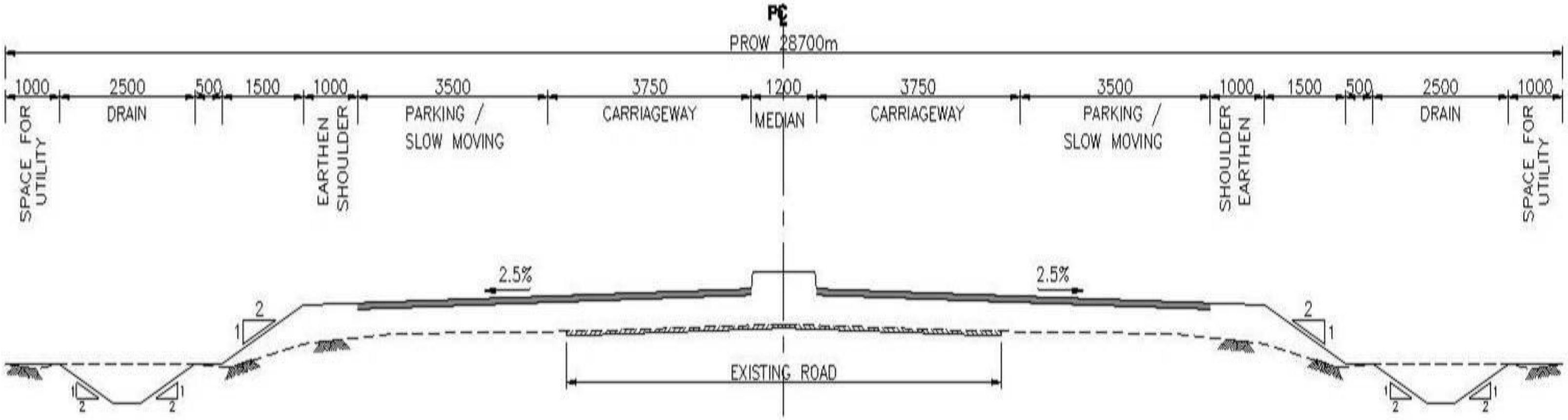
TCS No. 1				
S.No.	Design CH		Length (m)	Village/Town Name
	From	To		
1	48000	48800	800	KOTHNAPUR (BUILT UP)



TCS No.2 : 2-LANE RURAL SECTION

TCS No. 2			
S.No.	Design CH		Length (m)
	From	To	
1	41700	48000	6300
2	48800	49150	350
3	50000	66066	16066

Figure 2.4: Typical Road Cross Sctions at Approach Cross to Junction with SH-69 for Madapattu Thirukovilur Road

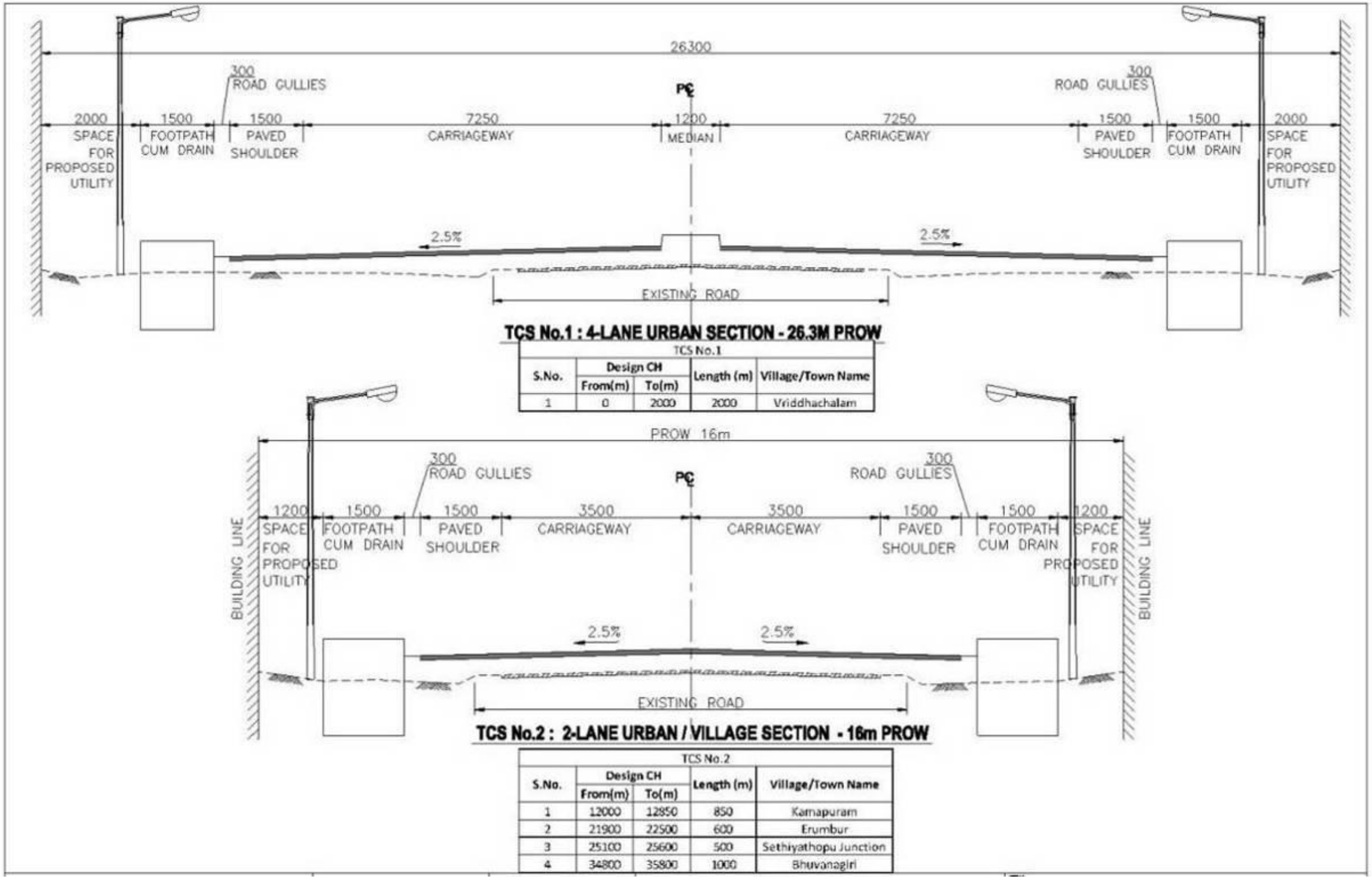


TCS No .3 CROSS SECTION AT THE APPROACH TO JUNCTION WITH SH-69

(This is to provide additional space for vehicles, queing up for sugar factory on SH-69)

TCS No. 3			
S.No.	Design CH		Length (m)
	From	To	
1	49150	50000	850

Figure 2.5: Typical Road Cross Section in Urban Area for Vridhachalam Bhuvanagiri Road



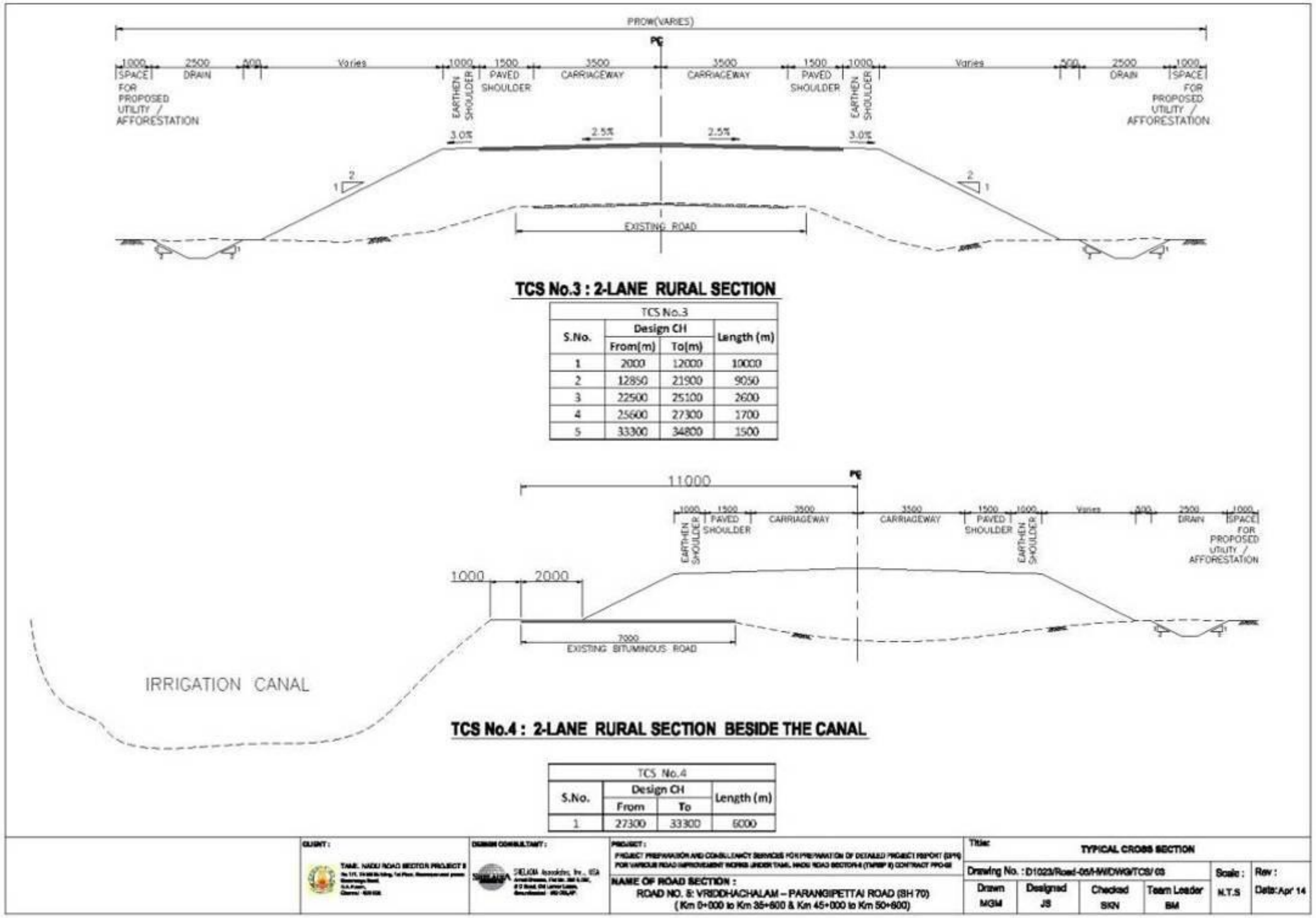
TCS No.1

S.No.	Design CH From(m)	Design CH To(m)	Length (m)	Village/Town Name
1	0	2000	2000	Vriddhachalam

TCS No.2

S.No.	Design CH From(m)	Design CH To(m)	Length (m)	Village/Town Name
1	12000	12850	850	Kamapuram
2	21900	22500	600	Erumbur
3	25100	25600	500	Sethiyathopu Junction
4	34800	35800	1000	Bhuvanagiri

Figure 2.6: Typical Road Cross Section in Rural Area for Vridhachalam- Bhuvanagiri Road



TCS No.3

S.No.	Design CH From(m)	Design CH To(m)	Length (m)
1	2000	12000	10000
2	12850	21900	9050
3	22500	25100	2600
4	25600	27300	1700
5	33300	34800	1500

TCS No.4

S.No.	Design CH From	Design CH To	Length (m)
1	27300	33300	6000

2.3.3 Identification of Realignment and Bypass Provision

There are 2 nos. of realignment locations on the Madapattu- Thirukovilur road. The details of these locations are shown in **Table 2.8**. The locations of realignment improvements planned on the Vridhachalam- Bhuvanagiri road are given in **Table 2.9**.

Table 2.8: Realignment Locations along Madapattu- Thirukovilur Road (SH-09)

S.No.	Design Chainage		Length (m)
	From	To	
1	48+951	49+141	190
2	64+537	64+719	182
Total			372

Table 2.9: Realignment Locations along Vridhachalam – Bhuvanagiri road (SH-70)

S.No.	Design Chainage		Length (m)
	From	To	
1	400	500	100
2	17950	18150	200
3	20650	21040	390
4	26730	26900	170
Total			860

2.4 CULVERTS AND BRIDGES

The Consultant has examined all existing bridges and cross-drainage structures on the project roads following the guidelines of IRC:SP:35-1990 “Guidelines for Inspection and Maintenance of Bridges” in order to determine their structural conditions, adequacy of waterway openings, load carrying capacity, anticipated future serviceability and the extent of repair/ strengthening and rehabilitation measures needed.

The necessity for the reconstruction of bridges and culverts was also examined for appropriate actions at the design stage. As far as possible, reconstruction of bridges is to be avoided. The distress of the bridges, if any, would first be identified by visual inspection and confirmed later on, as specified by the relevant IRC practice. The study to focus on factors, such as:

Geometrical aspects, including bridge widths and whether the existing structure can be economically incorporated into new road geometry;

- The capability of the bridge to meet the proposed design standards for traffic loading;
- Approach road conditions; and
- Waterway conditions.

Inventories were prepared to record the conditions of each major/minor bridge or cross-drainage structure falling within the identified section.

Madapattu- Thirukovilur Road (SH-09)

As per the inventory, there is 1 Minor Bridge and 34 Culverts (which include 12 Pipe and 22 Slab culverts) on the existing project road. There is a level crossing at km 44+520. Based on the inventory & condition survey of structures, latest circulars of MoRT&H & IRC circulars / codal provisions and keeping in view of the ToR, the following improvement proposals have been made:

Bridge at km 47+369 having a wall type abutment with simply supported slab resting on the tar paper bearing is retained with necessary repair and rehabilitation measures to the existing bridge portion.

The improvement proposals for 12 no's of existing pipe culverts are as follows:

- 4 no's of pipe culverts are proposed to retain with necessary repair and rehabilitation measures
- 1 no's of pipe culvert is proposed for widening to the required width as per road cross section
- 7 no's of pipe culverts are proposed for reconstruction to pipe culverts

The improvement proposals for 22 no's of existing slab culverts are as follows:

- 9 no's of slab culverts are proposed to retain with necessary repair and rehabilitation measures
- 2 no's of slab culverts are proposed for widening to the required width as per road cross section
- 11 no's of slab culverts are proposed for reconstruction to box culverts
- Additional 22 no's box culverts are proposed for improving the drainage system of the road.

Vridhachalam- Bhuvanagiri Road (SH-70)

As per the inventory, there are 4 Minor Bridges and 52 Culverts (which include 26 Pipe and 26 Slab culverts) on the existing project road.

Due to hydraulic deficiency, bridge at km 3+983 is proposed for reconstruction with Triple cell box type structure, bridge at km 24+920 is proposed for reconstruction with portal type structure. Bridge at km 25+149 having a wall type abutment and pier with simply supported slab resting on the tar paper bearing is retained and proposed for widening to 14.8m deck width with necessary repair and rehabilitation measures to the existing bridge portion. Bridge at km 26+700 having a wall type abutment with simply supported slab resting on the tar paper bearing is retained and proposed for necessary repair and rehabilitation measures as the deck width is 12.0 m and the additional width of widening of 0.45m required on either side is dispensed off.

Improvement proposals for 26 no's of existing pipe culverts are as follows:

- 3 no's of pipe culverts are proposed for widening to the required width as per road cross section.
- 2 no's of pipe culverts are proposed for reconstruction to pipe culverts.
- 21 no's of pipe culverts are proposed for reconstruction to box culverts

The improvement proposals for 26 no's of existing slab culverts are as follows:

- 3 no's of slab culverts are proposed to retain with necessary repair and rehabilitation measures,
- 2 no's of slab culverts are proposed for widening to the required width as per road cross section and
- 21 no's of slab culverts are proposed for reconstruction to box culverts.

Additional 64 no's box culverts are proposed for improving the drainage system of the road.

2.5 IDENTIFICATION OF BORROW AREAS

The Consultant has identified suitable quarry sites (sand and aggregates) and borrow areas along the project roads, collected samples, undertook field and laboratory tests of borrow materials and aggregates to determine their suitability for pavement and structural construction works, and also establish quality and quantity of various construction materials, and recommend their use for project execution. The borrow areas were selected outside the proposed right-of-way of the project roads. A Mass haulage diagram was prepared with quarry charts showing the locations of selected borrow areas, quarries and corresponding estimated quantities. The results of borrow earth, soil and aggregates were compiled following the formats given in IRC:SP:19-2001 "Manual for Survey, Investigation and Preparation of Road Projects (Second Revision)", with suitable modifications as per the site.

The Locations of borrow area for the project road has been shown in **Annexure 2.2**.

2.6 GEOTECHNICAL INVESTIGATIONS

For most of the structures it is the earth that provides the ultimate support. The behavior of the supporting ground must therefore affect stability of the structures and approach embankment /retaining structures. The supporting ground is invariably a soil (sound rocky stratum being very rare) which is weaker than most construction materials and hence a larger area or mass of the in-situ soil is necessarily involved in carrying the structural loads. Structural foundations should transmit the structural loads to the earth in such a manner that the supporting soil is not overstressed and does not undergo deformations that would cause unacceptable settlement of the structure. Hence the engineering characteristics of the supporting soil must be evaluated which affects vitally the choice of the type of structural foundations suitable for a structure.

Madapattu- Thirukovilur Road (SH-09)

As no proposals are considered for bridges, geotechnical investigations were not carried.

Vridhachalam- Bhuvanagiri Road (SH-70)

A comprehensive geotechnical investigation has been planned and executed in the form of deep boreholes for the proposed structures along the project road SH-70 Vridhachalam to Bhuvanagiri in order to obtain information on stratigraphy and physical properties of the soils at site including ground water table at the proposed structure locations. Detailed Geotechnical Investigations for the proposed structures was completed for the Road No. 5 (SH-70, Vridhachalam to Bhuvanagiri) through deep boreholes of 150/100mm diameter at planned locations according to the ToR.

Based on the results of the geotechnical investigation (both field and laboratory test data), a comprehensive assessment of the shear strength parameters and compressibility characteristics of the founding strata have been carried out to recommend for suitable and economical type of foundation and its load carrying capacity in accordance to the proposed structures. While recommending the foundation level in case of open or raft foundation or alternatively deep foundation in the form of pile foundation due consideration of the local hydraulic condition was taken and accordingly the recommendations were made.

2.7 HYDRAULIC AND HYDROLOGICAL INVESTIGATIONS

The Consultant carried out a desk study of available data on topography (topographic maps), storm duration, rainfall statistics, topsoil characteristics, vegetation cover etc. so as to assess the catchment area and hydraulic parameters for all existing and proposed drainage provisions. The findings of the desk study were further supplemented by a reconnaissance of the area. All important hydrological features were noted during the field investigations. The hydraulic and hydrological investigation was carried out in accordance with IRC:SP:13-2004 “Guidelines for the Design of small Bridges and Culverts (First Revision)” and IRC:5-1985 “Standard Specifications & Code of Practice for Road Bridges, Section I - General Features of Design (Seventh Revision)”.

The main objective of this hydrological and hydraulic study is to determine the required size of drainage structures to allow the estimated design flow of the streams to cross the road safely, and to check whether waterways of existing structures are sufficient to pass the flow without risk so that appropriate decisions could be taken concerning their rehabilitation.

For the purpose of the study, following data was collected for the hydrological and hydraulic calculations:

- Topographic survey data of cross drainage structures
- Survey of India topo maps to a scale of 1: 50,000 for identification of catchment area and its characteristics.
- Rainfall pattern of the project site
- HFL/FSL of bridges and overtopping details of existing road
- Details of canals crosses the alignment
- Characteristics of the catchment areas

Hydrological Analysis of Bridges: Since there are no major bridges on the both the project roads, i.e. Madapattu- Thirukovilur Road & Vridhachalam- Bhuvanagiri Road, the discharges of minor bridges were worked out as per methodology described under various applicable standards of IRC. The computed values are adopted through site validation and local inquiry with judgment.

The following methods have been used to estimate the peak discharge and waterway for bridge sites on major and minor streams.

- Area Velocity Method/Manning's Method
- Catchment Area Methods
  - Dicken's formula
  - Rational formula

Hydrological Analysis of Culverts: Cross drainage requirement of the project road is worked through catchment analysis. The peak runoff or the peak discharge for the given catchment area is found out by using a rational formula.

The number of culverts is provided such that the discharge carrying capacity of culverts within the catchment should be higher than the runoff discharge coming from the respective catchment.

There is no introduction of new culverts at the canal portion in Vridhachalam- Bhuvanagiri Road (SH-70) because it needs rising of the embankment which is uneconomical. Overtopping of road occurs at this location because of the backwater flow over the banks of the Vellar River during the maximum flooding time, which happens approximately once in 5 years. So, concluding that the road has to be designed as a road dam/causeway at this location.

2.8 ROAD SAFETY REVIEW

- Traffic signs are missing at many locations on the project road. No warning signs exist before the junction and curves. Directional signs exist only at few locations. These missing safety features will be the part of the proposed improvements.
- High Intensity Micro-Prismatic Grade Sheeting (HIP) (Type IV) shall be provided
- W-beam crash barrier shall be provided along both the project roads as per Section 9 of the Manual. The locations of W-beam crash barriers are given below in **Tables 2.10** and **2.11** for Madapattu- Thirukovilur road and Vridhachalam - Bhuvanagiri roads respectively.

Table 2.10: Proposed Locations for W-beam Crash Barrier on Madapattu- Thirukovilur Road

S.No.	Design Chainage		Length (m)	Side of the Project Road	Remarks
	From	To			
1	46+450	46+620	170	LHS	Water Logging
2	63+450	63+480	30	RHS	Water Logging
3	65+570	65+610	40	LHS	Pond
4	64+690	64+940	250	RHS	Pond

Table 2.11: Proposed location for W-beam Crash Barrier on Vridhachalam- Bhuvanagiri Road

S. No.	Design Chainage		Length (m)	Side of the Project Road	Remarks
	From	To			
1	11+780	12+000	220	RHS	Canal
2	21+030	21+120	90	RHS	Pond
3	27+500	33+230	5730	LHS	Canal

2.9. CONCLUSION

In this chapter the existing features of project road as well as planned improvements have been discussed. These project details will help in assessment of direct and indirect impacts of project on various components of environment. These impacts and planned mitigations are detailed in the subsequent chapters of this EIA document.

CHAPTER 3 ENVIRONMENT REGULATORY FRAMEWORK

3.1 APPLICABLE REGULATION

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 this chapter. Regulations concerning procedures and requirements that may directly concern the project, the capacity of the concerned institutions and their ability to successfully implement the Environmental Management Measures have been addressed in this chapter.

3.1.1 Legal Framework

The Government of India has laid out various policy guidelines, acts and regulations pertaining to sustenance of environment. 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 (MoEFCC) and the Central Pollution Control Board (CPCB) / State Pollution Control Board (SPCB).

3.1.2 Key Environmental Laws and Regulation

The brief description of these key environmental laws and regulation is given below:

a. The Environment (Protection) Act, 1986

This Act provides provisions for the Environment (Protection) Rules. The Environmental Impact Assessment Notification, 2006 and the Amendment there to (August 22, 2013) have been notified under the Environmental (Protection) Act, 1986. This law is applicable to the whole of Indian Territory as an umbrella act to protect and to conserve environment.

b. The Environmental Impact Assessment Notification 2006

The state highway expansions as in case of the present project where the project corridors are located in plain terrain do not need environmental clearance. As per EIA Notification 2006 amendment dated August 22, 2013, highway projects passing through ecologically sensitive areas and /or above 1000 m above mean sea level require environmental clearance.

c. Forest (Conservation) Act 1980

The Forest (Conservation) Act, 1980 pertains to the cases of diversion of forest area and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are applied for at the following levels of government:

- If the area of forests to be cleared or diverted exceeds 20ha (or 10ha in hilly area) then prior permission of Central Government (MoEFCC) is required;
- If the area of forest to be cleared or diverted is between 5 to 20ha, the Regional Office of Chief Conservator of Forests is empowered to approve;
- If the area of forest to be cleared or diverted is below or equal to 5ha, the State Government can give permission; and,
- If the area to be clear-felled has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the amount of area to be cleared.

Restrictions and clearance procedures proposed in the Forest (Conservation) Act applies wholly to the natural forest areas, even in case the protected/designated forest area does not have any vegetation cover. In the current case, there is no requirement for the diversion of forest land for the widening of road in either of the two corridors.

d. The Water (Prevention & Control of Pollution) Act, 1974

The Water (Prevention and Control of Pollution) Act, 1974 resulted in the establishment of the Central and State Level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of certain facilities.

e. The Air (Prevention and control of Pollution) Act, 1981

The SPCB is empowered to set air quality standards and monitor and prosecute offenders under The Air (Prevention and Control of Pollution) Act, 1981. Additionally, as per the Gazette notification dated 10 April 1997, SPCB is also empowered for public hearing of all projects including road projects.

f. Noise Pollution (Regulation and Control) Rules 2000

Considering the dexterous and psychological effects of the noise pollution on human well-being, MoEFCC has drawn up the Noise Pollution (Regulation and Control) rules 2000, according to which a person might make a complaint to the designated authority in the event that the actual noise levels exceed the ambient noise standards by 10dB (A) or more as compared to prescribed standard. The designated authority will take necessary action against the violator in accordance with the provision of these rules or other laws in force.

g. Biological Diversity Act, 2000

This act prevents persons undertaking biodiversity related activities without approval from the National Biodiversity Authority. Its ambit extends to whole of India. There are particular restrictions if the project involves participation of non-Indian persons. EA assesses whether bio-survey or bio-utilization is needed for the project (survey or collection of species etc. for the purpose). EA document outlines measure to avoid or minimize effect on biodiversity. In both the project roads approval from National Biodiversity Authority will not be required.

h. Ancient Monuments and Archaeological Sites and Remains Rules, 1959

The state archaeology comes under the department of language, art & culture. There is a central list of protected monument and state list of protected monuments and other archaeology and remains. There are no listed monuments coming within the purview of the act in both the project roads, hence this act is not applicable.

i. Fly Ash Notification, 2007

The MoEFCC has issued notification, 2007 & amended 2003, regarding the utilization of fly ash/bottom ash generated from coal/lignite based thermal power plant, to protect the environment, conserve top soil & prevent dumping & disposal of fly ash discharged from coal or lignite based thermal power plants. Further, there is need for restricting the excavation of topsoil for manufacturing of bricks & promoting the utilization of fly ash in the manufacture of building materials & in construction activity within the radius of 100 km from coal or lignite based thermal power plants.

As per the above notification fly ash/bottom ash generated from lignite/coal based thermal power plants needs to be used in brick manufacturing and in other items to be used in construction (e.g. clay bricks or tiles or blocks) & other construction activities.

No agency, person or organization shall, within a radius of 100 km of thermal power plant undertake construction or approve design for construction of roads or flyover embankment in contravention of the guideline//specification issued by the Indian Road Congress (IRC) as contained in IRC specification No SP:58 of 2001. Any deviation from this direction can only be agreed to on technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-chief of the concerned agency or organization or on production of a certificate of “Pond ash not available” from the thermal power plants (TPPs) located within 100 km of the site of construction. This certificate shall be provided by the TPP within two working days from the date of making request for ash.

Soil required for top or side covers of embankment of roads or flyovers shall be excavated from the embankment site and if it is not possible to do so, only the minimum quantity of soil required for the purpose shall be excavated from soil borrow area. In either case, the topsoil should be kept or stored separately. Voids created due to soil borrow area shall be filled up with ash with proper compaction and covered with topsoil kept separately as above. This would be done as an integral part of embankment project within the time schedule of the project.

Both the project roads are within a distance of 100 km radius from power plant at Neyveli, so the notification is applicable to project activities.

j. The Explosives Act (& Rules), 1884 (revised in 1983)

The purpose of this act is for safe transport, storage and use of explosive materials. Blasting shall be carried out as per The Explosives Rules, 1983. Prior intimation of operational hours of the blasting will be given to the people living near such blasting sites. Blasting will not be undertaken in night hours.

This act will be applicable to ensure safe transportation, storage and use of explosive materials at stone quarry sites only.

k. Public Liability Insurance Act, 1991

The purpose of this act is to provide public insurance liability for the purpose or providing immediate relief to the persons affected by accident occurring while handling any hazardous substances. The EA confirms that appropriate insurance policy will be taken out. EA identifies hazardous materials associated with the projects and associated accident hazards. Document describes steps to prevent accident hazards and to limit their consequences to the environment. The EA indicates commitment to provide information, training and equipment to ensure worker safety. EA describe the mechanisms to notify the concerned authority in the event of a major accident.

This act will applicable to ensure public liability insurance for all workers during construction phase.

l. Environmental Guidelines and Norms

The relevant sections of the guidelines considered for highway sector are shown in **Table 3.1** below.

Table 3.1: Environmental Guideline and Their Applicability to the Project

S No	Guideline	Year	Purpose	Applicability
1	Environmental guideline (MoEFCC) for rail/road/highway projects for the preparation of EIA report on Highway sector	1989	To guide the preparation of EIA/EMP reports	Direct
2	General guidelines (MoEFCC) as provided by the handbook of environmental procedures and guidelines	1994	For the investors	Direct
3	Environmental Impact Assessment (EIA)	1998	For environmental	Direct

S No	Guideline	Year	Purpose	Applicability
	Manual		appraisal committee (EAC) members and consultants	

3.1.3 Environmental Requirements of the State

No specific state-level legislation relevant to the environmental clearance requirements, other than those mentioned above are in force in the state of Tamil Nadu. However, permission will be required for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts. Permission from the State Department of Mining is required for establishing quarries. Clearance from the State Ground Water Board/Authorities is required for establishment of new tube wells/ bore-holes, etc.

In addition, with respect to hygiene and health, during the construction period, the provisions as laid down in the Factories Act, 1948 and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 would apply.

With limited possibility, the provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996 would also apply during the construction and the operation periods.

A brief note on important acts and rules specific to Tamil Nadu and applicable to the project are presented in the following sections.

a. The Tamil Nadu Highways Bill, 2000

The Tamil Nadu Highways Bill, 2000 was introduced in the Legislative Assembly of the state on 13-11-2000. Objective of the bill is stated as:

> ***"To provide for the declaration of certain highways to be State Highways, restriction of ribbon development along such highways, prevention and removal of encroachment thereon, construction, maintenance and development of highways, and levy of betterment charges and for matters connected therewith or incidental thereto"***

It provides for a legal status to the assets and premises of the highways along with functions and powers with the highway authorities to protect and maintain them. It specifically empowers highway authorities towards restriction of ribbon development, acquisition of property, prevention, and removal of encroachments, restriction of heavy traffic as also the load safety. Penalties can be levied under the provisions of the bill for causing damage to highways properties and unauthorized occupation of the highways land.

b. Tamil Nadu Forest Act 1882 and Tamil Nadu Timber Transit Rules, 1968

Tamil Nadu Forest Act is for providing absolute protection to forested area from all factors causing degradation, depletion and destruction of wildlife and wildlife habitats.

c. Tamil Nadu Groundwater (Development and Management) Bill, 2000

The said bill was introduced in the Legislative Assembly of the state on 13-11-2000. Objective of the bill is:

> ***"To protect groundwater resources, to provide safeguards against hazards of its over-exploitation and to ensure its planned development and management in the state of Tamil Nadu and for matters connected therewith or incidental thereto."***

The bill when passed as an act shall empower government through the Tamil Nadu Groundwater Authority to develop, control, regulate, and administer the groundwater in the state by ensuring its optimal and efficient utilization. The act also provides for conjunctive use of surface and groundwater. The act provides for registration of new users of wells and also prohibition of sinking wells in notified areas without permit. It shall empower the authorities to penalize the activities not in accordance with the act regarded as offences.

3.1.4 Other Legislation Applicable to Road Construction Projects

a. Specifications for Road and Bridge Works, Fifth Revision, MoRTH, Published by IRC, 2013

All road works in India are to be in accordance with the MoRTH specifications for Road and Bridge works and guidelines of Indian Roads Congress (IRC). The MoRTH specifications have special provisions towards protection of environment under Clause 501, Annexure A and the contractor is to satisfy the provisions. Apart from the Annexure A to clause 501, there are provisions for control of erosion, drainage, dust suppression, borrow area, and haul road management under relevant sections. Provisions of clause 501 Annexure A, covers the environmental aspects as:

General:

- The contractor shall take all necessary measures and precautions to carry out the work in conformity with the statutory and regulatory environmental requirements.
- The contractor shall take all measures and precautions to avoid nuisance or disturbance from the work as precautionary measures than abatement measures taken after generation of nuisance
- In the event of any spoil, debris, waste or any deleterious material from site being deposited on adjacent land, the same shall be removed and affected area shall be restored to its original state

Water:

- The contractor shall prevent any interference with supply/abstraction of water resources
- Water used for dust suppression shall be reused after settlement of material in collected water
- Liquid waste products to be disposed off such that it does not cause pollution
- No debris is to be deposited or disposed into/adjacent to water courses

Air:

- The contractor to devise and arrange methods to control dust, gaseous or other airborne emissions in such a way that adverse impacts on air quality are minimized
- Dust shall be minimized from stored material and stockpiles by spraying water
- Material likely to rise dust during transport is to be covered with tarpaulin
- Spraying of water on haul roads if found necessary

Noise:

- The contractor shall use all necessary measures to reduce noise from construction equipment and maintain all silencing equipment in good conditions.

Control of Wastes:

- No uncontrolled disposal of wastes shall be permitted. The contractor shall make specific provisions for disposal of all forms of fuel and engine oil, all types of bitumen, cement, surplus aggregate, gravels, bituminous mixtures etc. conforming to local regulations and acceptance of the engineer.

Emergency Response:

- The contractor shall plan and provide for remedial measures in case of occurrence of emergencies as spillages of oil, bitumen or chemicals

In addition to the above conditions, avoidance measures and control of activities having potential for generation of environmental impacts are devised. These include:

Section 111	Precautions for safeguarding the environment
Clause 201.2	Preservation of Property/Amenities during clearing and grubbing
Clause 301.3.2	Stripping and storing of topsoil for reuse during excavation for roadway and drains
Clause 302.4	Restriction on timings for blasting operations
Clause 304.3.6	Public safety near towns and villages where excavation is carried out
Clause 305.2.2.2	Locations of borrowing and relevant regulations
Clause 305.3.3	Stripping and storing of topsoil at borrow locations
Section 306	Soil erosion and sedimentation control
Clause 407.4.2	Provisions for turning on median and islands
Section 517	Recycling of bituminous pavement and excavated material
Clause 701.2.1	Use of geotextiles for control of soil erosion
Section 810	Use of Metal beam crash barriers for safety, relevant regulations and Specifications
Clause 1010	Quality of water for curing and construction
Clause 2501	Precaution during river training works

3.1.5 Institutional Setting – Environmental Context

The environmental regulations, legislation, policy guidelines and control that may impact this project, are the responsibility of a variety of government agencies. In all, as discussed in the subsequent sections, the following agencies would play important roles in this project.

a. Ministry of Environment, Forest and Climate Change (MoEFCC)

The primary responsibility for administration and implementation of the Government of India's (GoI) policy with respect to environmental management, conservation, ecologically sustainable development, and pollution control rests with the Ministry of Environment, Forests and Climate Change (MoEFCC). Established in 1985, the MoEFCC is the agency primarily responsible for the review and approval of EIAs pursuant to GoI legislation.

b. MoEFCC Regional Offices

The MoEFCC has set up regional offices, with each region having an office. The office for the present project is located at Bangalore. This office is responsible for collecting and furnishing information relating to EIA of projects, pollution control measures, methodology, and status, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, mangroves, and biological reserves.

c. Central Pollution Control Board (CPCB)

CPCB is a statutory authority attached to the MoEFCC and located in New Delhi, the main responsibilities include inter alia the following:

- Planning and implementing water and air pollution programs;
- Advising the Central Government on water and air pollution programs;
- Setting air and water standards; and
- Co-coordinating the various State Pollution Control Boards.

The role of the CPCB, (for this project) will only be in an advisory capacity while the project shall adhere to the norms and standards set up by the Tamil Nadu Pollution Control Board (TNPCB).

d. The Tamil Nadu State Pollution Control Board (TNSPCB)

The TNPCB has the mandate for environmental management at the state level, with emphasis on air and water quality. The board is responsible for:

- Planning and executing state-level air and water initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum Standards;
- Enforcing and monitoring of all activities within the State under the Air Act, the Water act and the Cess Act, etc.;
- Conducting and organizing public hearings for projects as defined by the EIA Notification 2006; and,
- Issuing No-objection Certificates (NOC) for industrial development defined in such a way as to include road projects.

In order to obtain environmental clearance from the MoEFCC, “Public Hearing” has been made mandatory The State PCB establishes a review panel and circulates the application for public review and comment in each affected district.

e. Tamil Nadu State Forest Department

The Tamil Nadu State Forest Department is responsible for the protection and managing the forest designated areas within the state. The Forest Department works out Forest Working Plans for the various forest divisions to manage and protect the forest resources. These plans form the basis for managing the forest resources and for chalking out specific plans and policies with respect to the conservation, protection, and development of the forest areas. The Forest Department will be responsible for granting clearances for forest areas that need to be cleared for the project, according to the provisions of the Forest (Conservation) Act, 1980.

3.1.6 World Bank Environmental Requirements

The various environmental requirements of World Bank for the project roads are described below.

a. Applicability of Various WB Safeguard Policies

The World Bank has ten safeguard policies; the details and applicability of the safeguard policies to the Project road are provided in **Table 3.2**.

Environmental requirements of the World Bank are specified in detail in its Operational Policy (OP) 4.01 and other related Operation Policies. In instances in which the procedural and regulatory requirements differ, the more stringent applies. The World Bank environmental requirements are based on a three-part classification system.

- *Category A*- requires a full Environmental Assessment (EA).
- *Category B*- projects require a lesser level of environmental investigation.
- *Category C*- projects require no environmental analysis.

On the basis of data and information collected during field survey and discussion with local experts and visualised potential associated impacts, consultant has categorised this project as category-A, which requires a full Environmental Assessment. Accordingly, a full Environmental Assessment has been carried out for both the project roads (SH-09 and SH-70)

Table 3.2: Applicability of World Bank Safe Guard Policies for Project Roads

WB Safe Guard Policy	Subject Category	Triggered or Not	Reason For Its Applicability	Mitigation Measures	Documentation
OP 4.01	Environmental Assessment	**Triggered**	Umbrella policy	All necessary mitigation measures will be incorporated during Environmental Assessment	EIA and EMP required.
OP 4.02	Environment Action Plan	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 4.03	Performance standards for Private Sector Activities	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 4.04	Natural Habitats	Not Triggered	Eco-sensitive-Forestry and wildlife related issues	Not Applicable	Not Applicable
OP 4.07	Water Resources Management	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 4.09	Pest Management	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 4.12	Involuntary Resettlement	**Triggered**	Road widening will lead to loss of livelihoods, loss of land and buildings etc	Comprehensive Action Plan	Applicable (Resettlement Action Plan prepared)
OP 4.10	Indigenous people	Not Triggered	No separate Indigenous people development Plan is required for the Project.	There are no indigenous people along both the roads	Not applicable
OP 4.11	Physical Cultural Resources	**Triggered**	A number of temples, shrines, churches, etc are located adjacent to road and RoW. Cultural property rehabilitation will be plan prepared.	Adequate mitigation measures if affected.	EMP & RAP are prepared to minimise any adverse effect on the cultural properties

WB Safe Guard Policy	Subject Category	Triggered or Not	Reason For Its Applicability	Mitigation Measures	Documentation
OP 4.20	Gender and Development	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 4.36	Forestry	Not Triggered	No forest land diversion for both project roads widening	Not Applicable	Not Applicable
OP 4.37	Safety of Dams	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 7.50	International Waterways	Not Triggered	Not Applicable	Not Applicable	Not Applicable
OP 7.60	Disputed Area	Not Triggered	Not Applicable	Not Applicable	Not Applicable

3.1.7 Summary of Clearance Requirement

The lists of all applicable GoI regulations are provided in the **Table 3.3**.

Table 3.3: Summary of Applicable Regulations

S. No.	Act / Rules	Purpose	Applicability to Proposed Corridors for Widening	Authority
1	Environment Protection Act-1986	To protect and improve overall environment	Yes (Applicable for construction & operation phases)	MoEFCC. GoI; DoE, State Govt. CPCB; SPCB
2	Notification for use of fly ash, 2003	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	Yes, (subject to meeting the specifications).	MoEFCC
3	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013	Set out rule for acquisition of land by government	Applicable	DM offices, Villupuram, and Cuddalore
4	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution Pollutants	Yes	TNPCB
5	Water Prevention and Control of Pollution Act, 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards	Yes	TNPCB
6	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEFCC for various land uses.	Yes (applicable during construction phase)	TNPCB
7	Public Liability and Insurance Act 1991	Protection form hazardous materials and accidents.	Yes (applicable during construction stage)	TNPCB
8	Minor Mineral and concession Rules	For opening new quarry.	Yes (Quarry Licenses shall be obtained by Contractors.)	District Collectors- Villupuram and

S. No.	Act / Rules	Purpose	Applicability to Proposed Corridors for Widening	Authority
				Cuddalore
9	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules1989	To check vehicular air and noise pollution.	Yes (applicable during construction stage)	Department of Transport
10	The Mining Act	The mining act has been notified for safe and sound mining activity.	Yes (Quarry Licenses shall be obtained by Contractors from licensed quarry).	Department of mining, GoTN
11	Municipal Solid Waste (Management & Handling) Rules, 2000 (MSW Rules)	Segregation, Handling & safe disposal of domestic solid waste	Yes (Applicable during construction stage)	Urban Local Body
12	Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008.	Safe handling, storage, transportation & disposal of hazardous wastes	Yes (Applicable during construction as there will be generation of discarded fuel & lubricants at construction camps)	TNPCB
13	Batteries (Management and Handling) Rules, 2001	Safe recycling of lead acid batteries	Yes (Applicable during construction as there will be uses of lead acid batteries at construction camp	MoEFCC

3.1.8 Summary of Environmental Regulatory Framework

The project has been initiated and is being carried out by the Tamil Nadu Road Sector Project, Government of Tamil Nadu. The primary responsibility of the project rests with the local PIU-TNRSP in providing encumbrance frees RoW to the contractor(s). As mentioned earlier, although both the corridors do not require environmental clearance under the provisions of EIA Notification 2006 and permission or consent for road widening from the TNPCB; the contractor(s) during project construction phase will be required to obtain 'Consent to Establish' and 'Consent to Operate' for construction camps and associated facilities (HMP, WMM Plant, crushers, Concrete Batching Plant etc.). The tree cutting permission will be required from Villupuram and Cuddalore District Collectors for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road respectively. There is no requirement of CRZ clearance for widening of both the project roads as they are far away from the coast. The license to store HSD and other petroleum products at construction camp(s) will be required from the Chief Controller of Explosives, Nagpur or its Regional Office in Tamil Nadu close to the project roads. The permission will also be needed from Central Ground Water Board during construction if contractor(s) decide(s) to withdraw ground water for construction purposes.

CHAPTER 4 BASELINE ENVIRONMENT

This chapter is in relation to the description of baseline environment of the project area with reference to physical, ecological and social aspects of the project roads. It is based on the data collected through environmental monitoring, field observation, public consultations and secondary data. The study area has been considered as 15 km distance on either side of both the project roads. Primary data were collected for the Right of Way and 500 m on either side of the project road to study direct impacts due to road widening activity.

For assessing the baseline environmental status of the project influence area, field inspection at all the sensitive locations, collection of secondary information for all the environmental components and discussions with the officials, NGO's and local public were conducted by the Consultants from April, 2014 to June, 2014.

4.1 BACKGROUND

The delineated study area for the Madapattu- Thirukovilur road falls in Villupuram district, while for the Vridhachalam- Bhuvanagiri road it lies within the Cuddalore district.

Villupuram district, earlier a part of Cuddalore district, was bifurcated as a separate district on 30th September 1993. Due to its history, the district closely resembles that of Cuddalore. Villupuram District lies between 11°38'25" N and 12°20'44" S: 78°15'00" W and 79°42'55" E with an area of 7222.03 hectares. It is the largest district in Tamil Nadu (with 22 Blocks as compared to the average of 13-14 blocks in the other districts), but is one of the least industrialized areas of the State. The district has 1,590 villages and 1,120 Gram Panchayats, which is highest in number as compared to other districts of Tamil Nadu. The majority of the population in the district depend on agriculture. The boundaries of the district are:

East and South: Cuddalore District
West: Salem and Dharmapuri District
North: Thiruvannamalai and Kanchipuram District.

The Madapattu- Thirukovilur road traverses in plain terrain passing through rural areas as well as several intermittent semi-urban such as Madapattu, Irundhai, Arumpattu, Madhampattu, Gopulapuram, Saravanapakkam, Pennaivalam, Ammavasappayam, T. Kunnathur. Edapalayam, Mudhalur, Thirukkovilur.

Geographical spread of Cuddalore district is 12°35' & 15°05'N (latitude) and 78°38' & 80°0'E (longitude). The total geographical area of the district is 3,678 square kilometers with a coastal line of 68 kilometers. The boundaries of the district are

East: Bay of Bengal
West: Villupuram District
North: Union Territory of Pondicherry
South: Nagapattinam District

The Vridhachalam- Bhuvanagiri road traverses in plain terrain passing through rural areas as well as several intermittent semi-urban and urban settlements namely, Vridhachalam, Gopalapuram, Kammapuram, Erumbur, and Bhuvanagiri.

A detailed survey has been carried out and strip plans have been prepared covering all environment features and components in the project stretch, within the project influence zone. The primary baseline data for the project roads were collected by the consultants during April to June 2014 .The metrological data form the nearest IMD observatory at Cuddalore has been collected and is considered for the study of impact due to project activities at both the corridors. Primary data for ambient air quality, ambient noise levels, water quality (ground and surface) and soil quality was generated (for which samples were collected and analyzed) by M/s Green Chem Solutions (P) Ltd, Chennai, a NABL accredited laboratory.

4.2 AIR ENVIRONMENT - BASELINE

4.2.1 Meteorological Factors and Climate

Both Cuddalore and Villupuram districts have a hot tropical climate characterized by the small daily range of temperature, humid weather and moderate rainfall. There is no clear cut demarcation of seasons. Months from March to June are considered as summer and December to February as cooler months. The onset of summer is from March, with the temperature reaching its peak by the end of May and June. Throughout the month of July daytime temperatures generally reach highs of around 35°C and at night the average minimum temperature drops down to around 25°C. In recent times the highest recorded temperature in July has been 40°C in the project region of Madapattu -Thirukovilur road and 38 °C in the project region of Vridhachalam- Bhuvanagiri road, with the lowest recorded temperature being 21°C.

Summer rains are sparse and the first monsoon, the South-West monsoon, sets in June and continues till September. North-East monsoon sets in October and continues till January. The rainfall during the South-West monsoon period is much lower than that of North-East monsoon. The South West monsoon lasts till September. October to December constitutes a North East monsoon season.

The average annual normal rainfall for the period 1973- 1991 was around 971 mm in Villupuram. The average rainfall varies from 1050-1400 mm in Cuddalore district; minimum being 1051.3 mm around Vridhachalam that gradually increases and reaches a maximum of 1402.6 mm around Chidambaram and 1347.1 mm around Porto Novo. The average annual rainfall for the last five years in Villupuram and Cuddalore districts are given in **Table 4.1** and **Table 4.2** respectively.

Table 4.1: Average Annual Rainfall for Last Five Years (2008-2012) for Project region of Madapattu- Thirukovilur Road

S No	Year	Average Annual Rainfall (mm)
1	2008	1,162.50
2	2009	1,058.65
3	2010	1,361.70
4	2011	1,015.91
5	2012	898.4

Table 4.2: Summary of Average Annual Rainfall for Last Six Years (2007-2012) for Project Region of Vridhachalam- Bhuvanagiri road

S No	Year	Average Annual Rainfall (mm)
1	2007	1,271.59
2	2008	1,661.18
3	2009	1,219.52
4	2010	1,461.84
5	2011	1,397.93
6	2012	793.09

However, the quantum of normal rainfall fluctuates greatly. Coastal districts of Tamil Nadu are in the highly cyclone prone zone of the east coast and its neighborhood falls under rainfall surplus category. Both the districts get rainfall mostly in the months of October to December from North East monsoon, which accounts for 72% of the total amount of rainfall.

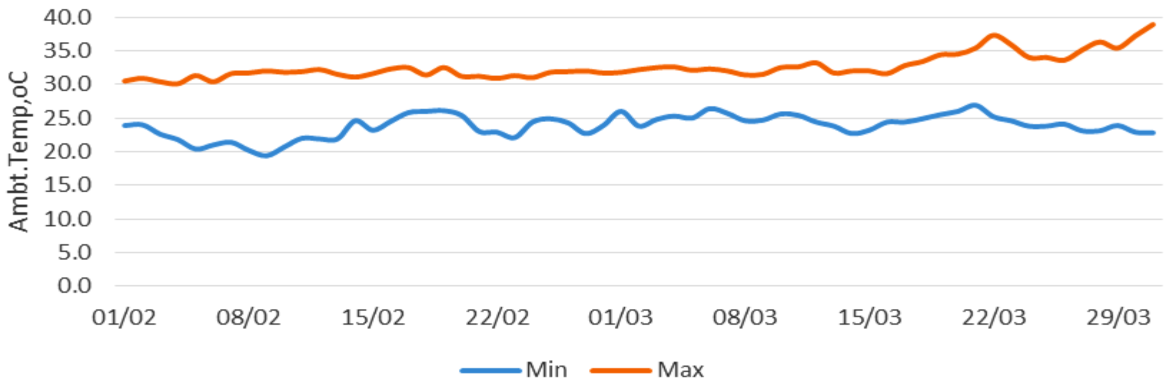
Meteorological Data during the Study Period

The meteorological data for the project roads has been obtained from the Cuddalore IMD observatory that is closest to both the project roads. The analysis of hourly meteorological data obtained by the consultants has been given below. The daily summary is attached as **Annexure 4.1**.

Ambient Temperature

The minimum average temperatures recorded during the study period were 19.4ºC and 22.7ºC in February and March 2014 respectively. The maximum temperatures recorded were 32.5ºC and 38.9ºC in February and March 2014 respectively. The overall average ambient temperature during the period was 28.2ºC. The increasing trends in diurnal variation of ambient temperatures are prominently visible in **Figure 4.1**.

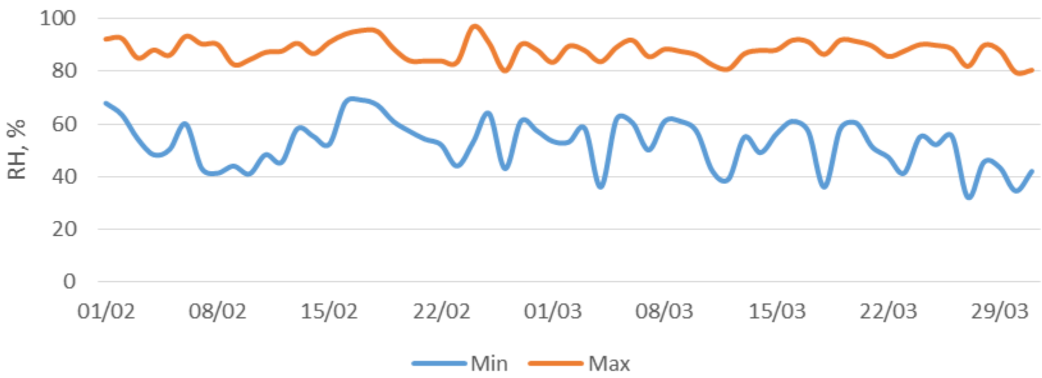
Figure 4.1: Daily Variations in Ambient Temperature



Relative Humidity

The daily variation graph of relative humidity is shown in **Figure 4.2**. The minimum average relative humidity recorded during the study period was 41% and 32% in February and March 2014 respectively. The maximum relative humidity recorded were 97%, and 91% in February and March 2014 respectively. The overall average relative humidity was 70% during the study period.

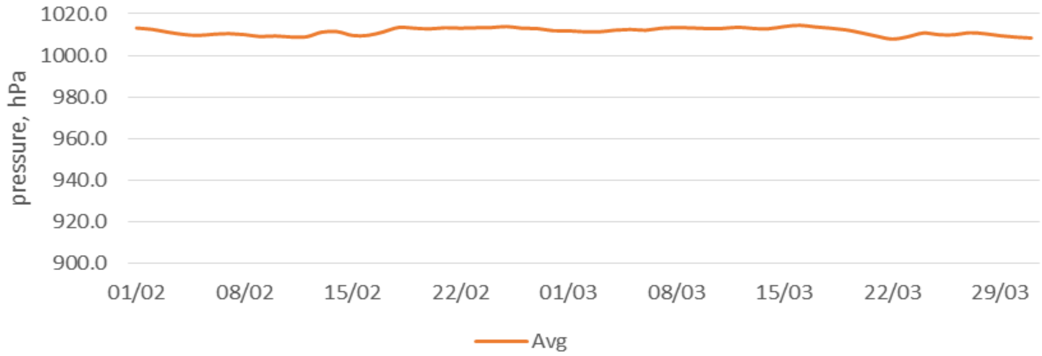
Figure 4.2: Daily Variations in Relative Humidity



Pressure

The daily atmospheric pressure level variation graph is shown in **Figure 4.3**. The daily averaged atmospheric pressure level during February and March was 1011 h Pa ± 2hPa.

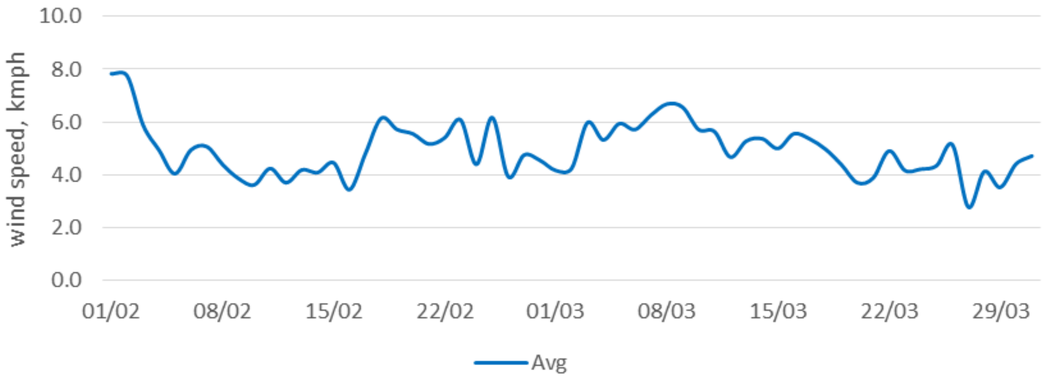
Figure 4.3: Daily variations in Atmospheric Pressure Level



Wind Speed

The daily variation in the average wind speed is shown in **Figure 4.4**. The daily averaged wind speed during February and March was 4.9 km/hr ± 1 km/hr.

Figure 4.4: Daily variations in Wind Speed



Visibility

The visibility data was not available from IMD.

Cloud Cover

In the general sky was clear or there were partial clouds during the observation period.

Wind Rose

The monthly wind patterns are presented as the wind rose diagrams. The wind-roses for February and March 2014 months are shown in **Figures 4.5 and 4.6** respectively.

In the months of February and March, the wind was predominantly observed blowing from NE sector. The annual wind rose diagram given in **Figure 4.7** indicates that dominant wind direction is from the ENE followed by SW.

Figure 4.5: Wind Rose Diagram for the Month of February2014

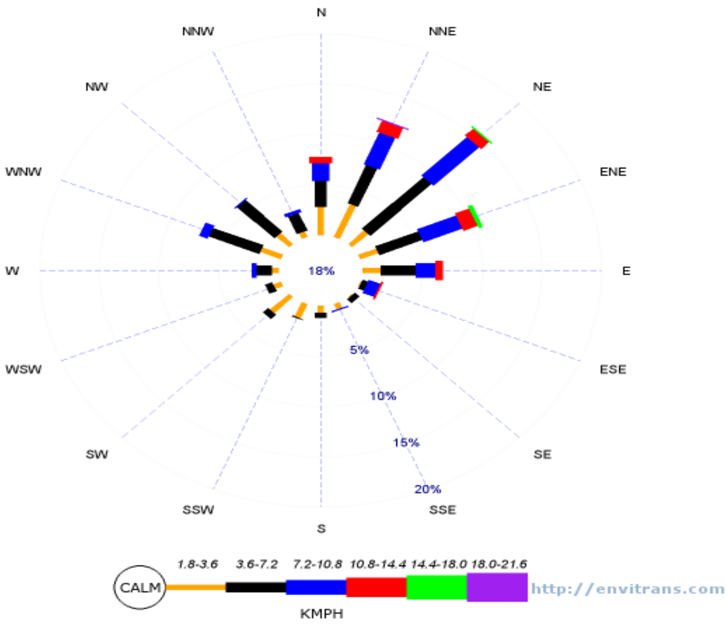


Figure 4.6: Wind Rose Diagram for the Month of March 2014

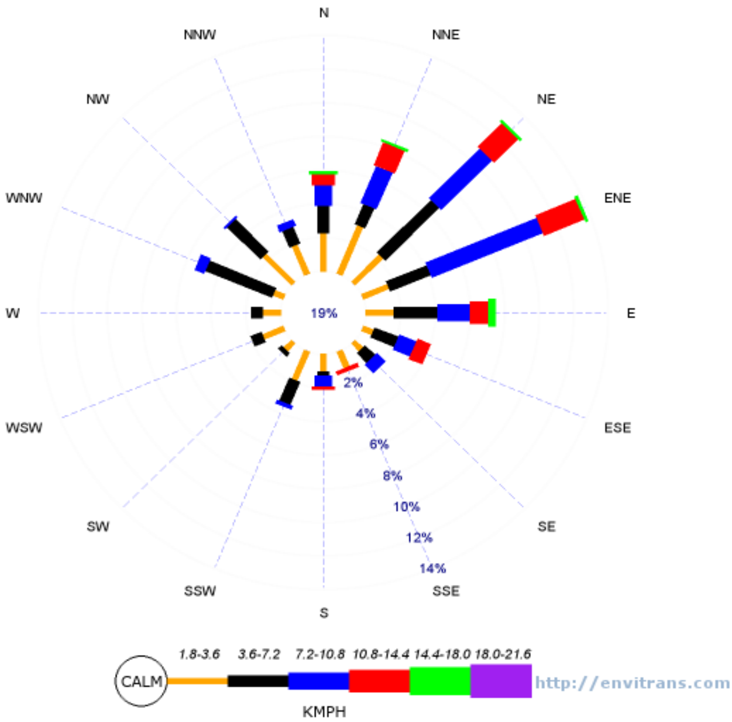
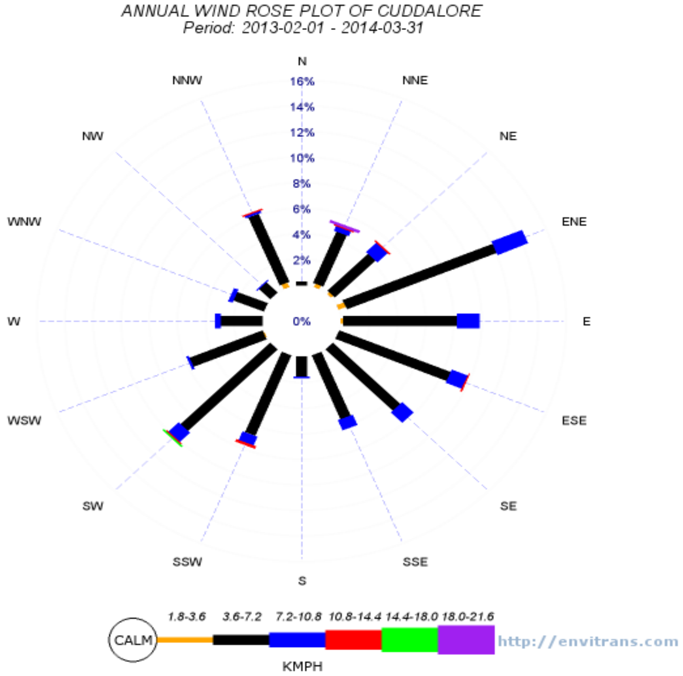


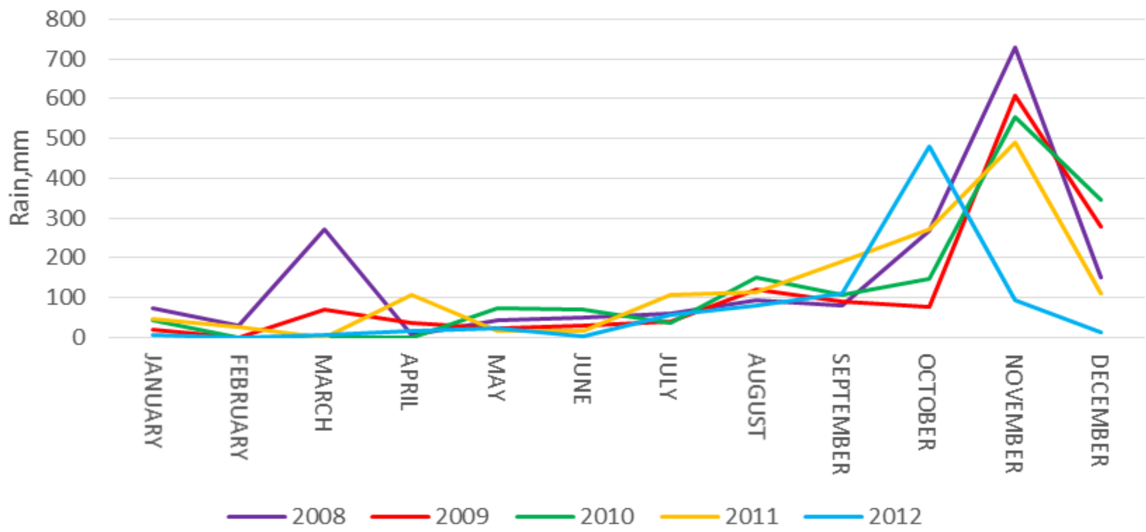
Figure 4.7: Annual Wind Rose Plot (01/02/2013 to 31/03/2014)



Rainfall

The district level rainfall data at the nearest IMD meteorological monitoring location of the last five years is presented in **Figure 4.8**. The recorded annual average rainfall in the Cuddalore district during 2008 – 2012 was 118.8 ± 29 cm. Most of the rainfall was observed in November and least in February.

Figure 4.8: Recorded Rainfall in Last Five Years



4.2.2 Ambient Air Quality

The ambient air quality was monitored to characterize baseline scenario in the study area and direct project influence area. The study area comprises of rural, residential and urban areas. The sources of air pollution in the region are mainly vehicular traffic; dust arising from unpaved roads and domestic fuel burning. The prime objective of the baseline air quality study is to establish the existing ambient air quality along the project road. This will also be useful for impact assessment during the construction and operation phases. In order to establish baseline ambient air quality, monitoring locations were finalized so as to be true representatives of the study area. Further, the locations have also been established with the following considerations:

- Meteorological conditions on synoptic scale;
- Topography/ terrain of the study area;
- Human settlements; and
- Representatives of likely impact areas along the project road

Details of the AAQM locations finalised are given in **Table 4.3** for Madapattu- Thirukovilur road and **Table 4.4** for Vridhachalam - Bhuvanagiri road. The results of monitoring are given in **Table 4.5** for Madapattu- Thirukovilur road and **Table 4.6** for Vridhachalam- Bhuvanagiri Road. The parameters selected for ambient air quality monitoring were SO_2, NOx, CO, $PM_{2.5}$ and PM_{10}. The locations of air quality monitoring have been shown in **Figure 4.9** for Madapattu-Thirukovilur road and **Figure 4.10** for Vridhachalam- Bhuvanagiri road.

Table 4.3: Ambient Air Quality Monitoring Locations for Madapattu- Thirukovilur Road

Location code	Name of the location	Classification/ Description of location
AAQ1	NH-45 intersection (km 41+700)	Residential and Rural Area
AAQ2	Kotanur Village (km 48+600)	Residential and Rural Area
AAQ3	Pennai Vallam, School (LHS) (km 58+300)	Sensitive
AAQ4	By crossing of Thiruvannamalai (km 66+200)	Residential and Urban Area

Table 4.4: Ambient Air Quality Monitoring Locations for Vridhachalam- Bhuvanagiri Road

Location code	Name of the location	Classification Description of location
AAQ1	Junction (km0+000)	Commercial
AAQ2	Kamapuram School (LHS) (km12+100)	Sensitive
AAQ3	Sethiathoppu junction (km25+400)	Commercial
AAQ4	School and village (LHS) (km35+600)	Sensitive
AAQ5	Near Sri putru mariyamman kovil (km45 to 48)	Commercial

Table 4.5: Ambient Air Quality Monitoring Results for Madapattu- Thirukovilur Road

Classification of area	Location code	PM_{10} (µ g/m^3)	$PM_{2.5}$ (µ g/m^3)	SO_2 (µ g/m^3)	NOx (µ g/m^3)	CO (m g/m^3)
Residential, Rural & other Areas	Annual Average	60	40	60	60	2.0
	24 hours	100	60	80	80	4.0
Sensitive Areas	Annual Average	60	40	15	15	1.0
	24 hours	100	60	30	30	2.0
Residential and Urban Area	AAQ1	41.2-50.4	18.8-24.9	6.1-8.9	14.2-20.8	<1.0
Residential and Rural Area	AAQ2	40.5-48.6	17.4-23.3	5.6-8.8	13.3-20.1	<1.0
Residential and Rural Area	AAQ3	33.3-39.7	15.2-18.0	5.9-7.2	15.4-17.0	<1.0
Residential and Rural Area	AAQ4	45.9-48.3	20.9-24.7	8.3-9.1	16.9-19.8	<1.0

Source: Consultants' Environmental Monitoring (Monitoring Carried out By Green Chem Solutions (P) Ltd., Chennai)

Table 4.6 Ambient Air Quality Monitoring Results for Vridhachalam- Bhuvanagiri Road

Classification of area	Location code	PM_{10} (µ g/m^3)	$PM_{2.5}$ (µ g/m^3)	SO_2 (µ g/m^3)	NOx (µ g/m^3)	CO (m g/m^3)
Residential, Rural & other Areas	Annual Average	60	40	60	60	2.0
	24 hours	100	60	80	80	4.0
Sensitive Areas	Annual Average	60	40	15	15	1.0
	24 hours	100	60	30	30	2.0
Residential and Urban Area	AAQ1	38.2 – 40.6	15.1 -19.4	6.0 – 10.8	13.4 – 21.2	<1.0
Residential and Rural Area	AAQ2	33.9 – 39.2	13.9 – 17.9	5.5 – 6.9	15 – 17.8	<1.0
Residential and Rural Area	AAQ3	39.3 – 43.2	18.8 – 23.9	6.6 – 8.5	16.9 – 18.7	<1.0
Residential and Rural Area	AAQ4	35.7 – 39.4	15.4 – 17.3	5.7 – 7.4	15.3 – 17.1	<1.0
Residential and Urban Area	AAQ5	37.6 – 41.7	17.8 – 21.2	5.9 – 8.2	15.9 – 18.1	<1.0

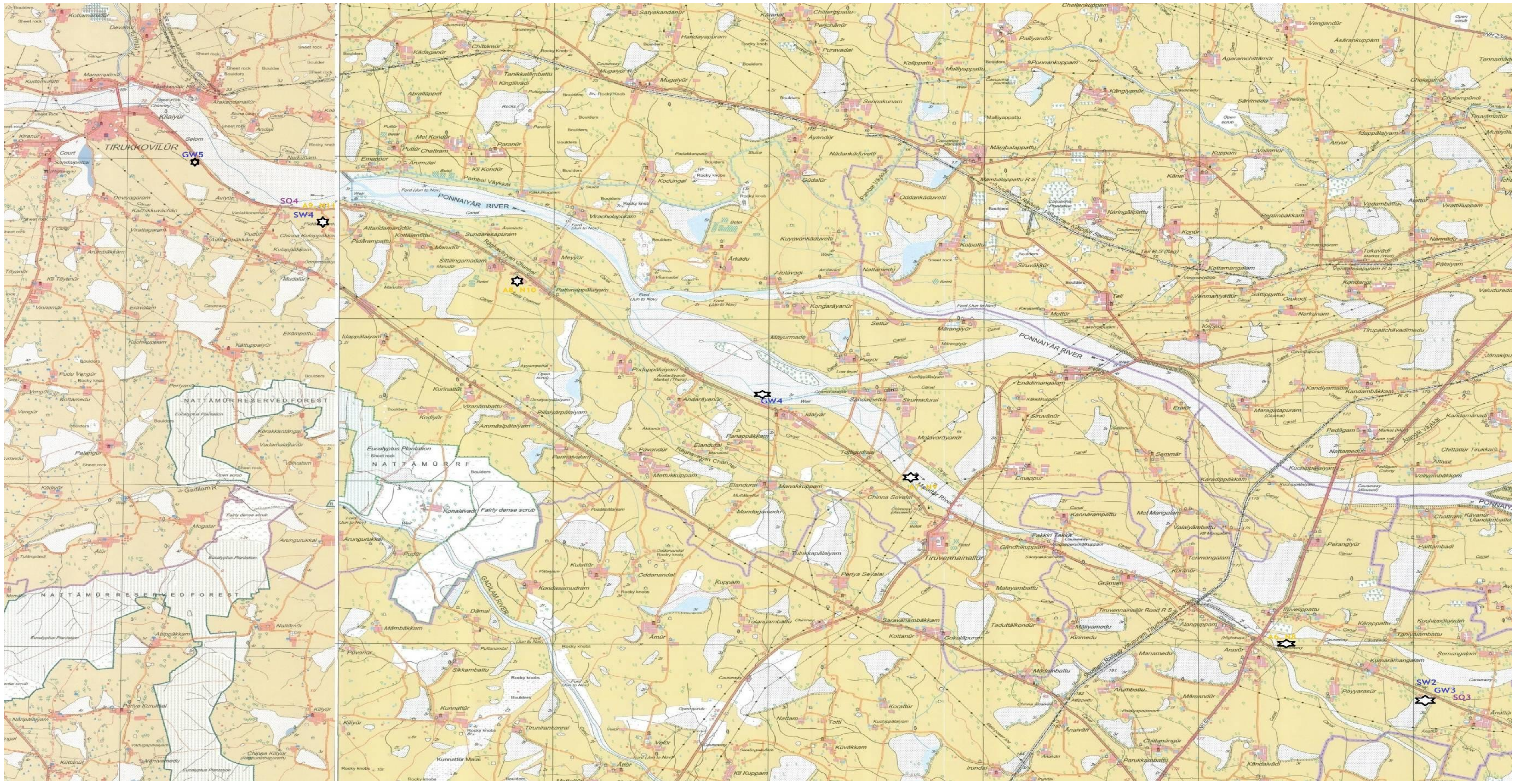
Source: Consultants' Environmental Monitoring (Monitoring Carried out By Green Chem Solutions (P) Ltd., Chennai)

The ambient air quality at all locations of both the project roads is well within limits stipulated by CPCB.

It is observed from above tables that for Madapattu - Thirukovilur road Particulate Matter concentration at all locations is in between 33.3 to 50.4 µ g/m3 (PM_{10}) and 15.2 to 24.7($PM_{2.5}$). The SO_2 concentration ranges from 5.6 to 9.1 µ g/m^3 and NOx value ranges between 13.3-20.8 µ g/m^3.

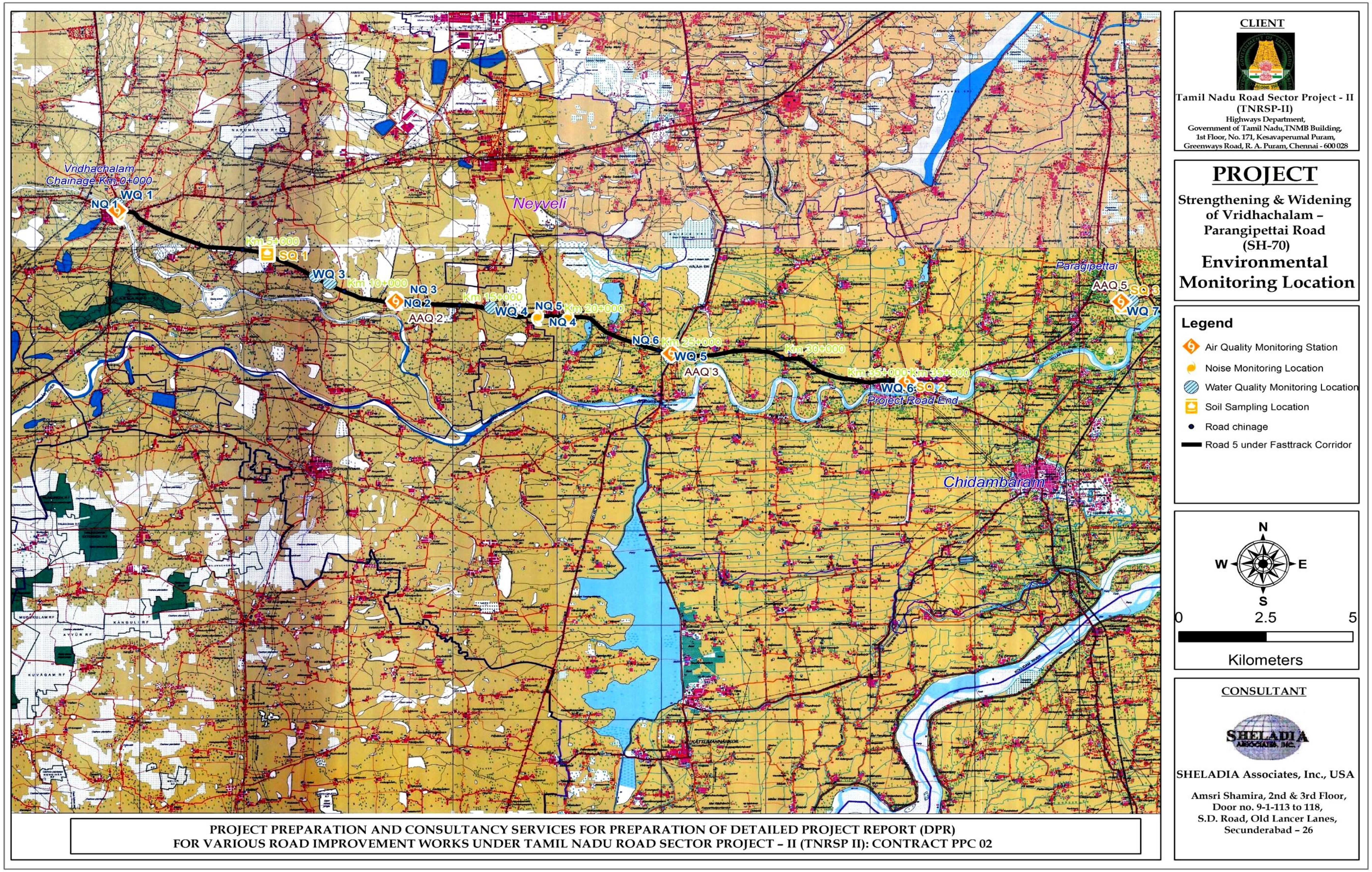
For Vridhachalam- Bhuvanagiri road Particulate Matter concentration at all locations is in the range of 36.7 to 41.2 µ g/m^3 (PM_{10}) and 15.3 to 20.6 ($PM_{2.5}$). The SO_2 concentration ranges from 6.1 to 7.7 µ g/m^3 and NOx value ranges between 16.3- 18.1 µg/m^3.

Figure 4.9: Locations of Monitoring for Ambient Air Quality, Water Quality (Surface and Ground), Noise Levels and Soil Quality



Sampling Locations for Various Environmental Parameters								
Name of Location	Chainage	Air	Noise	Name of Location	Chainage	Surface	Ground	**Soil Monitoring Locations**
Veerapuram Nallur	35+960	A5	N7	Veerapurama Nallur	35+960		GW1	• Agriculture field close to RoW at Chainage 35+800 (Around pond on LHS) • Agriculture field close to RoW at Chainage 66 + 200
NH-45 intersection	41+600	A6	N8	Pond (LHS)	35+800	SW1		
Village	48+600	A7	N9	Pond (LHS)	52+200	SW2		
Pennai Vallam, School (LHS)	58+300	A8	N10	Pennaivallam	57+420		GW2	
By crossing of Thiruvannamalai	66+200	A9	N11	Pond (LHS)	66+200	SW3		
				Thiruvannamalai	70+200		GW3	

Figure 4.10: Environmental Monitoring Locations



4.3 LAND ENVIRONMENT - BASELINE

4.3.1 Geography and Topography

Villupuram Taluk, with undulating terrain, is generally sloping towards southeast. The district has a number of isolated hillocks, mostly in Gingee area. The western border area in Sankarapuram and Kallakurichi Taluks is occupied by Kalrayan hill range. There are a number of residual and denundational hills in Thirukovilur, Kallakurichi and Gingee Taluks. In the Eastern sedimentary terrain, tertiary uplands are seen which are mainly composed of sandstone. The Madapattu- Thirukovilur road lies in Thirukovilur Taluk of Villupuram district.

The Vridhachalam- Bhuvanagiri road lies in Vridhachalam and Chidambaram Taluks of Cuddalore district. The area is occupied by denudating landforms like shallow buried pediment, deep buried pediment and pediments. The study area in the district is covered by eastern coastal plain, which is predominantly occupied by the flood plains of fluvial origin formed under the influence of Penniyar, and Vellar regions.

The topography is almost plain in the study area of both the project road corridors.

4.3.2 Geology and Mineralogy

Tamil Nadu is the leading holder of India's resources of vermiculite, magnetite, dunite, rutile, garnet, molybdenum and limonite. The State accounts for 81% lignite, 75% vermiculite, 69% dunite, 59% garnet, 52% molybdenum and 30% titanium mineral resources of the country.

Migmatite occurs extensively in Villupuram District around Thiruvannamalai. Gingee – Thirukkovilur is another example of regional migmatisation of granulite fancies of rocks at different stages culminating in homophonous granite. Rocks of Mio-Pliocene age (early Neogene) termed as Cuddalore Formation occupy a large area along the coast overlapping on to the Mesozoic sediments and at places over the crystalline basement. Cuddalore Formation consists of mottled, fine to coarse grained yellowish to brownish ferruginous sandstone, pebbly and cobbly sandstone, hard compact clay stone and light greenish grey clay with rare bands of limestone. The clay stone is of reddish, pinkish and whitish colour, compact in nature and kaolinitic composition. Cuddalore Formation contains large quantities of fossil wood around Tiruvakkarai in Villupuram District which have been declared and maintained as a National Fossil Wood Park by Geological Survey of India.

In Villupuram District, a magnetite-quartzite band was traced northwest of Manmalai and between Budamangalam and Talankunam and a total reserve of 0.345 million tonnes of ore was estimated, analysing 36.40% iron and 40.48% silica.

In addition to the prolific occurrence of multi colored granite deposits, Tamil Nadu is also endowed with high and medium quality black granite deposits around Tindivanam in Villupuram District. Lime shells of about 30,000 tonnes with CaO 54.45% are estimated from Marakkanam area in Villupuram District. Salts of sodium sulphite and sodium carbonate are reported from Tiruvamur & Asanur in Cuddalore district and Viramur & Kachirapalaiyam of Villupuram district. The yield of salts from the above localities is estimated to be of the order of 1500 tonnes.

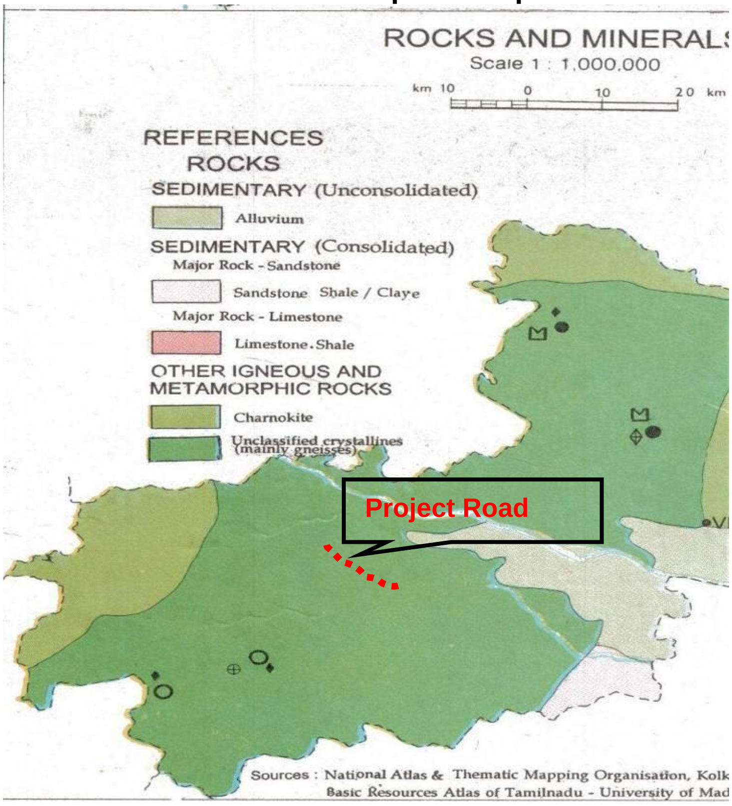
The entire Cuddalore district can be broadly divided into following 3 geomorphic zones.

i. Western Pedi plains of the entire area are covered by Mangalur and Nallur blocks. This area is occupied by denudational land forms like shallow buried pediment, deep buried pediment and pediments.
ii. Central part of the district is characterized by sedimentary high grounds, elevation >80 m of Cuddalore sandstone of Tertiary age. This zone occupies part of Vridhachalam, Kammapuram, Kurinjipadi, Cuddalore and Kattumannarkoil taluks.
iii. The rest of the area in the district is covered by eastern coastal plain, which predominantly occupied by the floodplain of fluvial origin formed under the influence of Penniyar, Vellar and Coleroon river systems.

Marine sedimentary plain is noted all along the eastern coastal region of the district. In between the marine sedimentary plain and fluvial flood plains, fluvial marine deposits are noted, which consists of sand dunes and back swamp areas.

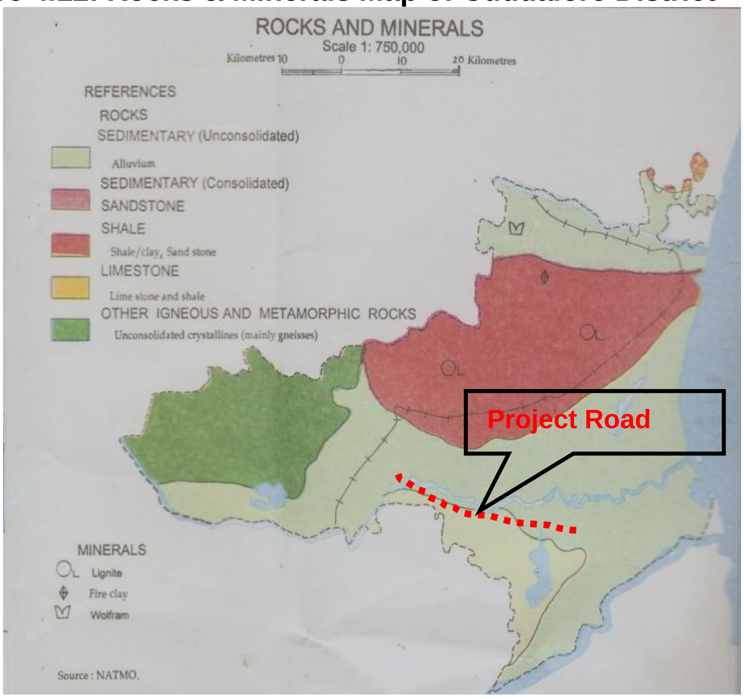
The rocks and minerals map of Villupuram and Cuddalore district are given in **Figures 4.11** and **4.12** respectively. The geological map of Villupuram district is given in **Figure 4.13**.

Figure 4.11: Rocks & Minerals Map of Villupuram District



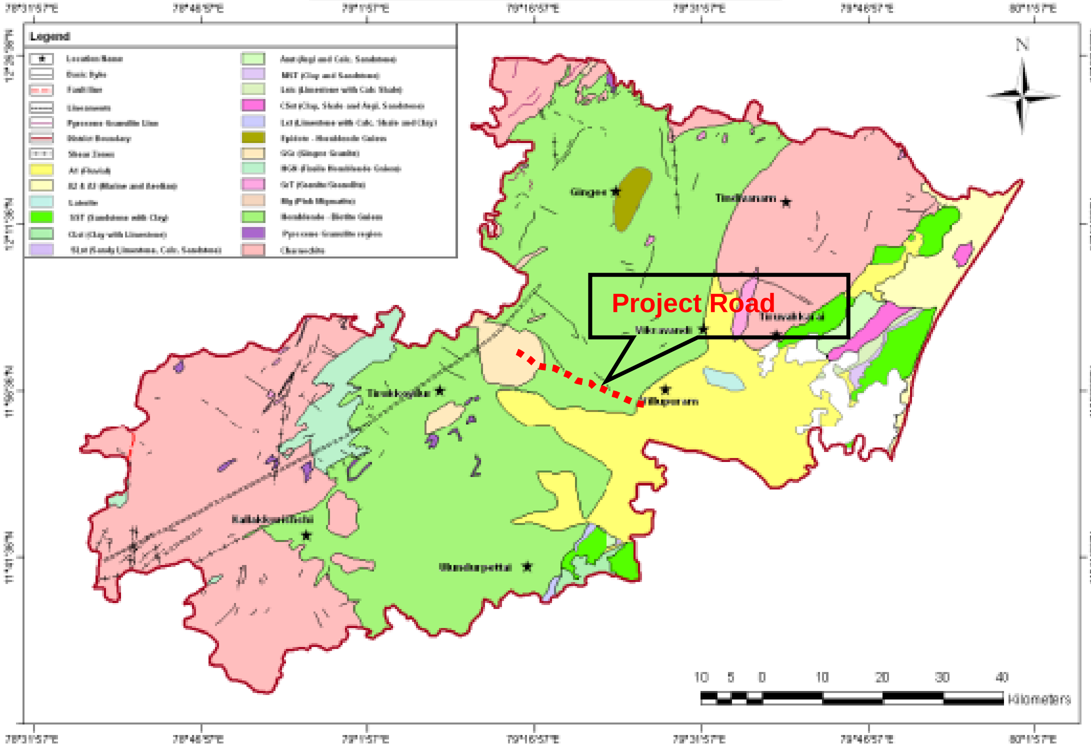
Source: National Atlas & Thematic Mapping Organization (NATMO), Department of Science & Technology

Figure 4.12: Rocks & Minerals Map of Cuddalore District



Source: National Atlas & Thematic Mapping Organization (NATMO), Department of Science & Technology

Figure 4.13: Geological Map of Villupuram District

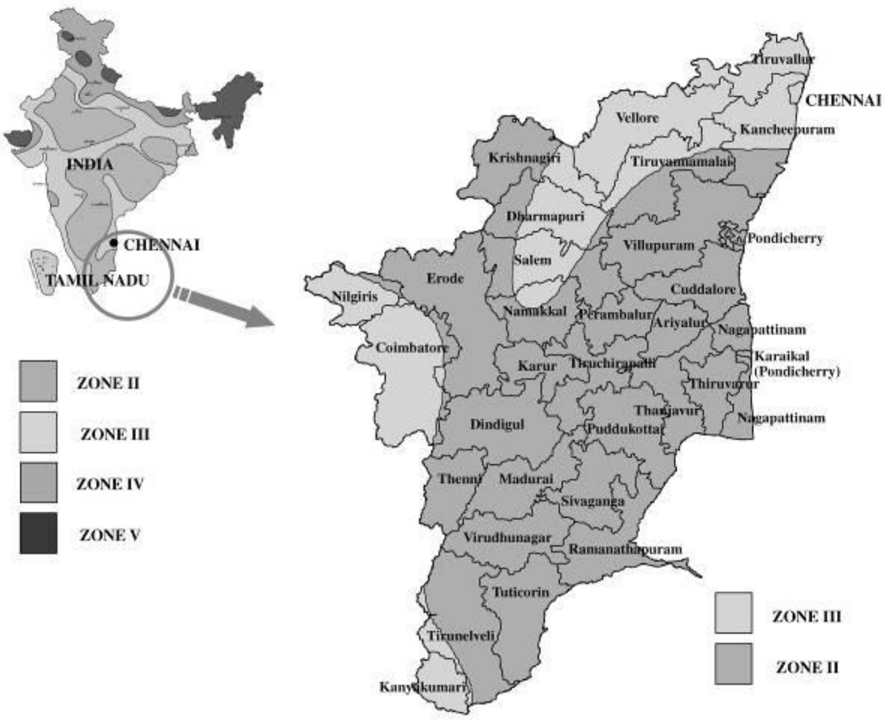


Source: Selvaraj et al., (2012) Petrology and geochemistry of mafic dykes from Villupuram district Southern granulite terrain of Tamil Nadu, India.

4.3.3 Seismology

The State of Tamil Nadu is a zone of low to moderate seismic activity with a sparse historical record of significant earthquakes. Both Villupuram and Cuddalore districts lie in Zone II of seismic activity. The seismic map of Tamil Nadu has been shown in **Figure 4.14.**

Figure 4.14: Seismic Map of Tamil Nadu



4.3.4 Land Use

Land use distribution of Villupuram and Cuddalore districts is given in **Table 4.7** and **Table 4.8** respectively.

Table 4.7: Land Use Pattern of Villupuram District

Land use	Area (ha)	Percentage
Forest	71,697	9.93
Barren and Uncultivable land	56,651	7.84
Land put to no agricultural use	135,874	18.81
Cultivable Waste	10,405	1.44
Permanent pastures & other grazing lands	4,195	0.58
Groves not included in the area sown	6,142	0.85
Current fallow	86,725	12.01
Other fallow lands	19,802	2.74
Net area sown	330,712	45.79
Total Geographical Area	722,203	100.00

Source: District Ground Water Brochure, Villupuram district

Table 4.8: Land Use Pattern of Cuddalore District

Land use	Area (ha)	Percentage
Forest	1,415	0.38%
Barren and Uncultivable land	14,647	3.92%
Land put to no agricultural use	55,875	14.97%
Cultivable Waste	6,072	1.63%
Permanent pastures & other grazing lands	608	0.16%
Groves not included in the area sown	19,716	5.28%
Current fallow	35,588	9.54%
Other fallow lands	19,369	5.19%
Net area sown	219,891	58.92%
Total Geographical Area	367,781	100.00%

Source: District Ground Water Brochure, Cuddalore district

It is clear from the above table that Villupuram district has significant barren and uncultivable land where as the Cuddalore district has significant agricultural land. The study area also shows similar characteristics as many patches of barren and uncultivable land have been seen along Madapattu- Thirukovilur road where as Vridhachalam-Parangipetai road is flanked by agricultural fields.

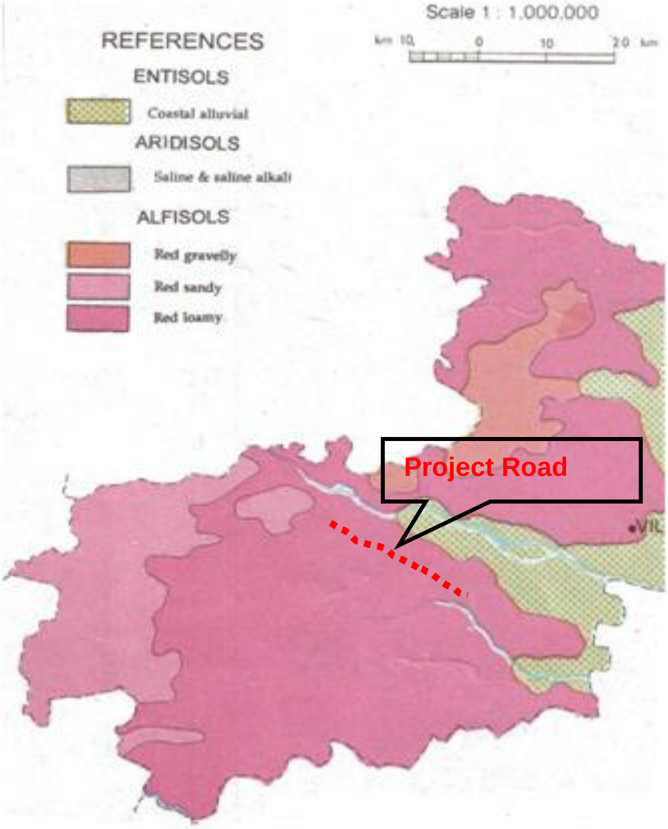
4.3.5 Soil Characteristics

Soil is a vital natural resource which is formed over hundreds of years from the erosion of the underlying geological strata, decaying organic matter, water and air. It is the home to a wide range of organisms and performs a range of functions essential to the well being of mankind and the natural and built environment.

The soils in the study area of Madapattu- Thirukovilur road are forest and red soils. These soils are loamy in nature. The soil map of Villupuram district is shown in **Figure 4.15.**

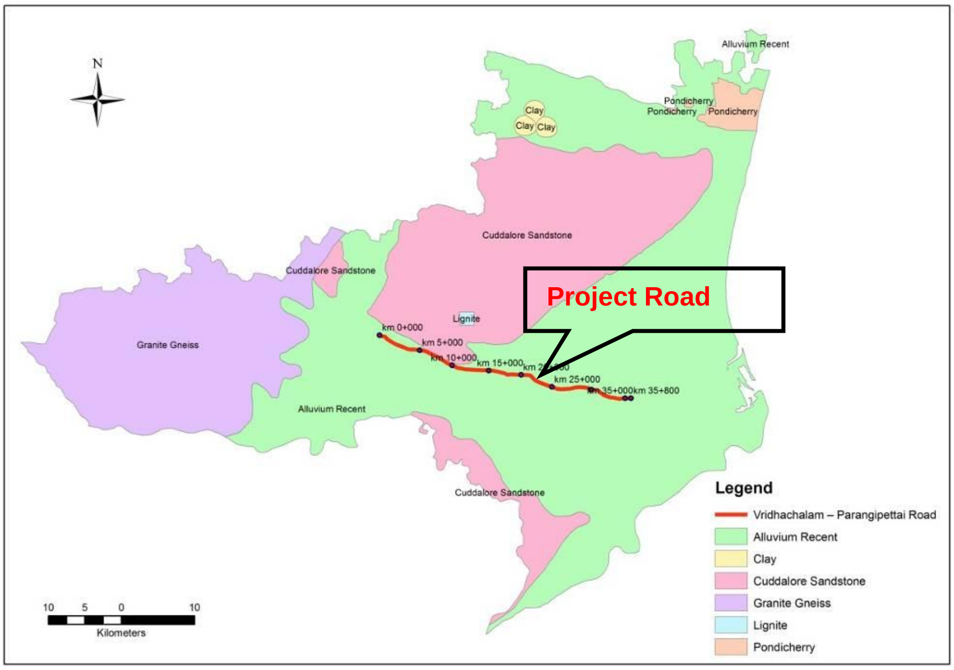
The soils in the study area of Vridhachalam- Bhuvanagiri road are younger alluvium, coastal alluvium, deltaic alluvium and red loamy. The younger alluvial soils are found as small patches along the streams and Vellar river course. The soil map of Cuddalore district is presented in **Figure 4.16**.

Figure 4.15: Soil Map of Villupuram District



Source: Soil Map, Survey of India Toposheet

Figure 4.16: Soil Map of Cuddalore District



Source: Soil Map, Survey of India Toposheet

The consultants collected soil samples at 2 locations from agriculture fields (km 35+800, km 66+200) in Madapattu-Thirukovilur road and at 3 locations from agriculture fields (km 6+000, km 35+600 and km 46+700) in Vridhachalam-Bhuvanagiri road. These soil samples were analyzed for physical characteristics (color, texture, water retention capacity, infiltration rate and density), particle size distribution, chemical characteristics (pH, electrical conductivity and organic carbon), and nutrient contents (NPK). Soil quality monitoring results are given in **Table 4.9** for Madapattu- Thirukovilur road and **Table 4.10** for Vridhachalam- Bhuvanagiri road. The monitoring locations have been shown in **Figure 4.9** and **Figure 4.10** for Madapattu-Thirukovilur road and Vridhachalam-Bhuvanagiri road respectively.

Table 4.9: Soil Quality Monitoring Results for Madapattu- Thirukovilur Road

S No.	Parameters	Unit	SQ1	SQ2
	Chainage		km 35+800	km 66+200
1	pH (10% solution)	-	7.95	6.54
2	Conductivity	Mmhos/cm	0.241	0.214
3	Sand	%	25	85
	Silt	%	10	15
	Clay	%	65	Nil
4	Texture		Clay soil	Sand soil
5	Moisture	%	10.48	3.43
6	Moisture retention capacity	%	3.49	1.14
7	Infiltration rate	Mm/hr	1.8	1.2
8	Organic Matter	mg/kg	142	153
9	Nitrogen	mg/kg	121	146
10	Potassium	mg/kg	130	128
11	Phosphorous	mg/kg	19	26
12	Sulphate	mg/kg	278	346
13	Sodium Sulphate	mg/kg	16	57
14	Calcium Sulphate	mg/kg	366	608
15	Oil and grease	mg/kg	<1.0	<1.0

Source: Consultants' Environmental Monitoring (Monitoring Carried out by Green Chem Solutions (P) Ltd., Chennai)

Table 4.10: Soil Quality Monitoring Results for Vridhachalam- Bhuvanagiri Road

S No.	Parameters	Unit	SQ1	SQ2	SQ3
1	pH (10% solution)	-	7.96	8.89	8.58
2	Conductivity	Mmhos/cm	0.410	0.243	0.314
3	Sand	%	95	88	70
	Silt	%	3	7	26
	Clay	%	2	5	4
4	Texture		Sand soil	Sand soil	Sand soil
5	Moisture	%	5.44	0.75	1.63
6	Moisture retention capacity	%	1.81	0.25	0.54
7	Infiltration rate	Mm/hr	1.80	1.6	1.5
8	Organic Matter	mg/kg	198	142	153
9	Nitrogen	mg/kg	162	128	144
10	Potassium	mg/kg	124	280	186
11	Phosphorous	mg/kg	23	19	27
12	Sulphate	mg/kg	237	632	368
13	Sodium Sulphate	mg/kg	27	715	40
14	Calcium Sulphate	mg/kg	357	832	608
15	Oil and grease	mg/kg	<1.0	<1.0	<1.0

Source: Consultants' Environmental Monitoring (Monitoring Carried out By Green Chem Solutions (P) Ltd., Chennai)

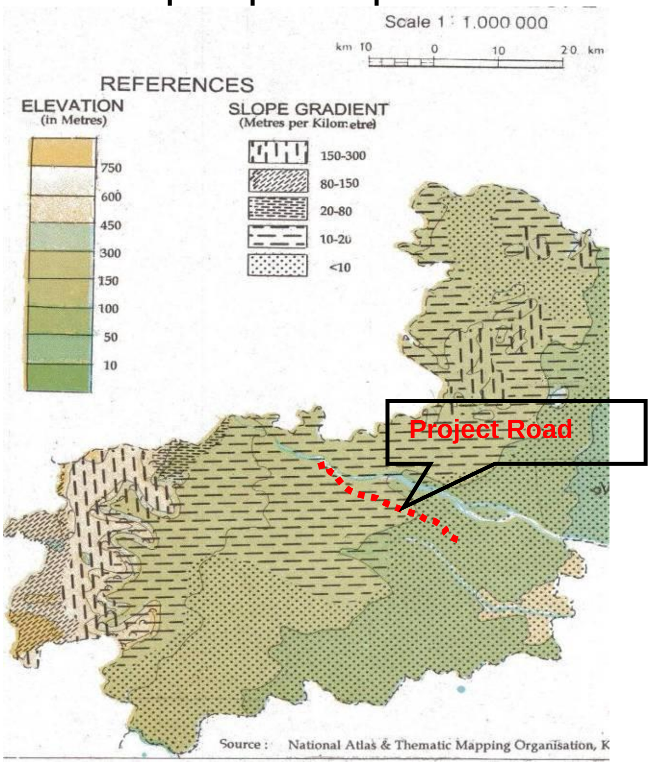
It is clear from the results that soils of both the roads have significant sand content except one sample. The soils are slightly alkaline in nature at both roads. The moisture content in soils is low due to sand in significant quantities. The soils could be categorized as moderately fertile.

4.3.6 Landslide / Landslip Problems

The ground slope in the study area is gentle towards coast in both the project roads. Almost the entire study area of both the corridors has nearly level slopes (0-1%). Elevation is low in the coastal area where backwaters have been formed by the incoming sea water through inlet channels or creeks and thus submerging the low lying coastal areas. The large Kaliveli swamp (about 50 sq km) is an example of such formation. Western and northwestern part of the district is rocky with densely forested slopes. Kalrayans is an important range running through the western hilly part. Its altitude ranges from 600 to 900 meters above MSL.

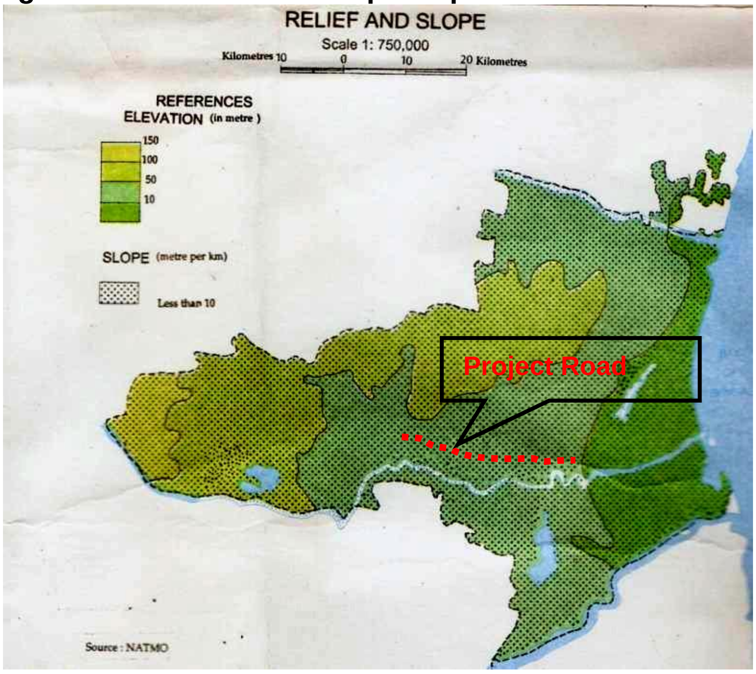
Both the project roads are located in more or less plain terrain with no possibility of landslides and land slips. The project area elevation varies between 10-50 m above mean sea level. The relief and slope map of Villupuram district and Cuddalore district are shown in **Figure 4.17** and **Figure 4.18** respectively.

Figure 4.17: Slope Map of Villupuram District



Source: National Atlas & Thematic Mapping Organization (NATMO), Department of Science & Technology

Figure 4.18: Relief and Slope Map of Cuddalore District



Source: National Atlas & Thematic Mapping Organization (NATMO), Department of Science & Technology

4.3.7 Agriculture

Agriculture is the most important occupation in the study area of both the project roads. Total cultivated land in the Villupuram district is 343,000 hectare. Major crops grown in the study area of Madapattu-Thirukovilur road is paddy. Ragi, pulses, gram, sugarcane, groundnut etc. Plantation crops are cotton, Vaazhai, gingerly, cashew nut, mango, coconut etc. River and tank water is harnessed for irrigation.

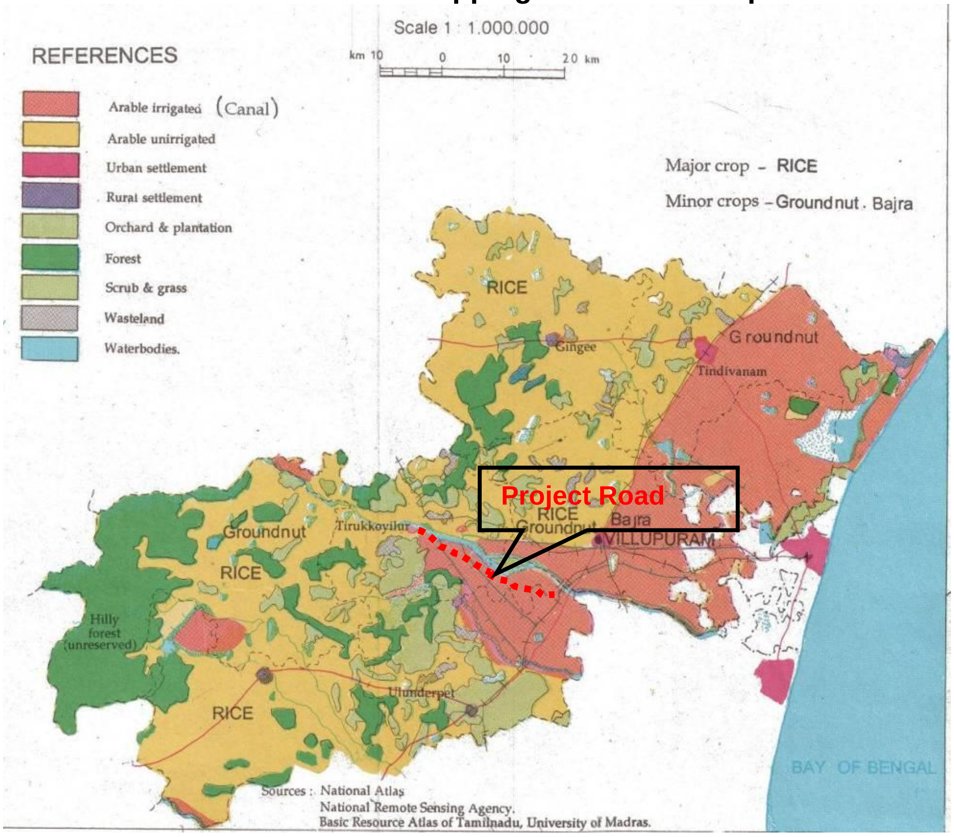
The rivers and streams in the study area are not perennial. The major sources of irrigation are tube wells and open dug wells. The surface flow in the rivers can be observed only during monsoon periods. The deficient monsoon rainfall has affected the flow of surface water into reservoirs, lakes, etc. Hence, under these circumstances the agriculturists have to totally depend upon an alternative source i.e. ground water to meet their irrigation requirements. The river irrigation in Villupuram district is less than 4.3% of total irrigated area.

The district largely depends on ground water, lakes and tanks for irrigation. The gross irrigated agriculture field in Villupuram district is 281,185 hectares which include irrigation facility such as dug wells, tube wells, tanks, canals, etc. There are 164,871 dug wells which irrigate a total area of 120,661 hectares, 23,454 tube-wells irrigating 54,525 hectares of field, 2,085 tanks irrigating total area of 6,648 hectares and 196 canals irrigating an area of 6,648 hectares.

In the study area of Vridhachalam- Bhuvanagiri road paddy is the major crop cultivated. The other crops grown are Groundnut, Sugarcane, Cholam, Cambu, Red gram, Cotton, Gingelly, Tapioca, Green gram, Black gram, Coriander, Vaazhai, Maize, Varagu and Cashew Nut. With 52% share, Cuddalore district is the top cashew nut producer in Tamil Nadu. Other important non food crops are Gingelly, Cotton and Coconut. For agricultural purposes maximum amount of available water resources is utilized through minor irrigation schemes. Like in case of study, area of Madapattu-Thirukovilur road, farmers use ground water as the alternative source for irrigation.

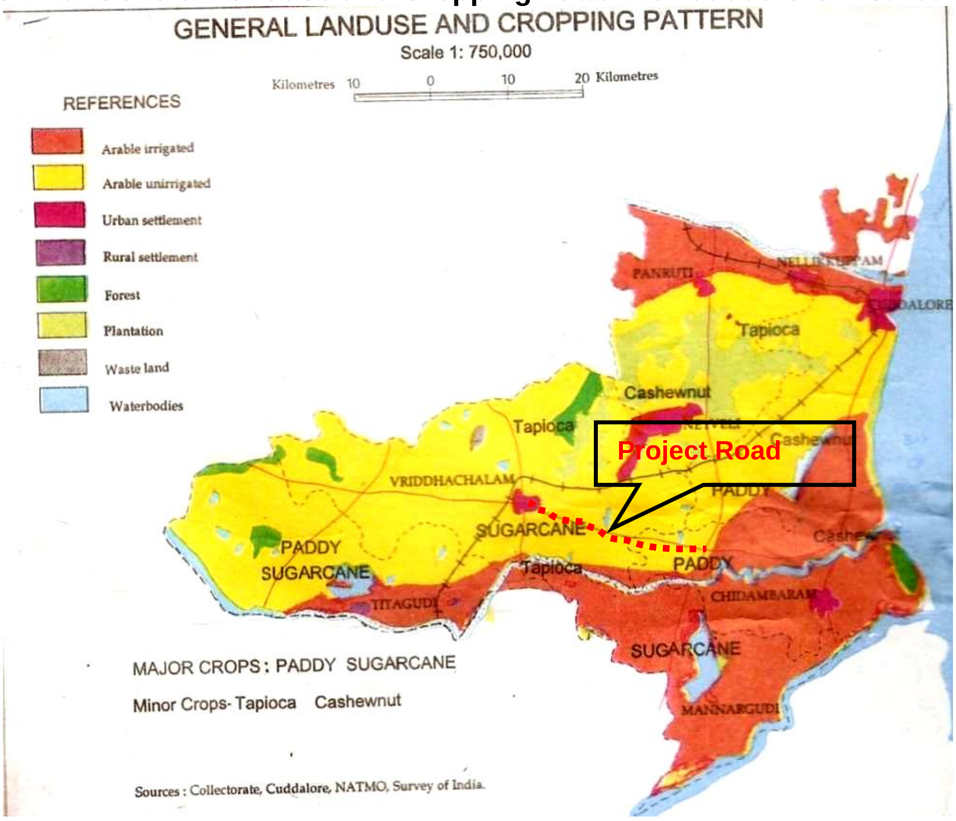
The general land use and cropping pattern in Villupuram and Cuddalore districts are shown in **Figures 4.19** and **4.20** respectively**.**

Figure 4.19: General Land use and Cropping Pattern of Villupuram District



Source: National Atlas & Thematic Mapping Organization (NATMO)

Figure 4.20: General Landuse and Cropping Pattern of Cuddalore District



Source: National Atlas & Thematic Mapping Organization (NATMO) & Survey of India

4.4 WATER ENVIRONMENT - BASELINE

Water is not merely a physical resource but it is densely encoded with social, spiritual, political and environmental meanings and these have a powerful effect upon patterns of water use and the relationship between water users and suppliers. The water environment of study area of both the corridors is described below:

4.4.1 Hydrology

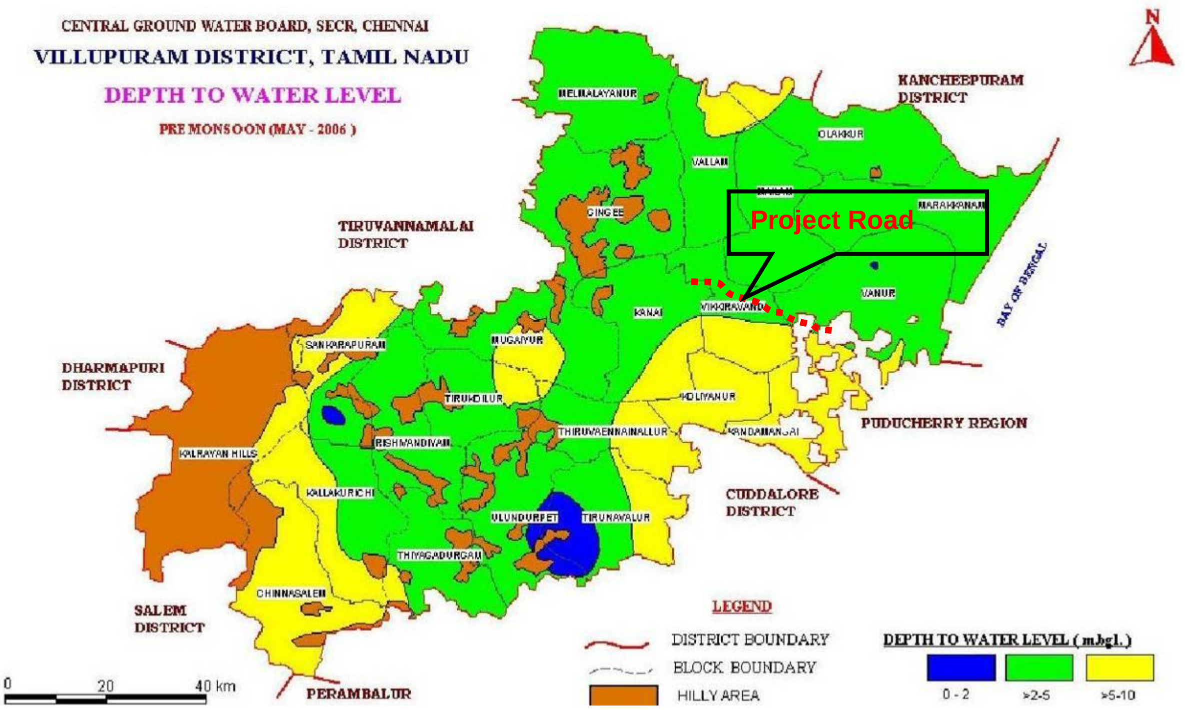
Madapattu- Thirukovilur Road

Major rivers draining Villupuram district are Ponnayar, Malattar and Gadilam. Out of these three rivers Ponnayar River falls in the study area near the end point of project road. The Ponnaiyar River flows from northwest to east towards the Bay of Bengal. This river is ephemeral in nature and carries only floodwater during the monsoon period. The drainage pattern is mostly parallel to sub parallel and drainage density is very low. There are small reservoirs across rivers in the district namely Gomukha, Vedur and Mahanathur.

Groundwater occurs under phreatic and semi–confined conditions in consolidated formations, which comprises weathered and fractured granites, gneisses and charnockites. In unconsolidated sedimentary rocks the groundwater occurs in phreatic, semi-confined conditions in Vanur sandstone, Kadapperi kuppam formation and Turuvai limestone. The depth of wells varies from 6.64 to 17 m below ground level. Water levels in observation wells of the Central Ground Water Board in shallow aquifers varied from 0.74 to 9.7 m below ground level during pre monsoon (May 2006) and it varies from 0.7 to 4.45 m below ground level during post monsoon (January 2007).

During pre monsoon, Central Ground Water Board recorded the depth of water levels in the range of 2 to 5 m below ground level in major parts of the district. In western and southeastern parts of the district, it ranged between 5 -10 m while in two isolated pockets as shown in **Figure 4.21** it ranged between 0-2 m below ground level.

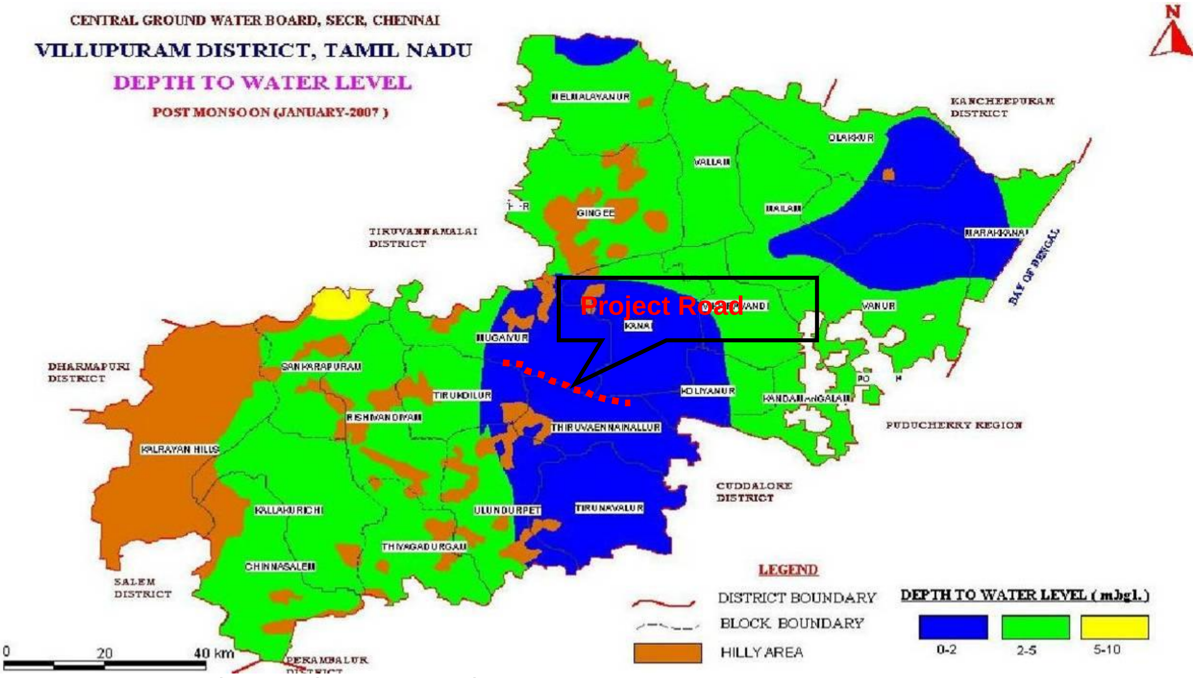
Figure 4.21: Pre-Monsoon Depth of Water Level in Villupuram district



Source: Central Ground Water Board

During post monsoon, the depth of water levels ranged from 2 to 5 m below ground level in major parts of the district. In central and northeastern parts of the district the range was recorded between 0 - 2 m below ground level as shown in **Figure 4.22.**

Figure 4.22: Post Monsoon Depth of Water Level in Villupuram district



Source: Central Ground Water Board

It is clear from the above Central Ground Water Board maps that water depth in study area ranges from 2- 10 m in pre-monsoon season and with onset of the monsoon, ground water depth becomes shallower in and around project area ranging between 2-5 m below ground level.

Vridhachalam- Bhuvanagiri Road

The Vellar is the major river in the study area. The Lower Vellar watershed in Cuddalore district, is characterized by coastal Tertiary Sedimentary rocks overlaid by Quaternary Alluvium.

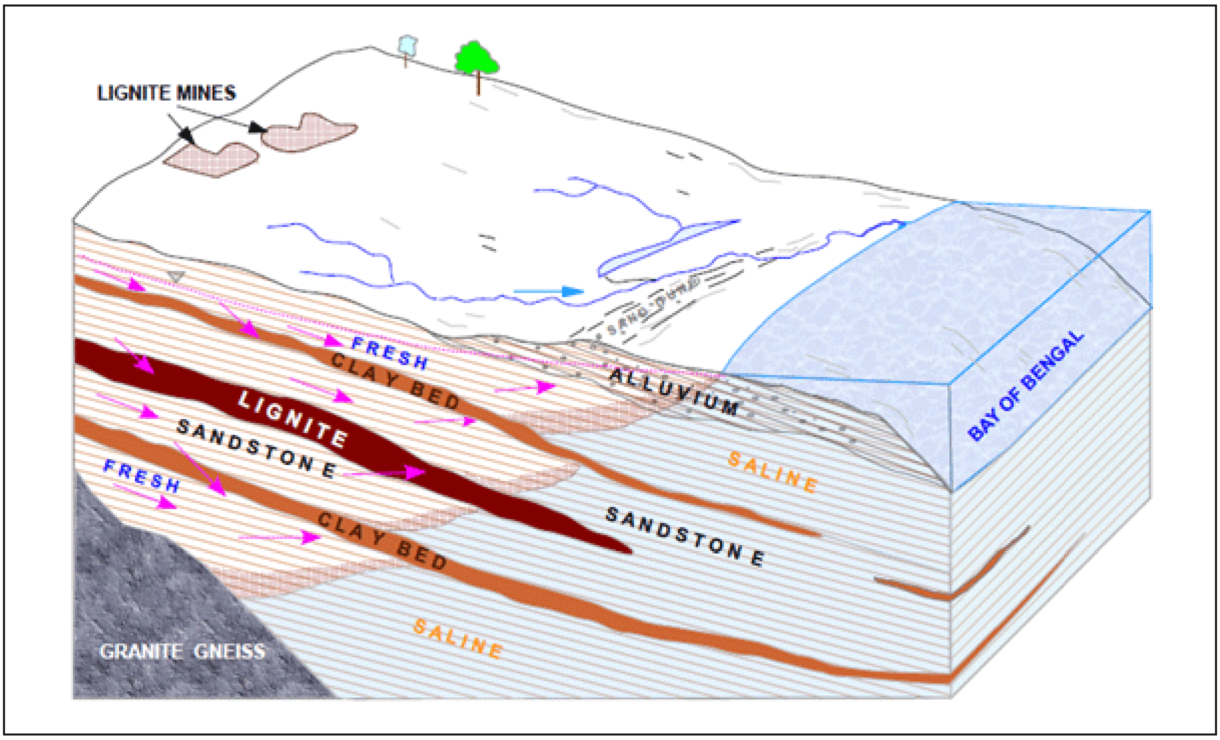
Freshwater occurs in the Quaternary Alluvium and underlying Cuddalore Sandstones of Tertiary age, which are being tapped up to the depth of 250 to 300 m. The quality of groundwater is in general potable, except for the coastal tract where saline groundwater occurs in the Quaternary Alluvium and freshwater aquifers are only in the underlying Cuddalore Sandstones. .

The aquifer system in the area is to the depth of 250 to 300 m and comprises four aquifers, two overlying the lignite bed, and the other two underlying it. The aquifer system of project area is shown in **Figure 4.23**.

The key groundwater management issues are the following:

- Sustainability of present groundwater abstraction, which requires water budgeting of each aquifer
- Saline water intrusion into ground water system
- Availability & sustainability of ground water resources of shallow and deeper aquifers

Figure 4.23: Schematic Views of the Aquifer Systems in the Area



Source: http://www.aquiferindia.org

4.4.2 Drainage Conditions/ Issues

Madapattu- Thirukovilur Road

The project road lies in the Ponniar Basin. Ponniar and its tributaries like Gadilam and Malattar drain the project region. All these rivers are ephemeral in nature and carry only flood water during monsoon. Malattar River joins Gadilam before flowing into the Bay of Bengal. Ponniar River flows through Thirukovilur and Villupuram Taluks.

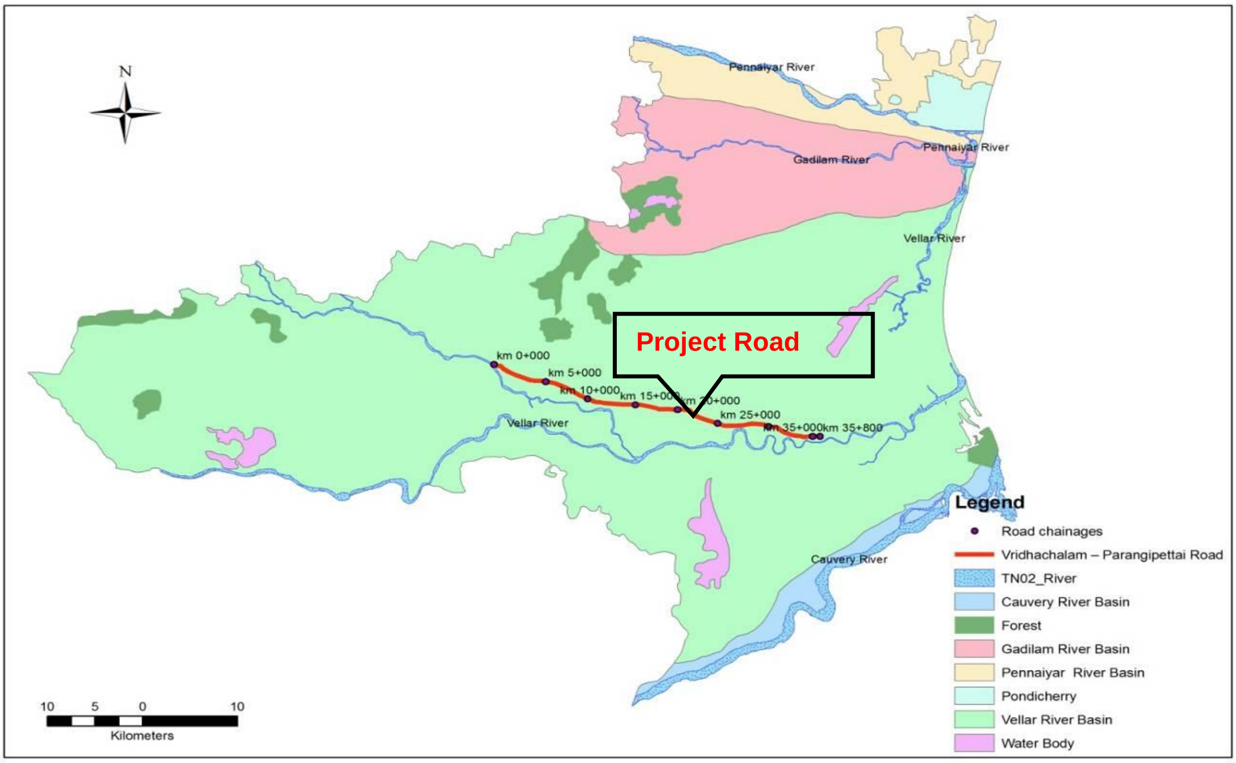
An important river near the project road is shown in **Figure 4.24**.

Figure 4.24: Project Road (Madapattu- Thirukovilur Road) & nearby Rivers

Vridhachalam- Bhuvanagiri Road

Manimuktha River drains the project region and flows within 200 m along the right side of the project road. Manimuktha is a tributary of Vellar River. The Vellar River rises at an elevation of 900 m near the village of Tumba in the Chittori hills, of the Eastern Ghats in the Salem district of Tamil Nadu. It flows generally in an easterly direction for a total length of 210 km through Salem and Cuddalore districts in Tamil Nadu and finally out falls into the Bay of Bengal near Porto Nova in Cuddalore district. It drains a total catchment area of about 8,922 sq km. The catchment area lies entirely in Tamil Nadu. The Gomuki and Manimuktha rivers are the important left bank tributaries and Sweta & Chinnar Rivers are the right bank tributaries of the Vellar. The rivers in/around the project area have been shown in **Figure 4.25** below:

Figure 4.25: River Basin Surrounding Vridhachalam-Bhuvanagiri Road



Source: River basin Map of Tamil Nadu, Survey of India Toposheet & satellite image.

4.4.3 Surface and Ground Water Quality

To understand baseline conditions of water quality, samples from ground and surface water sources were collected in both the project roads. The sampling locations were selected after the field investigations and review of all the water bodies/ resources along the project stretch. The water quality monitoring locations have been marked in **Figure 4.9** for Madapattu - Thirukovilur road and **Figure 4.10** for Vridhachalam- Bhuvanagiri road.

Sampling and Analysis Techniques:

Parameters for analysis of water quality were selected based on the utility of the particular source of water as per MoEFCC guidance. Water samples were collected from six locations on Madapattu- Thirukovilur road and 7 locations for the Vridhachalam- Bhuvanagiri road. Out of six water quality monitoring locations in Madapattu- Thirukovilur road three were surface water sources locations and three ground water source locations. In case of Vridhachalam- Bhuvanagiri road 6 samples were collected from ponds and river and one ground water. Samples were collected directly from the source and preserved in one liter jerry can bottle and for microbiological analysis separate 250ml sterilized bottles were used. The collected samples were analyzed as per the methods prescribed by APHA and IS: 3025. The quality of ground water was compared with IS 10500:2012 for drinking purpose. Surface Water quality water was compared with IS 2296 class C limits. Locations of the surface and ground water sampling sources are given in **Table 4.11** for Madapattu- Thirukovilur road and **Table 4.12** for Vridhachalam- Bhuvanagiri road.

Table 4.11: Locations of Water Sampling for Madapattu- Thirukovilur Road

Location code	Name of the location	Water Sampling Point
WQ 1	Veerapurama Nallur km 35+960	Hand pump- Ground Water
WQ 2	Pond (LHS) at km 35+800	Pond – Surface water
WQ 3	Pond (LHS) at km 52+200	Pond water- Surface Water
WQ 4	Pennaivallam at km 57+420	Hand Pump – Ground Water
WQ 5	Pond (LHS) at km 6+200	Pond- Surface Water
WQ 6	Thiruvannamalai at km 70+200	Hand Pump – Ground Water

Table 4.12: Locations of Water Sampling

Location code	Name of the location	Water Sampling Point
WQ 1	km 1+000 (RHS)	Pond water - Surface Water
WQ 2	Goathanur village (km8+600)	Hand Pump – Ground water
WQ 3	km 9+400 (LHS)	Pond water- Surface Water
WQ 4	km 16+350 (LHS)	pond water - Surface Water
WQ 5	Sethiathoppu junction (km 25+400)	Near bridge canal water- Surface Water
WQ 6	School and village (km35+600) (LHS)	Vellar River water- Surface Water
WQ 7	km 45 to 48	Pond water - Surface Water

Water Quality Analysis

The summary of surface water quality and ground water quality analysis has been given in **Table 4.13** and **Table 4.14** for Madapattu- Thirukovilur Road and **Table 4.15** and **Table 4.16** for Vridhachalam- Bhuvanagiri road.

Table 4.13: Summary of Surface Water Quality Results for Madapattu- Thirukovilur Road

S No	Parameters	Units	Surface Water			IS:2296 Class C Limits
			WQ 2	WQ 3	WQ 5	
1	pH @ 25°C	-	7.58	7.51	8.05	6.5 – 8.5
2	Conductivity 25° C	µmhos/cm	946	534	813	
3	Total Suspended Solids	mg/L	36	6	12	-
4	Total Dissolve Solid	mg/L	625	362	535	2000
5	Dissolved Oxygen	mg/L	6.9	6.1	7.2	Min 4.0
6	BOD @ 20°C for 5 days	mg/L	3	4	2	3.0
7	Chloride as Cl	mg/L	217	87	114	600
8	Free Ammonia	mg/L	0.51	0.12	0.18	-
9	Sodium absorption Ratio	-	2.92	0.98	1.17	-
10	Boron as B	mg/L	BDL	BDL	BDL	1.0
11	Sulphate as SO4	mg/L	21	BDL	45	400
12	Total Phosphate as PO_4	mg/L	1.41	0.19	BDL	
13	Total Nitrogen	mg/L	2.16	1.72	2.12	
14	Oil & Grease	mg/L	<1.0	<1.0	<1.0	-
15	Total Coliform	MPN/100ml	365	180	205	5000

Source: Consultants' Environmental Monitoring (Monitoring Carried out by M/s Green Chem Solutions (P) Ltd., Chennai)

Table 4.14: Summary of Ground Water Quality for Madapattu- Thirukovilur Road

S No	Parameters	Units	WQ 1	WQ 2	WQ 3	IS:10500
1	pH @ 25°C	-	7.96	8.02	7.83	-
2	Color	Hazen	<1.0	<1.0	<1.0	15
3	Odour	-	Agreeable	Agreeabl e	Agreeable	Agreeable
4	Taste	-	Agreeable	Agreeabl e	Agreeable	Agreeable
5	Turbidity	NTU	<0.5	<0.5	<0.5	5
6	Total Dissolved Solid	mg/l	1125	956	1478	2000
7	Aluminum (as AL)	mg/l	BDL	BDL	BDL	0.2
8	Ammonia (as total ammonia-N)	mg/l	BDL	BDL	BDL	No Relaxation
9	Anionic detergent (as MBAS)	mg/l	BDL	BDL	BDL	1.0
10	Barium (as Ba)	mg/l	BDL	BDL	BDL	No Relaxation
11	Boron (as B)	mg/l	BDL	BDL	BDL	1.0
12	Calcium (as Ca)	mg/l	40	46	88	200
13	Chloramines (as Cl_2)	mg/l	BDL	BDL	BDL	No Relaxation
14	Chloride (as Cl)	mg/l	337	346	458	1000
15	Copper (as Cu)	mg/l	BDL	BDL	BDL	1.5
16	Fluoride (as F)	mg/l	BDL	BDL	BDL	1.5
17	Free residual chlorine	mg/l	BDL	BDL	BDL	1.0
18	Iron (as Fe)	mg/l	0.09	0.11	0.07	No Relaxation
19	Magnesium (as Mg)	mg/l	51	39	57	100
20	Manganese (as Mn)	mg/l	BDL	BDL	BDL	0.3
21	Mineral oil	mg/l	BDL	BDL	BDL	No Relaxation
22	Nitrate (as NO_3)	mg/l	3.72	3.21	3.84	No Relaxation
23	Phenolic compound (as C_6H_5OH)	mg/l	BDL	BDL	BDL	0.002
24	Selenium (as Se)	mg/l	BDL	BDL	BDL	No Relaxation
25	Silver (as Ag)	mg/l	BDL	BDL	BDL	No Relaxation
26	Sulphate (as SO_4)	mg/l	158	41	118	400
27	Sulphide (as H_2S)	mg/l	BDL	BDL	BDL	No Relaxation
28	Total alkalinity (as $CaCO_3$)	mg/l	467	463	424	600
29	Total hardness (as $CaCO_3$)	mg/l	312	279	458	600
30	Zinc (as Zn)	mg/l	BDL	BDL	BDL	15
31	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	No Relaxation
32	Cyanide (as CN)	mg/l	BDL	BDL	BDL	No Relaxation
33	Lead (as Pb)	mg/l	BDL	BDL	BDL	No Relaxation
34	Mercury (as Hg)	mg/l	BDL	BDL	BDL	No Relaxation
35	Molybdenum (as Mo)	mg/l	BDL	BDL	BDL	No Relaxation
36	Nickel (as Ni)	mg/l	BDL	BDL	BDL	No Relaxation
37	Polychlorinated biphenyl	mg/l	Absent	Absent	Absent	No Relaxation
38	Polynuclear aromatic hydrocarbon (as PAH)	mg/l	Absent	Absent	Absent	No Relaxation
39	Total arsenic (as As)	mg/l	BDL	BDL	BDL	0.05
40	Total chromium (as Cr)	mg/l	BDL	BDL	BDL	No Relaxation
41	Total Coliform bacteria	MPN/ 100 ml	Absent	Absent	Absent	Absent
42	E coli	MPN/ 100 ml	Absent	Absent	Absent	Absent

Source: Consultants' Environmental Monitoring (Monitoring Carried out By Green Chem Solutions (P) Ltd., Chennai)

Table 4.15: Summary of Surface Water Quality for Vridhachalam- Bhuvanagiri Road

S No	Parameters	Units	Surface Water						IS:2296 Class C Limits
			WQ 1	WQ 3	WQ 4	WQ 5	WQ 6	WQ 7	
1	pH @ 25°C	-	6.86	8.07	8.41	8.08	8.16	7.58	6.5 – 8.5
2	Total Suspended Solids	mg/L	52	34	14	12	6.0	7.0	-
3	Total Dissolve Solid	mg/L	605	937	858	1089	1958	261	2000
4	Dissolved Oxygen	mg/L	2.1	5.0	6.2	4.9	7.1	6.8	Min 4.0
5	BOD @ 27°C for 3 days	mg/L	36	12	5.0	14	2.5	4.0	3.0
6	Chloride as Cl	mg/L	125	176	201	247	745	34	600
7	Free Ammonia	mg/L	0.81	0.32	0.28	0.42	0.12	0.22	-
8	Sodium absorption Ratio	-	0.64	1.74	1.78	1.83	5.63	0.36	-
9	Boron as B	mg/L	0.18	BDL	BDL	0.26	0.38	BDL	1.0
10	Sulphate as SO4	mg/L	9.4	107	59	269	156	25	400
11	Total Phosphate as PO_4	mg/L	0.42	0.50	0.46	0.38	0.61	0.34	
12	Total Nitrogen	mg/L	3.97	2.97	1.92	2.72	1.76	1.26	
13	Oil & Grease	mg/L	3.7	2.3	1.8	2.6	1.5	1.8	-
14	Total Coliform	MPN/ 100ml	750	284	110	305	42	86	5000

Source: Consultants' Environmental Monitoring (Monitoring Carried out by M/s Green Chem Solutions (P) Ltd., Chennai)

Table 4.16: Summary of Ground Water Quality Results for Vridhachalam- Bhuvanagiri Road

S No	Parameters	Units	WQ 2	IS:10500
1	pH @ 25°C	-	8.1	-
2	Color	Hazen	<1.0	15
3	Odour	-	UO	Agreeable
4	Taste	-	Agreeable	Agreeable
5	Turbidity	NTU	<0.5	5
6	Total Dissolved Solid	mg/l	518	2000
7	Aluminum (as AL)	mg/l	BDL	0.2
8	Ammonia (as total ammonia-N)	mg/l	BDL	No Relaxation
9	Anionic detergent (as MBAS)	mg/l	BDL	1.0
10	Barium (as Ba)	mg/l	BDL	No Relaxation
11	Boron (as B)	mg/l	BDL	1.0
12	Calcium (as Ca)	mg/l	88	200
13	Chloramines (as Cl_2)	mg/l	BDL	No Relaxation
14	Chloride (as Cl)	mg/l	79	1000
15	Copper (as Cu)	mg/l	BDL	1.5
16	Fluoride (as F)	mg/l	BDL	1.5
17	Free residual chlorine	mg/l	BDL	1.0
18	Iron (as Fe)	mg/l	BDL	No Relaxation
19	Magnesium (as Mg)	mg/l	BDL	100
20	Manganese (as Mn)	mg/l	BDL	0.3
21	Mineral oil	mg/l	BDL	No Relaxation
22	Nitrate (as NO_3)	mg/l	6.21	No Relaxation
23	Phenolic compound (as C_6H_5OH)	mg/l	BDL	0.002
24	Selenium (as Se)	mg/l	BDL	No Relaxation
25	Silver (as Ag)	mg/l	BDL	No Relaxation
26	Sulphate (as SO_4)	mg/l	53	400
27	Sulphide (as H_2S)	mg/l	BDL	No Relaxation

S No	Parameters	Units	WQ 2	IS:10500
28	Total alkalinity (as $CaCO_3$)	mg/l	296	600
29	Total hardness (as $CaCO_3$)	mg/l	316	600
30	Zinc (as Zn)	mg/l	BDL	15
31	Cadmium (as Cd)	mg/l	BDL	No Relaxation
32	Cyanide (as CN)	mg/l	BDL	No Relaxation
33	Lead (as Pb)	mg/l	BDL	No Relaxation
34	Mercury (as Hg)	mg/l	BDL	No Relaxation
35	Molybdenum (as Mo)	mg/l	BDL	No Relaxation
36	Nickel (as Ni)	mg/l	BDL	No Relaxation
37	Polychlorinated biphenyl	mg/l	Absent	No Relaxation
38	Polynuclear aromatic hydrocarbon (as PAH)	mg/l	Absent	No Relaxation
39	Total arsenic (as As)	mg/l	BDL	0.05
40	Total chromium (as Cr)	mg/l	BDL	No Relaxation
41	Total Coliform bacteria	MPN/100 ml	Absent	Absent
42	E coli	MPN/100 ml	Absent	Absent

Source: Consultants' Environmental Monitoring (Monitoring Carried out By Green Chem Solutions (P) Ltd., Chennai)

The analysis results indicate that two out of the three surface water samples of Madapattu-Thirukovilur road comply with all parameters specified in IS: 2296. In one sample BOD is exceeding the limit. In case of Vridhachalam - Bhuvanagiri road all six samples except one comply with IS: 2296 limits (Class C). In one sample Chloride level is exceeding the limit.

The analysis results indicate that all parameters of ground water quality comply with IS: 10500 standards in both the project roads.

4.4.4 Coastal and Marine Resources in Project Influence Area

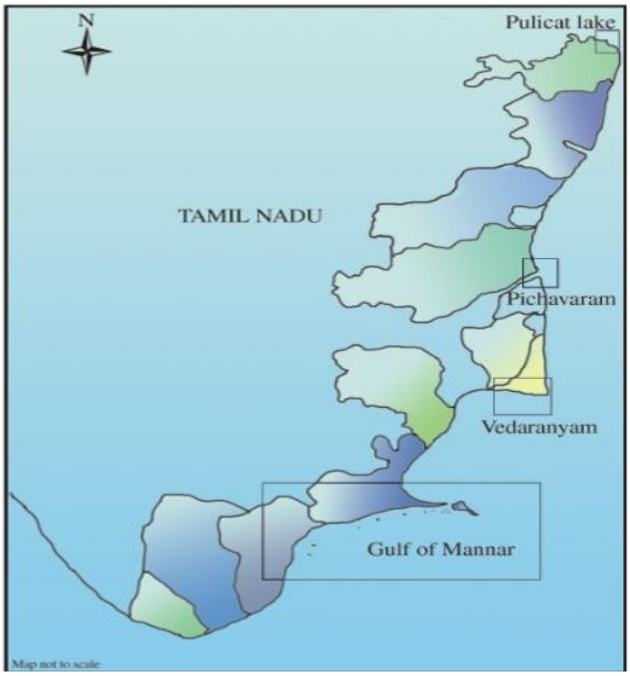
Out of the total coastline of 1076 km in Tamil Nadu, Villupuram district (project road district of Madapattu Thirukovilur road) shares a length of 40.7 km whereas Cuddalore district (Project road district of Vridhachalam- Bhuvanagiri road) shares a length of 50.70 km.

Coastal fisheries are a major activity and there are number of fishing harbours along the coast. Agriculture and plantations of Casuarina are quite common along the coast. There are two major ports along the coast viz., Chennai and Thoothukudi, two medium ports at Cuddalore and Nagapattinam and six minor ports at Pamban, Kilakarai, Rameswaram, Colachel, Kanyakumari and Valinokkam. The Gulf of Munnar Biosphere Reserve, Point Calimere Wildlife Sanctuary, Mangrove Forests at Pitchavaram and Muthupet and coral reefs at Thoothukudi add aesthetic and environmental dimension to the coast.

Study area of Madapattu- Thirukovilur road doesn’t fall under coastal zone or any marine resources as nearest coast line from project road is about 35 km aerial distance.

One of the largest and most unspoiled mangrove forests in Tamil Nadu is at Pitchavaram in Cuddalore District, extending over an area of 1100 ha. This mangrove forest is about 8 km from the end point (km35+800) of Vridhachalam- Bhuvanagiri road.

Figure 4.26: Map Showing the Ecologically Important Areas of Tamil Nadu



4.5 AMBIENT NOISE- BASELINE

Noise in general is a sound which is composed of many frequency components of different loudness distributed over the audible frequency range. Noise monitoring has been carried out during day and night time with a minimum of 4 readings per minute for 15 min in an hour for 24 hours. From the noted levels while using a handheld noise meter, in ‘A’ weighted averaging for ambient noise, Leq (Day) and Leq (Night) were calculated.

A preliminary reconnaissance survey was undertaken in both the project roads to identify the major noise generating sources along the project roads. To assess prevailing noise levels in the surroundings of project roads, ambient noise monitoring was carried out considering all categories of land uses along both the roads (like commercial, residential and silence zones) Total 4 locations within the study area were selected for noise level measurements in Madapattu- Thirukovilur road and 8 locations in Vridhachalam- Bhuvanagiri road. The locations of the noise monitoring finalized are given in **Table 4.17** for Madapattu- Thirukovilur road and **Table 4.18** for Vridhachalam- Bhuvanagiri road. The locations of noise level measurements are shown in **Figure 4.9** for Madapattu- Thirukovilur road and **Figure 4.10** for Vridhachalam-Bhuvanagiri Road.

Table 4.17: Ambient Noise Level Monitoring Locations for Madapattu-Thirukovilur Road

Location code	Name of Location	Classification
NQ 1	NH-45 intersection (km 41+700)	Commercial
NQ 2	Kotanur Village (km 48+600)	Residential and Rural Area
NQ 3	Pennai Vallam, School (LHS) (km 58+300)	Sensitive
NQ 4	By crossing of Thiruvannamalai (km66+200)	Residential and Urban Area

Table 4.18: Ambient Noise Level Monitoring Locations for Vridhachalam- Bhuvanagiri Road

Location code	Name of Location	Classification
NQ 1	Junction (km 0+000)	Commercial
NQ 2	Gopalapuram village Church and school (km8+600)	Sensitive
NQ 3	Kamapuram School (LHS) (km12+100)	Sensitive

NQ 4	School and hostel (RHS) (km18+200)	Sensitive
NQ 5	Church and school (RHS) (km20+200) to (20+600)	Sensitive
NQ 6	Sethiathoppu junction (km25+400)	Commercial
NQ 7	School and village (LHS) (km35+600)	Sensitive
NQ 8	Near Sri putru Mariyamman Kovil (km45 to 48)	Residential and rural area

4.5.1 Ambient Noise Levels

Leq (day) and Leq (Night) calculated using the monitoring results are given in **Table 4.19** for Madapattu- Thirukovilur Road and **Table 4.20** for Vridhachalam- Bhuvanagiri road and these have been compared with CPCB standards for the respective applicable category of monitoring locations.

Table 4.19: Ambient Noise Levels Measured on Madapattu- Thirukovilur Road

Location code	Classification of area	Noise level Leq dB (A)		CPCB standard Leq dB (A)	
		Day	Night	Day	Night
NQ 1	Commercial	58.7	49.6	65	55
NQ 2	Residential and Rural Area	52.6	41.7	55	45
NQ 3	Sensitive	48.8	37.2	50	40
NQ 4	Residential and Urban Area	51.4	42.9	55	45

Source: Green Chem Solutions (P) Ltd.

Table 4.20: Ambient Noise Levels Measured along Vridhachalam- Bhuvanagiri Road

Location code	Classification of area	Noise level Leq dB(A)		CPCB standard Leq dB(A)	
		Day	Night	Day	Night
NQ 1	Commercial	60.4	47.9	65	55
NQ 2	Sensitive	48.9	37.6	50	40
NQ 3	Sensitive	49.2	38.5	50	40
NQ 4	Sensitive	47.8	37.7	50	40
NQ 5	Sensitive	49.0	38.2	50	40
NQ 6	Commercial	61.3	48.8	65	55
NQ 7	Sensitive	48.5	37.4	50	40
NQ 8	Commercial	59.9	46.5	65	55

Source: Green Chem Solutions (P) Ltd.

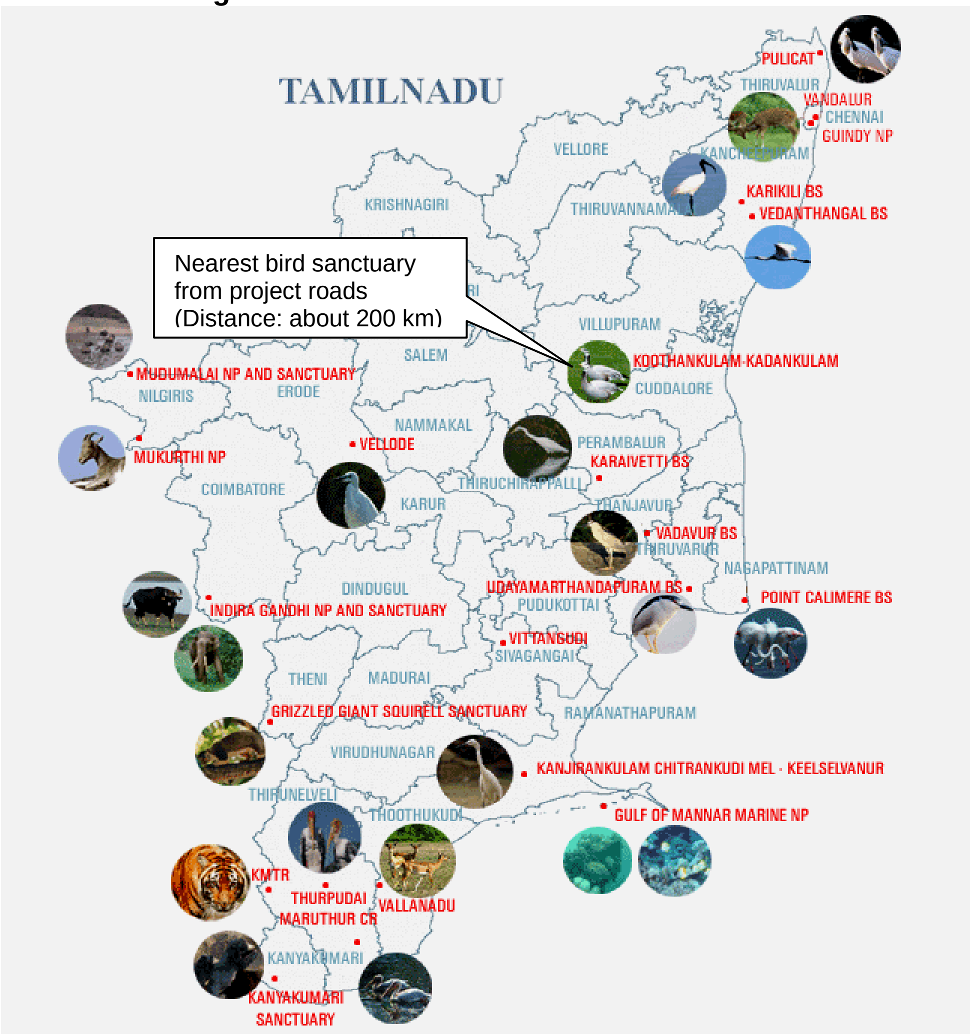
The measured 'Day' and 'Night' Leq values are well within the stipulated limits for respective land uses of monitoring locations at both the project roads.

4.6 FLORA AND FAUNA - BASELINE

The major protected areas in Tamil Nadu include 3 biosphere reserves, 5 national parks, 8 wildlife sanctuaries, 4 elephant reserves, 3 tiger reserves and 13 bird sanctuaries. These protected areas of the state contain viable populations of threatened wildlife, keystone species and endemic species and cover significant eco-system types, habitats, landscapes and wildlife corridors. These protected areas of the state are mainly managed for conservation of biodiversity, education, recreation, and preservation of historic sites, unique landscapes and seascapes. The details of protected areas in Tamil Nadu are given in **Annexure 4.2**. The protected areas of Tamil Nadu have been shown in **Figure 4.27**.

There is no wild life sanctuaries/park within 15 km aerial distance of the project site. The area did not record the presence of any critically threatened species. The records of Botanical Survey of India and Forest Department also did not indicate the presence of any high endemic or vulnerable species in this area. However, the flora of the region has an appreciable diversity which may be attributed to the diverse soil type and the physiographic of the region. There are no wildlife crossings also in both the project roads.

Figure 4.27: Protected Areas of Tamil Nadu



Source: Tamil Nadu Forest Department

4.6.1 Forest Area

Madapattu- Thirukovilur Road

Forests cover over 17% of the state's geographical area. Forest area in the Villupuram district constitutes about 9.9% of the total area of the district, which spreads in the areas bordering Salem, Dharmapuri and Thiruvannamalai Districts with divisions of reserve forest, interface forest and social forest. Teak wood, rose wood and sandalwood trees are grown in the hills. In the Kalrayan Hills and Gingee areas, some medicinal plants are also grown. In the social forest areas, trees raised are mainly for firewood and paper making. Babul, Eucalyptus and Casuarina are found to be grown in the district. In some pockets of the district, cashew nut is also grown.

The project road neither passes through any notified forest nor any notified forest lies within 15 km distance of the project road.

Vridhachalam- Bhuvanagiri Road

The total area covered under the forest in the Cuddalore district is 4171 ha, Reserved Forest 3691.69 ha and reserved land 427 ha. Most of the forest areas lie in Panruti, Chidambaram, Kattumannarkoil, Vridhachalam, Tittakudi Taluk. The forest areas around study area are shown in **Table 4.21.**

Table 4.21: RF/PF Forest around Vridhachalam- Bhuvanagiri Road

Forest	Aerial Distance (Approx)
Narumanam Reserve Forest (Cashew Plantation)	7 km
Ammeri Reserve Forest (Cashew Plantation)	8.5 km
Velangulam Reserve Forest (Cashew Plantation)	12 km
Semakkottai Reserve Forest (Cashew Plantation)	10 km
Kallamedu Reserve Forest (Cashew Plantation)	15 km
Kangiruppu Reserve Forest (Cashew Plantation)	15 km
Karmangdi Reserve Forest (Open mixed Jungle)	8 km

4.6.2 Flora

The prevailing flora in the direct area of influence and in the study areas of respective project roads is described below in **Table 4.22.**

Table 4.22: List of the Flora in the Study Area of Project Roads

Botanical Name	Tamil Name	Habit
Acacia Arabica	Thumba Maram	Tree
Albizia Lebbek	Vagai Maram	Tree
Azadirachta indica	Veppa Maram	Tree
Bambusa aryndinacea	Moongil	Shrub
Borassus flabelifer	Panai mMaram	Tree
Ficus religiosa	Arasa Maram	Tree
Lannea coromandalica	Oothiya Maram	Tree
Morinda tnctiria	-	Shrub
Moringa Sp	Murungai Maram	Tree
Pongamia pinnata	Punga Maram	Tree
Prosopis juliflora	Seemaikuruvai	Tree
Tamarindus indicus	Puliya Maram	Tree
Vitex negundo	Aralichedi	Shrub
Zizyphus julupa	Navel Maram	Shrub

The species wise and girthwise list of trees is given in **Annexure 4.3** for the corridors for trees girth < 30 cm and > 30 cm.

4.6.3 Fauna

The prevailing Fauna in the direct area of influence and in the study areas of respective project roads is described below in **Table 4.23**.

Table 4.23: List of Fauna in the Study Areas of Project Roads

Mammals:

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Lepus nigricollis	Hare	Schedule IV	Least Concern
Canis aureuss	Jackal	Schedule II	Least Concern
Funambulus palmarum	Indian Panai Maram Squirrel	Not listed	Least Concern
Rattus norvegicus	Field mouse	Schedule V	Least Concern
Macaca radiata	Bonnet Monkey	Schedule II	Least Concern
Bandicota bengalensis	Bandicoot rat	Schedule V	Least Concern
Rousettus leschenaultia	Fruit bat	Schedule V	Least Concern
Mus musculus	Common (House) mouse	Schedule V	Least Concern
Hystrix indica	Indian porcupine	Schedule IV	Least Concern

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Herpestes edwardsii	Common Mongoose	Schedule IV	Least Concern
Sus sucrofa	Wild pig	Schedule III	Least Concern

Reptiles:

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Plyas mucosus	Rat snake	Schedule II	Not known No conservation issue CITES Appendix II
Nerodia piscator	Fresh water snake	Schedule IV	Least Concern
Naja naja	Cobra	Schedule II	No special status CITES Appendix II
Bungaras bungaroides	Krait	Schedule IV	Least Concern
Vipera ruselli	Russel's (Daboia) viper	Schedule II	-
Calotes versicolor	Garden lizard	Common, widespread	No known threat issue
Chamaleo zeylanicus	Indian chameleon	Not listed	NT SL

Amphibians:

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Rana hexadactyla	Frog	Schedule IV	Least Concern
Rana tigrina	Bull frog	Schedule IV	Least Concern
Bufo melanosticus	Toad	Schedule IV	Least Concern

Birds:

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Eudynamys scolopaceus	Asian koel	Not listed	Common & widespread; no conservation issue
Corvus splendens	House crow	Schedule V	Least Concern
Acridotheres tristis	Common myna	Schedule IV	Least Concern
Columba livia	Rock pigeon	Schedule IV	Least Concern
Tylo alba	Barn owl	Schedule IV	Least Concern
Bubulcus ibis	Cattle egret	Schedule IV	Least Concern
Milvus migrans	Pariah kite	Not listed	Least Concern
Coracias benghalensis	Indian roller	Schedule IV	Least Concern
Centropus sinensis	Crow pheasant	Schedule IV	Least Concern
Passer domesticus	House sparrow	Not listed	Least Concern
Orthotomus sutorius	Tailor bird	Not listed	Least Concern
Microcarbo niger	Little cormorant	Schedule IV	Least Concern
Quilis contronix	Grey quail	Schedule IV	-
Phalacrocorax fuscicollis	Large (Indian) cormorant	Schedule IV	Least Concern
Quills conronix	Grey quail	Not listed	-
Cypsiurus balasinensis	Panai Maram swift	Not listed	Least Concern

Scientific Name	English Name	WLPA 1972: Schedule	IUCN Threat Category
Oriolus kundoo	Indian oriole	Schedule IV	Least Concern
Ploceus philippinus	Weaver bird	Not listed	Least Concern
Cuculus micropterus	Indian cuckoo	Schedule IV	Least Concern
Pycnonotus cafer	Red- vented bulbul	Not listed	Least Concern
Dicrurus macrocercus	Black drongo	Schedule IV	Least Concern
Alcedo atthis	Common kingfisher	Not listed	Least Concern
Chalcophaps indica	Emerald dove	Schedule IV	Least Concern
Ardeola grayii	Pond heron	Schedule IV	Least Concern

4.7 SOCIO-ECONOMIC ENVIRONMENT

Socio-economic study is an important integral part of the environmental study. Existing as well as upcoming project will have impact (adverse or beneficial) on the environment. The impact may alter the socio-economic status of the society in dual ways.

Information on the above said factors was collected to define the socio-economic profile of the study area. The information on socio-economic aspects was compiled from various secondary sources, including various government and semi government offices.

Many of the major changes in the socio-environment, and socio-cultural set up will be envisaged from the proposed project development. All these features of the socio-economic environment along the project road have been recorded. The social impacts, covering project affected persons, loss of structures, standing crops and trees have been covered under SIA report under separate cover. The demographic, features, population, literacy and occupational pattern of the project areas are explained in this section.

Population Details of Project Districts

Madapattu- Thirukovilur Road: As per 2011 Census, Villupuram district has a total population of 3,458,873 of which males account for 1,740,819 and females account for 1,718,054. The Urban population, according to 2011 census is 519,088 and rural population is 2,939,785 and the population density of the district per sq. km. is 410. The summary of Villupuram district demographic profile has been given in **Table 4.24.**

Table 4.24: Summary of Villupuram District Demographic Profile

Description	Number
Population (2011)	3,458,873
A. Sex wise	
Male	1,740,819
Female	1,718,054
B. Rural Population	2,939,785
C. Urban Population	519,088
Density	410
Sex Ratio (No. Of females per 1000 Males)	985
Literates	64.7%

Vridhachalam -Bhuvanagiri Road: As per 2011 census, the population of the Cuddalore district is 2,600,880 which comprises of 1,311,151 males and 1,289,729 females. The urban and rural population of the district is 882,631 and 1,718,249 respectively. Summary of Cuddalore district demographic profile of the district is presented in **Table 4.25.**

Table 4.25: Summary of Cuddalore District Demographic Profile

Description	Number
Population (2011)	2,600,880
• Sex wise	
Male	1,311,151
Female	1,289,729
• Rural Population	1,718,249
• Urban Population	882,631
Density	702
Literates	1,849,805
Male worker	636,911
Female worker	336,155
Rural workers	729,764
Urban worker	243,325
Cultivators	185,875
Agriculture laborers	449,204
House hold industrial workers	30,457
Other workers	307,530
Marginal workers	243,302
Non workers	1,312,329

4.7.1 Settlement/Villages

The Madapattu- Thirukovilur road passes mostly through rural habitations. The premoninent locations are Madapattu, Irundhai, Arumpattu, Madhampattu, Gopulapuram, Saravanapakkam, Pennaivalam, Ammavasappayam, T. Kunnathur and Edapalayam, Out of these Madapattu, Sarvanapakkam and Pennaivalam are semi urban settlements balance all are rural villages.

The Vridhachalam- Bhuvanagiri road passes through urban settlements of Vridhachalam and Bhuvanagiri. The semi urban settlement is Kammapuram and Gopalapuram. The rural settlements along the project road are Kara Kudal, Mavidanthal, Athanur, Kumara Mangalam, Keenanur, Sirvarapur, Sathapady, Katharai, Dharmanallur, Melvlayamdevi, Erumbur, Naltanikulam, Sethiyathope, Manjakolai, Manjakolai and B. Odaiyur,

The details of population, occupation and other details of the above settlements have been covered in the SIA report under separate cover.

Land Use Pattern

The land use pattern has already been discussed in the section 4.3.

Economic Base

Most of the residents of the project corridor depend on agriculture for their livelihood. Villupuram is one of the least industrialized districts of Tamil Nadu. There are very few agro based industries in the district such as Sugar industry. Details of the people affected due to proposed improvement is presented in SIA as a separate volume of the DPR

4.7.2 Socio-Cultural Properties

Religious Centers

Some Temples and Mosques are present along the project road. There are a total number of 25 religious structures existing along the project road which has been discussed in Chapter 7.

Cultural Heritage Sites

There are no specific heritage monuments or cultural heritage within the direct impact zone of the project road.

Archaeological Monuments

There are no specific heritage monuments or protected monuments and Archaeological sites within 500 m of the project road.

Sacred Groves

Sacred groves represent an ancient Indian conservation tradition, protected by local people out of reverence and respect, fear and sentiment. They are the home of the local flora and fauna, a veritable gene pool and a mini-biosphere reserve.

Madapattu- Thirukovilur Road: Villupuram district has one sacred grove know as "Puthupet Grove" is a thick tropical dry evergreen forest of 25 acres. This is located at a distance of 78 km from the project road.

Vridhachalam- Bhuvanagiri Road: There are five sacred groves - Kothattai, Chinna Komati, Chinna thana kuppam, Venagdam pettai and Kuzhaindhi kuppam in Cuddalore district. All these sacred groves are more than 50km away from the project site.

4.7.3. Common Properties Receptors

There are 3 sensitive receptors (educational) within the 15 m distance on either side of the existing centerline in Madapattu- Thirukovilur road and 10 sensitive receptors in Vridhachalam-Bhuvanagiri road. Details of sensitive receptors and impact due to road widening are discussed in Chapter 7.

CHAPTER 5 STAKEHOLDER CONSULTATION

5.1 OVERVIEW

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stakes in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

The stakeholders of the project include:

- Affected communities (on either side of the project road),
- Institutional stakeholders such as Highway Department, PCB, local bodies, Water Resource Department, Environmental Department, Forest Department, etc.

5.2 DEFINITION OF STAKEHOLDER

Stakeholders are the people, groups or organizations affected by a project and/or its outcomes. In infrastructure projects, by its nature as a means to enable operation, this definition gets a good workout because of the sheer number and diversity of stakeholders involved. Construction projects can involve a diverse range of stakeholders and the success of the project depends very much on fulfilling their needs and expectations. It is important, therefore, to identify and recognize project stakeholders and develop a rigorous stakeholder management process.

5.3 DETAILS OF CONSULTATIONS CARRIED OUT

5.3.1 Objectives of Stakeholder Consultations

The main objective of the consultation process is to minimize negative impacts of the project and to maximize the benefits of the project. Other objectives of the consultation process were the following:

- To promote public awareness and stakeholder about the proposed project, especially amongst the potentially impacted communities/individuals;
- To educate the potentially impacted communities/individuals about the proposed course of action and the project alternatives;
- To solicit the views of affected stakeholder on environmental and social problems;
- To gather inputs from the affected communities/individuals in crucial decisions regarding mitigation of the identified environmental and social issues;
- To stimulate community self evaluation and analysis;
- To inform Project Affected Persons (PAPs) about the entitlement framework;
- Resettlement Action Plan (RAP), and to settle their problems with mutual consent and to assist them during the relocation and resettlement; and
- To minimize public resistance to change by providing them a platform in the decision making process

5.3.2. Stages of Consultations and Information Dissemination

The consultations in the TNRSP II project are planned during the design stage to incorporate comments and suggestions of all stakeholders. The other round of consultations will be taken up after design completion. There will be a continuous dialogue with the locals during the construction phase. The project authorities and construction supervision consultants will take into account the suggestions of locals for the approval of construction camp sites. Post implementation TNRSP will take a user satisfaction study. This study will also be an outcome of the consultation process.

5.3.3 Methodology Adopted for Focus Group Discussions

Public consultation is conducted both during the screening stage as well as project preparation stage. Consultations conducted during the screening stage play an important role in defining the level and extent of consultation to be taken in the project preparation stage. It was held at two levels described below:

- *Local level*: Village Panchayats along the project road.
- *District level* consultations involving NGOs, Revenue Department, Highway Department officials, the local Forest Department will be taken up in the future;
- *Institutional level consultations*: State Forestry Department, Department of Science Technology and Environment, Urban Development and Tamil Nadu State Pollution Control Board were consulted.

5.4 DETAILS OF CONSULTATIONS FOCUS GROUP DISCUSSIONS (FGD)

Structured consultation with important stakeholders whose involvement is very much warranted for successful and smooth implementation of the project has been done under the project. For this purpose consultations at local level and the institutional have been conducted. These consultations were taken up in the months of May and June, 2014.

5.4.1 Consultation in Madapattu- Thirukovilur Road with Highway Department

One of the FGD in Madapattu- Thirukovilur was held on June 28, 2014 at Madapattu. From TNRSP side Assistant Divisional Engineer (ADE) from Vridhachalam office participated in the consultations. The TNRSP Divisional office for this project road is at Vridhachalam. The consultants also discussed, planned widening and improvement proposal with ADE. The views, comments and suggestions of participants and addressal in project design have been summarised below in **Table 5.1.**

Table 5.1: Highway Department Consultation, Issues and Addressal in Project Design (Madapattu- Thirukovilur Road)

S. No.	Location	Date and participants	Issues Raised	Addressal in Project Design
1	Highway Department Officials at Project Site (Madapattu)	28-06-2014 (ADE)	• The TNRSP officials suggested that there are giant Tamarind trees on either side of project road and in widening tree cutting on one side should be avoided. • There is Sugar Mill close to project road near km 49+600 (Sarvanapakkam junction) and during season there is traffic congestion on the road. The project should provide some relief measures for this. • ADE inquired whether any grade separator is planned in the project road • TNRSP officials inquired about the link road length	• The suggestion conveyed to the design team for finalisation of widening schedule to minimise the tree cutting. At a few locations trees have been saved. • The suggestion conveyed to design team. Additional one lane on either side of the junction in 400 m road length is proposed. This will avoid accident and congestion. • Consultants replied that no grade separator is planned. • The consultants replied that length of link road is about 5

S. No.	Location	Date and participants	Issues Raised	Addressal in Project Design
			• One rail line is crossing the project road. Any ROB is planned for this or not	km. • The consultants replied that ROB is not planned as part of the project, but Highway department is planning to construct ROB from State Government funds.

5.4.2 Consultations in Vridhachalam-Bhuvanagiri Road with Highway Department

In Vridhachalam- Bhuvanagiri road FGD also TNRSP side Assistant Divisional Engineer (AD) and Assistant Engineer (AE) from Vridhachalam office participated in the consultations. The consultants also discussed the planned widening and improvement proposal with AD and AE. The views, comments and suggestions of participants and addressal in project design have been summarised below in **Table 5.2**

Table 5.2: Highway Department Consultation, Issues and Addressal in Project Design (Vridhachalam- Bhuvanagiri Road)

S. No.	Location	Date and participants	Issues Raised	Addressal in Project Design
1	Highway Department Vridhachalam	06-05-2014 (ADE and AE)	• The HD officials inquired about tree cutting in the project and suggested that tree cutting should be minimized. • The AE inquired about 4 laning portion of the project. • ADE inquired what protection measure is being taken at Canal along the road from km 27+000 to 33+000 (Left side) • AE suggested that proper measures should be taken to minimise submergence. • AE inquired about the number of religious structures being impacted due to widening. • AE inquired any grade separator is planned or not. • AE inquired about bypasses and realignments as part of	• The consultants replied that 5,011 trees need to be cut. The cutting is due to concentric widening. The concentric widening takes up to minimise land acquisition. • The consultants replied that from km 0+000 to km 2+000 project road is planned for 4 laning. In the balance portion it is 2 lane with paved shoulders. • The consultants replied that metal beam crash barrier is planned on the canal side and road widening is planned on right side. • The Consultants replied that road raising is planned by 1.0 m in open areas and 92 new culverts have been planned for effective cross drainage. • The environmental expert replied that about 20 religious structures will be impacted. • The consultants replied that no grade separators are planned in the project. • The consultants replied that 4 small realignments planned for geometric improvements. Bypass possibilities being explored for Bhuvanagiri town. This bypass is not included in priority corridor.

S. No.	Location	Date and participants	Issues Raised	Addressal in Project Design
			the project. • AE suggested that DFO office Cuddalore should be contacted for confirmation of forest on the road.	• The consultants told that DFO will be contacted.

5.4.3 Focus Group Discussion with Population Residing Along Project Roads

Stakeholder consultation is a two-way process involving the interaction of various stakeholders and the project proponents. Considering the fact that involving local communities in the project planning is the basis of the participatory planning, stakeholder consultation forms an important part of the environmental assessment process. Often suggestions and options given by the people help in improving technical and economic efficiency of the project. Also, suggested improvement proposals by the people, if adopted in the project, generate a sense of ownership within communities and ease the implementation process.

Public consultation is an important method of involving various stakeholders, particularly, local community with reference to the proposed road improvement initiatives. It provides a platform for participants to express their views, concerns and apprehensions that might affect them positively or negatively. Through participation and consultation, the stakeholders influence development initiatives, and decision making process. The effectiveness of participation and consultation is directly related to the degree of involvement by the likely project affected persons and the local community and integration of outcome of consultations wherever feasible in the proposed development initiatives. Detailed consultation is required to ensure that likely Project affected persons, local community, interested groups, non-governmental organizations, civil society organizations; local government, line departments, etc. are consulted regularly, frequently and purposefully during different stages of the project including project preparation. The details of FGDs with the majority community are described below:

5.4.4 Dates and Places of FGDs Conducted

(a) Madapattu- Thirukovilur Road
Sarvanapakkam Junction (km 46+600): June, 28, 2014

Kolapakkam (km 65+000): June, 28, 2014

(b) Vridhachalam- Bhuvanagiri Road
Gopalpuram (km 8+500): 06th May 2014

Erambur (km 22+000): 06th May 2014

5.4.5 Major Community Issues

Community level consultations and the issues raised and the response of the project team has been tabulated in **Table 5.3** for Madapattu- Thirukovilur road and **Table 5.4** for Vridhachalam-Bhuvanagiri Road. Detailed coverage of Public Consultations is also provided in Social Impact Assessment Report while the photographs, news report of stakeholder consultation in local daily and attendance of the consultation has been shown in **Annexure 5.1**.

Stakeholder Consultation at Sarvanapakkam (km 46+600)

Stakeholder Consultation at Kolapakkam (km 65+000)

Table 5.3: Stakeholder Consultations, Issues and Addressal in Project Design (Madapattu- Thirukovilur Road)

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
1	Sarvanapakkam (km 46+600)	28-06-2014, Participants 59	• The participants informed that junction at 46+600 should be improved as there are many accidents at the junction • Participants suggested that in compensatory plantation Tamarind trees should be planted as there will be significant felling of Tamarind trees. • The participants demanded that bus shelters should be constructed along the project road as part of the road improvement. • The participants informed that there is a drainage problem in almost all habitations. The	• The consultants informed the participants that the junction will be improved and a proper roundabout will be constructed so minimise traffic conflicts. • The consultants noted the suggestion and informed the participants that in compensatory tree plantation Tamarind trees will be planted. • Consultants replied that bus shelters have been planned along the project road almost every km on both sides of the carriageway. • Replied that covered lined drain is planned in all

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
			road storm water enters into the houses. The road improvement works should take care of this issue. • One participant inquired about compensation to the affected shop owners • All the participants demanded safety of the locals due to traffic, especially when Sugar Mill operates and there is traffic congestion in the area. • The participants suggested that there is vacant land plot under the possession of electricity department. This can be used for commercial complex development • One participant inquired whether any bypasses have been planned in the entire length.	habitations and this covered drain will also act as a footpath for local population. • Replied that compensation for assets will be at replacement value. • Replied that one additional lane planned on either side of the junction (400 m) and there will be proper signages for speed reduction. • TNRSP official replied that the suggestion will be conveyed to the district administration. TNRSP cannot take any action directly on this issue. • Replied that a link road connecting SH-09 and SH-137 of about 5 km length. It will start at km 66+190 and will also be a bypass to Thirukovilur.
2	Kolapakkam (km 65+000)	28-06-2014 Participants - 59	• Participants suggested that a water pipeline exists along the road near Kolapakkam village. This should be properly shifted in consultation with Pachayat • Local Panchayat suggested that for compensatory plantation outside RoW, local villages and Pachayat may be contacted to identify vacant government land for compensatory afforestation. • One participant, whose land is coming in proposed RoW of Link road, suggested that wells should be avoided in RoW as these are irrigation sources in dry season. Construction new bridges	• The consultants noted the suggestion and conveyed to design team so that it is included in utility relocation plan. • Replied that consultants will get in touch with Panchayat for identification of vacant land after completion of design. • Replied that alignment has been finalised in such a way that most of the wells have been avoided. If any well is falling in RoW, it will be examined.

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
			are cost exorbitant. • One participant raised the issue of drainage and told that the road gets submerged during monsoon season and water enters into the houses • One participant inquired about the extent of road widening in the builtup portions. • One participants enquired when construction will start	• Replied that covered lined drain is planned in every built up area. The road level will also slightly rise. These measures will avoid drainage issues. • Replied that in builtup section corridor of impact is 16 m (8 m from centreline on either side) and 23 m in open areas. • The consultants replied that after DPR, there will be bidding process and this will take time. An exact time line cannot be given now.

Table 5.4: Stakeholder Consultations, Issues and Addressal in Project Design (Vridhachalam- Bhuvanagiri Road)

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
1	Gopalpuram (km 8+500)	06-05-2014, Participants 36	• Demanded for proper drainage facilities at villages during monsoon water flows over the road and enters into the houses • Speed breakers demanded at village to avoid accidents • Participants inquired whether the median is planned in the design • Participants suggested that acquisition of agricultural land should be minimized. • One participant inquired whether the encroachers will be paid for assets and land	• Project road is planned to be raised 1 m and lined covered drain planned at built up locations and outfall of drains will be at nearest culverts. Additional culverts (4 per km) planned in the design. • Explained that speed breakers not permissible under IRC guidelines. Other measures such bus stops and signages and marking on the road towards road users have been planned. • Replied that median is not planned in the widening as current proposal is for widening of the road to 2 lanes with paved shoulders. • Consultants replied that RoW is being utilised to the maximum extent. Land acquisition is planned at the location of geometric improvement and small realignments only. • Replied that compensation to encroachers or any affected party will be as per the

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
			• One lady participant demanded that property and acquisition for widening should be on both sides of the road for fair and equal treatment. • One participant inquired about shifting of electric and telephone poles and other underground utilities during the widening of the road. • One participant inquired about provisions of bus stops with shelters in the project. • One participant inquired whether any bypasses have been planned in the entire length. • One participant inquired when 4 laning of project is planned. • The consultants inquired whether participants welcome road widening or not.	provisions of the R&R policy of the project, which is under preparation. • Replied that existing RoW is being utilised fully and concentric widening is planned in the most portion. Only at the location of geometric improvements eccentric widening is planned. • Replied that utilities are outside RoW. If there is a need to shift these will be shifted. • Replied that 39 new bus stops have been planned. These bus stops will be with shelters. • Replied that no bypass has been planned up to km 34+000. Bypass for Bhuvanagiri town is under consideration. This bypass will be implemented later. • Replied that 4 laning will be taken up depending upon traffic requirement. At present traffic requires for two lane widening only. • The participants said that they welcome road widening and assured all cooperation during project execution.
2	Erambur (km 22+200)	06-05-2014 Participants -37	• The village Panchayat Vice president informed that area along the project road is agriculture and produces sugarcane, paddy and Dal, therefore, the acquisition should be minimum • One participant informed there are many accidents at village due to narrow road.	• The consultants informed that land acquisition is planned minimum possible. It is planned at locations of realignments and curve improvement • Replied that road is being widened and accident reduction measures are built into project design such as bus stops on sides, proper signage and lighting in the village. The lighting facilities will have to be maintained by village Panchayat.

S. No.	Location	Date and number of participants	Issues Raised	Addressal in Project Design
			• One participant demanded speed breakers at start and end point of villages	• Replied by the consultants that IRC specifications do not allow speed breakers on State and National Highways. Other measures as mentioned above are being taken up to avoid accidents
			• One participant raised the issue of drainage and told that the road gets submerged during monsoon season	• The consultants replied that lined drain is planned in built up areas. These lined drains will be covered and footpath will be developed on these. The outfall of drains will be at the nearest culvert. To avoid submergence road is being raised 1 m in open area and one foot in built up areas.
			• One participant inquired about the extent of road widening in built up portions.	• The consultants replied that there will be acquisition of 8 m from the existing centerline on either side of the road.
			• One participant inquired about compensation to encroachers	• The consultants replied that compensation to project affected persons will be paid as per R&R Policy of the project. But as per experience of previous projects encroachers will get compensation for their structure only.
			• One participant informed that shops in the village are of Temple properties and villagers are earning from these shops since last 60 years.	• The consultants informed that every effort will be made to minimise impacts to shops along the road and this suggestion will be communicated to design team.
			• All participants requested for minimum losses to structures and houses in built up sections.	• Suggestion noted and conveyed to design team for minimisation of losses to structures and shops.
			• One participant inquired when construction will start	• The consultants replied that after DPR, there will be bidding process and this will take time. An exact time line cannot be given now.

The attendance sheet of participants, news paper report of stakeholder consultation in local daily and photographs of consultations have been given **Annexure 5.1**.

5.5 CONCLUSION OF STAKEHOLDER CONSULTATIONS

The details of consultations have already been given in **Tables 5.1** to **5.4.** All the stakeholders' suggestions and comments were conveyed to the design team for consideration and incorporation in project design.

From the **Tables 5.1** to **5.4** it is clear that almost all concerns of stakeholders have been taken into account in the project planning and design.

CHAPTER 6 ANALYSIS OF ALTERNATIVES

6.1 INTEGRATION OF ENVIRONMENTAL CONSIDERATIONS IN THE ALTERNATIVES

Analysis of alternatives involves a systematic analysis to avoid or mitigate impacts that would be inevitable if technically (based on design speed and geometries) best-fit alignment is followed. An analysis of the various alternatives is attempted to arrive at the technically and environmentally best-fit alternative.

The consideration of alternatives to a proposal is a requirement of the EIA report. During the scoping process, alternatives to a proposal can be generated or refined, either directly or by reference to the key issues identified. A comparative analysis of alternatives will help to determine the best method of achieving project objectives while minimizing environmental impacts. Alternatives selected for analyses include 'no project, 'no action and feasible alternatives for new alignment sections of the project root. The relative impact of each alternative is compared against the baseline environment to select a preferred alternative, including 'no action' or 'no project alternative. Apart from this, various alternatives for a new link road connecting SH09 & SH137 in Madapattu- Thirukovilur road were considered based on technical feasibility, environmental and social parameters.

6.2 "WITH" AND "WITHOUT" SCENARIOS (NO ACTION REQUIRED)

The "with" and "without" project scenarios are analyzed with respect to the development of the state by the backdrop of requirement of reliable quality infrastructure for sustained growth of the economy and consequent well-being of its citizens. The comparison of both the scenario is presented in **Table 6.1.**

Table 6.1: With and Without Project Scenario

S No.	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
1.	All weather Accessibility		Due to improper drainage system & bad conditions of project roads, these get blocked for traffic during heavy rains.	Both the roads will be accessible throughout the year since drainage will be improved with the construction and improvement of cross drainage structures.	
2.	Road Safety/ Accident rate		There are least road safety measures at present on both the corridors and due to this sometimes road accidents take place at habitations and at junctions	For the safety of Pedestrian proper road side safety sign boards will be installed. Road geometry and pavement conditions will be improved. At habitations covered drain cum footpath and guard rails proposed.	
3.	Transportation/ vehicle maintenance /operating cost		Operating and maintenance cost of vehicles running on both the roads is very high as pavement condition is bad and also more wear & tear because of frequent application of sudden brakes.	Operating and maintenance cost of vehicles will significantly reduce with smooth road and more comfortable driving at critical sections due to road improvement works.	
4.	Travel time / increased speed		Travel time is more due to poor geometry of road and traffic congestion.	Reduction in travel time and speed will increase.	
5.	Loss of Property and livelihood		There are no major commercial establishments in the area due to bad connectivity.	The project may provide job/ livelihood opportunities to people through commercial establishment in the area due to good connectivity with other urban centers.	Road improvement will lead to displaced households, common property, utility, etc. Detail of impact is presented in the RAP and this RAP will try to mitigate the impact to the affected people of road improvement.
6.	Change in Environmental quality during construction		High level of noise, high emission of particulate matter and gaseous pollutants due to slow speed of vehicles, traffic congestion and poor road surface.		1. Temporary degradation of air quality during construction phase because of hot mix plant, stone crusher, generator and other machinery operations. 2. Machinery will cause noise pollution 3. Construction spills, wastes, degraded materials will cause

S No.	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
					deterioration of soil quality and surface water.
7.	Change in Environmental quality after construction		Deterioration of air quality through dust, gases and noise pollution because of vehicles speed and congestions.	Less Noise pollution because of ease in congestion.	
8.	Loss of vegetative cover		Losses of 2,267 trees in the corridor of Impact of Madapattu- Thirukovilur road and 5,011 on Vridhachalam- Bhuvanagiri road		Compensatory plantation will enhance vegetative cover of the area after 3-4 years.
9.	Access to basic facilities such as Markets, schools, Hospitals, etc.		Difficulty in accessing the basic facilities due to heavy traffic.	Easy access to basic facilities due to better road.	
8.	Employment opportunities & local economy growth.		Very limited business opportunities. Very poor economic condition of local public due to bad connectivity with major urban centers.	More business opportunities will be created for villagers from Irundhai, Arumpattu, Madhampattu, Gopulapuram, Saravanapakkam, Pennaivalam, Ammavasappaya, T.Kunnathur. Edapalayam, and Mudhalur on Madapattu- Thirukovilur road and Kara Kudal, Mavidanthal, Athanur, Kumara Mangalam, Keenanur, Sirvarapur, Sathapady, Katharai, Dharmanallur, Melvlayamdevi, Erumbur, Naltanikulam, Sethiyathope, Manjakolai, Manjakolai, and B.Odaiyur on Vridhachalam- Bhuvanagiri road and life style will be improved due to well connectivity with urban centers such as Panruti, Cuddalore, Thirukovilur, Bhuvanagiri, Chidambaram, and Vridhachalam. Apart from these, these road improvements will develop the	

S No.	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
				connectivity of these places with NH-45, SH-137 and, NH-45A	
9.	Others (Fuel consumption, Tourism)		Increase in fuel consumption, dust pollution because of rough road	Fuel consumption will be reduced due to smooth road Tourism opportunity may be developed after road improvement	

Based on analysis of “with” and “without” project scenario presented in **Table 6.1**, “with” project scenario, with its minor adverse impacts is more acceptable than the “without” project scenario. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the implementation of the project with the environmental management plan for mitigation of adverse environmental impacts will contribute to the development of economy and progress for its people of the vicinity as well as environmental improvements.

6.2.1 No Action Alternative

The 'No project scenario' is analysed with respect to the development of the state by the backdrop of requirement of reliable quality infrastructure for sustained growth of the economy and consequently the well-being of its citizens. Providing better connectivity in the state will ensure that goods and people from areas covered by the road can commute quicker and save time. Increase in trade and commerce activity is expected. The savings in the Vehicle Operating Costs make the project viable.

Villupuram district is among industrially backward district of the Tamil Nadu. The major industrial & mining activity in the adjoining district is Neyveli Lignite Mines and Cuddalore port will be getting a good boost due to improved connectivity. Better connectivity with these urban centers will help in industrial development in both the districts. It will give rise to employment potential for people in and around the region. However, there would be an increase in the vehicular pollution-air and noise, in the vicinity of the project roads. Some agricultural land will have to be diverted for road widening and realignments. In some settlements through which the project roads are passing, some people will lose their properties to accommodate the proposed widening.

If the project is not implemented, there is likelihood that the project roads will deteriorate further. In the absence of the World Bank financial assistance, the state will also find it extremely difficult to maintain the road. Increased air pollution, due to slow moving traffic and congestion, will follow. Noise levels will rise due to deterioration of the pavement as well as increased honking. Without the project, the traffic would continue to pose a safety risk for the road users.

Therefore, the 'project with the alternative scenario, with its minor adverse impacts is more acceptable than the "without" project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the implementation of the project will be a definite advantage to Tamil Nadu state in order to achieve all-round development of its economy and progress for its people. These road improvements will improve the deeper penetration of government benefit to the rural people and overall economic development of the state and nation.

6.2.2 Action Alternative

The alternatives in terms of location (alignment) for both the project roads are very limited, as the project objective is either to rehabilitate or to upgrade the existing roads, except at a few locations for avoidance of such existing sharp curves (poor geometric), water body or religious structures.

Apart from engineering considerations of improving the curves or geometric along corridors to IRC specifications, specific options of realignments that can improve the corridor's environmental performance by avoiding the removal of good old trees; avoiding the damage to community assets and religious places; avoiding old and narrow bridges etc. were also considered. Realignments have been considered at 4 locations in Vridhachalam- Bhuvanagiri road (total length of realignment 860 m) and 2 locations in Madapattu- Thirukovilur road (total length of 372 m).

6.2.3 Link Road Options Comparative study

Apart from this a 5.000 km of new alignment for linking SH09 with SH137 is part of proposed improvement on Madapattu- Thirukovilur road. The area of the proposed link road section was studied extensively and four alternative alignments were considered for the finalization of this link road out of which 'option 4' was found as most suitable option for due to less damage to existing dug wells, deviation from settlement areas and it does not require construction of major cross drainage structures as it is away from water bodies. Various parameters considered for finalisation of alignment are given in **Table 6.2** while all the proposed alternatives have been shown on Google earth in **Figure 6.1.** No bypass has been planned on the Vridhachalam - Bhuvanagiri road.

Figure 6.1: Link Road Options (on Madapattu- Thirukovilur Road)

Table 6.2: Bypass Options Study for Link Road

Description	Option 1	Option 2	Option 3	Option 4
Color	Pink	Yellow	Green	White
Side of Existing Road	Left	Left	Left	Left
Length (km)	5.55	5.65	5.05	5.00
Extents and Length of Existing Project Road being Bypassed	66+190 to 76+600, 10.34 km	66+190 to 76+600, 10.34 km	66+190 to 76+600, 10.34 km	66+190 to 76+600, 10.34 km
CD Structures, (Approximate)	1	1	1	4
Ponds	3	3	4	2
Buildings	2	0	0	0
Grade Separator Structures	0	0	0	0
Side Roads/Cart Tracks	2	3	3	3
Advantages	Geometry-wise less number of horizontal curves. Utilization of old abandoned road for a length of 1.2 km	Less number of CD Structures & far away from Water Bodies. Utilization of old abandoned road for a length of 1.2 km	Slightly avoiding the development area and geometry-wise smooth alignment. Utilization of old abandoned road for a length of 1.2 km	Fully deviated from settlement areas and avoiding major CD Structures as away from water bodies.

Description	Option 1	Option 2	Option 3	Option 4
Disadvantages	A 400m length of Cross Drainage Structure over a large water body and High Tension Poles are major Obstructions for Alignment. Two recently developed buildings shall be effected at the end of this alignment CH: 5+500	Passing through closer to the villages Verattagaram and Deviyagaram	A 120m length of bridge is required for crossing major pond.	Non utilization of the old abandoned road for a length of 1.2 km compared with other options.
Environmental Issues and Considerations	3 ponds impacted	3 ponds impacted	4 ponds impacted	2 ponds impacts (This option saves impacts on 2 ponds)
Trees to be cut (Estimated)	110	129	135	70(This option saves about 50 trees)
Religious structures	Nil	Nil	Nil	Nil
Agriculture land acquisition(Ha)	16.65	16.90	15.15	15.0(This option has least impact on agriculture land.

6.2.4 Other Environmental Advantages of Selected Link Road Option-4

The selected option has least length; therefore requirement of agriculture land is also the least for the link road construction. The RoW for the link road has been kept 30 m to minimise land acquisition.

The reason of link road construction is to avoid Thirukovilur city for the through traffic to Tindivanam and Chittoor. This link connecting SH-09 and SH-137 will lead to traffic outside Thirukovilur city. This will avoid traffic congestion in the Thirukovilur city and will also reduce vehicular emissions in the city.

From the **Table 6.2** and above discussion, it is clear that the selected option number 4 is the best option from environmental consideration also.

6.3. Design Decision Constraints For Various Alternatives

Road widening and design speed were considered for the various alternatives considered for the project.

- Road submerges in rainy season.
- There are water taps and water tanks in both the corridors.
- Religious structures
- Roadside ponds
- Hand Pumps
- Bore Wells and well
- Presence of canal in Vridhachalam- Bhuvanagiri road (km 27+500 to 33+200)
- New link road planned in Madapattu- Thirukovilur road is partially running through agriculture field, so land will be required for the new road construction. Most of the state highways in country have minimum 45 meter of right of way, but to save productive

agricultural land, 30 meter right of way is considered for the link road in the current project.

6.4 ENGINEERING ALTERNATIVES CONSIDERED

Design improvement in the project road is done taking into consideration of lane configuration, widening scheme, speed, embankment height and the urban or rural setting of the road. The substandard geometry in the rural area has been eliminated in the proposed design for the project road.

6.4.1 Alignment and Widening Alternatives

Lane Configuration: Based on the traffic requirement, both project roads require 2 lane configuration with paved shoulders. The paved shoulder will help to segregate slow moving and non motorized traffic. This will provide higher speed and safety to the through traffic. There are three widening options for both the project roads namely

(a) Concentric

(b) Eccentric left and

(c) Eccentric right.

The widening schedule and reasons for adoption have also been mentioned in **Table 6.3** and **Table 6.4** for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road.

Table 6.3: Widening Schedule for Madapattu- Thirukovilur Road

Chainage		Length (m)	Widening Side	Reason
From	To			
41+700	43+000	1300	Concentric	Madapattu Village and EROW is equally divided
43+000	43+850	850	RHS	EROW is more on the RHS and less on LHS
43+850	44+000	150	Concentric	EROW is equally divided
44+000	45+000	-	-	Out of Scope
45+000	45+100	100	RHS	EROW is more on the RHS and less on LHS
45+100	46+300	1200	Concentric	Madampattu Village
46+300	47+700	1400	LHS	EROW is more on LHS and less on RHS
47+700	47+900	200	Concentric	Kothanur village and EROW are equally divided
47+900	48+300	400	RHS	EROW is more on the RHS and less on LHS
48+300	48+750	450	Concentric	Kothanur village and EROW is equally divided
48+750	49+300	550	LHS	EROW is more on LHS and less on RHS
49+300	50+300	1000	Concentric	Saravanapakkam village and EROW is equally divided
50+300	55+100	4800	Concentric	EROW is equally divided
55+100	56+000	900	Concentric	Settlement on both sides and EROW is equally divided
56+000	57+400	1400	Concentric	EROW is equally divided
57+400	58+300	900	Concentric	Pennaivalam village and EROW is equally divided
58+300	59+050	750	RHS	EROW is more on the RHS and less on LHS
59+050	60+300	1250	LHS	EROW is more on LHS and less on RHS

Chainage		Length (m)	Widening Side	Reason
From	To			
60+300	60+500	200	RHS	Curve improvement of a series of curves
60+500	62+000	1500	Concentric	EROW is equally divided
62+000	64+550	2550	Concentric	Edapalayam Village, settlements on both sides and EROW is equally divided
64+550	65+650	1100	LHS	EROW is more on LHS and less on RHS
65+650	65+800	150	RHS	Curve improvement of a reverse curve
65+800	65+950	150	LHS	Curve improvement
65+950	66+200	250	RHS	To keep the alignment straight in the Major junction portion
66+190	71+147	4947	-	New Alignment Link Road

Table 6.4: Widening Schedule for Vridhachalam- Bhuvanagiri Road

Chainage(km)		Length (m)	Village Name	Rural / Built Up	Suggested	Reason
From	To					
0	2900	2900	Vridhachalam & Ponneri	Built Up	Concentric	Village/Urban
2900	3700	800	-	Rural	LHS	Temples and Settlements on RHS
3700	6600	2900	Karakudal, Ko. Athanur, Kumaramangalam	Built Up	Concentric	Village
6600	7600	1000	-	Rural	LHS	Severance on RHS is more
7600	10000	2400	Gopalapuram	Built Up	Concentric	Village
10000	11900	1900	-	Rural	RHS	To avoid more tree cutting on LHS
11900	13500	1600	Kammapuram	Built Up	Concentric	Village
13500	14000	500	-	-	Concentric	Existing BT width 9 to 10m
14000	14900	900	-	Rural	LHS	Severance on RHS is more
14900	18200	3300	-	-	LHS	Ditch on RHS
18200	20600	2400	Melvalayam Devi	Built Up	Concentric	Village
20600	21100	500	-	-	Curve Improvement	Existing Broken Back Curves
21100	21900	800	-	Rural	Concentric	Straight Geometry
21900	22500	600	Erumbur	Built Up	Concentric	Village
22500	23100	600	-	Rural	Concentric	Straight Geometry, Short Length
23100	24300	1200	Nallatanikulam	Built Up	Concentric	Village
24300	24800	500	-	Rural	Concentric	Straight Geometry, Short Length
24800	27200	2400	Sethiyathopu & Miralor	Built Up	Concentric	Village
27200	33300	6100	-	-	RHS	Canal on LHS
33300	35800	2500	Bhuvanagiri	Built Up	Concentric	Village

It is clear from the both tables that as per TNRSP policy maximum utilisation of Existing Right of Way (ERoW) has been made. This will result in the maximum utilisation of existing formation width and the minimum consumption of natural resources for the new formation width. Involuntary resettlement impacts will also be the minimum.

Improvement of the Existing Road Geometries

Scheme for existing road geometric correction has been considered as part of the proposed improvement. Proposed chainage and curve improvement radius has been shown in **Table 6.5** for Madapattu- Thirukovilur Road and **Table 6.6** for Vridhachalam Bhuvanagiri road.

Table 6.5: Chainage of Curve Radius Improvement on Madapattu- Thirukovilur Road

Sl. No	Design Chainage (km)		Existing Curve Radius (m)	Improved Curve Radius (m)
	From	To		
1	48+951	49+141	310	360
2	64+537	64+719	240	450

Table 6.6: Chainage of Curve Radius Improvement on Vridhachalam- Bhuvanagiri Road

Sl. No	Design Chainage (km)		Existing Curve Radius (m)	Improved Curve Radius (m)
	From	To		
1	0+400	0+500	70	180
2	11+060	11+165	200	610
3	17+900	18+300	-360,310	-600,600 (Reverse Curve)
4	20+635	21+050	170, 150 within a distance of 300m	450 radius Curve of length of 272
5	21+880	21+980	-150	-240
6	24+950	25+100	240,400	800 ,1000(Reverse curve)
7	26+300	26+550	-300,600	1200,1400
8	26+740	26+950	200,-200	-800
9	30+180	30+330	-200	-330
10	30+800	31+065	80	310
10	31+750	31+850	300	500
11	32+800	32+900	150	400
12	33+200	33+750	-200,-200,-200.	1500 & 4000 (Reverse Curve)
13	34+350	34+500	-200	-500
14	34+550	34+750	Broken Back Curves (200,200)	500 &800 (Reverse Curve)

6.4.2 Bypass Alternatives Considered in the Project

No bypass has been considered in both the project roads, but a new link road has been proposed between SH09 and SH137 in Madapattu- Thirukovilur road. This link road's start point will be km 66+190 of existing SH09 while the length of this link road will be 5.00 km. The alternative option for the link road alignment has already been discussed in section 6.2.2 above.

6.4.3 Realignment Alternatives Considered in the Project

There is no realignment alternative considered in the widening of both the project roads.

6.4.4 Environmental Enhancement and Road Safety Alternatives

Various environmental enhancement alternatives were considered as follows:

Bus Lay Bays with Passenger Sheds

The bus lay bays were integrated with the engineering design drawing when the environmental and social investigation underlined the need for the same. These were considered for almost all existing major habitation around the project road. There are 20 bus bays proposed along the Madapattu - Thirukovilur road in LHS and RHS whereas 39 have been proposed on Vridhachalam - Bhuvanagiri road. Typical Layout of Bus Bay is presented in section 2.3 while location of bus bay has been given in **Annexure 2.1**. The bus bays will also have a passenger shed.

Cultural Property Rehabilitation:

All the impacted cultural properties such as temple will be rehabilitated and those in the vicinity will be integrated into the road system.

Pond Enhancement

Five ponds in Madapattu - Thirukovilur and three ponds in Vridhachalam - Bhuvanagiri road are going to be partially impacted due to widening. These ponds will be properly rehabilitated and enhanced for better public use.

Additional Tree Plantation:

Compensatory forestry as per the statutory requirement as well as additional roadside tree plantation will be carried out to improve the aesthetic of the road as well as the environmental improvement of the surrounding.

6.4.5 Alternatives for Minimisation of Tree Cutting

The tree cutting has been avoided by adjusting the alignment at the following locations on Madapattu - Thirukovilur Road:

- km 46+100 to 47+700 widening planned on RHS to save the trees on the LHS without additional land acquisition. The RoW is available on the RHS
- km 51+200 to 55+200 widening planned on RHS to save the trees on the LHS

On the Vridhachalam- Bhuvanagiri road, trees have been saved at the following locations to minimise the tree cutting;

- km 10+000 to 11+900 widening planned right side in available RoW to save the trees on the left side
- km 27+500 to 33+200 widening towards the right side, hence trees on the left side are saved and another reason is the presence of the canal on the left side.

6.4.6 Alternatives for Construction Materials

In the current project as per the TNRSP policy the aim is to utilise available RoW to the extent possible to avoid land acquisition. Due to this there is the maximum utilisation of the existing formation of the road. This will result in minimisation of construction materials requirements as new formation will require more quantities of GSB, earthworks and aggregates.

Further, the locations where either existing road formation is raised or severely distressed, the existing pavement crust up to WBM/WMM will be utilized as either part of the sub base course or base course of the proposed new pavement as per Clause 7.2.1 of IRC-37-2012. The quantities will be established once the detailed designs are carried out for the complete highway. The measurement items/specifications will be formulated to account for salvaging or recycling of the existing pavement.

These both measures will have lesser impacts on natural resources and reduction in pollution on account of transportation and handling.

6.4.7 Alternatives for Construction Technologies

The project plans to use Hot Mix Asphalt Technology for construction due to competence of local contractors and similar projects being implemented with this technology.

The cold mix technology, although available but not being opted because of non availability of enough qualified contractors for this.

6.5 ECONOMIC ALTERNATIVES

In no project scenario, project influence area of both the project roads will have slow pace of economic development due to bad conditions of roads and limited connectivity during the rainy season of the year. With the implementation of the project, the region will have higher economic growth with better connectivity with urban and industrial center such as Cuddalore, Cuddalore Port and Neyveli and commercial areas for farmers of project influence area. In addition to this, project road will provide a better connection with the town and cities which are on NH 45 from Chennai to Tiruchirappalli.

CHAPTER 7 PROJECT IMPACTS AND ISSUES

7.1. PROJECT IMPACTS AND ISSUES

There is a growing awareness among the citizen about major environmental impacts of the road development projects. Some of the major environmental impacts of road projects on the natural environment and nearby communities (ecosystems) include increase in soil erosion & runoff water; increase in gaseous and dust emissions; generation of waste water from construction and labour camps; temporary health impacts on human beings; loss of avenue trees and productive agriculture land; change in land use; loss of community assets; accelerated urbanization; disruption of local economic activities during construction period; etc.

The TNRSP II being limited to improvement of existing State Highways, therefore, involves lesser environmental impacts and more of positive aspects. These situations do not call for full scale Environmental Assessment but do require impact identification, mitigation and a certain aspects of compliance monitoring and documentation. This chapter aims at identifying environmental impacts due to proposed improvement of the project road.

General impacts on natural environment and socio-economic environment due to road widening and improvements of both the project roads corridor are presented in **Table 7.1** and **Table 7.2.**

Table 7.1: 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 dismantling	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 cropping 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 recharge 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 7.2: General Impact on Social and Cultural Environment

Project Activity	Planning and Design Phase	Pre Construction Phase			Construction Phase					Operation	
										Direct	Indirect Induced development
Env. 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 n productivity	-	-	Conversion of Agricultural Land
Buildings and built structures	-	-	Loss of structures, Debri 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 damage 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		-

The significant environmental direct and indirect impacts on various environmental attributes during preconstruction, construction and operational Phase of the proposed road improvement project are discussed in the following sections.

7.1.1 Positive Impacts of the Project

The construction of improved roads reduces congestion in built-up areas and improves air quality in the areas by relieving a significant amount of traffic. Proposed road improvement will improve the quality of life for the population in the project influence area by boosting the local economy through better connectivity with the world. The improvements will also reduce accidents and congestion in built up sections which are on account of geometric deficiencies and lack of safety measures. Detail discussion about the positive impacts of proposed road improvement is already discussed in section 1.2.

7.1.2 Negative Impacts of the Project

Air pollution from fossil fuel powered vehicles can occur wherever vehicles are used and are of particular concern in congested street conditions and other low speed circumstances. Road noise can be a nuisance if it impinges on population centers, especially for roads at higher operating speeds, and near intersections. Noise health effects can be expected in such locations from road systems used by large number of motor vehicles. Another negative effect of the proposed road improvement project is the amount of space taken up. When cutting through avenue plantation, they prevent the growth of many trees as trees cannot grow through paved roads. On unpaved roads, vehicle tyres and foot traffic compact soil and prevent plant growth. As trees take up CO_2 and also house avian fauna, this increases the environmental damage.

But the implementation of EMP for the project will mitigate all these smaller negative impacts of the project and this road improvement project will further improve the environmental conditions of the surrounding corridor (direct and indirect project influence area).

7.2 PROJECT INTERVENTIONS

The project intervention necessitates dismantling of the few roadside residential and commercial structures (mostly encroachments), removal of vegetation (and tree felling. In addition to this project will require borrow earth and aggregates. The queries for these aggregates are locally available; hence no significant direct impact is envisaged.

Table 7.3: Potential Impacts and Requirement of Man, Materials & Machinery

S.No	Description	Unit	Quantity		Remarks
			Madapattu-Thirukovilur road	Vridhachalam-Bhuvanagiri Road	
1	Land Acquisition	ha	17.2468	5.8064	Minor Impacts
2	Dismantling of Structures	No.	385	790	Residential/Commercial/both
3	Removal of trees	No.	2,267	5,011	Moderate Impact
4	Removal of vegetation	ha	24	39	Including 15 ha for link road.
Man, Material and Machinery Requirement for Construction Activity					
5	Labour	No.	70	70	Total No.s of man days divided by time allotted for construction activity
6	Operators and drivers	No.	20	20	Total Machinery working time divided by 8hours of operator

S.No	Description	Unit	Quantity		Remarks
			Madapattu-Thirukovilur road	Vridhachalam-Bhuvanagiri Road	
					working.
7	Semi skilled labour-mate/ supervisor	No.	8	8	One mate/supervisor over 8 labours.
8	Officers/ incharge	No.	5	5	
9	Borrow Earth	cum	256,710	322,495	Requirement for embankment, subgrade shoulder, etc.
10	Fine Aggregate	cum	7,133	20,785	Concrete works, screening material and in GSB
11	Coarse Aggregate	cum	202,701	311,532	WMM, GSB, concrete and BT works
12	Water	Kilolitre	110,000	110,000	All construction activities and for worker use.
13	Crusher Plant/BT plant/ Batching Plant	No's	1	1	Based on the project requirement, capacity will be judged.
16	Paver, Grader,	No's	2	2 each	
17	Dumpers	No's	7	7	

7.2.1 Land Acquisition

The project will require land acquisition for up gradation of existing two lane carriageway of both the corridors to two lane with paved shoulder/four lane (13m top formation width in rural areas, 26.30 m in 4 lane section and 16 m in built-up sections). The horizontal and vertical alignment will be improved, to standard as per IRC/MoRTH guidelines, requiring additional land width for realignment and geometric improvements. There is no bypass in Vridhachalam- Bhuvanagiri road, but a link road of 5 km is planned as part of Madapattu - Thirukovilur road. For this link road there will be acquisition of about 15 ha land.

The land acquisition in Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road has been estimated at 17.2648 and 5.8064 ha respectively. Hence minor impact has been indicated.

7.2.2 Removal of Structures & Pavement

Table 7.4 below presents the details of pavement scarification and cross drainage structures to be removed for the up gradation of both the project roads. Strategies have been adopted to reuse these materials to minimize the impact of disposal of these materials. Hume pipes have limitation of re-use because of fixed diameter and suitability to specific conditions.

Table 7.4: Removal of structures and Pavement

Sr. No.	Item	Unit	Quantity		Remark
			Madapattu-Thirukovilur Road	Vridhachalam-Bhuvanagiri Road	
1	Bituminous Material	cum	25,200	37,590	No significant impact because it will be reused
2	Pavement Crust	cum	Nil	Nil	No impact, no requirement of removing pavement crust

3	Stone Masonry	cum	840	1050	No significant impact because it will be reused
4	RCC	cum	600	900	No significant impact because it will be reused
5	Hume Pipes	m	300	400	Can not be reused

Unlike the sustainable use of pavement and sub grade materials, roadside dwelling and business establishments would also be impacted and their impacted may not be transformed rather they need mitigation measures. Engineering Design team in consultation with environmental and social team has minimized/restricted land width in built-up areas. As a policy TNRSP is utilising maximum available RoW. Even after such engineering efforts, some of these residential and business units require to be dismantled (partially or fully). **Table 7.5** provides a total built-up area and a number of structures affected. The impact is not considered very high because these structures are in the form of temporary and semi permanent structures (For a detail analysis of impacts please refers Social Impact Assessment Report).

Table 7.5: Number of Affected Structures

Type of Impact	Permanent	Semi Permanent	Temporary	Other[2]	Total
Major Impact (Madapattu- Thirukovilur Road)					
Loss of Residence	10	9	27	-	**46**
Loss of Business	34	5	53	4	**96**
Loss of Residence cum Business	10	2	12	-	**24**
Minor Impact					
Loss of Residence	12	22	24		**58**
Loss of Business	12	15	14	10	**51**
Loss of Residence cum Business	10	9	6	-	**25**
Other Loss (CW, toilet, shed, etc)	-	-	8	77	**85**
Major Impact (Vridhachalam – Bhuvanagiri Road)					
Loss of Residence	11	35	162	-	**208**
Loss of Business	13	31	43	-	**87**
Loss of Residence cum Business	12	20	37	2	**71**
Minor Impact					
Loss of Residence	16	67	101	-	**184**
Loss of Business	9	31	49	1	**90**
Loss of Residence cum Business	9	24	20	-	**53**
Other Losses (CW, toilet, shed, etc.)	2	5	17	73	**97**

Source: Census and Socio Economic Survey, May-June 2014

[2] Compound wall or building under construction or shelter

7.2.3 Removal of Trees & Vegetation

Table 7.6 below presents the details of trees and vegetation to be removed for the upgradation, widening and geometric improvement of both the project roads. Trees up to toe line are to be felled. Case to case basis felling of trees will be considered for those trees, which are found on the embankment of slope of the carriageway. About 2,267 trees on Madapattu-Thirukovilyur route and 5,011 on Vridhachalam - Bhuvanagiri road need to be cut. However, for smooth operation of construction activity, machineries, a total of 34.5 ha on Madapattu- Thirukovilur road and 20.4 ha on Vridhachalam - Bhuvanagiri road vegetation within the proposed right of way need to be removed.

Table 7.6: Removal of Vegetation

Sr. No.	Location/ Description	Vegetation to be removed (Hectares)		Reason for removal of Vegetation
		Madapattu-Thirukovilur Road	Vridhachalam-Bhuvanagiri Road	
1	Along the alignment	17	17.90	Clearing and grubbing for construction activity
2	Plant site	2.0	2.0	Construction camp and stock yard
3	Diversion	0.5	0.5	Diversion
4	Link Road	15	Nil	Link Road alignment
5	Trees	2,267	5,011	Along the alignment

7.2.4 Extraction of Material for Construction Activity

Table 7.7 below presents the details of construction materials required for upgradation of both the project roads. The queries for these aggregates and borrow earth are locally available hence no significant direct impact is envisaged.

Table 7.7: Construction Material Requirement

Sr. No.	Construction Material	Unit	Quantity		Reason
			Madapattu-Thirukovilur Road	Vridhachalam-Bhuvanagiri Road	
1.	Borrow Earth	cum	256,710	322,495	Embankment, Subgrade & Shoulder
2.	Fine Aggregate	cum	7,133	20,785	Screening Material, concreting
3.	Coarse Aggregate	cum	202,701	311,532	WMM, Bituminous work, concrete
4.	Water%	Cum/day	236	236	Compaction

7.2.5 Construction Machinery

Table 7.8 below presents the quantum of vehicles & machinery required for project interventions and their influence area. These machineries will have a bearing on surrounding environment, especially on air & noise quality subject to emission levels of machinery.

Table 7.8: Construction Machinery

Sr. No.	Construction Machinery	Quantity (no's)		Influence area
		Madapattu-Thirukovilur Road	Vridhachalam-Bhuvanagiri Road	
1.	Dumpers	7	7	Quarry approach and Project road
2.	Excavators	3	3	Quarry sites & Project Road
3.	Road Rollers	2	2	Project Road
4.	Graders/ Pavers	2	2	Project Road
5.	Stone Crusher /BT Plant	1	1	Plant site

7.2.6 Labor for Construction Activity

Table 7.9 below presents the number of labourers required/ to be used in the construction activity at both the corridors.

Table 7.9: Labor for Construction Activity

Sr. No.	Construction Activity	Number of labour involved	
		Local People	Contractor's
1.	Quarry	50	5
2.	Clearing & Grubbing	20	8
3.	Crusher Plant	2	5
4.	BT Plant	5	10
5.	Paving	10	10
6.	Drivers/Operators	20	40
7.	Other Staff	5	22

Out of the above work force indicated about half will be migrated labour.

7.3 AIR ENVIRONMENT - IMPACTS

Air quality along the project road will be adversely impacted at congested locations like Madapattu, Sarvanapakkam, etc. on Madapattu- Thirukovilur road and Vridhachalam, Bhuvanagiri, Kammapuram and Gopalapuram on Vridhachalam- Bhuvanagiri road. There are no major urban centers on Madapattu- Thirukovilur road length. Thirukovilur town has been bypassed through a proposal of link road between SH-09 and SH-137. The project influence areas of both the roads will be impacted by air pollution, both during construction and operation phases. Construction phase impacts are of short term and have adverse impacts on the construction workers. Most of the dust rises from operations such as excavation, drilling, blasting, loading, unloading and transportation of materials. Suspended Particulate Matter (SPM) is the main pollutant during construction. Significant quantities of construction materials are blown away by winds in the form of dust from the stored materials along the site and from dump sites of construction debris. The fugitive dust released during the construction activities cause an immediate effect on the construction workers as well as on the settlements adjacent to the alignment, especially those in the downwind directions. Operation phase impacts will not be as severe as the construction phase impacts and these will be confined generally to a ribbon development close to the edge of the pavement.

7.3.1 Meteorology/ Climate

The entire alignment of both the project roads falls under hot tropical climate characterized by the small daily range of temperature, humid weather and moderate rainfall (1000-1300 mm). Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the addition of paved surface for the road and its structures construction. There will be an increase in daytime temperature around RoW of alignment due to loss of shade of trees. This rise in temperature will be localized as the project road surroundings are open and it runs around agriculture fields. The temperature rise phenomenon will be more prominent at locations of cutting of trees in clusters.

This increase in the daytime temperature assumes significance, especially to the local farmers residing near RoW as the entire project length experiences temperatures as high as 40^0C during summers. Although the impact is significant long-term and reversible in nature, it is unavoidable and shall be compensated for by avenue plantation around the road corridor and compensatory plantation of trees. However, it may be pointed out that the project at design phase has taken care to minimise tree felling in the RoW by realigning the road to save dense tree plantation stretches.

7.3.2 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. The quantification of emission is difficult for pre construction and construction phases. During operation phases vehicular emissions emitting from traffic will form line source of emissions from the vehicles.

Air quality along the respective project road corridors will be adversely impacted both during the construction and operation phases. Construction phase impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the downwind directions. Construction phase impacts will be confined generally to a band of width ranging from 50 to 100m from the edge of the Proposed Right of Way. The following sections present the impacts of the project activities on this component:

Generation of Dust

Construction Phase

Generation of dust is the most likely impact during these phases due to:

- Site clearance and use of heavy vehicles, machinery, etc.;
- Procurement and transport of raw materials and quarries to construction sites; the impacts will mostly be concentrated in the RoW. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

As the both the corridors have a soil type with significant sand content and the construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is also likely to be generated due to the various construction activities including:

- Stone crushing operations in the crushers
- Handling and storage of aggregates in the asphalt plants
- Concrete batching plants
- Asphalt mix plants due to mixing of aggregates with bitumen

Generation of dust is a critical issue and is likely to have adverse impacts on health of workers in the quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction period.

In addition to air pollution due to the activities mentioned above, there will be dust generation due to transport, and storage at site. This will prevail during the early phase of construction period.

Operation Phase

No dust generation is envisaged during the operation phase as the road will be paved and there will be embankment turfing. There will be growth of vegetation in the exposed portions of RoW due to rains and natural processes.

Generation of Exhaust Emissions

Construction Phase

Generation of exhaust gases is likely during the pre-construction phase due to the movement of heavy machinery for clearance of the RoW for construction. This impact is envisaged to be insignificant during the pre-construction phase.

High levels of SO_2, HC and NOx are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact is much localized, it can spread downwind depending on the wind speeds. The Environmental Management Plan needs to ensure that adequate measures are taken especially for health and safety of workers such as providing them with pollution masks during working hours. Also, the contractor should ensure that hot mix plants, stockyards, crushers, etc. are located away from residential areas. If adequate measures are taken, impacts from generated gases can be considered negligible.

Operation Phase

The major impact on air quality will be due to the plying of vehicles. The increase in air pollution is also identified by the public as one of the most undesirable impacts of any road development project. The impacts on air quality will, at any given time depend upon the traffic volume / rate of vehicular emission within a given stretch and prevailing meteorological conditions. Excess discharge of exhaust gases can occur due to (i) inadequate vehicle maintenance; (ii) use of adulterated fuel in vehicles and/or (iii) poor road conditions. To predict air quality in the vicinity of road corridor during operation phase air pollution modelling has been carried out to quantify the impacts incorporating all these variables.

7.3.3 Prediction of Carbon Monoxide (CO) and Oxides of Nitrogen (NOx) Concentrations along the Project Road using CALINE-3 Dispersion Model

The incremental concentrations of pollutants such as CO and Knox have been computed using the CALINE-3 model. This model has been developed by California Transport Department. However, it has been adopted for project route conditions by using emission factors prevalent in India. The CALINE-3 model requires emission rates, wind speed and weather conditions as input data. The worst meteorological conditions (wind speed 1m/s, stability-F during night time and wind speed 1m/s, stability-D during day time) have been used in the predictions.

Composite emission factors have been used to calculate emission rates from vehicles. The basic information on the emission factors has been derived from Indian Institute of Petroleum Publication “Vehicle Emissions and Control Perspective in India”. These factors have been adopted by CPCB as emission norms for vehicles from 2000 AD onwards. Since the particulate matter concentration is insignificant, it has not been considered in modelling.

The emission factors are given in **Table 7.10** below:

Table 7.10: Speed Corrected Emission Factors (in gm/km/vehicle)

Diesel Vehicle Trucks Speed (gm/km)								
Pollutant	10	20	30	40	50	60	70	80
CO	37.80	18.80	12.53	9.40	7.52	6.27	5.37	4.70
NO_x	66.83	33.42	22.28	16.71	13.37	11.14	9.55	8.36
Petrol Vehicles (Independent of speed)								
Pollutant	Cars			Two Wheelers			Three Wheelers	
CO	2.72			2.0			4.0	
NO_x	0.58			0.05			0.05	

Operative speeds have been assumed to be 80 kmph up to the horizon year 2030 and 60 km ph Beyond 2020. The predicted values at locations of ambient air quality are given in **Table 7.11** for Madapattu- Thirukovilur road and **Table 7.12** for Vridhachalam- Bhuvanagiri road.

Table 7.11: Predicted Ambient Air Quality for Operation Phase for Madapattu- Thirukovilur Road

S. No.	Location	Baseline Levels (ug/m3)		Predicted Incremental Values			Operation Phase Predicted Values		
				2020	2030	2040	2020	2030	2040
1	Madapattu Village (km 41+700)	CO	1000	74.56	167.46	309.69	1075	1167	1310
		NOx	20.8	3.32	14.38	29.50	24	35	50
2	Kotanur Village	CO	1000	74.56	167.46	309.69	1075	1167	1310

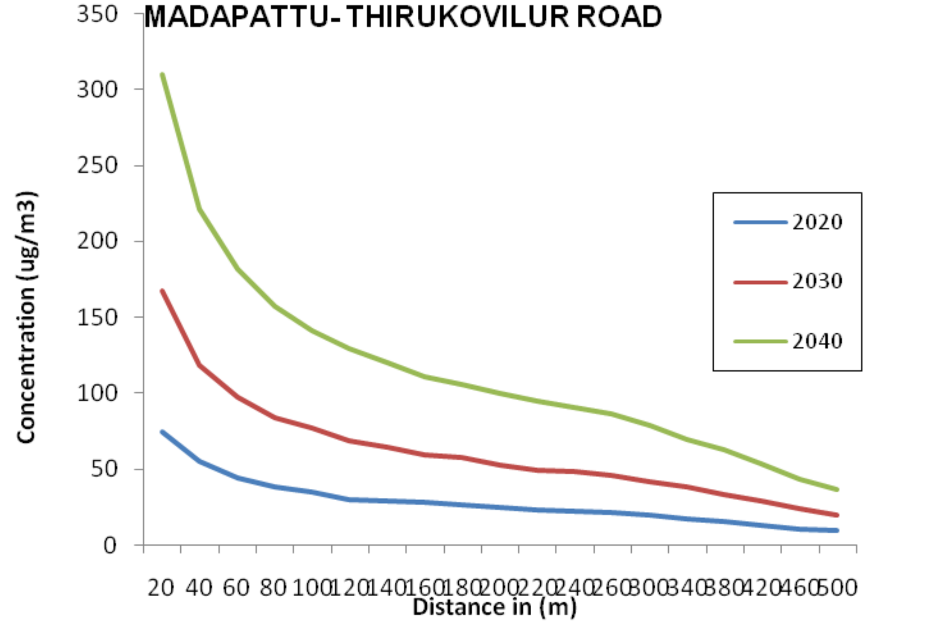
S. No.	Location	Baseline Levels (ug/m3)		Predicted Incremental Values			Operation Phase Predicted Values		
				2020	2030	2040	2020	2030	2040
		NOx	20.1	3.32	14.38	29.50	23	34	50
3	Pennaivallam Village	CO	1000	74.56	167.46	309.69	1075	1167	1310
		NOx	17	3.32	14.38	29.50	20	31	47
4	Thiruvannamalai Crossing(km 66+200)	CO	1000	55.06	118.14	221.37	1055	1118	1221
		NOx	19.8	2.03	9.95	20.09	22	30	40

Table 7.12: Predicted Ambient Air Quality for Operation Phase for Vridhachalam- Bhuvanagiri Road

S. No.	Location	Baseline Levels (ug/m3)		Predicted Incremental Values			Operation Phase Predicted Values		
				2020	2030	2040	2020	2030	2040
1	Vridhachalam (km 0+000)	CO	1000	41.29	317.2	116.99	1041	1317	1117
		NOx	21.2	8.85	16.22	33.18	30	37	54
2	Kammapuram (km 12+000)	CO	1000	41.29	317.2	116.99	1041	1317	1117
		NOx	17.8	8.85	16.22	33.18	27	34	51
3	Sethiathoppu Junction(km 25+000)	CO	1000	27.53	205.31	74.56	1028	1205	1275
		NOx	18.7	6.08	11.25	22.49	25	29	41
4	Bhuvanagiri (km 35+000)	CO	1000	41.29	317.2	116.99	1041	1317	1117
		NOx	17.1	8.85	16.22	33.18	26	33	50

It is clear from the above table that predicted concentrations are well within the limits of Rural and Residential areas in respect of CO and NOx till end of project life. It may be mentioned that above predictions are on the conservative side. Actual concentrations are expected to be lower in future years as there will be further stringent norms for vehicular emissions. The variation of NOx and CO concentrations has been given in **Figures 7.1** and **7.2** for Madapattu- Thirukovilur road and **Figures 7.3** and **7.4** for Vridhachalam- Bhuvanagiri road.

FIGURE 7.1: VARIATION OF PEAK ONE HOURLY CONCENTRATION OF CO WITH DISTANCE AT MADAPATTU- THIRUKOVILUR ROAD



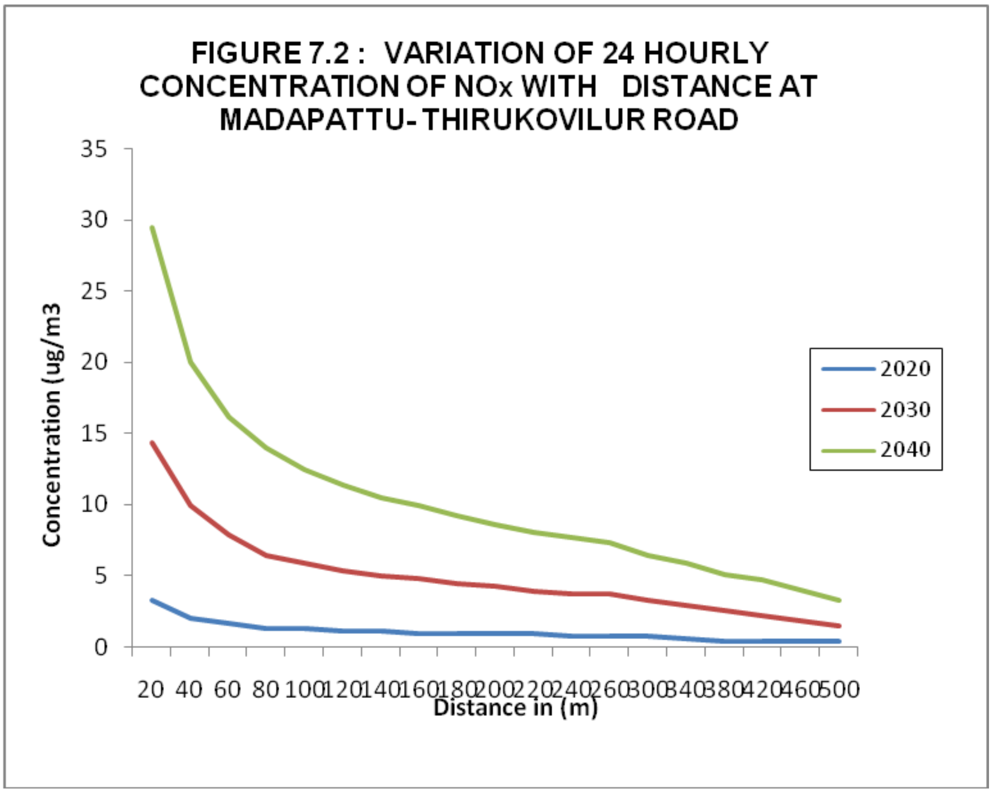


FIGURE 7.2 : VARIATION OF 24 HOURLY CONCENTRATION OF NOx WITH DISTANCE AT MADAPATTU- THIRUKOVILUR ROAD
Concentration (ug/m3
35
30
25
20
15
10
5
0
20 40 60 80 100 120 140 160 180 200 220 240 260 300 340 380 420 460 500
Distance in (m)
2020
2030
2040

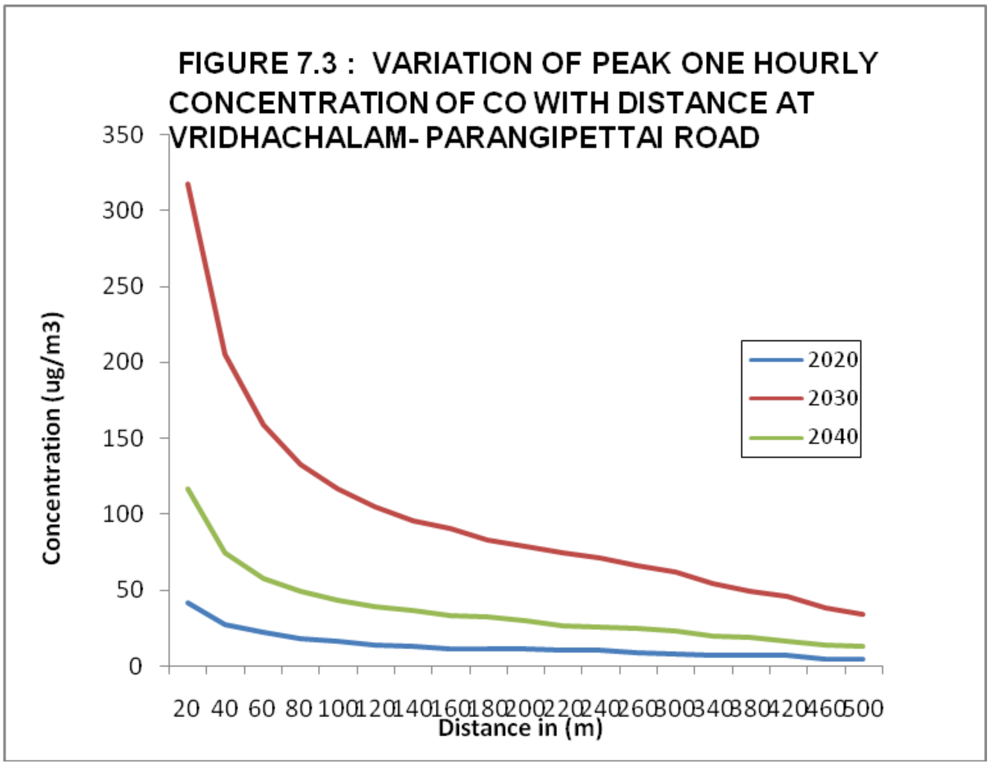
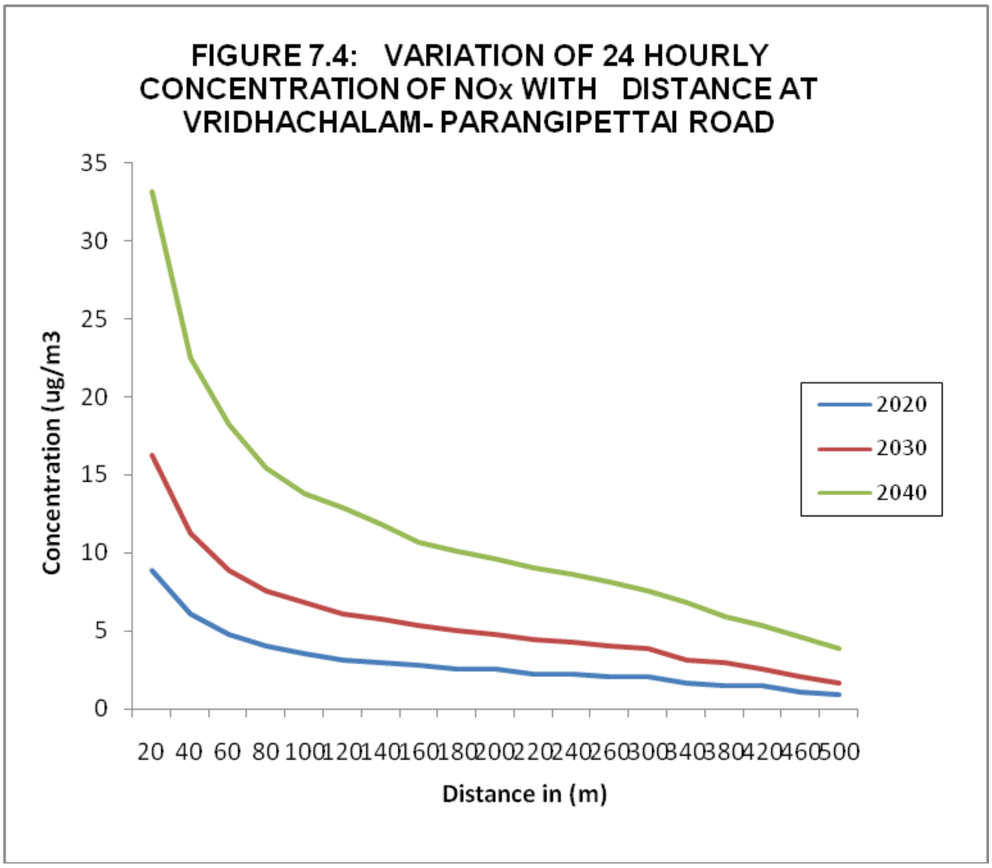


FIGURE 7.3 : VARIATION OF PEAK ONE HOURLY CONCENTRATION OF CO WITH DISTANCE AT VRIDHACHALAM- PARANGIPETTAI ROAD
Concentration (ug/m3)
350
300
250
200
150
100
50
0
20 40 60 80 100 120 140 160 180 200 220 240 260 300 340 380 420 460 500
Distance in (m)
2020
2030
2040



7.4 LAND ENVIRONMENT - IMPACTS

7.4.1 Topography and Geology

Construction Phase

During the construction phase change in topography will take place due to construction of the embankment in the Right of way. The bottom of sub grade is generally 1.0 m above the high flood level/high water table and keeping in view of local people's suggestion the proposed FRL is kept as 1.0m from the top of existing FRL which will lead to change in local topography around the road. The change in topography will be felt at locations of raising and new culvert locations, approaches of minor bridges to be reconstructed and major junctions to be improved. These locations for both the corridors have been given below:

Table 7.13: Locations of Additional Culverts in Madapattu- Thirukovilur Road

Sl. No.	Design Chainage (km)	Size of New Box Culvert N x W x H (m)
1	43+210	1x1.5x1.0
2	43+760	1x1.5x1.0
3	51+920	1x1.5x1.0
4	54+720	1x1.5x1.0
5	54+980	1x1.5x1.0
6	58+100	1x1.5x1.0
7	60+535	1x1.5x1.0
8	63+000	1x1.5x1.0

Sl. No.	Design Chainage (km)	Size of New Box Culvert N x W x H (m)
9	64+050	1x1.5x1.0
10	65+600	2x1.5x1.0
11	66+465	1x2.0x1.0
12	66+822	1x2.0x1.0
13	67+240	1x2.0x1.0
14	67+830	1x6.0x2.5 (Skew)
15	67+970	1x6.0x2.5 (Skew)
16	68+560	1x2.0x1.0
17	68+950	1x2.0x1.0
18	69+830	1x2.0x1.0
19	70+240	1x6.0x2.5 (Skew)
20	70+415	1x2.0x1.0
21	71+005	2x2.0x1.0

Table 7.14: Locations of Additional Culverts in Vridhachalam- Bhuvanagiri Road

Sl. No.	Design Chainage (km)	Size of New Box Culvert No x Span (m)
1	1+520	1x2.0x1.0
2	1+620	1x2.0x1.3
3	1+845	1x2.0x1.2
4	2+220	2x2.0x1.0
5	2+567	1x2.0x1.0
6	3+250	2x2.0x1.0
7	5+390	1x2.0x1.0
8	5+530	2x2.0x1.0
9	5+740	2x2.0x1.0
10	5+880	1x2.0x1.0
11	6+450	2x2.0x1.0
12	6+630	2x2.0x1.0
13	6+830	2x2.0x1.0
14	7+030	2x2.0x1.0
15	7+360	2x2.0x1.0
16	7+590	2x2.0x1.0

Sl. No.	Design Chainage (km)	Size of New Box Culvert No x Span (m)
17	8+010	1x2.0x1.0
18	8+520	2x2.0x1.0
19	9+110	2x2.0x1.0
20	9+640	2x2.0x1.0
21	10+170	2x2.0x1.0
22	10+300	2x2.0x1.0
23	10+570	2x2.0x1.0
24	10+890	2x2.0x1.0
25	11+500	2x2.0x1.0
26	11+900	1x2.0x1.0
27	13+010	1x2.0x1.0
28	13+710	1x2.0x1.0
29	13+910	1x2.0x1.0
30	14+090	1x2.0x1.0
31	14+290	1x2.0x1.0
32	14+750	1x2.0x1.0
33	14+940	1x2.0x1.0
34	15+180	1x2.0x1.0
35	15+390	1x2.0x1.0
36	15+630	1x2.0x1.0
37	15+890	1x2.0x1.0
38	16+030	2x2.0x1.0
39	16+120	1x2.0x1.0
40	16+250	1x2.0x1.0
41	16+920	1x2.0x1.0
42	17+380	1x2.0x1.0
43	17+730	1x2.0x1.0
44	18+660	1x2.0x1.0
45	19+000	1x2.0x1.0
46	20+100	1x2.0x1.0
47	20+550	2x2.0x1.0

Sl. No.	Design Chainage (km)	Size of New Box Culvert No x Span (m)
48	21+060	2x2.0x1.0
49	21+790	2x2.0x1.0
50	22+440	1x2.0x1.5
51	22+730	1x2.0x1.0
52	23+110	1x2.0x1.0
53	23+290	1x2.0x1.0
54	23+950	1x2.0x1.0
55	24+240	2x2.0x1.0
56	24+500	1x2.0x1.0
57	24+840	2x2.0x1.0
58	25+060	1x2.0x1.0
59	25+790	1x2.0x1.0
60	26+450	1x2.0x1.0
61	26+600	1x2.0x1.0
62	26+940	1x2.0x1.0
63	27+100	1x2.0x1.0
64	27+320	1x2.0x1.0

Table 7.15: Locations of Reconstruction of Minor Bridges in Vridhachalam - Bhuvanagiri Road

S. No	Existing Chainage (km)	Design Chainage (km)	Proposed Outer to Outer width (m)	Proposed minimum Water Way (m)	Proposed Span No x Span (m)
1	3+988	3+983	12.90	15.0	3x5.0m (Clear)
2	25+025	24+920	12.90	8.0	1x8.0 (Clear)

Table 7.16: Locations of Major Junction Improvement in Vridhachalam - Bhuvanagiri Road

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Type of Junction (+,T,Y)	Category of Cross Road	Cross Road leads to
1	49+633	49+595	+	SH-69	LHS-Ulundurpettai RHS-Villupuram
2	66+263	66+190	+	SH09	RHS-Thirukovilur
3	124+460 of SH 137	71+147	T	Link Road and SH 137	LHS – Elavanasur RHS – Thirukovilur/ Thiruvannamalai

Table 7.17: Locations of Major Junction Improvement in Vridhachalam- Bhuvanagiri Road

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Type of Junction (+,T,Y)	Category of Cross Road	Cross Road leads to
1	0+000	0+000	T	SH-10	LHS-Neyveli, Wadlore, Cuddalore RHS-Vridhachalam, Salem
2	1+742	1+742	+	SH-213	LHS-Neyveli, Wadlore, Cuddalore RHS-Salem, Jayankondam
3	25+286	25+180	+	NH-45C	LHS-Panrutti,Vikravandi RHS-Kumbakonam, Tanjavur
4	35+800	35+700	T	VR	Kurinjippadi

The change in Topography may also take place due to opening and operating of borrow areas/quarry for construction of roads. The changes in topography will not be pinching to the eyes while changes in topography at construction camps, borrow areas, and quarry sites will be temporary and limited to the construction phase.

The change in topography will be more visible at the site of link road from the Madapattu - Thirukovilur Road as there are agricultural fields presently at the proposed alignment of the link road. The change in the topography of project road will also be felt at locations of curve improvements. These locations have been given in **Tables 6.5 and 6.6** in the previous chapter.

Since a major portion of both the project roads is widening along the existing road length, therefore, requirement of construction material is not significant to cause any impacts on geology of the project region. The aggregates will be obtained from the licensed quarries and borrow areas and it will be done as per IRC guidelines. Blasting is not planned in the project during construction of both the corridors.

Operation Phase

The changes in topography in operation phase are not likely as after construction of embankment at link road and at locations of raising, there will be stabilisation. However, topography during the operation phase may be impacted due to break in the embankment. The frequent change in the topography of the area due to floods will not take place due to construction of embankment at locations of road submergence and construction of additional culverts. No additional changes in topography are anticipated during the operation phase.

7.4.2 Impact on Seismology

The construction and operation of both the project roads will not lead to any adverse impact on seismology settings in the regional environment around the respective project roads. On the contrary, the seismic events that could occur in the region could damage the road and structures if not constructed as per the specification recommended for the seismic zone. Present upgradation will incorporate both; existing structures will be checked & complied with new structures will be designed earthquake resistant. Both the project roads fall under Zone II as per seismic map.

7.4.3 Impact on Land

The major land use within the project corridors is extensive agricultural land and intermittent existence of various settlements such as village and small towns having active commercial and economic activity along the roadside. The accurate surveys and accurate markings and negotiations will determine land use changes and finalize the alignment to minimize acquisition procedures. The land acquisition for both the project roads has already been given in section 7.2.1. The most prominent land use change will be from agricultural land to road use, especially in Madapattu - Thirukovilur road because of link road construction as part of this road. Any additional land available must be put to use for productive purposes. Mitigation related to land acquisition and resettlement will be undertaken as specified by the Resettlement Action Plan (RAP). The land use is likely to be impacted in open areas and at outskirts of habitation due to demand of housing and commercial establishments on account of the growing population in the project road surrounding. The improvement of both the project roads will further accelerate economic growth so there will be changes in land use at a faster pace. On the Vridhachalam - Bhuvanagiri road there is marginal land acquisition, therefore, there will not be a change in land use. All the curve improvements in both the roads will be confined within the available RoW.

Construction Phase

During construction phase construction activity may use land beyond RoW or construction camp area. In the construction camp area there will be a short duration loss of land. Even in secondary construction sites like at borrow area, quarry sites and water resource point the contractor activity will cross outside the limit depending upon the demand for material availability. There will be a temporary change in land use at these locations. These activities will create demand and disturbances in the nearby agricultural area, built up area, etc. In case of any such issues, it should be cleared within the shortest period. Potential community impacts related to economic growth are closely related to land acquisition, aesthetic and landscape considerations, noise, air quality, etc. Other than the mitigation actions in these areas no additional measures are warranted. On completion of construction works, entire RoW will be cleared for any bituminous wastes or construction materials. Apart from this all the rented land for construction camp or borrow area will be suitably rehabilitated, so that these do not have any adverse impact on the safety of local residents or the environment. NoC from owner/local community will be taken and closure reports of these borrow areas & quarry will be prepared.

Debris Generation

The total quantity generation is about 26,940 m^3 in Madapattu- Thirukovilur road and 39,540 m^3 in Vridhachalam- Bhuvanagiri road. Although a maximum portion will be recycled, but remaining portion has to be disposed off on some land whatever left, will be dumped on suitable land in an environmental friendly manner.

Operation Phase

The likely impact after construction on the land use is ribbon development. This ribbon development occurs due to the establishment of commercial shops and housing accommodation. There is most of the times encroachment on the RoW. Immediately after the construction, it is necessary to ensure that no further deterioration or major land use change such as ribbon development occurs. Some suitable mitigation measures are to be planned by the project authorities.

7.4.4 Contamination of Soil

The soil in the study areas of both the corridors is classified as the red gravelly, red sandy and red loam soils. Impacts on soil during construction and operation phases have been described below:

Pre Construction and Construction Phase

Contamination of soil during the construction phase is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoils and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case dumping is done near water body locations such as road side ponds and local rivers. The aprehension of soil contamination is also there due to staorage of hazardous materials such as solvents, paints and other chemicals at construction sites and camps.

Compaction of soil will occur in the pre-construction phase due to movement of the construction equipment and machinery and during the setting up of construction camps.

Contamination of soil in the pre-construction phase may be considered as a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labour camps set up during pre-construction phase. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. as these will come up in this phase. Excavation of soil and other minerals for sub grade, embankment, earthworks, etc. will lead to loss of top fertile soil & change in the land use of the area.

Soil Compaction occurs beyond the carriageway and within the vegetated area of the RoW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compaction. This impact is direct and will be maximised in the RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where the vegetation can grow and rain infiltration will take place.

Operation Phase

During the operation phase, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of the spill. However, monitoring of soil quality will be done during construction & operation phases to observe changes in physical and chemical properties and composition of soils along the both the project roads.

During the operation period compaction will be restricted to the carriageway of the project road. Compaction cannot be said to be an impact of the operation phase as the pavement itself is a function of compacted base and sub base.

7.4.5 Soil Erosion

The project influence area of both the project roads is prone to soil erosion due to significant sand content in soil. The chances of soil erosion are there right from pre construction phase when there is a tree and vegetation removal for site clearance due to exposure of the top soil cover.

Construction Phase

During the construction phase locations prone to soil erosion will be bridge approaches, side slopes at raised locations, side slopes of borrow areas, locations of top soil storages at the site. These will be prone to erosion if proper compaction is not done and revegetation at finished surface is not taken.

Operation Phase

During the operation phase the finished side slopes and approaches of reconstructed bridges, raised areas and side slopes of the newly constructed link road as part of Madapattu-Thirukovilur road will be prone to erosion and rain cuts.

7.4.6 Borrow Pits and Quarries

The total quantity of earthworks required for the project is about 256,710 m^3 for Madapattu-Thirukovilur Road & 322,495 m^3 Vridhachalam- Bhuvanagiri Road.

Eleven borrow pits have been identified near the SH-09 alignment for Madapattu- Thirukovilur project road and 13 borrow areas have been identified for Vridhachalam- Bhuvanagiri road. The details of these have been given in **Annexure 2.2**. It has been estimated that the volume of earth available is sufficient for the earthworks at both the corridors. The fly ash utilisation is not planned in either of the project roads as it is technically not suitable as fill material, because the project road has low height fills. The planned fill is about 1-1.5 m height in certain sections of the roads. In both the project road existing and operating licensed quarries are planned to be used. These quarries have their own redevelopment plan as part of their approved mining plan. The locations of sand and aggregate quarries with reference to project road corridors have been shown in **Annexure 2.2**. It is clear from the annexure that sand quarries are located 10-15 km distance from Madapattu- Thirukovilur road and about 2 km from Vridhachalam-Bhuvanagiri road. The aggregate quarries are located 70-80 km from Madapattu- Thirukovilur Road and 80-85 km from Vridhachalam- Bhuvanagiri road.

Construction Phase

Cartage of the borrow materials to the construction sites is of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures need to be worked out for the minimisation of such impacts during the haulage of borrow materials.

Operation Phase

Rehabilitation of borrow areas from which earth has been excavated, is a potential problem which needs to be addressed. In addition to visual blight, safety issues can cause environmental and safety hazards. Opening of Borrow Areas may result in loss of productive soil. Moreover, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out. Additionally, they can also act as a breeding ground for vectors like mosquitoes just after monsoon.

7.4.7 Slope Stability

Construction Phase

The elevation of both the project roads varies from 10-150m above mean sea level, which is relatively a flat geography. Also, there is no major bridge across both the project roads which will require slope stabilization at the approaches. There may be certain degrees of slope stability issues in the new alignment of link road for the embankment during the construction phase which will be properly handled during the construction phase.

Operation Phase

There are certain degrees of slope stability at minor bridges and cross drainage structures, especially in the new link road on Madapattu- Thirukovilur road. There are certain degrees of slope stability issues of the embankment in the newly constructed road portions at both the corridors (at locations of curve improvements, roadside ponds closed to project road, newly constructed link road, etc.) during the operation phase, these slopes will be stabilized using turfing and vegetation. At the newly constructed link road the side slopes may erode due to torrential rains if these are not stabilised. There are no chances of slope failure as there are no steep slopes on either of the project roads.

7.5 WATER ENVIRONMENT - IMPACTS

The water environment, which comprises i.e. surface water and ground water, may be impacted quantitatively and qualitatively. Impacts over water resources are expected only in construction phase. There are no major or minor rivers crossing in both the project roads. There are no rivers or major streams crossing the alignment of proposed link road between SH-09 and SH-137 as part of Madapattu- Thirukovilur road. To facilitate the cross-drainage at these minor and seasonal water crossings, cross-drainage structures have been proposed including improvements in the existing structures. There will be storm water flow from the road through side drains to these streams. Due to creation of additional paved surface there will be an additional generation of runoff from the improved road surface.

7.5.1 Surface Water - Loss of Water Bodies, Runoff and Drainage, Alteration of Cross Drainage

Construction Phase Impacts on Surface Water Sources

(i) Loss of Water Bodies

The current project aims to widen both the project roads. There are some local ponds located along the project roads. Due to widening these will be impacted. The impacts will be in the form of siltation, part area may be impacted due to widening. The list of ponds located along both the project roads is given below and extent of impact is also mentioned.

Table 7.18: List of Road Side Ponds and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L			Distance from C/L(m)	Name of the CPR	
1				60+470	09.00	Pond	Partially Impacted
2	Pond	12	No Impact				
3	Pond	12.00	Partially Impacted	65+330			
4	Pond	10.00	Partially Impacted	65+660			
5	Pond	08.00	Partially Impacted	66+320			

Table 7.19: List of Road Side Ponds and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road Widening

S. No	Chainage		Location on EROW	Distance from center line(m)	Impact
	From	To			
Pond Locations					
1	0+950	1+000	RHS	9 m	Partially impacted
2	9+400	9+450	LHS	10 m	Not Impacted
3	11+700	11+800	LHS	14 m	Not impacted
4	16+400	16+500	LHS	14 m	Partially due to road widening on LHS
5	34+900	35+000	RHS	19 m	Not impacted

Operation Phase Impacts on Surface Water Sources

During the operation phase, there is little chance of degradation of water quality during normal operations. The implications of accidental discharge are potentially disastrous. But, it must be emphasised that the probability of such an accident is quite low, indeed one of the objectives of the design is the enhancement of road safety. These accidental discharges will not only impact surface water source, but shall have impacts on soils also.

(iii) Runoff and Drainage

The degradation of surface water quality can occur during the construction phase from the increased sediment load into watercourses near the construction sites. This may be aggravated by removal of trees and consequent increase in soil erosion. Smaller streams that criss-cross the road are unlikely to be subjected to such run-off discharges because they have properly raised berms on their banks. Further, these are seasonal streams only. Increased load of fine sediment will make the water more turbid and will decrease water storage capacity of the water body. This turbidity may impact aquatic ecology.

In the operation phase increased run off will result from impervious surface created due to road widening. The estimation for storm water runoff has been carried out for both the project roads separately.

(a) Madapattu- Thirukovilur Road

*Increase in runoff per year (m^3) = increase in runoff coefficient due to construction * annual rainfall in the area (m) * area of the constructed surface (m^2)*

The appropriate run-off coefficients are: 0.95 for asphalt, 0.2 for silty and sandy soil, 0.3 for loamy soil, and 0.55 for Black cotton soil.

Area of constructed surface = 24.5 (existing road length km) x 1000 x 5m (increase in width of road due to paved shoulder and earthen shoulder) + 5000 (length of link road) x 12m (Formation width average)

Area = 122500+60,000=182500 m^2

Average rain fall in Villupuram in last five years= 1099mm=1.099 m

Run off = (0.95-0.30) x 182500 x 1.099=130,368.875 m^3

(b) Vridhachalam- Bhuvanagiri Road

*Increase in runoff per year (m^3) = increase in runoff coefficient due to construction * annual rainfall in the area (m) * area of the constructed surface (m^2)*

The appropriate run-off coefficients are: 0.95 for asphalt, 0.2 for silty and sandy soil, 0.3 for loamy soil, and 0.55 for Black cotton soil.

Area of constructed surface = 35.8(existing road length km) x 1000 x 5m (increase in width of road due to paved shoulder and earthen shoulder)

Area of Constructed surface =179,000 m^2 (Assumption an average width of 5 m taken in entire length although initial 2 km is proposed to four lane)

Average rainfall in Cuddalore district=1300 mm=1.3 m

Run off = (0.95-0.30) x 179, 000 x 1.3=151,255 m^3

The above additional storm water runoff has to be taken care by the road drainage network.

(iii) Alteration of Cross Drainage

Impacts of road construction, which lead to alteration of drainage, are generally due to construction of cross drainage at locations of crossings. This alteration of drainage will occur at locations of minor bridge reconstruction sites due to diversion operation. The locations of new minor bridge construction sites in both the corridors are given in **Table 7.15** for Vridhachalam-Bhuvanagiri road and no minor bridge reconstruction is planned on Madapattu- Thirukovilur road. This requires stream and or gully training for the period during which the minor bridge and cross drainage structures are to be constructed. Alteration of drainage can lead to soil erosion of adjacent areas, disturb the local vegetation. If the period of alteration is long, there are chances of local ecology being impaired. However, cross drainage works should not be carried out in the rainy season when the water levels in local streams are high. The impacts due to, alteration of drainage can be minimized effectively, with adequate mitigation measures and pre planned construction schedules.

7.5.2 Ground Water

(i) Loss of Ground Water Resources

The alignment of both the project roads is passing through the area which is mostly dependent on ground water for irrigation as wells for drinking. Some of groundwater sources such as wells bore wells and over head tanks and hand pumps are located within the RoW of the project road. The water sources likely to be impacted are given below:

Table 7.20: List of Hand Pumps and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS					RHS		
S. No .	Name of the CPR	Distance from C/L (m)	Impact	Chainage	Distance from C/L (m)	Name of the CPR	Impact
1	Hand Pump	15.00	No Impact	45+360			
2				45+460	08.00	Hand Pump	Impacted fully
3				45+850	09.00	Hand Pump	Impacted fully
4				46+050	12.00	Hand Pump	
5	Hand Pump	07.00	Impacted fully	47+650			
6	Hand Pump	07.00	Impacted fully	47+960			
7	Hand Pump	08.50	Impacted fully	48+295			
8	Hand Pump	08.00	Impacted fully	48+435			
10				48+470	07.00	Hand Pump	Impacted fully
11				49+420	07.00	Hand Pump	Impacted fully
12	Hand Pump	12.00	No Impact	49+560			
13				49+660	07.00	Hand Pump	Impacted fully
14	Hand Pump	09.00	Impacted fully	49+860			
15				50+430	08.00	Hand Pump	Impacted fully
16	Hand Pump	12.00	No Impact	51+170			
17				53+230	09.00	Hand Pump	Impacted fully
18				55+250	07.00	Hand Pump	Impacted fully
19				55+420	12.00	Hand Pump	
20				55+630	05.00	Hand Pump	Impacted fully
21	Hand Pump	08.00	Impacted fully	57+650			
22	Hand Pump	08.00	Impacted fully	58+150			
23	Hand Pump	12.00	No Impact	58+530			
24				58+670	09.00	Hand Pump	Impacted fully
25	Hand Pump	10.00	Impacted fully	58+900			
26				59+810	10.00	Hand Pump	Impacted fully

LHS				Chainage	RHS		
S. No.	Name of the CPR	Distance from C/L (m)	Impact		Distance from C/L (m)	Name of the CPR	Impact
27				60+300	08.00	Hand Pump	Impacted fully
28				60+490	08.00	Hand Pump	Impacted fully
29				62+100	08.00	Hand Pump	Impacted fully
30				62+610	11.00	Hand Pump	
31	Hand Pump	09.00	Impacted fully	62+750			
32	Hand Pump	05.00	Impacted fully	65+490			
33	Hand Pump	11.00	No Impact	65+880			
34	Hand Pump	11.00	No Impact	66+110			

Table 7.21: List of Hand Pumps and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road

LHS				Chainage	RHS		
S. No.	Name of the CPR	Distance from C/L (m)	Impact		Distance from C/L (m)	Name of the CPR	Impact
1				0+300	9	Hand Pump	Impacted fully
2	Hand Pump	6	Impacted fully	19+100			
3	Hand Pump	8	Impacted fully	19+230			
4	Hand Pump	6	Impacted fully	19+865			
5	Hand Pump	6	Impacted fully	19+880			
6	Hand Pump	6	Impacted fully	20+600			
7				22+170	5	Hand Pump	Impacted fully
8	Hand Pump	6	Impacted fully	23+430			
10				23+700	7	Hand Pump	Impacted fully
11				24+060	7	Hand Pump	Impacted fully
12	Hand Pump	8	Impacted fully	25+560			
13	Hand Pump	8	Impacted fully	27+560			
14				28+080	5	Hand Pump	Impacted fully
15				28+300	8	Hand Pump	Impacted fully
16				28+400	7	Hand Pump	Impacted fully
17				29+370	7	Hand Pump	Impacted fully
18				31+420	6	Hand Pump	Impacted

LHS				Chainage	RHS		
S. No.	Name of the CPR	Distance from C/L (m)	Impact		Distance from C/L (m)	Name of the CPR	Impact
							fully
19	Hand Pump	23	No Impact	34+050			
20	Hand Pump	7	Impacted fully	34+412			
21	Hand Pump	6	Impacted fully	34+970			
22	Hand Pump	9	Impacted fully	35+770			

Table 7.22: List of Wells and Bore Wells and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1				41+700	20.00	Irrigation Bore Well + Electric motor	No Impact
2	Irrigation Bore Well + Electric motor	14.00	No Impact	42+900			
3				45+850	07.50	Irrigation Bore Well + Electric motor	Impacted Fully
4				49+440	08.00	Bore Well +Electric Motor	Impacted Fully
5	Irrigation Bore Well + Electric motor	12.00	No Impact	55+540			
6				55+730	12.50	Irrigation Bore Well + Electric motor	No Impact
7	Irrigation Bore Well + Electric motor	12.00	No Impact	55+920			
8	Irrigation Bore Well + Electric motor	10.00	Impacted Fully	56+790			
9	Irrigation Bore Well + Electric motor	13.00	No Impact	56+920			
10				57+200	08.00	Irrigation Bore Well + Electric motor	Impacted Fully
11	Drinking Bore Well+ Electric motor	12.00	No Impact	58+150			
12	Irrigation	10.00	No Impact	64+360			

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
	Bore Well + Electric motor						
13				64+800	04.50	Irrigation Bore Well + Electric motor	Impacted Fully
14	Drinking Bore Well+ Electric motor	08.00	Impacted Fully	64+820			
15				65+470	06.00	Irrigation Bore Well + Electric motor	Impacted Fully
16				66+560	11.00	Irrigation Bore Well + Electric motor	No Impact

Table 7.23: List of Wells and Bore Wells and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Bore Well with motor	12	No Impact	09+460			
2				27+735	6	Bore Well with motor	Impacted Fully

Table 7.24: List of Public Taps and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Public Tap	15.00	No Impact	42+370			
2	Public Tap	10.00	Fully Impacted	42+600			
3	Public Tap	10.00	Fully Impacted	44+580			
4				45+450	08.00	Public Tap	Fully Impacted
5				45+460	08.00	Public Tap	Fully Impacted
6				45+420	09.00	Public Tap	Fully Impacted
7				45+550	09.00	Public Tap	Fully Impacted
8				45+630	07.00	Public Tap	Fully Impacted
9				45+670	04.50	Public Tap	Fully Impacted
10				45+680	04.00	Public Tap	Fully Impacted

LHS			Impacts		RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)		Chainage	Distance from C/L (m)	Name of the CPR	
11				45+730	04.50	Public Tap	Fully Impacted
12				45+740	05.00	Public Tap	Fully Impacted
13				45+750	04.00	Public Tap	Fully Impacted
14				45+930	07.00	Public Tap	Fully Impacted
15				46+025	06.00	Public Tap	Fully Impacted
16				46+070	10.00	Public Tap	Fully Impacted
17	Public Tap	07.00	Fully Impacted	48+080			
18	Public Tap	10.00	Fully Impacted	48+435			
19	Public Tap	12.00	No Impact	48+660			
20				49+250	12.00	Public Tap	
21				49+440	08.00	Public Tap	Fully Impacted
22				49+665	06.50	Public Tap	Fully Impacted
23				50+005	07.00	Public Tap	Fully Impacted
24				50+020	07.00	Public Tap	Fully Impacted
25				50+040	07.00	Public Tap	Fully Impacted
26				50+200	12.00	Public Tap	No Impact
27				53+230	09.00	Public Tap	Fully Impacted
28				58+050	09.00	Public Tap	Fully Impacted
29				58+080	10.00	Public Tap	Fully Impacted
30	Public Tap	10.00	Fully Impacted	58+230			
31				58+260	08.00	Public Tap	Fully Impacted
32				58+420	07.00	Public Tap	Fully Impacted
33				58+540	08.00	Public Tap	Fully Impacted
34				58+650	07.00	Public Tap	Fully Impacted
35	Public Tap	08.00	Fully Impacted	58+680			
36	Public Tap	09.00	Fully Impacted	58+750			
37				58+820	10.00	Public Tap	Fully Impacted
38				59+810	07.00	Public Tap	Fully Impacted

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
39				60+130	05.00	Public Tap	Fully Impacted
40				60+320	05.00	Public Tap	Fully Impacted
41				62+380	08.00	Public Tap	Fully Impacted
42				62+450	07.00	Public Tap	Fully Impacted
43	Public Tap	07.00	Fully Impacted	62+670			
44	Public Tap	08.00	Fully Impacted	62+750			
45				65 +470	08.00	Public Tap	Fully Impacted
46				65+62	07.00	Public Tap	Fully Impacted
47	Public Tap	07.00	Fully Impacted	65+800			
48				65+860	07.00	Public Tap	Fully Impacted
49				66+020	07.00	Public Tap	Fully Impacted
50				66+100	07.00	Public Tap	Fully Impacted
51	Public Tap	11.00	No Impact	66+113			
52	Public Tap	07.50	Fully Impacted	66+180			
53				66+200	12.00	Public Tap	No Impact

Table 7.25: List of Public Taps and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1				0+020	8	Public Tap	Fully Impacted
2				0+550	7	Public Tap	Fully Impacted
3	Public Tap	14	Fully Impacted	0+720			
4				0+980	6.5	Public Tap	Fully Impacted
5				01+035	5	Public Tap	Fully Impacted
6				01+160	4.5	Public Tap	Fully Impacted
7	Public Tap	5	Fully Impacted	01+220	5	Public Tap	Fully Impacted
8				01+270	5	Public Tap	Fully Impacted
9	Public Tap	12	Fully Impacted	01+280			

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
10	Public Tap	5	Fully Impacted	01+440			
11				02+570	8	Public Tap	Fully Impacted
12				02+700	7	Public Tap	Fully Impacted
13				02+800	8	Public Tap	Fully Impacted
14				02+920	8	Public Tap	Fully Impacted
15				03+000	8	Public Tap	Fully Impacted
16				03+300	9	Public Tap	Fully Impacted
17				03+310	8	Public Tap	Fully Impacted
18	Public Tap	5.5	Fully Impacted	04+960			
19				05+070	5	Public Tap	Fully Impacted
20	Public Tap	5	Fully Impacted	05+260			
21	Public Tap	5	Fully Impacted	06+360			
22	Public Tap	8	Fully Impacted	08+440			
23	Public Tap	8	Fully Impacted	08+460			
24	Public Tap	8	Fully Impacted	08+480			
25				08+360	6	Public Tap	Fully Impacted
26				08+450	8	Public Tap	Fully Impacted
27				08+470	8	Public Tap	Fully Impacted
28				08+490	8	Public Tap	Fully Impacted
29	Public Tap	8		08+500			
30	Public Tap	12	No Impact	08+620			
31	Public Tap	6		08+640			
32	Public Tap	6		08+700			
33				08+740	7	Public Tap	Fully Impacted
34	Public Tap	6		09+400			
35	Public Tap	12	No Impact	09+480			
36	Public Tap	12	No Impact	09+500			
37	Public Tap	8	Fully Impacted	10+010			
38	Public Tap	6	Fully Impacted	10+060			
39	Public Tap	7	Fully Impacted	10+550			
40	Public Tap	7	Fully Impacted	10+620			

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
41	Public Tap	7	Fully Impacted	11+100			
42	Public Tap	7	Fully Impacted	11+960			
43	Public Tap	6	Fully Impacted	12+060			
44	Public Tap	5	Fully Impacted	12+590			
45	Public Tap	10	Fully Impacted	13+080			
46	Public Tap	10	Fully Impacted	15+020	6	Public Tap	Fully Impacted
47				15+180	7.5	Public Tap	Fully Impacted
48	Public Tap	6.5	Fully Impacted	16+300			
49	Public Tap	12	Fully Impacted	19+250			
50				19+300	8	Public Tap	Fully Impacted
51	Public Tap	12	Fully Impacted	19+700			
52	Public Tap	12	Fully Impacted	19+730			
53	Public Tap	6	Fully Impacted	19+770			
54	Public Tap	7	Fully Impacted	19+860			
55	Public Tap	6	Fully Impacted	19+870			
56	Public Tap	4	Fully Impacted	22+100			
57	Public Tap	5	Fully Impacted	23+450			
58				34+500	6	Public Tap	Fully Impacted

Table 7.26: List of Overhead Water Tanks and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

S. No.	LHS		Impacts	Chainage	RHS		Impacts
	Name of the CPR	Distance from C/L (m)			Name of the CPR	Distance from C/L (m)	
1	Over Head Tank + Bore Well + Electric Motor	23.00	No Impact	42+550			
2				42+750	12.00	Ground Level Syntex Tank + Bore Well + Motor	No Impact
3	Irrigation Water Tank	07.50	Impacted Fully	44+750			

S. No.	LHS		Impacts	Chainage	RHS		Impacts
	Name of the CPR	**Distance from C/L (m)**			**Name of the CPR**	**Distance from C/L (m)**	
4				45+360	07.00	Over Head Tank + Bore Well + Electric Motor	Impacted Fully
5				45+660	15.00	Ground Level Syntex Tank + Bore Well + Motor	No Impact
6	Irrigation Water Tank	12.00	No Impact	46+150			
7	Ground Level Syntex Tank + Bore Well + Motor	08.00	Impacted Fully	47+750			
8	Ground Level Syntex Tank + Bore Well + Motor	08.00	Impacted Fully	48+350			
9	Ground Level Syntex Tank + Bore Well + Motor	12.00	No Impact	48+620			
10				48+665	13.00	Ground Level Syntex Tank + Bore Well + Motor	No Impact
11				49+330	07/50	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
12				49+400	13.00	Ground Level Syntex Tank + Bore Well + Motor	No Impact
13				49+420	07.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
14				49+975	08.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
15	Ground Level Syntex Tank + Bore Well + Motor	08.00	Impacted Fully	50+680			
16				50+830	08.00	Ground Level	Impacted Fully

S. No.	LHS		Impacts	Chainage	RHS		Impacts
	Name of the CPR	Distance from C/L (m)			Name of the CPR	Distance from C/L (m)	
						Syntex Tank + Bore Well + Motor	
17				53+420	08.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
18	Ground Level Syntex Tank + Bore Well + Motor	07.00	Impacted Fully	55/370			
19	Ground Level Syntex Tank + Bore Well + Motor	08.00	Impacted Fully	57+700			
20	Ground Level Syntex Tank + Bore Well + Motor	09.00	No Impact	58+040			
21				58+360	08.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
22				58+620	05.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
23				58+740	08.00	Over Head Tank + Bore Well + Electric Motor	Impacted Fully
24	Ground Level Syntex Tank + Bore Well + Motor	11.00	No Impact	58+850			
25	Ground Level Syntex Tank + Bore Well + Motor	11.00	No Impact	59+080			
26				62+360	05.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
27	Over Head Tank + Bore Well + Electric Motor	10.00	No Impact	62+750			
28	Ground Level Syntex Tank + Bore Well +	10.00	No Impact	62+750			

S. No.	LHS		Impacts	Chainage	RHS		Impacts
	Name of the CPR	Distance from C/L (m)			Name of the CPR	Distance from C/L (m)	
	Motor						
29	Over Head Tank + Bore Well + Electric Motor	12.00	No Impact	62+480			
30	Over Head Tank + Bore Well + Electric Motor	12.00	No Impact	64+450			
31	Ground Level Syntex Tank + Bore Well + Motor	05.00	Impacted Fully	64+950			
32				65+640	06.00	Ground Level Syntex Tank + Bore Well + Motor	Impacted Fully
33	Ground Level Syntex Tank + Bore Well + Motor	08.00	Impacted Fully	65+670			
34	Ground Level Syntex Tank + Bore Well + Motor	07.00	Impacted Fully	65+865			
35				66+000	12.00	Over Head Tank + Bore Well + Electric Motor	No Impact

In case of Vridhachalam- Bhuvanagiri road no bore well or well is being impacted. The hand pumps and Overhead tanks are also not seen within the corridor of impact.

The loss of the above mentioned supplies of relatively pristine water would be a direct negative impact. However, the project envisages the replacement of each source of water supply before removing a single one. It is also envisaged that the affected population will provide its inputs on where to locate the new source.

7.5.3 Water Requirement for Project

The water requirement for construction depends on the climatic conditions, type of equipment, type of material available, mix design, type of construction plant and number of people working on the project. With the following assumptions the approximate water quantity required for each project road has been calculated.

- 8-10% of weight of soil for the embankment construction
- 7-8% of weight of soil for sub grade construction
- 5-6% of weight of GSB materials for GSB and WMM
- 150 liters/ cum for concrete

The water requirement has been assumed based on past project experience and on the strict quality control basis. A domestic requirement of 150 liters per worker for each day has been assumed. For this project about 100 resident workers have been considered for each site. Details of the water requirement assessed for each project road is presented in **Table 7.27**.

Table 7.27: Requirement of Water for Proposed Construction Works

S. No.	Purpose	Cum/day
1	Permanent works (Total quantity in cum)	110,000 (2 Years) or 150 cum /day
2	Dust Suppression at work zone in (cum/day)	25
3	Curing (cum/day)	8
4	Laboratory (cum/day)	5
5	Haul Roads (cum/day)	15
6	Crusher (cum/day)	10
7	Plant Cleaning and workshop washing in (cum/day)	8
8	Domestic Purpose in (cum/day)	15
Total Requirement(cum/day)		**236**

The daily water requirement for the permanent works has been calculated assuming the construction period of 2 years. Hence the total requirement for the two roads will be 472 m^3/day.

A large portion of required water during the construction phase will be withdrawn from ground water in such a manner that the local water supply is not affected. In the project area, water table depth is low so there will be impact on ground water resources. The ground water withdrawal has to be monitored closely by the construction supervision consultant. The water withdrawal will not be from the single location as the project is linear in nature.

7.5.4 Water Quality

Impact on Surface Water - Construction Phase

The degradation of water quality can occur during the construction phase of increased sediment load into water courses such as ponds, and open dug wells close to the project road. The prominent surface water sources close to the Vridhachalam - Bhuvanagiri road is Manimukhta and Vellar River. This may be aggravated by removal of trees and consequent increase in soil erosion. The water quality of the surface water bodies which are partly being impacted will also degrade during the construction phase.

As soil in the study area is red loamy type in Madapattu- Thirukovilur road and younger alluvium type on the Vridhachalam - Bhuvanagiri road. Both types of soil have significant silt; the impacts due to the increased sediment load will be significant and need to be addressed for surface water bodies.

Increased load of fine sediment will make the water more turbid. If the concentrations are exceptionally high (>185 mg/l), smaller fish can be harmed. Heavier sediment may smother the algae growing in the lower strata and would completely alter the substratum of the watercourse.

Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers' camps and from spillage in vehicle parking and/or fuel and lubricant storage areas, if these are located close to the surface water bodies.

Since the soil is loamy and contains a large proportion of silt, percolation to underlying aquifer will be very fast. Therefore, any pollutant discharge may quickly percolate into the ground water.

Impact on Surface Water - Operation Phase

During the operation phase, there is little chance of degradation of water quality during normal operations. The implications of accidental discharge are potentially disastrous. But, it must be emphasized that the probability of such an accident is quite low, indeed one of the objectives of the design is the enhancement of road safety.

Impact on Ground Water - Construction Phase

Ground water quality will be impacted during construction phase if there is discharge of untreated wastewater from construction camps and workers' camps in the open land due to percolation.

Impact on Ground Water - Operation Phase

During the operation phase, there are no chances of ground water contamination because the construction camp will cease to exist and vehicular movement on finishing road is unlikely to impact the ground water quality. The runoff from the road surface will get diverted to nearest surface water drain/stream through the roadside drains.

7.6 NOISE ENVIRONMENT - IMPACT

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface.

The baseline noise levels monitored at various locations along the alignments of both roads indicate the baseline levels are well within in the stipulated limits of CPCB in respect for the respective land uses of monitoring locations. Noise levels in the project influence area are low as the ambience is rural particularly in agriculture fields. The noise is of concern as during construction and operation phases because there will be generation of significant noise.

The impacts on noise due to the project will be of significance in both the construction as well as the operation phases.

7.5.1. Ambient Noise Levels

Construction Phase

Noise levels during the construction phase are mostly expected to be indicative of prevalent baseline levels apart from localised noise levels at locations where construction phase activities are taking place such as establishment of workers' camps, stockyards, etc. These increased noise levels will prevail only for a short duration during the pre construction phase. Moreover, as these activities are not likely to be placed near settlement locations the increased noise impact is bound to be negligible.

There will be temporary noise impacts in the immediate vicinity of the project corridor due to the various construction activities. The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during the construction phase. The typical noise levels associated with the various construction activities and the various construction equipments are presented in **Table 7.28**.

Table 7.28: Typical Noise Levels of Principal Construction Equipment

CLEARING		**STRUCTURE CONSTRUCTION**	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		**LANDSCAPING AND CLEAN-UP**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Source: U.S. Environmental Protection Agency. Noise from Construction Equipment and Operations. Building Equipment and Home Appliances. NJID. 300.1. December 31. 1971

Though the noise levels presented for the various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Proper mitigation measures as to regulate the timings of construction, employing noise protection measures, etc. need to be worked out.

Operation Phase

Increase in noise is expected which may be of significant nuisance for sensitive receptors such as academic institutions and hospitals along both the project roads. The noise level predictions have been carried out for increased traffic (during the operation phase of the project) through the mathematical model and locations along both the project roads have been identified where noise levels exceed permissible limits. Based on predicted noise levels mitigation measures have been planned at the identified noise sensitive receptors.

7.5.2. Prediction of Traffic Noise Levels using FHWA Model

During the impact the operation phase will be of significant noise generation due to vehicular movement

To assess the noise levels at the various sensitive receptor locations along the corridor, the prediction of noise levels[3] has been made for the years 2020, 2030 and 2040 using the FHWA Transport Noise Model.

The FHWA Noise Model presented below is based upon calculating the hourly L_{eq} for all category-wise vehicles separately and then adding these logarithmically to obtain the overall hourly L_{eq} as follows:

$$L_{eq}(hi) = Loei + {}^{10}\log \frac{Ni}{SiT} + {}^{10}\log \left(\frac{15}{D}\right)^{1+\alpha} - 13 + \delta s$$

Where,

L_{eq} (hi)	Equivalent noise level at the hour (hi) for vehicle type (i)
L_{oei}	Reference mean energy level for (ith) vehicle type
Ni	Number of vehicles of (ith) class passing in time (T) one Hour (1 hour)
Si	Average Speed of vehicles of (ith) class (kmph)
T	Time duration corresponding to Ni, one hour
D	Perpendicular distance in (m) from centreline of the traffic lane to observer
α	Factor relating to absorption characteristics of the ground cover between roadway and observer (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis)
δ_s:	Shielding factor for barrier (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis)

The combined effect of all the vehicle categories can be determined at the receptor by adding the individual values using the following equation.

$$L_{(h,total)} = \log_{10} \sum_{h=i} 10^{Leq(hi/10)}$$

Reference Noise Levels

The vehicular noise emission levels significantly vary with vehicle speed. It is therefore necessary that speed dependency of noise emissions for various categories of vehicles is taken into account while using the model for noise prediction due to the roadway. In this work the speed-noise relations presented by National Environmental Engineering Research Institute (NEERI) in their report on Environmental and Social Assessment Delhi - NOIDA Bridge Project have been adopted (**Table 7.29**).

[3] Operational noise for the highway are predicted through the model developed by Federal Highway Administration, Department of Transportation of the U.S. Likely noise levels at various receptor locations predicted through FHWA noise model in present study. The various assumptions predicting the noise levels along the corridor through the FHWA model were:

- No significant change in the vehicle characteristics is anticipated during the projected period;
- There are no major grade differences in the project area as it is generally a plain terrain and gentle slopes of 1% to 3%., and no significant effect of grade on the noise levels is anticipated;
- The traffic along the proposed section is assumed to flow simultaneously in both the lanes and in both directions;
- Noise from other sources apart from the highway is not being accounted for in the modelling; and
- The receptor is considered to be independent of the noise emitted from the adjacent stretches

Table 7.29: Speed-Noise Relationships for Various Motor Vehicles

Speed (kmph)	Cars (dB (A)	Trucks & Buses (dB (A))	2/3 Wheelers (dB (A))
30	56.0	73.0	58.0
40	59.0	76.0	61.0
50	63.0	80.0	66.0
60	68.0	81.0	68.0
70	68.0	81.5	70.0
80	70.0	82.0	72.0
90	72.0	83.0	74.0
100	74.0	83.5	76.0

Traffic Volumes and Speed

To arrive at the hourly distribution of the category-wise traffic over a day for the horizon years the ratio of category-wise hourly traffic to the daily traffic based on the 2014 surveyed data has been taken for both the project roads.

The predicted noise levels at locations of baseline monitoring have been given in **Table 7.30** for Madapattu- Thirukovilur road and **Table 7.31** for Vridhachalam- Bhuvanagiri road below:

Table 7.30: Predicted Noise Levels (dB (A)) During Operation Phase for Madapattu- Thirukovilur Road

S.No.	Location	Predicted* Noise Levels 2015		Predicted* Noise Levels 2030		Predicted* Noise Levels 2040	
		Day	Night	Day	Night	Day	Night
1	Madapattu Village (km 41+700)- Commercial	61.70	60.90	64.40	63.60	66.60	65.80
2	Kotanur Village (km 48+600) Rural and Residential	61.70	60.90	64.40	63.60	66.60	65.80
3	Pennai Vallam, School (LHS) (km 58+300) Sensitive	61.70	60.90	64.40	63.60	66.60	65.80
4	By crossing of Thiruvannamalai (km 66+200)- Rural Residential	61.70	60.90	64.40	63.60	66.60	65.80

* *Predicted Level at 30 m*

Table 7.31: Predicted Noise Levels (dB (A)) During Operation Phase for Vridhachalam- Bhuvanagiri Road

S.No.	Location	Predicted Noise Levels 2015		Predicted Noise Levels 2030		Predicted Noise Levels 2040	
		Day	Night	Day	Night	Day	Night
1	Junction (km 0+000) Commercial	62.20	60.10	65.0	62.50	67.30	64.40
2	Gopalapuram village Church and school (km8+600) sensitive	62.20	60.10	65.0	62.50	67.30	64.40
3	Kamapuram School (LHS) (km12+100)- Sensitive	62.20	60.10	65.0	62.50	67.30	64.40
4	School and hostel (RHS)(km18+200)-Sensitive	62.20	60.10	65.0	62.50	67.30	64.40

5	Church and school (RHS)(km20+200) to (20+600) Sensitive	62.20	60.10	65.0	62.50	67.30	64.40
6	Sethiathoppu junction (km25+400) - Commercial	62.20	60.10	65.0	62.50	67.30	64.40
7	School and village (LHS) (km35+600) sensitive	62.20	60.10	65.0	62.50	67.30	64.40

Predicted Level at 30 m

It is clear from the above table that predicted noise levels for Vridhachalam-Bhuvanagiri road are higher in comparison to Madapattu- Thirukovilur road. This is because of higher projected vehicular traffic on the Vridhachalam - Bhuvanagiri road. The predicted results indicate that 'Day' time noise levels are within limits up to the horizon year 2030 for commercial areas and exceed for Residential and sensitive receptors since beginning but 'Night' time noise levels are exceeding the limits for all types of receptors from the beginning. The predicted noise levels at 30 m distance have been given considering corridor of impact 16 m in urban areas and 23 m in rural and open areas. At 30 m from centreline maximum impact on receptors is expected. However, graphical variation has been given for higher distances. The noise level variation with distance for various horizon years has been given in **Figures 7.5 to 7.7** for Madapattu-Thirukovilur road and **Figures 7.8 to 7.10** for Vridhachalam- Bhuvanagiri road. Based on the outcome of mathematical modelling noise barriers have been planned at the identified sensitive receptors.

Figure 7.5 : Noise Levels, Leq (Day) and Leq (Night) Variation(Madapattu-Thirukovilur Road (SH-9), Year 2020)

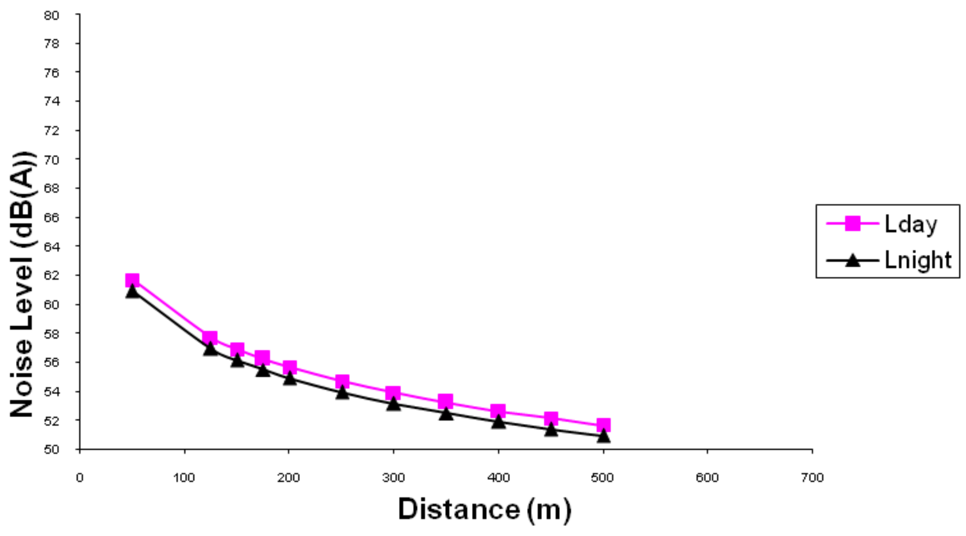


Figure 7.6 : Noise Levels, Leq (Day) and Leq (Night) Variation Madapattu-Thirukovilur Road (SH-9), Year 2030)

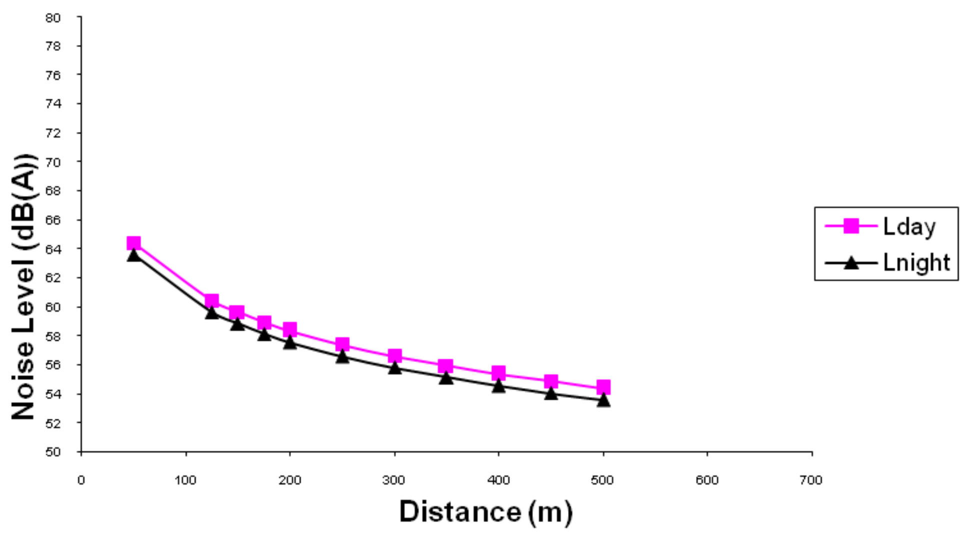


Figure 7.7: Noise Levels, Leq (Day) and Leq (Night) Variation(Madapattu-Thirukovilur Road (SH-9), Year 2040)

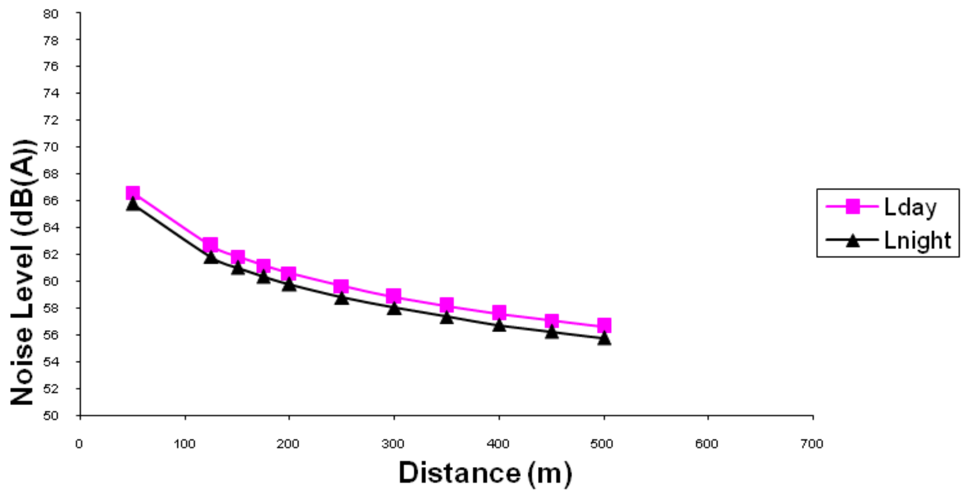


Figure 7.8 : Noise Levels, Leq (Day) and Leq (Night) Variation (Vridhachalam-Parangipettai Road (SH-70), Year 2020)

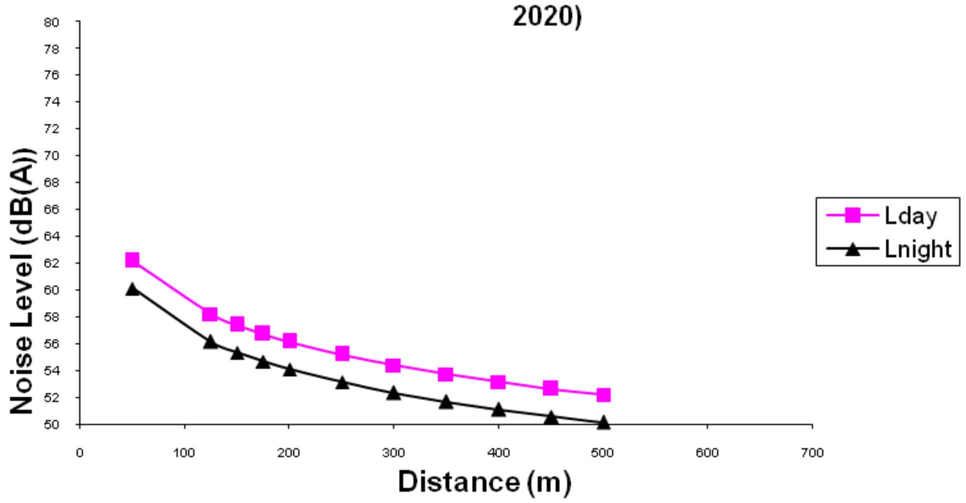


Figure 7.9 : Noise Levels, Leq (Day) and Leq (Night) Variation(Vridhachalam-Parangipettai Road (SH-70), Year 2030)

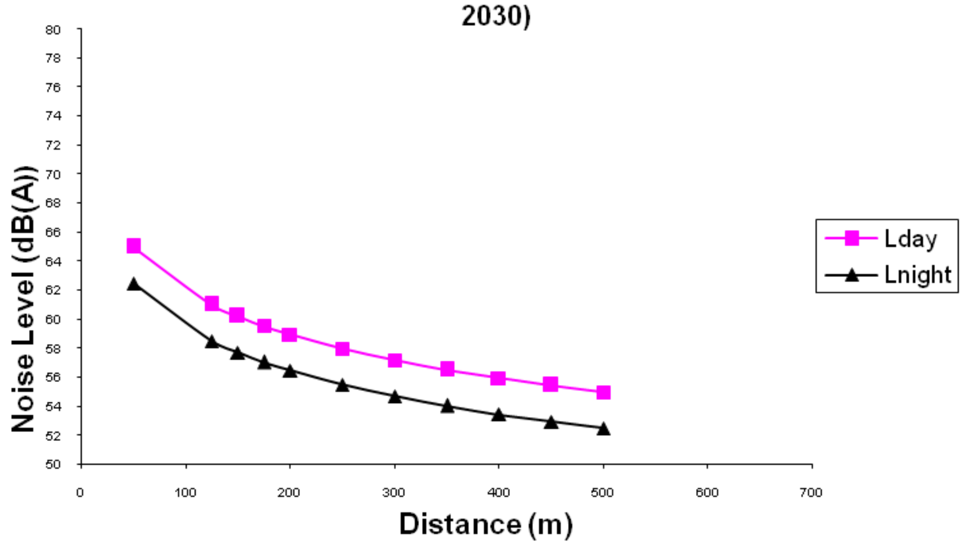
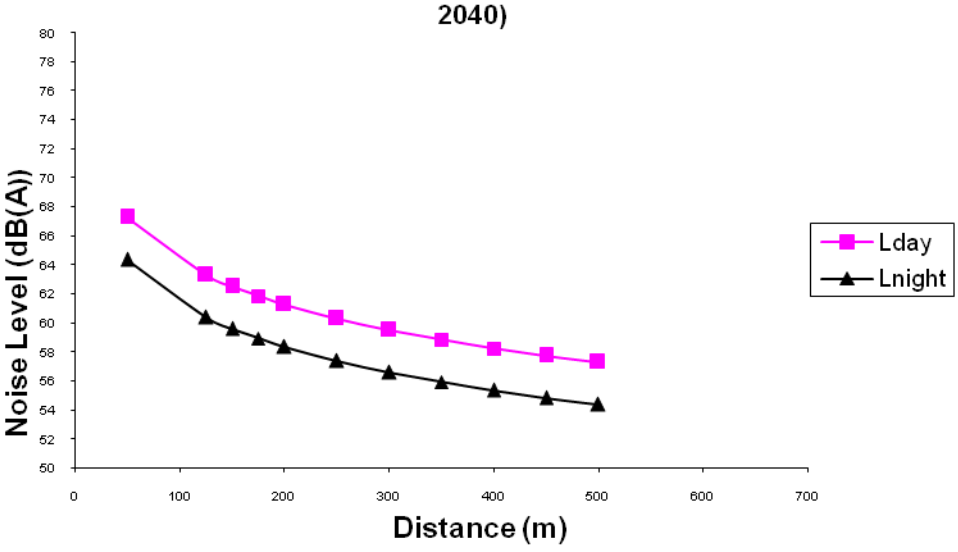


Figure 7.10 : Noise Levels, Leq (Day) and Leq (Night) Variation(Vridhachalam-Parangipettai Road (SH-70), Year 2040)



7.7 FLORA AND FAUNA - IMPACT

7.7.1 Forest Area

In both of the project roads there is no requirement for forest land diversion. None of the project road is adjacent to or passing through the reserved/protected/revenue forest.

7.7.2 Wild Life

No potential impact on fauna is envisaged due to improvement of both the project roads as none is close to any of the areas rich in wildlife. The project influence area has domesticated fauna. The Notified Wild Life Parks/ Bird Sanctuaries/ Wetland are located beyond project influence area of 15 km.

7.7.3 Tree Cutting

Trees located within the toe line (bottom of formation) need to be removed for efficient construction workmanship and more importantly to prevent collision with the trees, in case of an accident. Roadside trees with strong and rigid stems can pose safety hazards. Some trees obstruct clear sight distances. Others have a propensity to overturn when old and are potential safety hazards depending upon age and decay condition. All such trees that are safety hazards need to be cleared.

There will be a significant, direct impact on cutting of the roadside trees, it includes

- The loss of shade
- Loss of tree products.
- Loss of birds nesting place
- Removal of roadside trees will also reduce comfort levels for slow moving traffic and pedestrians.
- The removal of trees will facilitate erosion and contribute to the loss of the micro-ecosystems developed on the roadside.
- Besides this tree act as a noise barrier, dust absorption, air purifier etc.

The principal impact on flora is identified as removal of trees and vegetation. The trees to be cut on the Madapattu - Thirukovilur road are 2,267 and 5,011 on Vridhachalam- Bhuvanagiri road for road widening. The detail list of these trees has been included in the EIA report **Annexure 4.3.**

7.7.4 Removal of Vegetation

Clearing and grubbing of the area is the foremost requirement to start the construction activities in accordance with MoRTH specifications. The impact due to removal of vegetation includes

- Dust generation during windy atmosphere
- Loss of productive topsoil
- Soil erosion during the rainy season, may lead to water contamination.

Measures have been taken in reducing and curtailing the clearing and grubbing of excess land. In addition to tree removal, there will be removal of vegetation from the corridor of impact. The area of vegetation removal has been estimated at 34.5 and 20.4 ha for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road respectively.

7.7.5 Cattle Grazing

No cattle grazing grounds have been found along the corridor of Impact and in the immediate vicinity of the project road. There is the existence of an extensive agriculture field on either side of project road.

7.8 IMPACT ON SOCIOECONOMIC AND HEALTH ENVIRONMENT - IMPACT

Adverse socio-economic impacts include all disruptions on the social and economic interactions of communities due to the road intervention. This involves an effect on both the adjacent communities (mostly direct) as well as the nearby communities (mostly indirect). The various impacts have been detailed as:

- General impacts that apply to the entire project Influence Area **(Table 7.2)**.
- Specific impacts on likely properties and PAPs, within the Corridor of Impact.

General Impacts

Engineering, environmental and socio-economic surveys, conducted during the design phase, for the generation of the baseline information, give indications of several adverse impacts in the vicinity of the alignment, which are related to common human psychology and general in nature.

7.8.1 Fear of uncertainties regarding future

These normally become long lived, given the length of time, which elapses between initial surveys and commencement of construction.

Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation. These involve:

- The uncertainty of the amount of land/property to be acquired,
- Time of acquisition and evacuation,
- Extent and amount compensation,
- Provision of alternative land or job, etc.

The project involves widening along the existing alignment for both the corridors. On the Madapattu - Thirukovilur road there is a link road of the new alignment. The villages wise land acquisition for both the project roads is given in **Tables 7.32 and 7.33** for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri Road respectively.

Table 7.32: Village wise Summary of Land Acquisition for Madapattu- Thirukovilur Road

S No	District	Taluk	Village Name	Village No.	Total Area ha
1	Villupuram	Ulundurpet	Chittanangur	111	0.0225
2			Attippattu	109	0.0701
3			Madambattu	106	0.0390
4		Tirukkovilur	Taduttalkondur	164	0.0347
5			Saravanambakkam	104	0.4592
6			Periyasevalai	103	0.1270
7			Manakkuppam	161	0.0342
8			Elandurai	160	0.0020
9			Pavandur	115	0.0061
10			Pennaivalam	114	0.0401
11			Puduppalaiyam	117	0.0012
12			Kunnattur	118	0.0171
13			Sittilingamadam	119	0.1257
14			Marudur (Vada)	109	0.0064
15			Elarambattu	111	0.0115
16			Mudalur	110	0.0988
17			Kulapakkam (Aviyur)	106	0.2163
18			Vadakunnemali	107	0.0149
19			Aviyur	92	4.8884
20			Kattuppaiyur	105	1.0637
21			Kachchikkuvachchan	94	4.7638
22			Arumbakkam	51	3.8621
23			Tayanur (Kil)	52	1.3599
	Total additional land required				**17.2648**

Table 7.33: Village wise Summary of Land Acquisition for Vridhachalam- Bhuvanagiri Road

SNo	District	Taluk	Village / Town Name	Village No	Total Extent in ha
1	Cuddalore	Vridhachalam	Vridhachalam	87	0.0844
2			Budamur	88	0.2710
3			Ponneri (Kulappakkam)	121	0.0244
4			Mavadandal (Kulappakkam)	120	0.0893
5			Kumaramangalam	117	0.0083
6	Cuddalore	Vridhachalam	Gopalapuram	131	0.0029
7			Kinanur	132	0.0062
8			Kammapuram	149	0.1535

SNo	District	Taluk	Village / Town Name	Village No	Total Extent in ha
9			Siruvarappur	144	0.0026
10			Sattappadi	148	0.0711
11			Adanur (U)	147	0.2185
12		Chidambaram	Valaiyamadevi (Melpadi)	2	0.7565
13			Valaiyamadevi (Kilpadi)	3	0.2396
14			Erumbur	10	0.7534
15			Settiyatope	14	0.0291
16			Miralur	15	0.7479
17			Manjakkollai	22	0.5429
18			Siyappadi	21	0.3347
19			Odaiyur (Bhuvanagiri)	20	0.3726
20			Vandarayanpattu	19	0.6531
21			Alisikudi	18	0.1046
22			Adivarahanattam	37	0.2995
23			Suttukkuli	38	0.0056
24			Bhuvanagiri (Mel)	40	0.0345
Total additional land required					**5.8064**

7.8.2 Inducement of Land Prices

Once the project widening and improvement becomes common knowledge, there may be a danger of unscrupulous speculators moving in to purchase land at what might seem to be advantageous prices, prior to the commencement of the official procedures. Such impact is more likely to occur in the case of urban fringe areas during the design and pre-construction phase.

7.8.3 Inducement of Squatter Influx

Squatters may attempt to occupy land along and adjacent to the proposed alignments, in the hope of receiving compensation or some other inducements to leave when construction commences. Such squatters could cause undue pressure on local resources such as water and firewood, which could result in conflicts with those who are harvesting the resources presently.

7.8.4 Loss of Utilities and Amenities

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

- Natural (trees, bushes and grasslands), and
- Physical structures (public or private assets and utilities).
- Relocation of utilities like electricity, water and telephone lines

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

7.8.5 Public Health and Safety

The adverse impact on health of the public living near RoW is not anticipated during the construction phase as construction activities will be within RoW. The mitigation measures will be implemented as part of EMP to avoid any adverse impacts due to movements of construction machinery and vehicles on haul roads. In operation phase, there will be a positive impact on health of public as the project will relieve traffic congestion. Accessibility to health facilities will improve through better roads.

The concern for safety stems from the proposals for faster vehicular movement along the road with ruling design speed in rural area is 80-100 km/hr while in built up area it is 65 km/hr. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss of life in case of an accident.

The storage of the inflammable and toxic materials may result in accidents during construction phase an accidental spill may take place due to vehicle collisions.

Construction Phase

Construction phase activities including site clearances and movement of heavy vehicles & machinery along with transport of earth in trucks is likely to have negative impacts on the health of the people coming in contact with dust and exhausts generated by such activities. Concerns regarding the safety of people due to accidents also arise but are limited.

The general mobility of both local residents and their livestock in and around the construction area is likely to be hindered. Unmonitored construction activities like dismantling of structures, cutting of trees, haulage material obstruction vision, spillages of lubricants, on the road making it slippery may create an accident risk for local residents, particularly to children. Traffic detours are also likely to have an impact on the safety of the vehicular traffic as improve signage during night time may result in accidents, especially for fast moving vehicles.

Operation Phase

In the operation phase occupational safety will enhance as curves are being improved and protection in the form of guard rails along with foot path is being proposed at built up sections.

7.8.6 Resettlement of People

People, displaced from their homes and agricultural lands on account of the project, shall induce additional pressures to the local resource base. These include pressure on:

- Grazing lands and fuel-wood,
- Public services such as schools and medical facilities.
- This is critical since the number of displaced persons being squatters is larger than legal landholders formally displaced.

7.8.7 Land Use Changes

Land use changes along the road corridors are anticipated. These shall bring about a change in the characteristics of the adjacent lands. There would be a succession of land uses and higher return uses would displace the lower returns uses. This phenomenon will occur at major intersections and in settlement areas along the project corridors. The urban fringe areas along the project roads will be subjected to ribbon development.

Both the project road traverses in plain terrain passing through rural areas as well as many intermittent semi-urban settlements. In rural areas the land use on both sides is agricultural land/open spaces interspersed with small structures. There are a few ponds located close to the road. The abutting land use in the built-up areas is predominantly residential and commercial. Educational institutions and worshiping places exist in some of the villages and towns. The details of these have already been given in chapter 5.

The SIA and RAP documents under separate cover address social issues arising out of acquisition of land and other assets, eviction of squatters and removal of encroachments resulting in social and / or economic displacement of households / individuals / community, either direct or indirect. These documents have been prepared to comply with the Resettlement Framework of TNRSP, World Bank Operational Manual 4.12 World Bank Operational Manual 4.10 and Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.

7.8.8 Disturbance to the Road Side Services

Along the highway, near settlements, small shops get attracted to serve the local people as well as the highway users. A composite socio-economically interdependent has been developed as a consequence. The shops serve a dual purpose by providing income and employment to locals as well as a service to the road users. It is likely that due to implementation of the project some of the shops may get displaced. This would cause a negative impact on the livelihood of people as well as loss of service to the local people and road users.

7.8.9 Removal of Encroachments and Squatters

In order to reduce the number of PAPs, land clearing shall be restricted to within the Corridor of Impact (CoI) which principally lies within the RoW. The width of the CoI varies according to the design and is narrower in the settled areas, where the numbers of PAPs are likely to be more. However, some amount of land clearing will be essential in several of these stretches.

The potential impacts likely to arise from clearance of encroached residential areas (especially in settlements along the project corridors) may involve loss of valuable residential space to the residents. In the case of squatter settlements, displacement might lead to the loss of shelter if adequate measures are not taken for their resettlement. Compensation may not be enough for the affected persons to gain access to shelter. Other impacts include disturbance to family and community life and increased distance from their workplace. In such cases the displaced persons may again resort to squatting.

The extent of loss in the case of encroached agricultural lands shall be relatively less, in comparison with residential and commercial properties. This because, the encroached lands form only a small part of the total cropped land of the farmers.

Specific Impact

Other socio-economic impacts involve the presence of sensitive community facilities within the Corridor of Impact such as worship places and cultural properties.

7.8.10 Sensitive Community Structures

There are no historical, archeological and cultural sites protected and notified by Archeological Survey of India falling within the RoW. Other cultural properties falling in RoW include temples, Churches, grave yard, cremation ground, and mosques. Some of these will be impacted due to project road widening. The list of cultural properties falling within and close to RoW has been prepared and given in **Tables 7.34** and **7.35** for Madapattu- Thirukovilur Road and Vridhachalam- Bhuvanagiri Road respectively. This table also indicates the degree of impact due to project road improvement. Impact on cultural properties along the project road was avoided while finalising the alignment, still some of these will be partially or fully impacted due to road improvements.

Table 7.34: List of Cultural Properties and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

Sl. No.	LHS		Impact	Chainage	RHS		Impact
	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1				42+180	18.00	Christian Burial Ground	No impact
2				45+360	13.00	Christian Burial Ground	No impact
3	Cremation ground	08.00	Partially Impacted	47+420			
4				56+920	13.00	Cremation Ground	No impact
5	Burial Ground	10.00	Partially Impacted	59+00	59/770		

Table 7.35: List of Cultural Properties and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road

Sl. No.	LHS		Impact	Chainage	RHS		Impact
	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Grave Yard	13	No impact	02+480			
2				04+500	13	Grave Yard	No impact

Construction Phase

One of the impacts of project road widening is interrupted access to the cultural properties on either side of RoW. There are chances that users of the cultural property may face difficulty in accessing the property during the period of pre- construction.

Loss of Access is likely to be severe during the construction period, due to movement of construction machinery, construction and labour camps or setting up of borrow areas, setting up of construction camps, etc.

Operation Phase

During operation phase issue of accessibility of cultural property will not arise because after construction work situation will be similar to pre construction with respect to access to these properties.

7.9 BUS SHELTER, BUS BAYS, TRUCK LAY BYS, RESTING PLACE AND SERVICE ROAD

Widening is proposed in the project highway to minimize the negative impact due to upgradation/widening of the project road. Out of the total of 19 existing pucca bus waiting sheds, 18 will be impacted in Madapattu- Thirukovilur Road while 39 new bus shelters will be constructed in Vridhachalam- Bhuvanagiri Road as part of the proposed road improvement project.

Table 7.36: List of Existing Bus Shelters and Extent of Impact Due to Project Road Widening of Madapattu- Thirukovilur Road

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Bus Shelter	06.00	Impacted Fully	45+300			
2	Bus Shelter	06.50	Impacted Fully	45+700			
3				47+750	08.00	Bus Shelter	Impacted Fully
4				48+150	07.00	Bus Shelter	Impacted Fully
5				48+520	13.00	Bus Shelter	No Impact
6				49+230	07.50	Bus Shelter	Impacted Fully
7				50+270	07.00	Bus Shelter	Impacted Fully
8				53+580	08.00	Bus Shelter	Impacted Fully
9				55+330	07.00	Bus Shelter	Impacted Fully
10				56+010	07.00	Bus Shelter	Impacted Fully
11	Bus Shelter	07.50	Impacted Fully	58+620			
12	Bus Shelter	07.00	Impacted Fully	59+105			
13				60+030	07.00	Bus Shelter	Impacted Fully
14	Bus Shelter	07.00	Impacted Fully	62+250			
15	Bus Shelter	06.50	Impacted Fully	63+450			
16	Damage Bus Shelter	06.00	Impacted Fully	63+710			
17	Bus Shelter	06.50	Impacted Fully	64+450			
18				64+940	05.00	Bus Shelter	Impacted Fully
19	Bus Shelter	06.00	Impacted Fully	65+750			

Table 7.37: List of Existing Bus Shelters and Extent of Impact Due to Project Road Widening of Vridhachalam- Bhuvanagiri Road

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1				0+700	5.5	Bus Shelter	Impacted Fully
2	Bus Shelter	4.5	Impacted Fully	01+980			
3				03+050	5	Bus Shelter	Impacted Fully
4	Bus Shelter	5	Impacted	03+660			

LHS					RHS		
S. No.	Name of the CPR	Distance from C/L (m)	Impacts	Chainage	Distance from C/L (m)	Name of the CPR	Impacts
			Fully				
5				04+390	5	Bus Shelter	Impacted Fully
6	Bus Shelter	5	Impacted Fully	05+055			
7	Bus Shelter	6.5	Impacted Fully	06+350			
8	Bus Shelter	5	Impacted Fully	07+300			
9				07+310	6	Bus Shelter	Impacted Fully
10	Bus Shelter	5.5	Impacted Fully	08+110			
11				08+510	5	Bus Shelter	Impacted Fully
12	Bus Shelter	7	Impacted Fully	09+428			
13				10+060	6	Bus Shelter	Impacted Fully
14	Bus Shelter	5	Impacted Fully	10+980			
15	Bus Shelter	6	Impacted Fully	12+128			
16	Bus Shelter	6	Impacted Fully	12+225			
17	Bus Shelter	6	Impacted Fully	13+350			
18	Bus Shelter	6	Impacted Fully	14+220			
19	Bus Shelter	6	Impacted Fully	15+190			
20				16+450	5	Bus Shelter	Impacted Fully
21				18+300	8	Bus Shelter	Impacted Fully
22	Bus Shelter	6	Impacted Fully	18+350			
23				19+430	7	Bus Shelter	Impacted Fully
24	Bus Shelter	7	Impacted Fully	19+500			
25	Bus Shelter	7	Impacted Fully	20+230			
26	Bus Shelter	7.5	Impacted Fully	22+300			
27	Bus Shelter	7	Impacted Fully	22+330			
28	Bus Shelter	7	Impacted Fully	23+370			
29				23+790	6.5	Bus Shelter	Impacted Fully
30	Bus Shelter	7	Impacted Fully	25+310			
31	Bus Shelter	6	Impacted Fully	27+170			

LHS			Impacts	Chainage	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
32				27+500	7	Bus Shelter	Impacted Fully
33				28+100	6	Bus Shelter	Impacted Fully
34				28+440	5	Bus Shelter	Impacted Fully
35				29+370	7	Bus Shelter	Impacted Fully
36				30+560	6	Bus Shelter	Impacted Fully
37				31+550	6	Bus Shelter	Impacted Fully
38				32+350	6	Bus Shelter	Impacted Fully
39	Bus Shelter	7	Impacted Fully	33+970			
40	Bus Shelter	6	Impacted Fully	34+950			
41	Bus Shelter	6.5	Impacted Fully	35+830			

7.10 OTHER COMMUNITY STRUCURES

The impacts on socio-economic environment have been assessed on common property resources, business environment and direct and indirect impacts on the population residing in the surrounding the project road corridor.

The common property resources include educational institutes, health facilities, religious structures, drinking water sources, etc. The data for all existing common property resources along the project highway has been collected and extent of impacts has been given from **Tables 7.38** to **7.41**.

Table 7.38: List of Religious Structures and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS			Impact	Chainage	RHS		Impact
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Temple	28.00	No Impact	38+690			
2	Temple	20.00	No Impact	42+370			
3	Hindu Cultural Complex	08.00	Impacted partially	45+010			
4	Mary-Matha Statue	12.00	No Impact	45+365			
				45+400	11.00	Church	No Impact
5	Hindu Cultural Statues	07.00	Impacted fully	45+850			
6				49+480	10.50	Temple	Impacted partially
7				49+495	10.50	Mariyamma Temple	Impacted Partially
8	Balaji Temple	10.00	Impacted partially	49+640			
9				49+970	07.50	Shiva Statue	Impacted Partially

LHS			Impact	Chainage	RHS		Impact
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
10	Vinayak Temple	09.00	Impacted partially	50+800			
11	Murugan Temple	12.00	No impact	53+600			
12	Temple	12.00	No Impact	55+250			
13				55+670	07.00	Murugan Temple	Impacted Partially
14	Mariyamma Temple	10.00	Impacted partially	58+550			
15	Mariyamma Temple	12.00	Impacted partially	58+880			
16	Vinayaka Temple	07.00	Impacted partially	59+100			
17				59+700	12.00	Temple	No Impact
18				59+870	11.00	Church	No Impact
19				61+670	11.00	Mariyamma Temple	No Impact
20				62+650	11.00	EAD-GA	No Impact
21	Mary – Matha Statue	11.00	No Impact	64+370			
22				64+410	09.00	Mary – Matha Church	Impacted partially
23	Mariyamma Temple	09.00	Impacted partially	64+470			
24				64+920	04.00	Temple	Impacted Fully
25	Anjaneya Statue	07.00	Impacted Fully	64+460			
26	Vinayaka Temple	07.00	Impacted Fully	65+650			
27	Vinayaka Temple	11.00	No Impact	66+000			

Table 7.39: List of Religious Structures and Extent of Impact Due to Vridhachalam- Bhuvanagiri Road

LHS			Impact	Chainage	RHS		Impact
S. No.	Name of the CPR	Distance from C/L (m)			Distance from C/L (m)	Name of the CPR	
1	Religious St.	8	Impacted partially	0+040			
2				0+150	9	Religious St.	Impacted partially
3				0+350	4	Religious St.	Impacted Fully
4				0+900	5	Religious St.	Impacted Fully
5	Religious St.	18	No Impact	01+310			
6	Religious St.	7	Impacted Fully	01+350			
7				01+660	11	Religious St.	
8				01+850	5	Religious St.	Impacted Fully

LHS					RHS		
S. No.	Name of the CPR	Distance from C/L (m)	Impact	Chainage	Distance from C/L (m)	Name of the CPR	Impact
9				02+650	5	Religious St.	Impacted Fully
10				03+330	7.5	Religious St.	Impacted Fully
11	Religious St.	4.5	Impacted Fully	03+460			
12				08+210	26	Religious St.	No Impact
13				08+520	8	Religious St.	Impacted Fully
14				09+200	10	Religious St.	Impacted Fully
15	Religious St.	6	Impacted Fully	12+050			
16	Religious St.	8	Impacted Fully	12+300			
17	Religious St.	6	Impacted Fully	12+470			
18				15+500	8	Religious St.	Impacted Fully
19	Religious St.	7	Impacted Fully	16+450			
20				19+320	12	Religious St.	Impacted Fully
21				20+200	7	Religious St.	Impacted Fully
22				22+240	4	Religious St.	Impacted Fully
23				22+270	9	Religious St.	Impacted Fully
24				22+430	6	Religious St.	Impacted Fully
25				22+500	6	Religious St.	Impacted Fully
26	Religious St.	4.5	Impacted Fully	22+700			
27				22+770	5	Religious St.	Impacted Fully
28	Religious St.	5	Impacted Fully	23+300			
29				23+560	12	Religious St.	Impacted Fully
30	Religious St.	10	Impacted Fully	27+540			
31				27+940	7	Religious St.	Impacted Fully
32	Religious St.	5	Impacted Fully	28+120			
33	Religious St.	16	No Impact	33+980			
34				34+425	8	Religious St.	Impacted Fully
35				34+900	10	Religious St.	Impacted Fully
36	Religious St.	5.5	Impacted Fully	35+790			

Table 7.40: List of Educational Institutes and Extent of Impact Due to Madapattu- Thirukovilur Road Widening

LHS			Impacts	CL	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)		Chainage	Distance from C/L (m)	Name of the CPR	
1	Govt. School	13.00	Partially Impacted	41+750			
2			Partially impacted	45+400	11.00	School	
3	School	20	No impact	47+500			
4			Partially Impacted	47+900	11	School	
5			Partially Impacted	50/350	11.00	Govt. Elementary School	Partially Impacted
6	School	10		55+900			
7	Govt. School	08.00	Partially Impacted	58+270			
8			Partially Impacted	59+700	11	School	

Table 7.41: List of Educational Institutes and Extent of Impact Due to Vridhachalam-Bhuvanagiri Road

LHS			Impacts	CL	RHS		Impacts
S. No.	Name of the CPR	Distance from C/L (m)		Chainage	Distance from C/L (m)	Name of the CPR	
1				0+700	10	Govt. School	No Impact
2				08+620	10	Govt. School	No Impact
3	School	6	Impacted Fully	12+150			
4	School	10	Impacted Fully	35+760			

7.11 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

The widening of both the project roads is planned to cater for future growth in the study area of respective corridors in terms of economy, traffic and population. The cumulative impact assessment has been carried out in the following relevant scenarios:

- Cumulative Impacts of Vehicular Traffic at Intersections
- Cumulative Impacts on Road safety
- Cumulative Impacts on Valued Ecosystem Components along the Project Roads

7.11.1 Cumulative Impacts of Vehicular Traffic at Junctions

At the intersections of both the roads there will be increased traffic in future years and this will cause increased vehicular noise and air pollution at intersection. Another possible impact is increased frequency of accidents if traffic is not regulated properly. In road Madapattu-Thirukovilur road there are only three major intersections (at km 49+633, km 66+263, and km km 71+147) and in Vridhachalam Parangipettai Road there are four major intersections (km 0+000, km 1+742, km 25+180 and km 37+700).

The other socio-economic impact identified at intersections is that in open areas there is a tendency of establishment commercial shops on either side of the roads approaching to the intersection.

On the Madapattu - Thirukovilur road all the three major intersections are located in open and rural areas. On this project road corridor there are 44 minor junctions also and all these are planned to be improved.

In case of Vridhachalam- Parangipettai road there are 4 major junctions and 120 minor junctions. Out of 4 major junctions 2 are located in urban built up sections (two in Vridhachalam and one in Bhuvanagiri). All the major and minor junctions are planned to be improved as per location specific drawing prepared.

The minor junctions normally connect to rural roads/Ordinary District Roads (ODRs) / Major District Roads and at these locations issue of increased air pollution and noise levels is not anticipated. The issue of commercial establishment opening at these junctions is also not anticipated.

7.11.2 Cumulative Impacts of Road safety

The concern for safety stems from the proposals for faster vehicular movement along both the project roads. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss of life in case of an accident. The consultants have taken up road safety audit and it was found that safety features along the project roads almost do not exist. The signages are in poor conditions.

These existing safety features will keep on deteriorating with time if interventions through the project design are not taken.

During Pre Construction and Construction Stage

During the site clearance and the construction works progress, many of the existing signages will get dismantled for the widening works. For smooth traffic movement contractor has to erect necessary signages, construct the diversions and temporary protection measures at steep slopes, water bodies and habitations.

During Operation Phase

It is very necessary to maintain the safety features provided as part of road improvement works in the operation phase. If these are not maintained, then there will be an increase in road accidents.

7.11.3 The Cumulative Impacts on Valued Ecosystem Components (VEC)

The valued ecosystem components identified in both the project roads during environmental screening are number of trees, green tunnel, ecologically sensitive receptors, rivers/lakes, land use, drainage, topography, pollution (air, water and noise), drinking water resources, noise sensitive receptors, and village ponds.

The cumulative impacts on the trees due to road widening and improvement works will be adverse during the pre construction and construction stage as there will be removal of trees for widening. There are no green tunnels on either of the project roads or notified ecologically sensitive areas within 15 km aerial distances on both roads. Both the corridors are not crossing any River and are not adjacent to any lake. Hence there is no question of any cumulative impacts on these valued ecosystem components.

Both the project roads are located in plain terrain and involve only widening of existing roads. The impacts on topography on account of widening of roads will not be much as there is no requirement of any major bridge construction. But there will be an indirect impact of topography along the project road corridors due to construction of new buildings for housing and commercial activities.

The predominant land use along both the project roads is agriculture. Due to construction of a new link road as part of the Madapattu - Thirukovilur road there is a change in land use from agriculture to road use. In future years due to expansion of habitations along the project roads the land use change will take place from agriculture to residential/commercial.

The widening of project roads will increase storm water runoff from the formation width. The project interventions take care of the road drainage. With the passage of time road drainage system effectiveness will reduce because of clogging of roadside drains and flow of waste water from the houses having plinth level above FRL. This will be due to the reason that public residing along project roads keep plinth levels higher than road level. In open areas cumulative impacts on drainage system are not anticipated.

Due to increased traffic, future economic and population growth there will be an overall increase in all three types of pollution (air, water and noise). But air quality predictions show that due to road traffic emissions, air quality will be within stipulated standards. The commercial activity and any industrial growth will also contribute to air, water and noise pollution. From the road there will be no contribution to water pollution after completion of construction works.

The cumulative impacts on drinking water resources on account of road widening will be adverse as some of the water resources will be lost due to widening and these have already been discussed. Since road improvement will spur commercial and economic growth so stress on water resources will increase with time. The ground water recharge potential will also decrease in the project region due to the creation of additional paved surface on account of the construction of new houses and commercial space.

The village ponds exist along both the corridors and impacts on account of road widening have not been identified during the construction phase. The road widening will not result in a reduction in the volume of the pond. The cumulative impacts on ponds will be increased siltation, unauthorized encroachment and reduced water accumulation on account of reduction in the catchment area. The impacts related to road widening will be temporary and will be taken care by the planned mitigation measures.

The noise sensitive receptors identified along the both the project roads are educational institutes, and health facilities. As discussed in previous sections some of these sensitive receptors are being partially impacted and will be subjected to increased noise levels and air pollution. Due to project interventions these noise sensitive receptors will be saved from the exposure of air and noise pollutions due to the project interventions.

CHAPTER 8 IMPACTS MITIGATION AND ENHANCEMENT

8.1 MITIGATION, AVOIDANCE AND ENHANCEMENT

In the project avoidance and reduction of impacts has been adopted so that the requirement of mitigation measures is minimized. The widening schedule has been finalised in such a manner that there is minimum impact on environmental features. Because of avoidance measures following environmental features have been saved. In order to minimise impact on a canal (on LHS) on the Vridhachalam - Bhuvanagiri road, widening has been planned on the RHS in the project road portion km 27+200 to 33+200.

Table 8.1: Environmental Features Saved through Avoidance Measure at Design Stage

Environmental Features	Potential Impact		Under Direct Impact		Saved through Widening Schedule	
	1*	2*	1*	2*	1	2
Trees (nos.)	2427	5121	2267	**5011**	**160**	**110**
Surface Water source	5	6	3	**3**	**2**	**3**
Ground Water source	35	24	23	**22**	**12**	**2**
Schools and Hospitals	3	11	3	**5**	**0**	**6**
Sensitive Community Properties	27	39	18	**34**	**9**	**5**
Bus Shelters	19	34	18	**34**	**1**	**0**

* 1-Madapattu- Thirukovilur Road, 2 - Vridhachalam- Bhuvanagiri road

8.2 AIR ENVIRONMENT – MITIGATION MEASURES

8.2.1 Meteorological Factors and Climate - Mitigation

Other than removal of tree for road widening and construction of new formation for link road in Madapattu- Thirukovilur road, no significant impacts to area, climatic conditions or micro-climatic parameters are expected as a result of the project implementation. Though no change in the macroclimatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal, plantations and the addition of increased pavement surface. Compensatory afforestation (in the ratio of 1:10), avenue planting and landscaping proposed in junctions shall help in restoring the green cover along both the corridors. Hence any changes felt during construction stage will automatically offset during the operation phase due to compensatory afforestation and avenue plantation.

8.2.2 Air Quality Emissions - Mitigation

During the construction period the impact on air quality, due to the material movement and the actual construction activities on a large area, will be significant. There could be an increase in the dust level all along the haul roads, crusher plant and borrow and dumping areas.

Emissions from the construction machinery are the major source of ambient air pollution during the construction phase. Continuous use of concrete mixers, generators, bulldozers, rollers, cranes, trucks, etc. give a rise in the baseline NOx levels, which may at times exceed the permissible emission limits. The degree of impact may increase during the winter season due to temperature inversion.

Construction Phase

There are no impacts over the project corridor before construction, however all activities during construction stage are to adhere to the contractual obligations and approval from TNPCB such as consent for the establishment and consent to operate shall be obtained under Air Act for the Hot Mix Plant, WMM Plant, Concrete batching plant, etc.. All vehicles operating for the contractor and the consultant shall obtain pollution Under Control Certificate and good maintenance of all vehicles and machines must be confirmed.

Location of all construction establishments such as hot mix plants, WMM plant, Crusher plant, Construction camps, offices etc. shall ensure all legal requirements to keep high quality and standard.

All required permissions are to be obtained from Tamil Nadu State Pollution Control Board and Mining Department for establishing quarries, Borrow areas, and stone crushers. Asphalt and hot mix plants are required to be located at least 500 meters away from the nearest sensitive receptors and residential habitations. A routine concentrated effort to control roadside dust during construction is required. Road surface, excavations and construction sites will be daily sprayed with water to keep them up in moisture for dust control. All the trucks in the work sites carrying earth, sand or stones will be covered with tarpaulin sheets to avoid spilling.

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

Mitigation Measure for Mobile Source Emissions

In order to curb the increased fugitive dust emissions in the area, due to vehicular movement and raw material transport, provisions will be made for sprinkling water on all the haul roads in the area. This will be carried out daily on a regular basis as per the need or instruction from Construction Supervision Consultant (CSC) during the entire construction period, especially in the winter and summer seasons. Special attention will be given to all the haul roads passing through residential areas. Daily inspections of haul roads and construction sites will be carried out to ensure the removal of construction debris to the landfill sites.

Dust covers will be used over the beds to prevent fugitive dust emissions. Additionally, any of these materials which may collect on the horizontal surfaces of these trucks during loading will be removed before transportation.

Construction requiring street closure in sensitive areas likes school zones, hospitals and heavy traffic areas will be done during off-peak hours.

Idling of delivery trucks, or other equipment, will not be permitted during periods when they are being unloaded or are not in active use.

Concrete will be supplied from an onsite batching plant in order to reduce the distance concrete delivery trucks travel.

Low Emission Diesel (LDO) construction vehicles will be used wherever possible.

Mitigation Measure for Fixed Source Emissions

Under adverse meteorological conditions, oxides of Nitrogen emissions are expected to have a significant influence up to 1 km downwind of the construction yard. Hence special attention will be paid in locating the yards away from habitation.

All stationary equipment will be located away from receptor locations, in order to allow dispersion of emitted pollutants.

Areas prone to fugitive dust emissions (such as demolition, excavation and grading sites and routes of delivery vehicles across areas of exposed earth) will be stabilized using water.

Though the exclusion area for construction will allow control of oxides of Nitrogen emissions at major villages, during the winter season the ambient air quality in the predominant downward direction will be monitored in a quarter for 24 hours, to assess the emissions level at sparse settlements, to decide the need and extent of restriction on night time construction activity. If the air quality limits are found to be violated, the construction, operation during night times, especially in the winter season, will be carried out under restricted conditions. The work scheduled, and the operation time of each machine, will be modified to have limited construction activity, allowing control on the ambient air quality levels.

An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will need to be provided in the event of the emissions exceeding the SPCB norms. Other potential measures include plantation around the periphery of the hot-mix plants. The additional measures recommended for air quality control are as follows:

- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once in a quarter during the period the plant is in operation.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the CPCB norms. A vehicle maintenance schedule prepared by the contractor and approved by the Engineer shall be adhered to.

Operation Stage

In the operation phase of the corridor, the ambient air quality levels are expected to be better when compared to "No Project Scenario"

However, as the traffic increases the ambient air quality may decline. The effect will be more pronounced during the winter seasons when night time ground level inversion occurs due to drop in temperature.

During the operation stage of the project, vehicular emissions of critical pollutants (PM_{10}, $PM_{2.5}$, CO, SO_2 and NO_x) will be monitored. Compensatory plantation will be done in available clear space in RoW. It is planned to plant ten trees for every tree to be cut.

8.2.3 Air Quality Monitoring

In order to check the effectiveness of mitigation measures ambient air quality monitoring is planned during the construction and operation phases. The monitoring is planned at construction camps and at locations of baseline monitoring. The detail of monitoring locations, frequency and parameters is given in **Table 5.3** of Environmental Management Plan.

8.3 LAND ENVIRONMENT – MITIGATION MEASURES

The major impacts identified on land environment are soil erosion, land acquisition, and soil contamination. Except land acquisition all impacts are on account of construction activities; therefore, contractors need to prepare several mitigation plans for these activities. Some of the management plans are to be developed before starting construction activity. The list of these management plans is as mentioned below:

- Debris transportation, handling and disposal plan;
- Borrow area quarry/crusher area development and management plan;
- Construction water management plan;
- Landscaping and visual integration management plan;
- Traffic diversion/management plan during construction;
- Road safety, emergency response plan;
- Top soil collection and disposal plan;
- Construction camp and workforce management plan; and
- Solid Waste management plan.

Some of the above indicated management plan have been provided as annexures to this chapter and have been referred in subsequent sections. In order to avoid soil contamination on account of handling, storage and use of hazardous materials such as paints, varnishes, solvents, fuels, etc. the contractor will follow 'EHS Guidelines of IFC' and compliance with 'Manufacture,Storage,and Import of Hazardous Chemicals (Amendment) Rules, 2000'.

The quarry locations might affect the site traffic movement on the proposed carriageway. The list will be updated/modified after the ground alignment is made. However, the following measures will be adopted for those quarries which lie within 500 m of the proposed roadway.

- Those quarries which lie within 500 to 2000 m of the proposed roadway shall follow the precautionary measures given below.
  (a) During construction time there will be a diversion of traffic at this location sprinkling water for the earthen road to minimize the fugitive dust and good traffic management is necessitated
  (b) At the quarry site controlled blasting techniques, like the restricted quantity of explosive to be charged per delay detonator etc. will be carried out, to restrict the range of fly rock.
  (c) Suitable visual and audible signals shall be given to indicate commencement and end of blasting period, etc. and the use of delay detonators in blasting (Refer: Appendix 1.1 in EMP on Guidelines for Aggregate Quarry Management).

8.3.1 Topography and Geology - Mitigation

The quarries for sand and aggregates identified have been given in Annexure 2.2 and these are all licensed quarries and currently under operation. It will be ensured that contractors procure materials from these quarries only. During procurement of construction materials from these quarries the contractor as part of procurement contract with the quarry owner will put a condition that there is no child labour at the quarries. Further, it shall be verified by the Environmental cum Safety Engineer of the Contractor and Environmental Engineer of Construction Supervision Consultants that these are being operated properly. In case a new quarry is opened, the contractor will follow GUIDELINES FOR AGGREGATE QUARRY MANAGEMENT given in **Annexure 8.1**

For earthworks, borrow areas have been identified on non productive agricultural lands and in case these are on agricultural land the farmers' will is to level for ease in irrigation. The list of borrow areas has been given in Chapter-5. In order to operate these borrow areas the contractor will follow 'GUIDELINES FOR BORROW AREA MANAGEMENT' given in **Annexure 8.2.**

The quarry locations should be well guarded by the fencing or construction of protective wall so that no animals or humans may get into the well of quarries.

The closed quarries may used as an impounding reservoir or comply with closure plan when they are no more in long use. The crusher units are to be covered by a windbreaker sheet wall or fitted with a cyclone scrubber to decrease the suspended particulate matter. Frequent sprinkling of water in the premises of the crusher will reduce the fugitive dust and also growing vegetative screen will control the suspended particulate matter.

To conserve the water resources, construction of recharge pits at borrow areas, restoration of water body in stone quarry locations will be constructed.

Impacts on topography have been identified at locations of raising and at locations of new CD construction and reconstruction of old CDs. The raising will have a positive impact from environmental angle at locations of flooding and submergence. The raised locations in both the corridors are not in habitations and these will be well integrated with the local topography. The visible changes at link road (new alignment) will be subsided once there is growth of vegetation and avenue plantation in the RoW.

8.3.2 Change in Seismology - Mitigation

As indicated in the previous chapter, there will be NO impact on the seismological setting of the region. Rather, as part of the project all the existing structures will be checked and constructed as per the seismological requirements of the region in conformity to the IRC 6, 2000 guidelines.

8.3.3 Change in Land Environment – Mitigation

The land acquisition has been minimised as maximum use of RoW has been made. The land requirement for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road has been estimated at 17.2648 and 5.8064 ha respectively. The landowners shall be compensated as per Rehabilitation and Resettlement action plan prepared. Since land acquisition is marginal and spread along the lengths of respective roads, therefore, land use changes will be very marginal and not visible.

Topsoil should be preserved and backfilled to agricultural land or collected at compost sites or village side barn. This topsoil may also be spread back on side slopes for growth of vegetation.

Construction Phase:

(a) Tree Cutting

Except during tree cutting and related disturbances while removing the root system of trees along the side of the project road no other erosion impact are expected prior to the construction stage. It is also possible that the removal of the root system of trees could be during construction stage (i.e. during clearing & grubbing). The loose soil during this stage could be washed away during the rainy season.

Therefore, no trees shall be cut by the construction at that particular stretch is confirmed to start within a couple of days. No trees outside the construction limit/RoW shall be cut and removed. Once the construction starts contractor is to use various methods, including a sprinkling of water to avoid wind erosion of soils besides the control of dust. The contractor will follow 'GUIDELINES FOR TREE FELLING' given in **Annexure 8.3.**

(b) Soil Erosion

There could be considerable erosion during the various activities along the construction corridor of project road. The contract specifications of 306B (refer MoRTH) related to the soil erosion and sedimentation control shall be adhered to. Implementation of erosion control measures is crucial to the project. The construction will induce large scale erosion along the construction corridors unless a management plan for the corridor is strictly implemented by the contractor. The most important strategy could be that the contractor should not leave any opportunity for rapid soil erosion and also working during rainy season should be avoided. This can be executed by an implementable project management plan, Construction management plan and EMP. Potential loss of top soils will be avoided by the removal and storage of topsoil according to the contract specification in all areas of possible fertile soil loss such as excavated borrow areas, working areas and storing places. If construction works are to be carried out in agricultural areas (link road between SH-09 and SH 137 in Madapattu- Thirukovilur road, then the contractor shall remove and store top soil so as to use it on the top portion of shoulders or the productive areas. The potential risk of pollution of topsoil due to construction camp, construction material storage, vehicle repair and maintenance depot, crusher, hot mix plants etc. are taken care of in the relevant section and also in environmental mitigation table with suitable specification for actual implementation. Prior to the beginning of construction, the contractor needs to prepare a top soil management plan as per clause no 301.3.2 during the opening of borrow pits and for plants and machinery topsoil will be removed and kept safe for productive use in the agriculture area or it should be used while closing the contract establishment. This can be used on side slopes of the embankment prior to use of grass sods.

For cross drainage structure down drains/chutes will be lined with rip –rap/ masonry or concrete to prevent erosion. Side slopes will be adjusted to 1:1.5 or flatter to reduce erosion potential. If the slope is steeper, it should be stabilized by covering it with riprap or other material such as soil erosion control blanket as specified in IRC SP 21 2009 to prevent soil erosion.

Construction in erosion prone areas shall be avoided in the rainy seasons.

All such disposal by the contractor should be as per the MoRTH specifications. In order to address this issue local institutions have to agree and accept the material for safe disposal at the identified locations.

Debris Generation: Due to the removal of structures (Residential and commercial), pavement scarification and cross drainage structures lot of debris will generate, which need to be disposed off properly to avoid contamination of land and water. For safe and environmentally friendly disposal of waste debris the instruction/procedure specified in **Annexure 8.4**: 'GUIDELINE FOR DEBRIS DISPOSAL SITES', will be followed by the contractor.

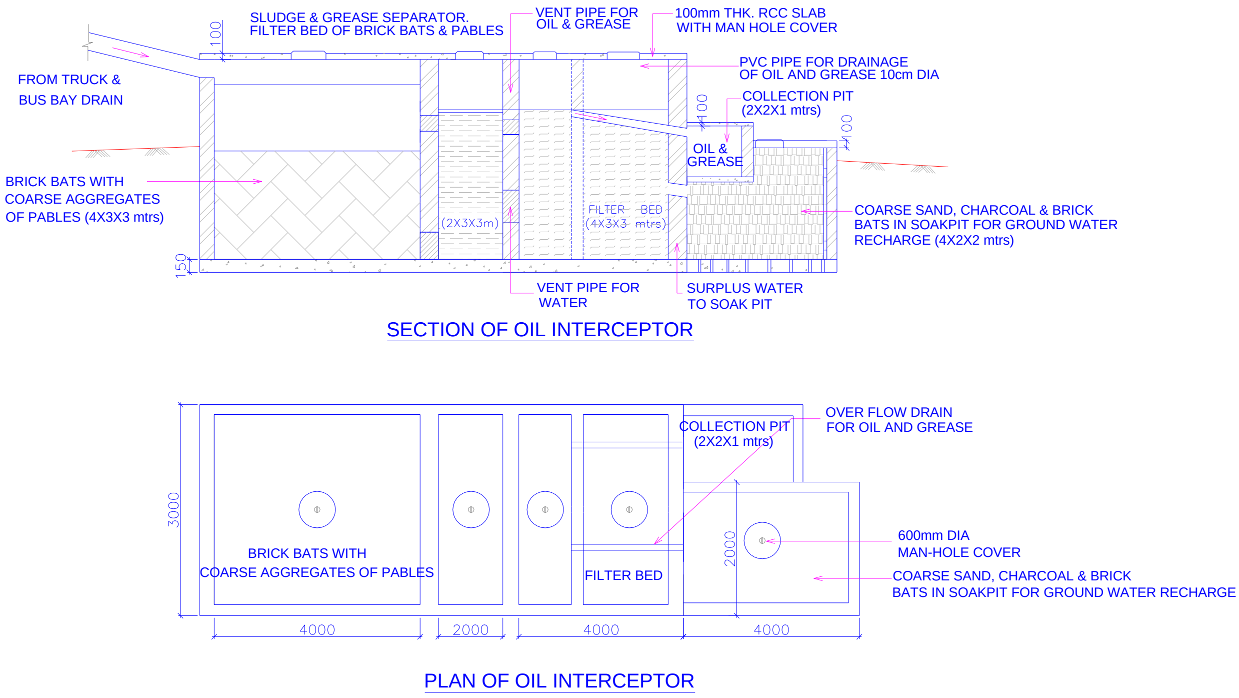
8.3.4 Contamination of Soil - Mitigation

Contamination of soil can damage the natural soil and can also contaminate the surface as well as ground water sources. Details of the activities from which the contamination can occur and mitigation measures for these are presented below;

Potential Impact	Mitigation/Enhancement
Scarified bitumen wastes, Excess production of hot mix and rejected materials.	Scarified waste and excess/rejected hot mix, with the consent of village authority, will be used in village road construction.
Debris generated from dismantling of structures.	A comprehensive list of instructions/procedures has been suggested in **Annexure 8.4**: GUIDELINE FOR DEBRIS DISPOSAL SITES, for contractor to adhere to for safe and environmentally friendly disposal of debris.
Maintenance of the machinery and operation of the diesel generator sets on site	The base of all machinery, generators will be paved and all the waste/spill will be drained to oil interceptor before discharging. Layout of oil interceptor is presented in **Figure 8.1.**
Oil Spill from the operation of the diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets	
Operation of the emulsion sprayer and laying of hot mix	Proper demarcation of the surface to be sprayed /paved will be done to minimize the excessive spread of emulsion/hot mix.
Operation of the residential facilities for the labour and officers	The residential facilities will be provided with proper sanitation, and planed setup of construction camp. A comprehensive plan of construction camp is prepared in **Annexure 8.5:** GUIDELINE FOR SITING & LAYOUT OF CONSTRUCTION CAMP
Storage and stock yards of bitumen and emulsion	The base of bitumen/emulsion stock yard will be paved and all the waste/spill will be drained to oil interceptor before discharging.

Oil interceptor: Oil and grease from the polluting run-off is another major concern. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage areas, diesel oil pumps, vehicle parking areas of the construction camps. Vehicle/machinery and equipment maintenance and refuelling will be carried out so that spillage of fuels and lubricants do not contaminate the soil. The source is well defined and restricted. An "oil interceptor" will be provided for wash down and refuelling areas. Fuel storage will be in proper bunded areas. All spills and collected petroleum products will be disposed off in accordance with MoEFCC and TNPCB guidelines. Fuel storage and fueling areas will be located at least 300m from all cross drainage structures and major water bodies. **Figure 8.1** provides the details of the arrangement for the oil interceptor for the removal of oil and grease.

Figure 8.1: Conceptual Plan of Oil Interceptor



8.3.5 Soil Quality Monitoring

In order to see the effectiveness of mitigation measures soil quality monitoring is planned during construction and operation phases. The soil quality monitoring locations have been selected agriculture fields close to RoW. The monitoring plan and locations have been given in Chapter 5 of the EMP.

8.3.6 Slope Stability - Mitigation

Maintaining natural geographical contours for preservation of the natural landscape by regulating the cut and fill activity to safe integrity of natural beauty. The earth material required should be borrowed from the wasteland or barren land as identified in the DPR and also shown in **Annexure 2.2.** If good soil is excavated from the farm land the slope of cutting should be 1:2 and the depth cutting should not exceed 2.5 meters further this excavated land should be used as water pond. This pond can be utilised for fishing or for storage of water for irrigation in dry season. In both the corridors, high embankment stretches (> 3m) are not there as there is no major bridge, grade separator or ROB planned to be constructed. The slope protection in the current case will be done through turfing. For this purpose, it is best to use locally grown grasses and bushes, as these are best adapted to the local soil, temperature and rainfall conditions. Plantation is best done just after the first pre-monsoon showers, which gives a time of 2-3 weeks for the grass to take root before the onset of monsoon. Normally, no watering of the grassed slopes is done following the planting. However, watering of the slopes may be provided if the grass turfing is done in the non-monsoon season, or to respond to dry conditions following turfing. The above methods of providing vegetation cover on embankment slopes follow the provisions in IRC-56-1974, "Recommended Practice for Treatment of Embankment Slopes for Erosion Control".

8.4 WATER ENVIRONMENT – MITIGATION MEASURES

Due to the proposed project, there will be some direct and indirect long term impacts on the water resources. **Table 8.2** below presents the major adverse impacts on the water resources and the mitigation measures taken.

Table 8.2: Impacts on Water Resources and Mitigation Measures

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Loss of water Bodies	Major, direct impact	Part or complete acquisition of source of water	• Land acquisition to be minimized with the provision of Retaining walls. • Relocation of ground/surface water sources.
2	Alteration of Cross Drainage	Very Low Impact	Reconstruction of minor bridges and culverts and construction of new culverts will alter the cross drainage.	• Widening of minor bridges and construction of additional culverts will be an improvement in the drainage characteristics of the project area
3	Runoff and drainage	Direct Impact	Siltation of water bodies Reduction in ground recharge. Increased drainage discharge	• Silt fencing to be provided. • Rain water harvesting cum recharge pit structures to be provided to compensate the loss of pervious surface. • Continuous drain is provided, unlined in a rural area and lined drain cum foot path in urban areas.
4	Water requirement for project	Direct Impact	Water requirement for construction activity. Water requirement of labour.	• The contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. This is required to avoid depletion of water resources
5	Water Quality			
a	Increased sedimentation	Direct impact	increased sediment laden run-off alter the nature & capacity of the watercourse	• Silt fencing to be provided. • Sediment control measures are to be followed.
b	Contamination of Water	Direct adverse impact	• Scarified bitumen wastes • Oil & Diesel Spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labor and officers • Routine and periodical	• Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. • Oil Interceptor will be provided for accidental spill of oil and diesel at construction camps. • Rejected material will be laid in village roads or as directed by the engineer. • The septic tank will be constructed

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
			maintenance	for waste disposal.
6	Water quality - monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	• Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

8.4.1 Surface Water: Loss of Water Bodies, Runoff and Drainage, Alteration of Cross Drainage - Mitigation

(i) Loss of Water Bodies

The loss of surface water sources will occur due to widening of project roads. The surface water sources likely to be impacted are road side ponds. The existence of roadside ponds and impact due to widening has already been given chapter 7. In order to reduce impact necessary silt fencing arrangement will be provided. In order to compensate for volume lost deepening will also be carried out. Pond specific drawings have been provided in **Annexure 5.41** respectively of EMPs. The mitigation and enhancement measures include retaining walls, plantation on side slopes, metal beam crash barrier, seating arrangement around trees, stepped access to ponds, etc. The other mitigation measures have been given below:

The water from the surface drainage should not be tapped from the non-perennial rivers and water tanks, wells, which are utilized for drinking purposes.

If any perennial surface water source is planned to be used, then, consent of water resource department/irrigation department should be taken.

No construction waste could be dumped into the Pioneer or Manimukhta Rivers or any other flowing surface water source as it constricts the passage to the flow of water. Appropriate location should be sited for the workers camp and provided with drainage and wastewater facilities. The construction camp should be located at least 1 km away from perennial water sources.

Cleaning of the vehicles or washing should be restricted at construction camps only. When the excavation is undertaken in the wet area of the water body, the banks will be protected, such that the slopes are not steeper than 1 vertical to 2 horizontal. The storage of construction material if needed should be done at least 500 m away from surface water bodies.

Protection works such as geotextures, the silt screen should be provided to control the erosion at these points. No significant impact is noticed for the underground water except relocation of bore well that has to be drilled with consent from the concerned water supply authority.

(ii) Runoff and Drainage, Alteration of Cross Drainage

Following mitigations have been planned for the runoff and drainage:

- Continuous Drain (lined/unlined) is provided throughout the project road for efficient drainage of storm water.
- Lined drain is provided in built-up sections (**Tables 8.3** and **8.4**) for quick drainage of storm water.
- The increased runoff due to increased impervious (Bituminous Top) surface will be countered with the increased pervious surface area through rainwater harvesting structures, on both sides, at 1 km interval. The rain water harvesting structure drawing has been provided in **Annexure 5.45** of the EMP.
- The local bodies need to discourage /stop the filling of private water bodies, ponds etc. to develop commercial places and shops due to the improved roads and improved connectivity.

Table 8.3: Locations of Covered Drains cum Footpath on Madapattu- Thirukovilur Road

Sl. No.	Proposed Chainage (km)		Length (m)	Location of Built-up area
	From	To		
1	48+000	48+800	800	Kothnapur

Table 8.4: Locations Covered Drain cum Footpath in Vridhachalam- Bhuvanagiri Road

S. No.	Proposed Chainage		Length (m)	Location of Built-up area
	From	To		
1	0+000	2+000	2000	Vridhachalam
2	12+000	12+850	850	Kamapuram
3	21+900	22+500	600	Erumbur
4	25+100	25+600	500	Sethiyathopu Junction
5	34+800	35+800	1000	Bhuvanagiri

8.4.2 Ground Water

(a) Loss of Ground Water Resources

The ground water resources likely to be impacted due to widening of project road corridors are hand pump, dug wells, bore wells, water taps and storage tanks. The extent of impacts has been given in **Tables 7.20** to **7.26** for both the roads. All the public water supply taps, hand pumps, overhead storage tanks will be relocated at the project cost before dismantling the existing source. The site of relocation will be identified in consultation with the community. For the sources being impacted compensation shall be paid to the owners as per provisions of the Resettlement Action Plan. These have been recorded as part of the assets being impacted due to widening.

(b) Rain Water Harvesting Structures

Since widening of the project road would result in the creation of additional impervious surface. To compensate for this rain water harvesting structures have been planned along both sides of project roads @ one structure per km. The typical design of the rain water harvesting structure has been given in **Annexure 5.45** of the EMP.

8.4.3 Water Requirement for Project

The contractor will make own arrangements for construction water. Since surface water sources are limited in project influence areas of both the project roads, in all probability ground water will be used for construction. The contractor will obtain necessary permission for withdrawing water from ground/surface water sources. The water conservation techniques will be used to minimise water usage.

Withdrawal of ground water for construction activity will be having localized and short term impact as the project is linear in nature and withdrawal will not be from a single location. Construction of proper drainage and water harvesting structure will recharge the ground water. Rain water harvesting structures are planned at the rate of one structure per km on either side in both the project roads. The necessary budget for these has been built in the EMP budget. These measures will compensate for ground withdrawal if any for construction.

During the operation phase no impact on ground water is anticipated as there will be no requirement for roads. Any minor requirements for providing water to saplings will be arranged from surface water sources.

8.4.4 Water Quality

Though the proposed project will not alter the existing water quality on a permanent basis, during the construction phase the extent of surface runoff and silt load to natural watercourse may increase, giving rise to a negative impact on the receiving natural water bodies.

The technique for the separation of oil and water is gravity separation, arrangement for combined sediment and oil and grease separator. Enough detention time is provided for run-off to allow silt to settle and oil/grease to float onto the surface. Other techniques such as emulsification, acid cracking and biodegradation of oil have been considered but rejected because they are suitable for high concentrations of oil and require much greater control and supervision over the process. Oil water separator tank will be constructed at the construction camp at vehicle washing areas and at maintenance areas (Drawing given in **Figure 8.1**).

In order to reduce silt load silt fencing arrangement will be provided at location of top soil storage, roadside ponds and surface water bodies at the construction site. Approximate length of silt fencing and identified locations for these have been given in **Tables 8.5** and **Table 8.6** for Madapattu- Thirukovilur road and Vridhachalam- Bhuvanagiri road respectively. The conceptual plan for silt fencing has been shown in **Figure 8.2**.

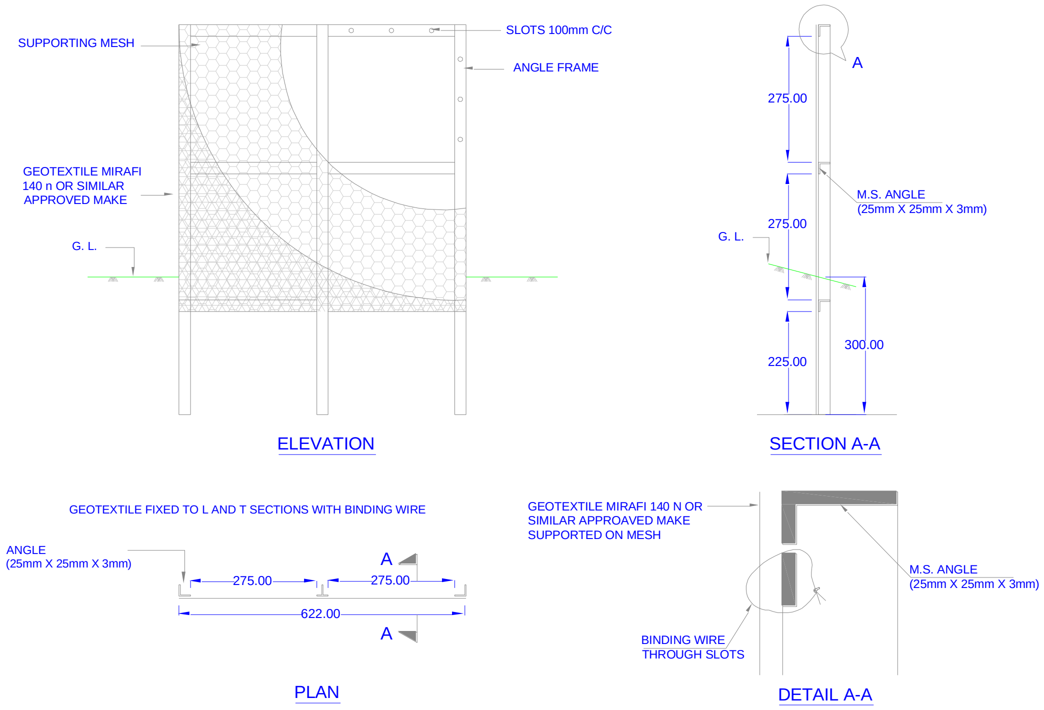
Table 8.5 List of Silt Fencing Locations on Madapattu- Thirukovilur Road

Sl. No.	Location	Length (approximate)	Remark
1	Top soil storage	500m	Around the periphery of dumping yard (For link road)
2	Borrow area site	100m	Along the length of borrow area in down slope direction
3	Surface Water bodies	1000m	Equals to diameter/length or as instructed by engineer.
4	Plant Site	100m	In down slope direction of fine material

Table 8.6 List of Silt Fencing Locations on Vridhachalam- Bhuvanagiri Road

Sl. No.	Location	Length (approximate)	Remark
1	Top soil storage	500m	Around the periphery of dumping yard
2	Borrow area site	100m	Along the length of borrow area in down slope direction
3	Surface Water bodies	7000m	Equals to diameter/length or as instructed by engineer.(5900 m for canal on LHS from km 27+300 to 33+200)
4	Plant Site	100m	In down slope direction of fine material

Figure 8.2: Conceptual Plan of Silt Fencing



No significant physicochemical parameter will be altered over the water quality by the proposed road expansion, however during construction all efforts shall be made to clear the scarified bituminous hazardous material and disposed off at the landfill or dumping into barren land with HDPE liners closed with impermeable clay soils. The scarified bituminous material may also be reutilised in soft shoulders and covered with compacted earthen layer at the top.

The construction camp will not be located within 1000m of major water bodies or road side ponds.

The construction workers will be allotted a specific area of land on which the workers temporary camp is to be built. Adequate sanitary facilities, drainage, washing and toilets with septic tanks and refuse collection and disposal will be provided for the workers. The provision of a potable water supply, cooking fuel and toilet facilities will be made as per the stipulated guidelines of the Indian Labour Act. Wastewater from the labour camps should be stored and properly treated for subsequent use for gardening and non domestic purposes.

All approach roads to rivers and other surface water bodies need to be closed permanently to avoid vehicle washing and to avoid major pollution sources. This is applicable to all areas including the secondary construction sites.

During the operation stage, regular cleaning of chocked/blocked or damaged drainage provision is necessary to avoid operational impact additional to existing culverts, new ones are proposed to take care of the increased runoff.

The runoff from the road will be collected in sidedrains and discharged to culverts at suitable intervals. Before discharging the runoff to natural watercourses, it is planned to pass the runoff through sedimentation tanks, or grit traps, and oil separators, to reduce the quantity of sediment and petroleum derivatives discharged to a watercourse.

There will not be any impact on ground water quality during the operation phase rather proper drainage and construction of water harvesting pit along the road will recharge the ground water of the area and it will contribute towards improving the water table.

8.4.5 Water Quality Monitoring

In order to check the effectiveness of mitigation measures water quality monitoring is planned during the construction and operation phases of the project. The water quality monitoring frequency, locations and parameters have been given in Monitoring plan in **Table 5.3** of Environmental Management Plan.

8.5 NOISE ENVIRONMENT – MITIGATION MEASURES

The primary sources of noise level during the construction phase are the construction machinery and vehicular noise, due to material movement on site. Though the effect of noise will be insignificant during the day time, the residential areas located in the vicinity of the construction sites may experience an increase in the night time ambient noise levels.

In order to minimise noise at noise sensitive receptors portable noise barrier wall may be installed. The noise barriers in the form of tree plantation and in the form of concrete wall are planned specifically to the site. These have been detailed in EMP. The summary of noise generating activities during various phases of the project and generic mitigation measures is given below in **Table 8.7**.

Table 8.7: Noise Impacts in Highway Projects and Noise Generating Activities

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Sensitive receptors	Direct impact	Increase in noise pollution	• Noise barrier to be provided • Traffic calming devices to be used. • NO Horn Zone sign Post.
2a	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Man, material & machinery movements Establishment of labor camps on-site offices, stock yards and construction plants	• Area specific and for short duration • Machinery to be checked & complied with noise pollution regulations. • Camps to be set up away from the settlements, in the downwind direction.
2b	Noise Pollution (Construction Stage)	Marginal Impacts	Stone crushing, asphalt production plant and batching plants, diesel generators etc. Community residing near to the work zones	• Camps to be set up away from the settlements, in the downwind direction. • Noise pollution regulation to be monitored and enforced. • Temporary as the work zones will be changing with completion of construction
2c	Noise Pollution (Operation Stage)	Marginal Impact	Due to increase in traffic (due to improved facility)	• It will be compensated with the uninterrupted movement of heavy and light vehicles till the facility reaches the level of service C.
3	Noise Pollution Monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	• Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

8.5.1. Noise Pollution, Sensitive Receptor – Mitigation

Noise mitigation in Construction Phase:

The following mitigations could be incorporated under any of the alternatives to minimize future noise impacts in the planning area. Using enclosures or walls, installing mufflers on, could reduce construction and demolition noise Engines, substituting quieter equipment or construction methods, minimizing time of operation, and locating equipment farther from sensitive receptors. To reduce construction noise at nearby receptors, mitigation measures would be incorporated into construction plans and contractor specifications.

Mitigation measures that have been identified could include the following:

- Limiting noisier construction and demolition activities between 6 AM and 10 PM would comply with reduced construction noise impacts during sensitive nighttime hours;
- Shielding noisy equipment with acoustic barriers would reduce noise levels from construction equipment;
- Detouring construction trucks away from noise-sensitive areas would eliminate construction truck noise from those areas;
- Equipping construction equipment engines with adequate mufflers, intake silencers, and engine enclosures would reduce their noise by 5 to 10 dBA (source U.S. EPA, 1971);
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA;
- Turning off construction equipment during the prolonged periods of nonuse would eliminate noise from construction equipment during those periods;
- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation;
- Locating stationary equipment away from receiving properties would decrease noise from that equipment in relation to the increased distance;
- Using on-site materials and disposing of excavated material nearby, if possible, would eliminate transporting those materials on area roadways;
- Performing construction activities off-site, such as concrete mixing, would eliminate those noise sources from the project area;
- The noise barrier wall may be erected at the identified noise sensitive receptors and at some of the places tree plantation;
- During construction at habitations or near noise sensitive receptors portable noise barrier may be used. These noise barriers will be in the form MS sheet and will protect the public conflict with construction activities;
- Efforts to reduce truck trips by increasing load size, decreasing fill requirements, or combining trips would reduce noise impacts on sensitive receptors; and
- Rerouting truck trips away from residential areas would reduce noise impacts on sensitive receptors.

The locations of noise sensitive receptors and planned mitigation measures have been given in **Table 8.8** below. These mitigation measures have been planned based on results of noise level predictions.

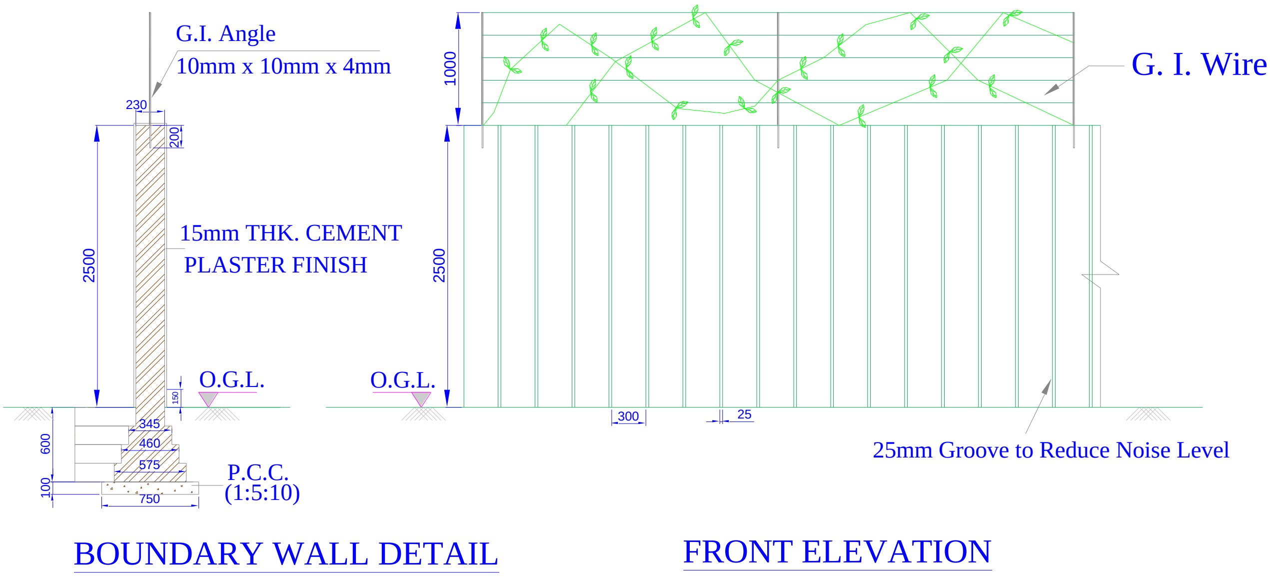
Table 8.8: Noise Mitigation Measures along Project Road

S. No.	Receptor	Location	Distance from Centerline (m)	Impact	Mitigation Measure
A: Madapattu- Thirukovilur Road					
1	School	41+800(LHS)	13	No impact	Raising of Boundary Wall Height (Length =60 m)
2	School	45+400(RHS)	10.5	Partial Impact	Raising of Boundary Wall Height (Length =200 m)
3	School	47+500 (LHS)	20	No impact	Boundary wall for safety and Plantation inside

S. No.	Receptor	Location	Distance from Centerline (m)	Impact	Mitigation Measure
					(Length=100 m)
4	School	47+900(RHS)	11	Partial Impact	Raising of Boundary Wall Height (Length =60 m)
5	School	50+300(LHS)	11	Partial Impact	Raising of Boundary Wall Height (Length =60 m)
6	School	55+900 (LHS)	12	No Impact	Well raised high Boundary wall (No noise barrier)
7	School	58+300(LHS)	8	Partial Impact	Raising of Boundary Wall Height (Length =50 m)
8	School	59+700 (RHS)	11	Partial Impact	Raising of Boundary Wall Height (Length =250 m)
B: Vridhachalam- Bhuvanagiri Road					
1	School	8+600(RHS)	9	Partial Impact	Raising of Boundary Wall Height (Length =150 m)
2	Hospital	11+100(LHS)	22	No Impact	Scope for Plantation in available space (100x10 m)
3	School	16+200 (RHS)	10	Partial Impact	Raising of Boundary Wall Height (Length =100 m)
4	School	20+400 (RHS)	6	Partial Impact	Constructing of New Boundary Wall (Length =30 m)
5	School	20+600(RHS)	11	Partial Impact	Constructing of New Boundary Wall (Length =30 m)
6	School	25+400	14	Impacted	Constructing of New Boundary Wall (Length =30 m)
7	School	27+900(RHS)	6	Impacted	No scope to provide plantation as well as Boundary wall as Height is already 3 m
8	School	35+500(LHS)	11	Partial Impact	Constructing of New Boundary Wall (Length =30 m)
9	School	35+600 (LHS)	11	Partial Impact	Constructing of New Boundary Wall (Length =30 m)

The typical design of boundary wall for noise protection is given in **Figure 8.3** below:

Figure 8.3: Conceptual Drawing for Noise Barrier



Mitigation of Noise in operation phase:

During the operation stage, there will be an increase in ambient noise levels due to continuous traffic movement. Ambient noise levels during the night time will be high due to the movement of heavy traffic.

- Planting vegetation along roadways could reduce noise levels.
- The noise barriers planned at noise sensitive locations will bring down the levels by 5 to 10 dB (A). The noise barrier constructed has to be maintained during the operation phase.
- There is a need to monitor noise levels after completion of construction of noise barrier to see the effectiveness.

8.5.2 Noise Pollution Monitoring

In order to check the effectiveness of mitigation measures ambient noise level measurements will be carried out during the construction phase and operation phases. For this environmental monitoring plan has been prepared and this plan has been given in **Table 5.3** of Environmental Management Plan.

8.6 Flora and Fauna - Mitigation Measures

The generic environmental impacts and mitigation measures for biological environment have been summarised below in **Table 8.9.**

Table 8.9: Generic Impacts and Mitigations for Biological Environment

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Forest area	No impact	No forest area diversion in the project	None
2	Wild Life	No Impact	No wildlife habitat	None
3	Trees Cutting	Direct impact	Increase in soil erosion, silting of water bodies, Dust & noise pollution. Loss of shade & loss of tree products	• Alignment adjusted to save the trees. • Compensatory tree plantation in the ratio of 1:10, i.e. for each tree cut, ten saplings will be planted. • Avenue plantation along corridor. • Trees < 30 cm girth size will be

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
				transplanted to the extent possible.
4	Vegetation	Direct Impact	Increase in soil erosion, silting of water bodies, noise pollution. Dust Pollution	• Clearing and grubbing will be minimized, and sprinkled with water to reduce dust pollution. • Exposed surface like embankment slopes will be protected with turfing. • Open land in and around the plant will be vegetated.
5	Cattle Grazing	No Impact	No cattle grazing found	• Nil
6	Aquatic Ecology	Direct Impact	The impact on road side water bodies during construction due to waste water discharge and sedimentation	• Silt fencing planned at the water bodies. Construction camp and workers' camp planned away from water bodies. Regular monitoring of water bodies planned.

8.6.1 Forest Area - Mitigation

In both of the project roads there is no requirement for forest land diversion. None of the project road is adjacent to or passing through the reserved/protected/revenue forest, hence no mitigation measures are warranted.

8.6.2 Wild Life - Mitigation

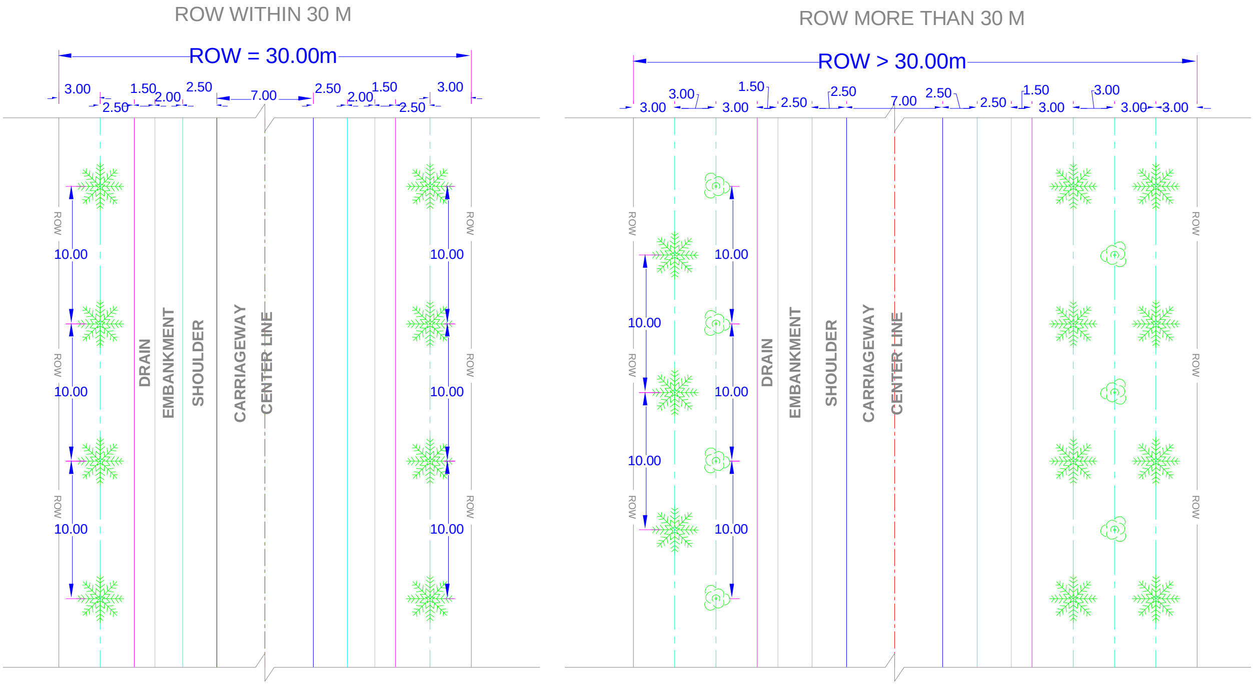
No mitigation measures are warranted as both the project roads are not having any corridors of wildlife and not close to any National Park, Wild Life Sanctuary or Bird Sanctuary.

8.6.3 Trees and Vegetation - Mitigation

(a) Avenue plantations

The Tamil Nadu Forest Department would raise the required quantity of healthy seedling height for planting on Roadside and these seedlings are planted along the roadside in ROW (Right of Way) area, where there are more lands available, number of rows may be increased. The environmental management plans envisage monitoring of the plantation for every year. The avenue plantation will be carried out by the TNRSP through the State Forest Department by signing the MoU. Since available space in RoW is limited only one row towards the boundary side will be feasible. The schematic arrangement for avenue tree plantation has been shown in **Figure 8.4**.

Figure 8.4: Conceptual Plan for Avenue Plantation



(b) Compensatory Afforestation

Compensatory afforestation outside RoW will be carried out by the state forest department. For this suitable land in close coordination with village Panchayats will be identified. The TNRSP will deposit the necessary funds for this to the State Forest Department. The guidelines provided in EMP will be referred for compensatory afforestation.

Agriculture is the major economic activity in the surroundings of the project road. The rural areas depend primarily upon the agriculture as villagers use different agriculture equipment and carts to transport commodities. It is very essential to safeguard the humans and cattle, especially at intersections with the fast moving vehicles on the road. These locations should have sign board with speed breakers if possible.

(c) Landscaping at Junctions and Side Slopes

The landscaping is planned at major junctions. At intersections only shrubs will be planted. For selection of species guidelines given in EMP will be followed.

(d) Transplantation of Poles

The trees <30 cm in girth and within RoW have been enumerated and these will be transplanted to the extend possible.

8.6.4 Cattle Grazing - Mitigation

No cattle grazing seen along both the corridors, hence no mitigation measures are warranted.

8.7 SOCIO-ECONOMIC ENVIRONMENT – MITIGATION MEASURES

8.7.1 General Impacts - Mitigation

The socio-economic impacts related to the project are direct and indirect. The direct impacts are to the people whose land and other assets are being acquired, whereas indirect impacts are inconvenienced during construction, difficulty in access to property and due to dismantling of utilities. The generic impacts and mitigation measures related to socio-economic environment have been summarised below:

Table 8.10: Generic Impacts on Socio-economic Environment and Mitigation Measures

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Fear of uncertainties regarding future	Direct, longterm Impact	Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation.	Public participation sessions will be conducted in different stages of the project. Few consultations have already been conducted.
2	Inducement of land prices	Direct impact	Danger of unscrupulous speculators moving in to purchase land	Revenue Authorities will decide the market rate
3	Inducement of squatter influx	Direct impact	Squatters may attempt to occupy adjacent land in the hope of receiving compensation undue pressure on local resources	The dates of the base-line socio-economic survey have been considered as a cut off date for identification of project affected people PAP.
4	Loss of utilities and amenities	Direct Impact	Natural (trees, bushes and grasslands), and Physical structures (public or private assets and utilities).	Relocation of utilities will be completed prior to start of project work. These have been further discussed in details in RAP
5a	Public Health and Safety	High direct adverse impact	Psychological impacts on their owners and others associated with them. Debris generated	Advance notice as per RAP will be given to the owners of the affected properties. Debris, so generated will be disposed off to the satisfaction of CSC. Monitoring of air, water, noise and soil during construction and operation phases. Details given in EMP **Table 5.3** on Environmental monitoring. Debris generated will be disposed off as per Debris management plan given in **Annexure 8.4**.
5b	Labour Camps	Direct Impact	Can have clashes with the local population Pressure on basic facilities like medical services, power, water supply, etc Transmission of communicable diseases, including AIDS. Sanitary conditions in the labour camps	All contractors will be encouraged to recruit the local people as labourer at least for unskilled and semi-skilled jobs. Hygiene and basic facilities will be ensured at labour camp to prevent the spread of disease. (Refer **Annexure 5.1** sitting and layout of construction Camps, and **Annexure 5.9** Workers Safety during construction in EMP of respective corridors)
5c	Allied activities	Indirect Impact	Social and economic life of the local population due to	Detailed traffic control plans shall be prepared and submitted to the

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
			quarrying and crushing operations, traffic diversions, etc. Traffic jams and congestion, loss of access and other road accident risks temporary land acquisition	engineer for approval 5 days prior to commencement of work on any section of road.
5d	Accidents and Safety	Direct Impact	School children Ladies carrying pots full of water	The contractor will provide, erect and maintain barricades, including signs marking flags, lights and flagmen as required by the Engineer.
6	Resettlement of People	Indirect impact	Pressure on civil amenities, water sources, grazing lands, fuel wood, medical facilities etc.	A comprehensive resettlement action plan has been prepared to improve the standard of living of the affected population
7	Land Use Changes	Indirect impact	Succession of land uses and higher return uses would displace the lower return uses at major intersections and in settlement areas. Urban fringe areas will be subjected to ribbon development.	Project is widening of existing of pavement and there is marginal land acquisition, hence no major change in land use pattern is envisaged along the project roads.
8	Disturbance to roadside services	Indirect Impact	Some Shops may be shifted, no income from highway users, hence loss of service to the local people	The cleaning of such informal establishment will be carried out as phase-wise resettlement program
9	Removal of encroachments and squatters	Indirect impact	Loss of shelter disturbance to family and community life	The impact will be avoided by implementation of phase-wise resettlement action program Notice will be served at least 3 months in advance.
10	Sensitive community facilities	Indirect impact	Loss of community facilities or institutions	Impacts on sensitive community facilities have been avoided. The fully impacted community facilities will be relocated in consultation with the community and partially impact facilities include only impact on the boundary wall. These will be properly restored.
11	Host Community	Indirect Impact	Displaced, resettled families will put pressure on the existing scarce infrastructure and amenities available with the host community	Special provision has been made in the resettlement action plan for the host community

8.7.2 Specific Impacts - Mitigation

Construction Phase

(a) Safety of Pedestrians

Adverse impact on the safety of pedestrians and passage of traffic approaching or passing are likely if construction works are not managed properly. It is essential that works should be planned before handing over the contractor with due considerations for the safety of pedestrians and workers during the night-time. Adequate warning signs, barricades, etc. to inform the road users are essential in this regard.

Implementation of road safety plan during project execution is an important mitigation measure.

(b) Waste Water Disposal

Disposal of sewage and domestic solid waste generated at the construction workers' camps will have a negative impact on the aesthetics and environment of the surrounding area. It has to be disposed off in an efficient manner. The work camps also create a water demand close to local urban bodies.

The sewage system at the workers camps shall be properly designed and built, so that no water pollution takes place. All workers have to be supplied with potable drinking water and arrangement for the supply and storage of water shall be made by the contractor, in such a way that the water availability and supply to nearby communities remains unaffected. If a new tube-well has to be bored all necessary sanctions and approvals from CGWA will be obtained. Water would be stored and properly treated for subsequent use for gardening and non domestic purposes (Details on Construction camp and management and facilities are provided in EMP)

Operation Phase

The improved roads on the other hand, will increase accessibility to local and regional health center and other community support facilities. The project will be implemented with due considerations for the safety of pedestrians and school children. The measures will include speed humps, speed delimiting signs, service roads, etc. at desired locations, especially near habitations and sensitive locations, such as, schools and colleges.

Disposal of solid waste management is of the most concern in the project activity, all the scarified waste should be disposed off to the nearest landfill or it should be reutilised in the construction. All the campsites should be closed and cleared as per the closure plan, all borrow area pits at settlement shall be covered as these sites act as a breeding ground for mosquitoes.

8.7.3 Land Acquisition

Affected CPRs and private structures will be compensated as per Social Management framework of the project approved by the Government of Tamil Nadu. The resettlement budget comprises of the estimated value of compensation for land, structures, trees, crops, various resettlement assistance, cost of CPRs, institutional cost, contingency, hiring of NGO for RAP implementation, monitoring and evaluation consultant, etc. The project authority will release requisite funds under resettlement budget in a timely manner which will be submitted in land plan schedules as part of DPR..

The resettlement and rehabilitation budget will (about INR 100 millions) be estimated based on the information, data collected from the field and other reliable sources. The budget will be updated and adjusted as per the market rate of various items as the project continues. The compensation amount for the acquisition of land, structures, trees, standing crops, etc. will be determined by the Competent Authority of the Villupuram District as per the GoI and State Government Rules.

The resettlement budget is indicative and has been estimated as per the present rate. The unit cost would be updated and adjusted to the inflation rate as the project continues. Compensation for land will be as per the applicable act. A differential amount between replacement value and compensation amount will be paid by the Project Authority as assistance.

8.8 BUS SHELTER, BUS BAYS, TRUCK LAY BYS, RESTING PLACE AND SERVICE ROAD

Widening of both the project roads is planned concentric in most portions. Due to this most of the existing bus shelters are being impacted. The project plans to compensate the bus shelters loss due to widening. The proposed locations of bus shelters are given in **Annexure 2.1** for both roads. In total 18 new bus shelters are planned in Madapattu- Thirukovilur road and 39 in Vridhachalam- Bhuvanagiri road. The drawing of bus shelter has been given in Chapter 2.

Truck Laybye and Parking Area

Truck Parking/Rest areas are provided for the convenience and to ensure certain essential facilities to the project road user. These are provided to the motorist to stop and rest for short periods. It is general practice to provide a minimum of one rest area at every 50 to 60km of travelling distance. The length of project road is less than 40km; hence as such there is no need to provide any truck parking plaza.

8.9 AVOIDANCE OF DISRUPTION AND SAFETY RISKS DURING THE CONSTRUCTION STAGE

8.9.1 Disruption to the community

Alignment has been worked out to minimize impacts on sensitive community facilities. The extent of the impact has already been discussed in chapter 7. Fully impacted religious structures will be relocated with the consent of the community. Those partially being impacted will be repaired and beautified. The necessary budget for this has been included in EMP budget.

Traffic Jams, Congestion and Safety

Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of road. The traffic control plans will contain details of temporary diversions, details of arrangements for construction under the traffic and details of traffic arrangements after cessation of work each day.

Temporary diversion (including a scheme of temporary land acquisition) will be constructed with the approval of the CSC and the PIU. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.

The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water, if necessary.

The Contractor will take all necessary measures for the safety of traffic during construction and 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 highway under improvement.

8.9.2 Safety of the Workers

The contractor requires attending to the health and safety risk of workers by maintaining and cleaning up campsites and safeguarding the environment of land adjacent to construction camp. During construction of the road there will be major or minor accidents by lack of knowledge of handling new equipments; workers functioning without proper personal protective equipment (PPE); not possessing first aid facilities at work sites and Fire hazard due to the absence of fire protective equipment at the sites of oil, bitumen, diesel and any other form of chemical storage.

Construction Phase

The construction camp shall be located at least 500 meters away from major habitation. Most of the construction workers will be from the local area, but if outstation construction workers are engaged, they will be allotted a specific area of land on which the temporary camp is to be built for workers. Adequate sanitary facilities, drainage, washing and toilets with septic tanks and refuse collection and disposal facility shall be provided for the workers. The provision of a potable water supply, cooking fuel and toilet facilities will be made as per the stipulated guidelines of the Indian Labour Act.

Strict control to reduce the air pollution, at stone crushers, Hot mix plants and concrete batching plants by constructing temporary wind breakers or equipping the construction equipment with built in cyclone separators or bag filters, shall be carried out. Frequent sprinkling of water at these sites will reduce the fugitive dust. Noise can be controlled by shielding noisy equipment with acoustic barrier, detouring construction trucks away from silent receptors, equipping the construction equipment with adequate mufflers, intake silencers and engine enclosures. All the workers at construction and batching plants shall compulsorily be equipped with personal protective equipment based on their nature of possible risk and hazard like a gum boot, helmet, earplugs, air mask and goggles. Periodical check up for the construction workers are to be arranged by the contractors by qualified doctors to ensure good health and once in three months.

8.10 CUMULATIVE ENVIRONMENTAL IMPACT – MITIGATION MEASURES

8.10.1 Cumulative Impacts of Vehicular Traffic at Junctions - Mitigation

In order to minimize impacts at major intersections, traffic regulation has been planned through designing layout of each intersection as part of highway design. As part of the environmental enhancements landscaping has also been planned at two major junctions of Madapattu-Thirukovilur road and 3 major junctions of Vridhachalam- Bhuvanagiri road. There will be plantation of shrubs as part of the landscaping. The proper design of intersections will avoid idling of vehicles at the intersection locations and build up of vehicular emissions. The reduction in vehicular noise will also be there as there will be a reduction in vehicle speed before reaching the intersection through the transverse rumble strips planned to be provided at junctions and major intersections. The rumble strips will be provided at the intersection locations given in **Table 8.11** and **8.12.**

Table 8.11: Proposed Locations of Rumble Strip at Intersections on Madapattu- Thirukovilur Road

S. No.	Existing Chainage (km)	Design Chainage (km)	Remarks
1	41+765	41+750	NH-45 Junction Approach
2	-	66+400	Junction at km 66+200
3	-	70+850	Junction at km 71+147

Table 8.12: Proposed Locations of Rumble Strip at intersections on Vridhachalam- Bhuvanagiri Road

S. No.	Existing Chainage (km)	Design Chainage (km)	Remarks
1	0+096	0+100	Junction at CH: 0+000
2	1+550	1+550	Junction at CH: 1+740
3	1+901	1+900	Junction at CH: 1+740 & 4 Lane to 2 Lane configuration change
4	24+704	24+600	Speed Change & Junction at CH: 25+180
5	25+804	25+700	Speed Change & Junction at CH: 25+180
6	35+650	35+550	Junction at CH: 35+700

The establishment of commercial ventures at the intersections can be regulated through the strict vigilance by the local PIU for the RoW protection and in coordination with local civic authorities.

8.10.2 Cumulative impacts of Road safety - Mitigation

Design Phase

The missing safety features are part of road improvement works. The planned safety measures have been detailed below:

(i) Traffic Sign Material

High Intensity Micro-Prismatic Grade Sheeting (HIP) (Type IV) shall be provided for the both the project roads.

(ii) Crash Barrier

W-beam crash barrier shall be provided along the project highway at the following locations as per Section 9 of the Manual as a minimum. This W-beam crash barrier shall be provided at least 30m in advance of the hazard and 10m beyond the hazard.

Table 8.13: Proposed Locations of Crash Barrier on Madapattu- Thirukovilur Road

Sl. No.	Design Chainage (km)		Length (m)	Side of the Project Road	Remarks
	From	To			
1	46+450	46+620	170	LHS	Pond
2	63+450	63+480	30	RHS	Pond
3	64+690	64+940	250	RHS	Pond
4	65+570	65+610	40	LHS	Pond

Table 8.14: Proposed Locations of Crash Barrier on Vridhachalam- Bhuvanagiri Road

Sl. No.	Design Chainage (km)		Length (m)	Side of the Project Road	Remarks
	From	To			
1	11+780	12+000	220	RHS	Canal
2	21+030	21+120	90	RHS	Pond
3	27+330	27+640	310	LHS	Canal, on left side of slip road
4	27+420	27+545	125	LHS	Between main Carriageway and Slip Road
5	27+645	30+900	3255	LHS	Canal
6	31+000	31+700	700	LHS	Canal
7	31+790	31+850	60	LHS	Canal
8	32+040	32+670	630	LHS	Canal
9	32+800	32+860	60	LHS	Canal

(iii) Pedestrian Guard Rail

The railing of the pedestrian guard rail will be of tubular steel in conformance to IS: 1239. Other specifications will be in-accordance to clause 808 of 'Specification for Road and Bridge works' MoRTH. Pedestrian guard rail will be provided along the project roads at the following locations as per Manual and IRC guidelines as a minimum.

Table 8.15: Proposed Locations of Pedestrian Guard Rail on Madapattu- Thirukovilur Road

Sl. No.	Design Chainage (km)		Length (m)	Location	Remarks
	From	To			
1	48+000	48+800	800	Front of Footpath, both sides	Built-up Area

Table 8.16: Proposed Locations of Pedestrian Guard Rail on Vridhachalam- Bhuvanagiri Road

Sl. No.	Design Chainage (km)		Length (m)	Location	Remarks
	From	To			
1	0+000	2+000	2000	Front of Footpath, both sides	
2	0+940	0+980	40	Back of Footpath on RHS	Pond on RHS
3	1+580	1+630	50	Back of Footpath on RHS	Pond on RHS
4	12+000	12+850	850	Front of Footpath, both sides	

(iv) Transverse Rumble strips

Transverse rumble strips will be provided where there is necessity for stopping sight distance restrictions, high approach speeds or a history of stop sign violation collisions. These rumble strip will be provided at the following locations as a minimum:

Table 8.17: Proposed Locations of Transverse Rumble strips on Madapattu- Thirukovilur Road

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Remarks
1	41+765	41+750	NH-45 Junction Approach
2	42+701	42+700	Speed Change
3	44+044	44+020	Speed Change
4	45+047	45+020	Speed Change
5	45+927	45+900	Speed Change
6	47+430	47+400	Speed Change & Kothanur Village
7	50+638	50+600	Speed Change & Periyasevalai Village
8	54+752	54+700	Speed Change & School
9	56+150	56+100	Speed Change
10	57+251	57+200	Speed Change
11	60+504	60+450	Speed Change
12	61+554	61+500	Speed Change
13	65+771	65+700	Speed Change & Junction at km 66+200

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Remarks
14	-	66+400	Junction at km 66+200
15	-	70+850	Junction at km 71+147

Table 8.18: Proposed Locations of Transverse Rumble Strips on Vridhachalam- Bhuvanagiri Road

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Remarks
1	0+096	0+100	Junction at CH: 0+000
2	1+550	1+550	Junction at CH: 1+740
3	1+901	1+900	Junction at CH: 1+740 & 4 Lane to 2 Lane configuration change
4	5+707	5+700	Speed Change
5	7+719	7+700	Speed Change
6	9+116	9+100	Speed Change
7	11+932	11+900	Kammapuram Village
8	13+636	13+600	Kammapuram Village
9	16+142	16+100	Speed Change
10	17+655	17+600	Speed Change
11	20+483	20+400	Speed Change
12	21+990	21+900	Erumbur Village
13	22+690	22+600	Erumbur Village
14	24+704	24+600	Speed Change & Junction at CH: 25+180
15	25+804	25+700	Speed Change & Junction at CH: 25+180
16	27+354	27+250	Speed Change and Slip Road
17	28+801	28+700	Speed Change and Slip Road
18	33+707	33+600	Bhuvanagiri Village
19	35+650	35+550	Junction at CH: 35+700

Pre Construction and Construction Stage

The Contractor shall provide an adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers and flag persons for traffic control. If there are traffic jams during construction, measures shall be taken to relieve the congestion with the assistance of the local traffic police. Safety of workers undertaking various operations during construction will be ensured by providing helmets, masks, safety goggles, etc. One Qualified Safety Officer and one

Safety Supervisor must be available in the Contractor's working team for the entire construction period.

The Contractor shall submit the construction safety checklist in the format given in **Annexure 8.6** filled up to fourth column to the Engineer by 5th of every month. The Engineer shall fill up the remaining column of the checklist and forward to the Employer within a week period.

Operation Stage

The contractors constructing the project roads will maintain the roads, including assets for five years after completion of construction works. The safety features installed shall also be maintained by the contractor. Hence road safety has been well taken care in the project planning, construction and operation phases.

8.10.3 Cumulative impacts on Valued Ecosystem Components (VEC)

In order to minimize cumulative impacts due to tree cutting, the project plans compensatory plantation in 1: 10 ratio, i.e. for each tree to be cut 10 trees will be planted. The budget has been kept for five years maintenance in the post construction phase. Hence there will be a positive impact on this valued ecosystem.

The changes in land use along the project roads are bound to happen due to population pressure. The TNRSP in close coordination with civic authorities has to be watchful for ribbon development along the project roads.

The contractor maintaining the road will also maintain drains constructed as part of the road improvement works. The drainage system will remain effective and no cumulative adverse impacts anticipated. Footpath cum drains have been planned in built up areas so these drains will remain effective as there will be less chances of clogging due to household wastes.

The study area of both the project roads has limited industrial pollution sources (only Neyveli Lignite mines in case of Vridhachalam- Bhuvanagiri road) and has good air quality, and good ground water quality. The industrial growth centers have yet not been planned along either of the project roads; hence air, water, and noise pollution issues are not foreseen. The pollution due to vehicular movement will be taken care by the planned mitigation measures and to check the effectiveness of mitigation measures periodic environmental monitoring is planned along both the project roads in the operation phase.

Since widening of project roads will reduce ground water recharge potential due to the creation of additional paved surface, therefore, this has been taken care by provision of rainwater harvesting structures at every 1 km on either side of the both the project roads. It is anticipated that over a long period of time ground water recharge potential will balance. Further, all community drinking water sources being impacted will be relocated in consultation with the community at the project cost.

The village ponds suitable for beautification have been selected for environmental enhancements for making effective use for the community. The siltation to these ponds shall be avoided during construction through the provision of silt fencing arrangements. The siltation in these ponds will also reduce as plantation has been planned on side slopes of ponds. All the plantation and pond enhancement works will be maintained by the contractor for five years during the operation phase.

The noise sensitive receptors will be maintained by the contractor during the operational phase and no adverse impact on account of the vehicular traffic movement is expected on these during the operation phase.

ANNEXURE 1.1: APPROACH AND METHODOLOGY

BASIC APPROACH

The potential environmental issues, impact and associated environmental aspects have been examined in detail for the project life cycle. The environmental studies for the project involve several stages during the course of environmental investigation. These can be broadly categorized as

- Secondary data collection, analysis & documentation
- Gap assessment of secondary data
- Primary data generation to fill the identified gap

Starting from reconnaissance studies and feasibility studies to the detailed design, the environmental aspects have been taken into account for materialising a thorough environmental analysis. This analysis will ultimately lead to develop an environmental oriented design for each component of the project. Major part of the environmental analysis will go to the preparation of a project specific environmental management and monitoring plan for the rest of the project life cycle.

Although the project largely follows the requirements of the Government of India, the recent revised requirements of the World Bank were fully considered while formulating a methodology for the EIA process. World Banks EMP requirements are simple and practically implementable for the contractors and for consultants responsible for supervision.

The methodology as usual involves:

- Site reconnaissance
- Detailed baseline survey
- Stakeholder consultations
- Impact surveys
- Mitigation and environmental enhancement surveys

The consultation with stakeholder has been carried out at various locations and levels for example, people residing along the project roads, statutory undertakers, project authorities. The potential environmental aspects have been examined in detail throughout the design process. Starting from feasibility stage to detailed design, the environmental aspects have been taken into consideration for effecting environmental design, monitoring and management plan. The incorporation of observation and assessments of those likely to be directly affected by the widening and improvement of the project roads is an essential feature of the methodology and become increasingly important as an assessment process unfold in different stages. The specific details of the consultations conducted during the process are discussed in detail in chapter 8 i.e. public participation and consultation.

OBJECTIVE OF THE EIA STUDY

It is often useful to highlight the project constrains where in the actual bottlenecks of the project need to be identified and removed gradually to improve and optimise the economic, social and environmental benefits accruing from the project implementation.

The objective of environmental impact assessment study is to identify the adverse and positive impacts due to project implementation, suggest avoidance, mitigation and enhancement measures in project design and to prepare Environmental Management Plan (EMP) for pre-construction, construction and operation phases of the project.

The objective of EIA study is to meet World Bank safeguards requirements and to prepare an effective environmental management plan as an outcome of EIA study.

STEPS IN THE PROCESS

The environmental impact assessment procedure proceeded simultaneously with detailed design of the project road. The important findings of the assessment gave important feedback to the design team, especially in terms of the sensitive receptors utility /facilities to be impacted, water logged stretches and accident prone locations. It helped modify the designs at locations where impacts had to be avoided and incorporate mitigation measures wherever the impacts were unavoidable due to other constraints. The stepwise methodology adopted for the EIA is as follows:

Environmental Screening

The consultant project preparation team had visited both the project roads and details of this reconnaissance survey have been separately prepared and presented in the environmental screening report for the project road. The site visit and the initial assessment have become the key elements of the schedule of preparation as a part of screening report. In addition to field investigations and observations, consultations were held with local officials and available environmental documentation was assembled for review.

Scoping

The scope of the assessment for this study was determined by the Terms of Reference of the DPR Consultants, the statutory requirements for the area of influence required by the Ministry of Environment, Forests and Climate Change and consultations with experts. In addition the screening study undertaken, identified valued ecosystem components (VECs).

Delineation of Project Impact Zone

A comprehensive survey had been conducted for delineation of project impact zone for the purpose of environmental impact screening studies.

Reconnaissance Surveys

The study team of DPR consultants visited the selected alignment and information on each km was collected in formats for each VECS. Detailed strip mapping carried out as part of the detailed design, data collection also provided valuable information regarding area adjacent to the pavement. The strip maps are part of the environmental screening report.

Secondary Data Collection

Keeping in line with the new methods, literature survey had been carried out using the internet and quite a lot of useful materials have been downloaded. This included both published and unpublished environmental data. Literature searches were undertaken and relevant agencies such as Department of Forest, the State Pollution Control Board were contacted and appraised of the proposed project. Sources of previously collected data included:

- Tamil Nadu State Pollution Control Board
- Tamil Nadu State Forest Department
- Survey of India (SoI) maps of the potentially affected districts

Baseline Environmental Monitoring

A comprehensive survey had been conducted for the purpose of environmental impact assessment and environmental screening studies. For this purpose, a data sheet was devised to collect quantitative social and environmental data together with local project specific consultations. This will be the basis for further investigations for future studies.

Establishing Baseline Environmental Profile

The documentation of the baseline conditions was completed for a 10 km wide strip on all sides of the road alignment-Project Influence Area (PIA) as per the MoEFCC guidelines. Primary surveys were carried out for determination of ambient air quality, water quality, soil quality at various locations along the proposed alignment and noise levels were also measured at different locations to have an idea of prevailing noise levels in the area. A detailed chainage wise tree count at 200m interval in the corridor of impact (15 m on either side of existing centerline) has also been undertaken. A separate list of trees having girth size less than 30 cm within the available RoW has been prepared with an objective to transplant these trees after construction works as part of the compensatory tree plantation.

Identification and Evaluation of Potential Impacts

Potential significant impacts were identified on the basis of analytical review of baseline data; review of land uses and environmental factors; analytical review of the socio-economic conditions within the project influence area; and review of assessment of potential impacts as identified by previous road projects.

Assessment of Alternatives

Alternatives were continuously assessed throughout the process of DPR preparation. The consultants did a detailed study on selection of alternatives during project preparation. A more formal assessment was also undertaken as a part of the environmental assessment process, including the assessment of the "No Action" an alternative as is customarily included as a part of the formal assessment methodologies to ensure that it has been given proper consideration. Other sources, such as satellite imagery, were used to identify and analyse alternatives.

Finalisation of Alignment

The design and decision-making process and finalisation of road alignment will integrate environmental, resettlement and rehabilitation issues and prompted the early identification of appropriate actions. Such actions included, for example, shifts in alignments based on awareness of the locations of cultural resources, and biological resources such as significant areas of trees and orchards.

Mitigation and Environmental Enhancement Measures

Environmental concerns were identified in early stages of project preparation. This has enabled to streamline the design process and to avoid or otherwise mitigate potential impacts. Other measures will require appropriate actions in the construction and operation phases. Positive actions, not only avoid adverse impacts, but also capitalise on opportunity to correct environmental degradation or improve environmental conditions. The positive actions were identified during the DPR process.

Identification of the Requirements of Environmental Regulations

Legal, policy and institutional aspects relevant to the project road widening have been studied. The requirements of World Bank pertaining to safeguards have also been identified. The identified WB and statutory requirements will be complied with during the project implementation stage.

Integration of Impacts in the Design Process

The design and decision-making process integrated environmental, resettlement and rehabilitation issues and prompted the early identification of appropriate actions. Such actions included, for example, shifts in alignments based on awareness of the locations of cultural resources, common property resources, and biological resources such as significant areas of trees and orchards.

Preparation of Environmental Management Plan

Environmental management plan has been prepared as part of the Environmental Assessment. Responsibilities have been assigned for the various actions identified to limit the adverse impacts of the project and budget allocations have been made for the funds required for mitigation as well as enhancement measures.

Continuous Public Consultation and Participation

Extensive consultations were held at various stages of the project. A chapter in the present report details out the methods, approaches and outcomes of the consultations held. The issues raised by the communities and the various stakeholders were incorporated in the design and construction/operation plan of the project highway. The consultations held are in line with World Bank requirements.

ANNEXURE 2.1: PROPOSED LOCATION FOR BUS BAYS WITH PASSENGER SHELTER ALONG PROJECT ROADS

(a) Madapattu- Thirukovilur Road

S.No.	Design Chainage	Side	Village Name
1	45+430	RHS	Madapattu
2	45+510	LHS	
3	48+050	LHS	Kothanur
4	48+220	RHS	
5	49+350	LHS	Periyasevalai
6	49+850	RHS	
7	55+190	RHS	Pavandhur
8	55+360	LHS	
9	57+420	RHS	Pennaivalam
10	57+610	LHS	
11	58+700	RHS	Ammavasai palayam
12	58+800	LHS	
13	60+200	LHS	T.Kunnattur
14	60+300	RHS	
15	62+100	LHS	Edapalyam
16	62+270	RHS	
17	64+400	LHS	Muthalur
18	64+400	RHS	
19	65+830	LHS	Kolapakkam
20	65+900	RHS	

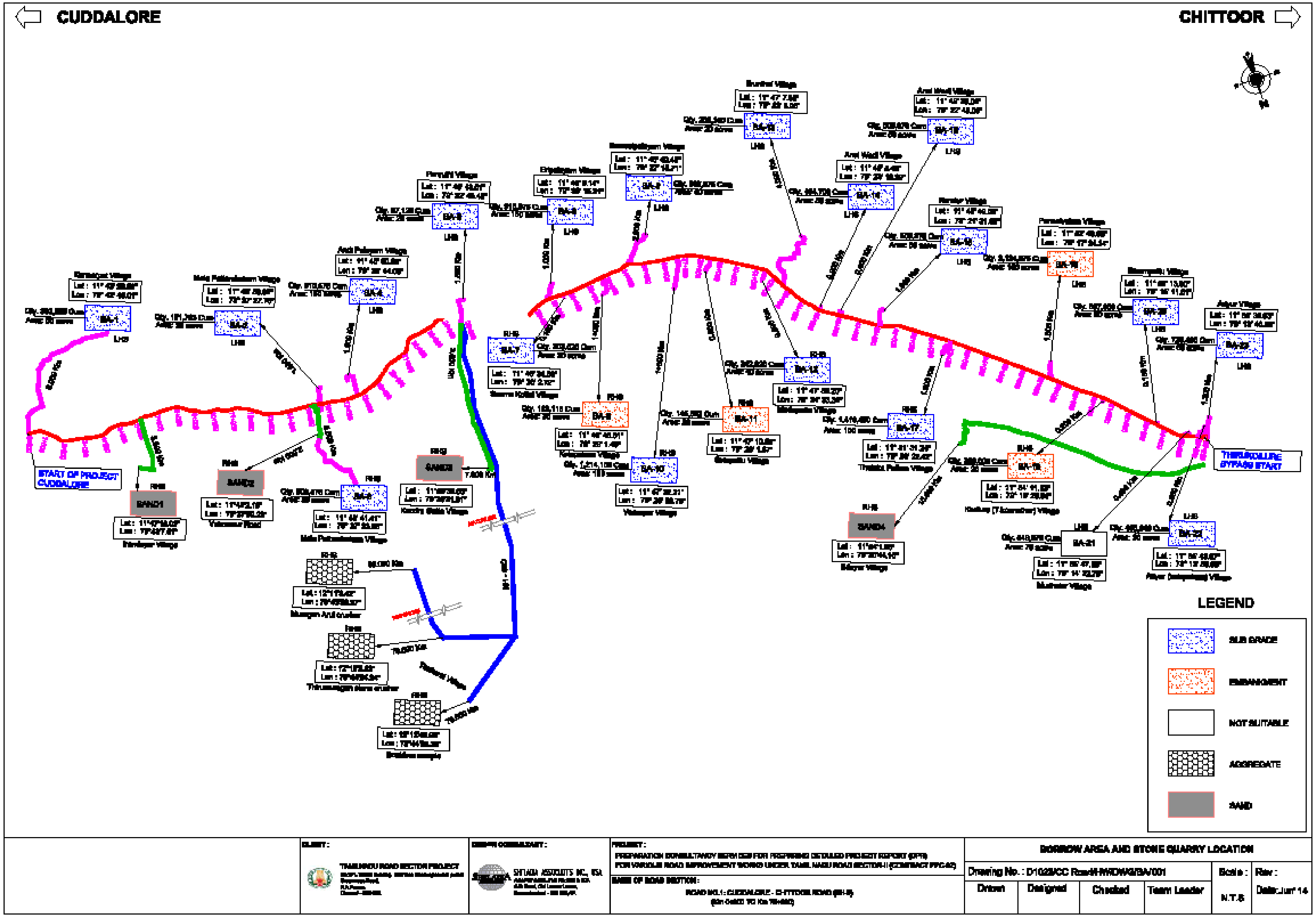
(b) Vridhachalam- Bhuvanagiri Road

S.No.	Design Chaniage (Km)	Side	Village Name
1	3+210	LHS	Kara Kudal
2	3+130	RHS	
3	4+450	LHS	Mavidanthal & Go. Athanur
4	4+450	RHS	
5	5+400	LHS	Kumara Mangalam
6	5+200	RHS	
7	6+420	LHS	Kumara Mangalam
8	6+630	RHS	
9	7+975	LHS	Gopalapuram
10	8+005	RHS	
11	9+930	LHS	Keenanur
12	9+930	RHS	
13	10+830	LHS	Kammapuram
14	10+830	RHS	
15	12+550	LHS	Kammapuram
16	12+590	RHS	

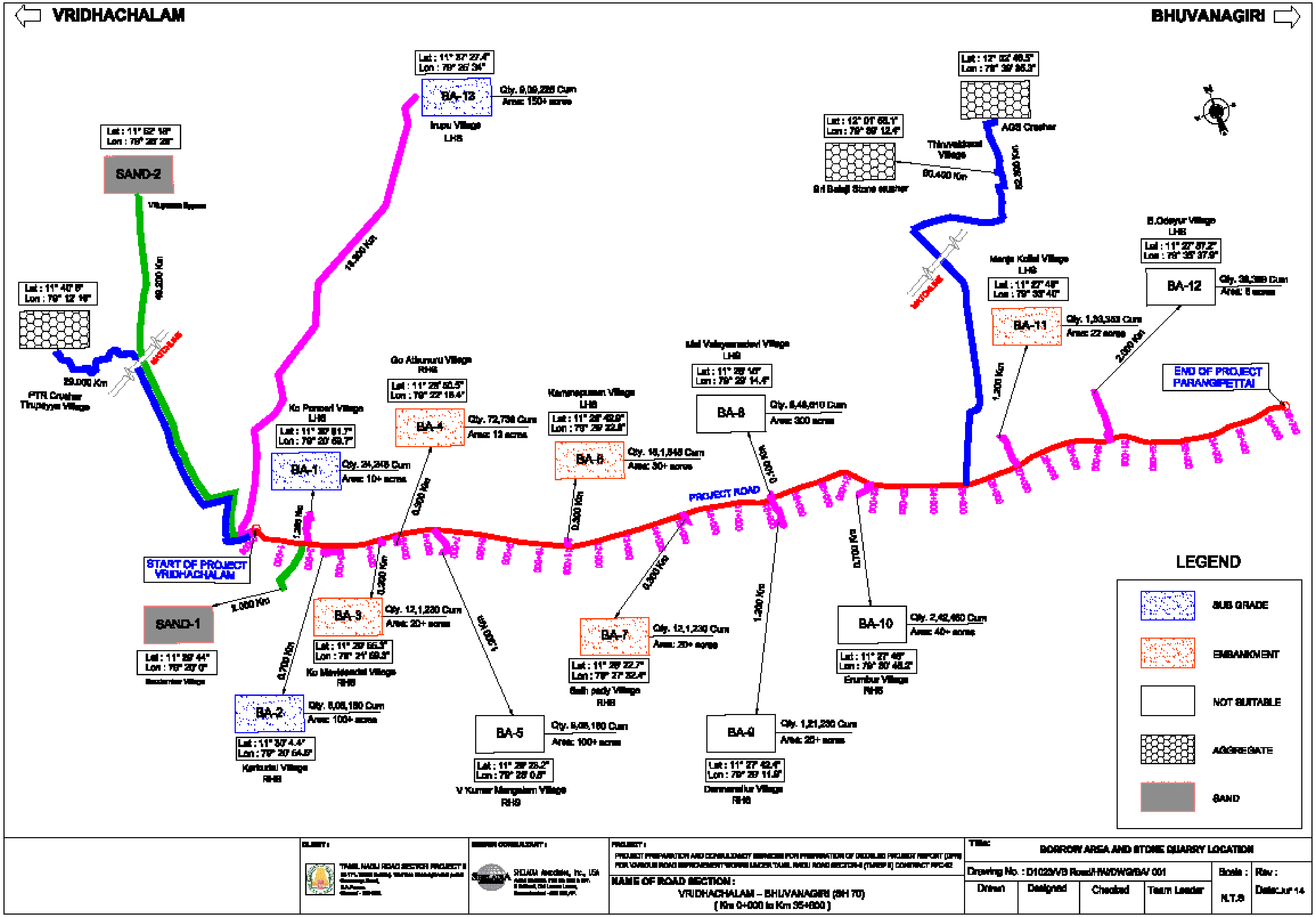
S.No.	Design Chaniage (Km)	Side	Village Name
17	14+050	LHS	Sirvarapur
18	14+050	RHS	
19	15+265	LHS	Sathapady
20	15+310	RHS	
21	16+310	LHS	Katharai
22	16+510	RHS	
23	18+370	LHS	Dharmanallur & Melvlayamdevi
24	18+370	RHS	
25	19+520	LHS	Melvlayamdevi
26	19+520	RHS	
27	22+235	LHS	Erumbur
28	22+235	RHS	
29	23+620	LHS	Naltani kulam
30	23+800	RHS	
31	25+380	LHS	Sethiyathope
32	25+430	RHS	
33	27+400	RHS	Manjakolai
34	28+520	RHS	Manjakolai
35	30+570	RHS	B.Odaiyur
36	33+970	LHS	MelBhuvanagiri
37	34+030	RHS	
38	35+175	LHS	Bhuvanagiri
39	35+350	RHS	

ANNEXURE 2.2: LOCATIONS OF BORROW AREA AND QUARRY

Madapattu-Thirukovilur Road (SH-09)



Locations of Borrow area and Quarry for Viradhachalam-Parangipattai road (SH-70)



ANNEXURE 4.1: SUMMARY OF MONITORED DAILY METEOROLOGICAL DATA OF STUDY AREA

Date	Average Wind Speed (kmph)	Average Visibility (km)	Cloud Cover	Average Barometric Pressure (hPa)	Temperature (^{0}C)		Relative Humidity (%)	
					Min	Max	Min	Max
01-Feb-14	7.8	-	-	1013.2	23.9	30.5	68	92
02-Feb-14	7.7	-	-	1012.6	24.0	30.9	64	93
03-Feb-14	5.9	-	-	1011.3	22.6	30.4	54	85
04-Feb-14	4.9	-	-	1010.1	21.8	30.1	48	88
05-Feb-14	4.0	-	-	1009.7	20.4	31.3	50	86
06-Feb-14	4.9	-	-	1010.2	21.0	30.4	60	93
07-Feb-14	5.1	-	-	1010.5	21.4	31.6	43	90
08-Feb-14	4.4	-	-	1010.0	20.2	31.7	41	90
09-Feb-14	3.9	-	-	1009.1	19.4	32.0	44	83
10-Feb-14	3.6	-	-	1009.4	20.7	31.8	41	84
11-Feb-14	4.2	-	-	1008.9	22.0	31.9	48	87
12-Feb-14	3.7	-	-	1009.0	21.9	32.2	45	88
13-Feb-14	4.2	-	-	1011.2	21.9	31.5	58	91
14-Feb-14	4.1	-	-	1011.5	24.6	31.1	55	87
15-Feb-14	4.5	-	-	1009.6	23.2	31.6	52	91
16-Feb-14	3.4	-	-	1009.7	24.5	32.3	68	94
17-Feb-14	4.8	-	-	1011.4	25.8	32.5	69	96
18-Feb-14	6.1	-	-	1013.5	26.0	31.4	67	95
19-Feb-14	5.7	-	-	1013.1	26.1	32.5	61	89
20-Feb-14	5.6	-	-	1012.8	25.4	31.2	57	84
21-Feb-14	5.2	-	-	1013.3	23.0	31.2	54	84
22-Feb-14	5.4	-	-	1013.1	22.9	30.9	52	84
23-Feb-14	6.1	-	-	1013.3	22.1	31.3	44	83
24-Feb-14	4.4	-	-	1013.4	24.4	31.0	53	97
25-Feb-14	6.2	-	-	1013.9	24.9	31.8	64	91
26-Feb-14	3.9	-	-	1013.1	24.3	31.9	43	80
27-Feb-14	4.7	-	-	1012.9	22.7	32.0	61	90
28-Feb-14	4.6	-	-	1011.9	23.9	31.7	57	88

Source: IMD, AWS
Cloud Cover Type: C: Clear Sky, P: Partial Clouded

Wind Velocity, Barometric Pressure, Daily Temperature and Relative Humidity for the Month of March2014

Date	Average Wind Speed (kmph)	Average Visibility (km)	Cloud Cover	Average Barometric Pressure (hPa)	Temperature (^{0}C)		Relative Humidity (%)	
					Min	Max	Min	Max
01-Mar-14	4.2	-	-	1011.9	26.0	31.8	53	83
02-Mar-14	4.2	-	-	1011.4	23.8	32.2	53	90
03-Mar-14	6.0	-	-	1011.4	24.8	32.5	58	88
04-Mar-14	5.3	-	-	1012.2	25.3	32.6	36	84
05-Mar-14	5.9	-	-	1012.5	25.0	32.1	62	89
06-Mar-14	5.7	-	-	1012.2	26.4	32.3	60	92
07-Mar-14	6.3	-	-	1013.1	25.7	32.0	50	86
08-Mar-14	6.7	-	-	1013.5	24.6	31.4	61	88
09-Mar-14	6.6	-	-	1013.3	24.7	31.5	61	88
10-Mar-14	5.7	-	-	1012.9	25.6	32.5	57	86
11-Mar-14	5.6	-	-	1013.0	25.4	32.6	42	82
12-Mar-14	4.7	-	-	1013.6	24.4	33.2	39	81
13-Mar-14	5.3	-	-	1013.0	23.8	31.7	55	87
14-Mar-14	5.4	-	-	1012.9	22.7	32.0	49	88
15-Mar-14	5.0	-	-	1013.9	23.2	32.0	56	88
16-Mar-14	5.6	-	-	1014.5	24.4	31.6	61	92
17-Mar-14	5.4	-	-	1013.8	24.4	32.8	57	91
18-Mar-14	5.0	-	-	1013.1	24.9	33.4	36	86
19-Mar-14	4.4	-	-	1012.3	25.5	34.4	58	92
20-Mar-14	3.7	-	-	1010.9	26.0	34.5	60	91
21-Mar-14	3.9	-	-	1009.3	26.9	35.4	51	90
22-Mar-14	4.9	-	-	1007.9	25.2	37.3	47	86
23-Mar-14	4.2	-	-	1009.0	24.6	35.9	41	88
24-Mar-14	4.2	-	-	1010.8	23.8	34.0	55	90
25-Mar-14	4.4	-	-	1010.0	23.8	34.0	52	90
26-Mar-14	5.1	-	-	1010.0	24.1	33.6	55	89
27-Mar-14	2.8	-	-	1010.9	23.1	35.1	32	82
28-Mar-14	4.1	-	-	1010.5	23.1	36.3	46	90
29-Mar-14	3.5	-	-	1009.5	23.9	35.4	43	88
30-Mar-14	4.4	-	-	1008.8	22.9	37.2	35	80
31-Mar-14	4.7	-	-	1008.4	22.8	38.9	42	80

Source: IMD, AWS
Cloud Cover Type: C: Clear Sky, P: Partial Clouded

District Rainfall Data in mm for last Five Years

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	73.3	28	272.5	3.9	41.8	50.4	59	92.7	78.7	269.4	728	151.1
2009	20.2	0	69.1	36.6	21.3	29.7	38.9	119.8	89.7	74.6	607.3	278.6
2010	41.3	0	0	0	71.6	68.5	36.3	149.9	108.2	145.4	553.3	345
2011	45.2	24.8	0	105.2	15.4	17.1	105.3	112.8	189.4	270.5	491.7	111.2
2012	5.6	0	5.1	14.8	24	2.4	55.4	78.6	109.1	479.6	94.3	13.9

Source: IMD

ANNEXURE 4.2: DETAILS OF PROTECTED AREAS IN TAMIL NADU

Protected Natural Habitats

Tamilnadu Government has established many National Parks and Wild Life Sanctuaries to protect important species. None of the national parks and Wild life Sanctuaries pass through the Project enroute. The following is the list of National Parks and Wildlife Sanctuaries (WS) and their year of establishment are presented in Table below.

National Parks

Tamil Nadu has 5 declared National Parks with a total area over 307.84 km2 (118.86 sq mi), covering only 0.24% of the state. This is the third lowest % area covered of all Indian states and Union territories.

List of National Park in Tamilnadu

Name of National Park	Area (in km^2)	Establishment
Indira Gandhi National Park (Aanamalai National Park)	117.10	1989
Mudumalai National Park	103.24	1990
Mukurthi National Park	78.46	1982
Gulf of Mannar Marine National Park	6.23	1980
Guindy National Park	2.82	1976

Wildlife sanctuaries:

There are 7 wildlife sanctuaries plus 13 bird sanctuaries that together cover over 2,997.60 km2 (1,157.38 sq mi), 2.30% of the total state area.

List of Wild Life Sanctuaries in Tamil Nadu

Name of Wild Life Sanctuaries	Area (in km^2)	Animals
Grizzled Squirrel Wildlife Sanctuary, near Srivilliputhur in Virudhunagar district	485	Grizzled Giant Squirrel, Flying Squirrel, Tree Shrew, Elephant, lion-tailed macaque, Nilgiri Tahr, mouse deer, barking deer
Indira Gandhi Wildlife Sanctuary, Coimbatore District	841.49	Indian Elephant, Gaur, Tiger, Panther, Sloth Bear, Wild Boar, Dhole, Nilgiri Langur, Lion-tailed Macaque, Sambar, Four horned Antelope, Chital and a host of birds, notably the Trogar, Pied Hornbill and several types of Eagles may be seen
Kalakkad Wildlife Sanctuary in Tirunelveli District		Lion-tailed macaque. All four species (common Langur, Nilgiri Langur, Bonnet Macaque and lion tailed Macaque) can be seen. . Other animals include Nilgiri tahr, sambar, sloth bear, gaur, Indian elephant, tiger, flying squirrel, panther, Dhole, pangolin and a variety of birds and reptiles.
Mundanthurai Sanctuary, Tirunelveli District	282.08	Part of Kalakkad Mundanthurai Tiger Reserve
Kanyakumari Wildlife Sanctuary, Kanyakumari district	457.78	Tiger habitat in declared a sanctuary in February 2008.
Mudumalai Wildlife Sanctuary in Nilgiris district is contiguous with Mudumalai National Park.	217.76	Elephant, Gaur, Sambar, Chital, Dhole Panther, Tiger, Sloth bear, Python, Barking deer, Four-horned antelope, common Langur, Otter, Crocodiles (mugger) and a variety of birds and reptiles may be seen.
Sathyamangalam Wildlife Sanctuary in Erode district, the largest wildlife	1,411.6	Bengal Tigers, Indian Elephants, Gaurs, and leopards, Spotted deer, Blackbuck, Sambar deer,

Name of Wild Life Sanctuaries	Area (in km^2)	Animals
sanctuary in Tamil Nadu, was declared a sanctuary in 2008.		Barking deer, Four-horned antelope, wild boar, Sloth bear, striped hyenas, Treepies, Bulbuls, Babblers, Mynahs and Crows

List of Bird Sanctuaries in Tamil Nadu

Name of Wild Life Sanctuaries	Area (in km2)	Bird
Chitrangudi Bird Sanctuary, Ramanathapuram District	0.48	Spot-billed Pelicans, Cormorants, Egrets, Grey heron, Spoon-billed Stork
Kanjirankulam Bird Sanctuary, Ramanathapuram District	1.04	Cormorants, egrets, grey heron, Spoon-billed Storks, teals and pelicans.
Karaivetti Bird Sanctuary, Perambalur District	4.54	Egrets, Pelican, Grey Heron, Black-headed Ibis and Common Spoonbills.
Karikili Bird Sanctuary, Kancheepuram Districts	612	Cormorants, Egrets, Grey heron, Spoon-billed Stork.
Koothankulam Bird Sanctuary, Nanguneri Taluk of Tirunelveli district	1.3	largest reserve for breeding water birds in South India
Melaselvanur - Kilaselvanur Bird Sanctuary, Ramanathapuram District	5.93	Grey pelican and Painted Stork
Point Calimere Wildlife and Bird Sanctuary, Point Calimere, Nagapattinam district	17.26	flamingos and Black Buck Antelope, Teals, Gulls, Terns, Plovers and Stilts
Pulicat Lake Bird Sanctuary, Pulicat, Thiruvallur District Second largest brackish-water eco-system on the East Coast of India	461.02	Greater Flamingos
Udayamarthandapuram Bird Sanctuary, Tiruvarur District	0.45	Little cormorant, darter, spoon bill, Indian Reef Heron, Grey heron, whitenecked stork
Vaduvoor Bird Sanctuary, Thanjavur in Thiruvarur district	1.28	Babul, River tern, Black-headed munia, Grey heron, White-breasted kingfisher Spotted Dove and more
Vedanthangal Bird Sanctuary, Kancheepuram District	0.3	Cormorants, egrets, gray heron, Spoon-bill Stork and migratory birds such as Garganey, Teals, Shovallers
Vellode Birds Sanctuary, Erode District	0.8	Spoon bills, teals, pintail ducks, and darters.
Vettangudi Bird Sanctuary, Thirupattur in Sivaganga district	0.344	White ibis, Asian openbill stork and night heron. It has also attracted indigenous, endangered species such as painted stork, grey heron, darter, little cormorant, little egret, intermediate egret, cattle egret, common teal, spotbills, pintail and flamingos.

Wildlife Habitat outside Protected Areas

There are two zoos recognised by the Central Zoo Authority of India in Tamil Nadu.

- Arignar Anna Zoological Park is 5.10 km^2 (1.97 sq mi) in Chennai.
- Madras Crocodile Bank Trust, a reptile zoo and herpetology research station, located 40 km south of Chennai

Five unrecognized mini zoos stimulate public awareness of wildlife conservation.

- Amirthi Zoological Park, Vellore, Vellore district
- Kurumpampatti Wildlife Park, Salem district

- Yercaud Deer Park, Salem district
- Mukkombu Deer Park, Tiruchirapalli district
- Ooty Deer Park, Nilgiris district

ANNEXURE 4.3: TREE LIST

Girth Wise Lst of Trees within 15m on Either Side from Existing Centerline on Madapattu- Thirukovilur Road (SH-9)

Left Hand Side

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
1	41.7-41.8	Vaazhai (Pol) <30		1					1
2		Thennai (Pol) <30		1					1
3		Pappaali (Pol) <30		1					1
4		Thoongumoonji						1	1
Sub Total				3				1	4
1	41.8-42.0	Arasan						1	1
2		Baniyar						1	1
3		Veppa Maram						1	1
4		Panai Maram						1	1
5		Puliyai Maram						3	3
6		Thoongumoonji						1	1
Sub Total								8	8
1	42.0-42.2	Arasan						1	1
2		Badam (Pol) <30	1						1
3		Naval						1	1
4		Veppa Maram						2	2
5		Veppa Maram (Pol) <30		1					1
6		Pungai (Pol) <30		1					1
7		Puliyai Maram						3	3
Sub Total			1	2				7	10
1	42.2-42.4	Pungai						1	1
2		Sewakku (Numorous) (Fenced) (P.L)	1						1
3		Puliyai Maram	1					4	5
Sub Total			2					5	7
1	42.4-42.6	Veppa Maram						1	1
2		Sewakku (Numorous) (800)	1						1
3		Puliyai Maram						4	4
4		Teak						1	1
5		Thoongumoonji						1	1
Sub Total			1					7	8
1	42.6-42.8	Baniyar						1	1
2		Illupa						1	1
3		Maa (Fenced) (P.L)	1						1
4		Mungai (Fenced) (P.L)	1						1
5		Sapotta (Fenced) (P.L)	1						1
6		Puliyai Maram						3	3
7		Thoongumoonji						1	1
Sub Total			3					6	9
1	42.8-43.0	Veppa Maram						1	1
2		Panai Maram						1	1
3		Puliyai Maram						3	3
4		Thoongumoonji						1	1
Sub Total								6	6
1	43.0-43.2	Illupa						1	1
2		Veppa Maram						1	1
3		Sewakku (Numorus)	1						1

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
4		Puliyai Maram						2	2
5	43.0-43.2	Velivelaan (CN)	1						1
Sub Total			2					4	6
1	43.2-43.4	Panai Maram						2	2
2		Puliyai Maram						4	4
Sub Total								6	6
1	43.4-43.6	Baniyar						1	1
2		Illupa						1	1
3		Panai Maram						1	1
4		Sewakku (Numorous)	1						1
5		Puliyai Maram						6	6
6		Thoongumoonji						1	1
Sub Total			1					10	11
1	43.6-43.8	Arasan						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	43.8-44.0	Arasan						1	1
2		Illupa						1	1
3		Maa						1	1
4		Veppa Maram						1	1
5		Puliyai Maram						3	3
6		Velivelaan (CN)	1						1
Sub Total			1					7	8
1	44.0-44.2	Badam (Pol) <30	1						1
2		Veppa Maram						1	1
3		Veppa Maram (Pol) <30		1					1
4		Puliyai Maram						3	3
5		Thoongumoonji						2	2
6		Velivelaan (Pol) <30		1					1
Sub Total			1	2				6	9
1	44.2-44.4	Veppa Maram						1	1
2		Panai Maram (CN)	1						1
3		Puliyai Maram						7	7
4		Velivelaan (CN)	1						1
Sub Total			2					8	10
1	44.4-44.6	Arasan						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						4	4
Sub Total								6	6
1	44.6-44.8	Arasan						1	1
2		Veppa Maram						1	1
3		Panai Maram					3		3
4		Puliyai Maram						4	4
5		Velivelaan (CN)	1						1
Sub Total			1				3	6	10
1	44.8-45.0	Arasan						1	1
2		Puliyai Maram						5	5
3		Thoongumoonji						2	2
4		Vaagai						1	1
Sub Total								9	9
1	45.0-45.2	Baniyar						2	2
2		Illupa						2	2
3		Veppa Maram						4	4
4		Panai Maram				1	2		3

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
5		Sewakku (CN)	1						1
6		Puliyai Maram						8	8
7	45.0-45.2	Thoongumoonji						4	4
Sub Total			1			1	2	20	24
1		Arasan						2	2
2	45.2-45.4	Veppa Maram						3	3
3		Puliyai Maram						6	6
4		Thoongumoonji						1	1
Sub Total								12	12
1		Veppa Maram						3	3
2	45.4-45.6	Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								7	7
1		Illupa						2	2
2	45.6-45.8	Veppa Maram						2	2
3		Puliyai Maram						6	6
Sub Total								10	10
1		Baniyar						1	1
2	45.8-46.0	Puliyai Maram						7	7
3		Thoongumoonji						2	2
Sub Total								10	10
1	46.0-46.2	Puliyai Maram						7	7
Sub Total								7	7
1		Baniyar						2	2
2	46.4-46.6	Panai Maram					2		2
3		Puliyai Maram						8	8
4		Thoongumoonji						2	2
Sub Total							2	12	14
1		Baniyar						2	2
2	46.6-46.8	Veppa Maram						4	4
3		Puliyai Maram						11	11
4		Thoongumoonji						2	2
Sub Total								19	19
1	46.8-47.0	Veppa Maram						1	1
Sub Total								1	1
1		Veppa Maram						2	2
2	47.0-47.2	Puliyai Maram						5	5
3		Thoongumoonji						1	1
Sub Total								8	8
1		Veppa Maram						3	3
2	47.2-47.4	Puliyai Maram						6	6
3		Thoongumoonji						1	1
Sub Total								10	10
1		Baniyar						2	2
2		Illupa						1	1
3	47.4-47.6	Veppa Maram						1	1
4		Puliyai Maram						4	4
5		Thoongumoonji						2	2
Sub Total								10	10
1		Baniyar						1	1
2	47.6-47.8	Illupa						1	1
3		Veppa Maram						3	3
4		Puliyai Maram						7	7
Sub Total								12	12
1	47.8-48.0	Veppa Maram						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
2		Puliyai Maram						8	8
3		Thoongumoonji						1	1
Sub Total								11	11
1	48.0-48.2	Veppa Maram						4	4
2		Puliyai Maram						10	10
3		Thoongumoonji						1	1
Sub Total								15	15
1	48.2-48.4	Baniyar						1	1
2		Veppa Maram						2	2
3		Panai Maram				1	2		3
4		Puliyai Maram						4	4
Sub Total						1	2	7	10
1	48.4-48.6	Naval						3	3
2		Veppa Maram						2	2
3		Puliyai Maram						5	5
Sub Total								10	10
1	48.5-49.0	Veppa Maram						1	1
2		Puliyai Maram						6	6
3		Thoongumoonji						3	3
Sub Total								10	10
1	48.6-48.8	Baniyar						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						5	5
4		Thoongumoonji						2	2
Sub Total								10	10
1	49.0-49.2	Baniyar						1	1
2		Veppa Maram						4	4
3		Panai Maram				1			1
4		Puliyai Maram						4	4
Sub Total						1		9	10
1	49.0-50.0	Baniyar						1	1
2		Veppa Maram						3	3
3		Puliyai Maram						5	5
4		Thoongumoonji						1	1
Sub Total								10	10
1	49.2-49.4	Veppa Maram						3	3
2		Puliyai Maram						5	5
3		Thoongumoonji						2	2
Sub Total								10	10
1	49.4-49.6	Veppa Maram						2	2
2		Puliyai Maram						5	5
3		Thoongumoonji						3	3
Sub Total								10	10
1	49.6-49.8	Baniyar						2	2
2		Panai Maram				1	1		2
3		Puliyai Maram	3					3	6
Sub Total			3			1	1	5	10
1	50.0-50.2	Veppa Maram						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	50.2-50.4	Baniyar						1	1
2		Puliyai Maram						6	6
Sub Total								7	7
1	50.4-50.6	Baniyar						2	2
2		Veppa Maram						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
3		Puliyai Maram						2	2
Sub Total								6	6
1	50.6-50.8	Veppa Maram						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								6	6
1	50.8-51.0	Arasan						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						4	4
Sub Total								6	6
1	51.2-51.4	Illupa						2	2
2		Veppa Maram						2	2
3		Puliyai Maram						4	4
Sub Total								8	8
1	51.4-51.6	Baniyar						2	2
2		Puliyai Maram						5	5
Sub Total								7	7
1	51.6-51.8	Baniyar						3	3
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								6	6
1	51.8-52.0	Veppa Maram						4	4
2		Puliyai Maram						2	2
Sub Total								6	6
1	52.0-52.2	Veppa Maram						1	1
2		Puliyai Maram						4	4
3		Thoongumoonji						2	2
Sub Total								7	7
1	52.2-52.4	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						3	3
Sub Total								7	7
1	52.4-52.6	Naval						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						4	4
Sub Total								7	7
1	52.6-52.8	Puliyai Maram						5	5
2		Thoongumoonji						1	1
Sub Total								6	6
1	52.8-53.0	Veppa Maram						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						2	2
Sub Total								7	7
1	53.0-53.2	Badam					2		2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total							2	4	6
1	53.2-53.4	Arasan						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	53.4-53.6	Illupa						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	53.6-53.8	Illupa						1	1
2		Puliyai Maram						5	5

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								6	6
1	53.8-54.0	Illupa						1	1
2	53.8-54.0	Veppa Maram						1	1
3		Puliyai Maram						4	4
Sub Total								6	6
1	54.0-54.2	Puliyai Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	54.2-54.4	Illupa						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						3	3
Sub Total								6	6
1	54.4-54.6	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								5	5
1	54.6-54.8	Puliyai Maram						5	5
2		Thoongumoonji						1	1
Sub Total								6	6
1	54.8-55.0	Illupa						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						2	2
Sub Total								6	6
1	55.0-55.2	Illupa						3	3
2		Puliyai Maram						2	2
3		Thoongumoonji						2	2
Sub Total								7	7
1	55.2-55.4	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								5	5
1	55.4-55.6	Illupa						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	55.6-55.8	Puliyai Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	55.8-56.0	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	56.0-56.2	Veppa Maram					1	3	4
2		Puliyai Maram						1	1
Sub Total							1	4	5
1	56.2-56.4	Arasan						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								6	6
1	56.4-56.6	Veppa Maram						3	3
2		Puliyai Maram						2	2
Sub Total								5	5
1	56.6-56.8	Puliyai Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	56.8-57.0	Pungai						1	1
2		Puliyai Maram						4	4

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								5	5
1	57.2-57.4	Puliyai Maram						4	4
2	57.2-57.4	Thoongumoonji						1	1
Sub Total								5	5
1	57.4-57.6	Illupa						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	57.6-57.8	No Tree (CN)	1						1
Sub Total			1						1
1	57.8-58.0	Veppa Maram						2	2
2		Puliyai Maram						4	4
Sub Total								6	6
1	58.0-58.2	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						2	2
Sub Total								6	6
1	58.2-58.4	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	58.4-58.6	Puliyai Maram						5	5
Sub Total								5	5
1	58.6-58.8	Veppa Maram						3	3
2		Puliyai Maram						2	2
Sub Total								5	5
1	59.0-59.2	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	59.2-59.4	Veppa Maram						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								6	6
1	59.4-59.6	Puliyai Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	59.6-59.8	Veppa Maram						3	3
2		Puliyai Maram						2	2
Sub Total								5	5
1	59.8-60.0	Arasan						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	60.0-60.2	Veppa Maram						4	4
2		Puliyai Maram						1	1
Sub Total								5	5
1	60.2-60.4	Veppa Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	60.4-60.6	Veppa Maram						1	1
2		Puliyai Maram						6	6
Sub Total								7	7
1	60.6-60.8	Eucalyptus						1	1
2		Veppa Maram						3	3
3		Thoongumoonji						2	2
Sub Total								6	6
1	60.8-61.0	Veppa Maram						2	2
2		Puliyai Maram						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								4	4
1	61.0-61.2	Arasan						1	1
2	61.0-61.2	Illupa						1	1
3		Puliyai Maram						3	3
Sub Total								5	5
1	61.2-61.4	Panai Maram	2						2
2		Puliyai Maram	2						2
Sub Total			4						4
1	61.4-61.6	Baniyar						1	1
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								4	4
1	61.6-61.8	Arasan						1	1
2		Puliyai Maram						3	3
Sub Total								4	4
1	61.8-62.0	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								5	5
1	62.0-62.2	Arasan						1	1
2		Eucalyptus						2	2
3		Naval						1	1
4		Veppa Maram						1	1
Sub Total								5	5
1	62.2-62.4	Veppa Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	62.4-62.6	Eucalyptus						1	1
2		Veppa Maram						3	3
3		Thoongumoonji						2	2
Sub Total								6	6
1	62.6-62.8	Panai Maram				1	1		2
2		Puliyai Maram						3	3
Sub Total						1	1	3	5
1	62.8-63.0	Baniyar						1	1
2		Illupa						1	1
3		Panju						1	1
4		Puliyai Maram						3	3
Sub Total								6	6
1	63.0-63.2	Illupa						2	2
2		Veppa Maram						1	1
3		Pungai						2	2
Sub Total								5	5
1	63.2-63.4	Puliyai Maram						3	3
2		Thoongumoonji						2	2
3		Vaagai						1	1
Sub Total								6	6
1	63.4-63.6	Baniyar						1	1
2		Veppa Maram						2	2
3		Panai Maram						1	1
4		Puliyai Maram						2	2
Sub Total								6	6
1	63.6-63.8	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								5	5
1	63.8-64.0	Eucalyptus						1	1
2	63.8-64.0	Illupa						2	2
3		Veppa Maram						2	2
4		Thoongumoonji						1	1
Sub Total								6	6
1	64.0-64.2	Veppa Maram						2	2
2		Thoongumoonji						2	2
Sub Total								4	4
1	64.2-64.4	Illupa						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						6	6
4		Thoongumoonji						1	1
5		Vaagai						1	1
Sub Total								10	10
1	64.6-64.8	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								5	5
1	64.8-65.0	Veppa Maram						2	2
2		Puliyai Maram						1	1
3		Thoongumoonji						2	2
Sub Total								5	5
1	65.0-65.2	Veppa Maram						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								6	6
1	65.2-65.4	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Vaagai						1	1
Sub Total								5	5
1	65.4-65.6	Illupa						2	2
2		Veppa Maram						2	2
3		Vaagai						2	2
Sub Total								6	6
1	65.6-65.8	Veppa Maram						2	2
2		Thoongumoonji						1	1
Sub Total								3	3
1	65.8-66.0	Velivelaan (Pol) (CN)	1						1
Sub Total			1						1
Grand Total			**25**	**7**		**5**	**14**	**764**	**815**

Girth Wise List of Trees within 15m on Either Side from Existing Centerline on Madapattu- Thirukovilur Road (SH-9)

Right Hand Side

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
1	41.7-41.8	Arasan						1	1
2		Puliyai Maram						2	2
3		Velivelaan (CN)	1						1
Sub Total			1					3	4
1	41.8-42.0	Veppa Maram						1	1
2		Pungai						1	1
3		Puliyai Maram						1	1
Sub Total								3	3
1	42.0-42.2	Pungai						2	2
2		Puliyai Maram						2	2
3		Vaagai						1	1
Sub Total								5	5
1	42.2-42.4	Veppa Maram						1	1
2		Sewakku (Numorus) (Fenced) (P.L)	2						2
3		Puliyai Maram						1	1
4		Thoongumoonji						1	1
Sub Total			2					3	5
1	42.4-42.6	Panai Maram (CN)	1						1
2		Sugarcane Field	1						1
3		Puliyai Maram						1	1
4		Velivelaan (CN)	1						1
Sub Total			3					1	4
1	42.6-42.8	Paddy Field (Fenced) (P.L)	1						1
2		Puliyai Maram						2	2
3		Vaagai						1	1
4		Velivelaan (CN)	1						1
Sub Total			2					3	5
1	42.8-43.0	Arasan						1	1
2		Thennai (Numorus) (Fenced) (P.L)	1						1
3		Veppa Maram						1	1
4		Puliyai Maram						2	2
5		Thekku (Numorus) (Fenced) (P.L)	1						1
6		Velivelaan (CN)	1						1
Sub Total			3					4	7
1	43.0-43.2	Baniyar						1	1
2		Illupa						1	1
3		Puliyai Maram						3	3

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
4	43.0-43.2	Thoongumoonji						2	2
Sub Total								7	7
1	43.2-43.4	Arasan						1	1
2		Moongil (CN)	1						1
3		Illupa						1	1
4		Veppa Maram						1	1
5		Puliyai Maram						2	2
6		Velivelaan (CN)	1						1
Sub Total			2					5	7
1	43.4-43.6	Arasan						1	1
2		Badam (Pol) <30		1					1
3		Moongil (CN)	1						1
4		Maa (Pol) <30		1					1
5		Pungai (Pol) <30		1					1
6		Puliyai Maram						1	1
Sub Total			1	3				2	6
1	43.6-43.8	Thennai (Fenced) (P.L)	1						1
2		Cotton Field (Fenced) (P.L)	1						1
3		Sewakku (Numorus) (800+)	1						1
4		Puliyai Maram						2	2
5		Thekku (Fenced) (P.L)	1						1
6		Thoongumoonji						1	1
Sub Total			4					3	7
1	43.8-44.0	Sugarcane Field (Fenced) (P.L)	1						1
2		Puliyai Maram						2	2
3		Thoongumoonji						2	2
4		Vaagai						1	1
Sub Total			1					5	6
1	44.0-44.2	Arasan						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						3	3
4		Thoongumoonji						1	1
Sub Total								6	6
1	44.2-44.4	Baniyar						1	1
2		Puliyai Maram						7	7
3		Velivelaan (CN)	1						1
Sub Total			1					8	9
1	44.4-44.6	Arasan						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	44.6-44.8	Thennai					1		1

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
2	44.6-44.8	Veppa Maram						1	1
3		Puliyai Maram						3	3
4		Velivelaan (CN)	1						1
Sub Total			1				1	4	6
1	44.8-45.0	Arasan						1	1
2		Illupa						1	1
3		Panai Maram (CN)	1						1
4		Puliyai Maram						5	5
5		Thoongumoonji						1	1
Sub Total			1					8	9
1	45.2-45.4	Baniyar						2	2
2		Illupa						2	2
3		Veppa Maram						1	1
4		Puliyai Maram					1	6	7
5		Thoongumoonji						2	2
Sub Total							1	13	14
1	45.4-45.6	Baniyar						1	1
2		Illupa						2	2
3		Veppa Maram						2	2
4		Puliyai Maram						5	5
5		Thoongumoonji						2	2
Sub Total								12	12
1	45.6-45.8	Veppa Maram						2	2
2		Puliyai Maram						7	7
3		Thoongumoonji						2	2
Sub Total								11	11
1	45.8-46.0	Pungai						1	1
2		Puliyai Maram						8	8
Sub Total								9	9
1	46.0-46.2	Arasan						1	1
2		Veppa Maram						1	1
3		Panai Maram				1			1
4		Puliyai Maram						6	6
Sub Total						1		8	9
1	46.2-46.4	Baniyar						1	1
2		Pungai						1	1
3		Puliyai Maram						7	7
4		Thoongumoonji						3	3
Sub Total								12	12
1	46.8-47.0	Veppa Maram						3	3
2		Puliyai Maram						6	6
3		Thoongumoonji						1	1
Sub Total								10	10

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
1	47.2-47.4	Baniyar						1	1
2		Veppa Maram						4	4
3		Puliyai Maram						7	7
Sub Total								12	12
1	47.4-47.6	Veppa Maram						3	3
2		Panai Maram					1		1
3		Puliyai Maram						6	6
4		Thoongumoonji						1	1
Sub Total							1	10	11
1	47.6-47.8	Badam				1	1		2
2		Illupa						1	1
3		Veppa Maram						3	3
4		Puliyai Maram						2	2
5		Thoongumoonji						3	3
Sub Total						1	1	9	11
1	47.8-48.0	Baniyar						2	2
2		Veppa Maram						3	3
3		Puliyai Maram						3	3
4		Thoongumoonji						1	1
Sub Total								9	9
1	48.0-48.2	Baniyar						1	1
2		Illupa						1	1
3		Veppa Maram						4	4
4		Puliyai Maram						7	7
5		Thoongumoonji						2	2
Sub Total								15	15
1	48.2-48.4	Baniyar						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						7	7
4		Thoongumoonji						1	1
Sub Total								10	10
1	48.4-48.6	Arasan						2	2
2		Veppa Maram						3	3
3		Puliyai Maram						5	5
Sub Total								10	10
1	48.5-49.0	Baniyar						3	3
2		Panai Maram				1			1
3		Puliyai Maram						6	6
Sub Total						1		9	10
1	48.6-48.8	Baniyar						2	2
2		Naval						1	1
3		Puliyai Maram						7	7
Sub Total								10	10

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
1	49.0-49.2	Veppa Maram						3	3
2		Puliyai Maram						7	7
Sub Total								10	10
1	49.0-50.0	Veppa Maram						3	3
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								6	6
1	49.2-49.4	Naval						2	2
2		Veppa Maram						2	2
3		Puliyai Maram						5	5
		Thoongumoonji						1	1
Sub Total								10	10
1	49.4-49.6	Veppa Maram						3	3
2		Puliyai Maram						4	4
3		Thoongumoonji						3	3
Sub Total								10	10
1	49.6-49.8	Naval						2	2
2		Puliyai Maram						8	8
Sub Total								10	10
1	50.0-50.2	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								5	5
1	50.2-50.4	Arasan						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						3	3
Sub Total								6	6
1	50.4-50.6	Puliyai Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	50.6-50.8	Veppa Maram						2	2
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
4		Velivelaan (CN)	1						1
Sub Total			1					6	7
1	50.8-51.0	Veppa Maram						1	1
2		Puliyai Maram						4	4
3		Thoongumoonji						1	1
Sub Total								6	6
1	51.2-51.4	Veppa Maram						2	2
2		Puliyai Maram						3	3
Sub Total								5	5
1	51.4-51.6	Arasan						1	1

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
2	51.4-51.6	Puliyai Maram						5	5
Sub Total								6	6
1	51.6-51.8	Veppa Maram						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	51.8-52.0	Veppa Maram						4	4
2		Puliyai Maram						2	2
Sub Total								6	6
1	52.0-52.2	Veppa Maram						4	4
2		Puliyai Maram						2	2
Sub Total								6	6
1	52.2-52.4	Naval						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						4	4
Sub Total								6	6
1	52.4-52.6	Veppa Maram						3	3
2		Puliyai Maram						3	3
Sub Total								6	6
1	52.6-52.8	Naval						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						3	3
4		Thoongumoonji						1	1
Sub Total								6	6
1	52.8-53.0	Veppa Maram						2	2
2		Puliyai Maram						3	3
Sub Total								5	5
1	53.0-53.2	Puliyai Maram						5	5
Sub Total								5	5
1	53.2-53.4	Arasan						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						2	2
Sub Total								6	6
1	53.4-53.6	Illupa						2	2
2		Puliyai Maram						4	4
Sub Total								6	6
1	53.6-53.8	Illupa						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						2	2
Sub Total								5	5
1	53.8-54.0	Veppa Maram						2	2
2		Puliyai Maram						3	3
Sub Total								5	5
1	54.0-54.2	Puliyai Maram						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
2	54.0-54.2	Thoongumoonji						2	2
Sub Total								4	4
1	54.2-54.4	Puliyai Maram						2	2
2		Thoongumoonji						3	3
Sub Total								5	5
1	54.4-54.6	Puliyai Maram						4	4
2		Thoongumoonji						3	3
Sub Total								7	7
1	54.6-54.8	Puliyai Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	54.8-55.0	Illupa						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						1	1
Sub Total								5	5
1	55.0-55.2	Veppa Maram						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	55.2-55.4	Veppa Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	55.4-55.6	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								5	5
1	55.6-55.8	Veppa Maram						3	3
2		Puliyai Maram						3	3
Sub Total								6	6
1	55.8-56.0	Puliyai Maram						4	4
2		Thoongumoonji						2	2
Sub Total								6	6
1	56.0-56.2	Puliyai Maram						5	5
2		Thoongumoonji						1	1
Sub Total								6	6
1	56.2-56.4	Puliyai Maram						7	7
Sub Total								7	7
1	56.4-56.6	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	56.8-57.0	Baniyar						2	2
2		Pungai						1	1
3		Puliyai Maram						1	1
4		Thoongumoonji						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								6	6
1	57.0-57.2	Veppa Maram						2	2
2		Thoongumoonji						4	4
Sub Total								6	6
1	57.2-57.4	Veppa Maram						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	57.4-57.6	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	57.6-57.8	No Tree (CN)	1						1
Sub Total			1						1
1	57.8-58.0	Illupa						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						3	3
Sub Total								5	5
1	58.0-58.2	Veppa Maram						3	3
2		Puliyai Maram						1	1
3		Thoongumoonji						1	1
Sub Total								5	5
1	58.2-58.4	Baniyar						1	1
2		Puliyai Maram						5	5
Sub Total								6	6
1	58.4-58.6	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Thoongumoonji						2	2
Sub Total								6	6
1	58.6-58.8	Baniyar						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	58.8-59.0	Puliyai Maram						5	5
2		Thoongumoonji						1	1
Sub Total								6	6
1	59.0-59.2	Baniyar						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						2	2
Sub Total								5	5
1	59.2-59.4	Veppa Maram						2	2
2		Panai Maram				1	2		3
3		Thoongumoonji						1	1
Sub Total						1	2	3	6
1	59.4-59.6	Puliyai Maram						4	4
2		Thoongumoonji						2	2

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								6	6
1	59.6-59.8	Arasan						1	1
2		Puliyai Maram						4	4
Sub Total								5	5
1	59.8-60.0	Puliyai Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	60.0-60.2	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	60.2-60.4	Arasan						2	2
2		Thoongumoonji						3	3
Sub Total								5	5
1	60.4-60.6	Puliyai Maram						6	6
Sub Total								6	6
1	60.6-60.8	Arasan						1	1
2		Veppa Maram						2	2
3		Puliyai Maram						3	3
Sub Total								6	6
1	60.8-61.0	Veppa Maram						1	1
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								4	4
1	61.0-61.2	Illupa						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						1	1
Sub Total								3	3
1	61.2-61.4	Arasan						1	1
2		Baniyar						1	1
3		Veppa Maram						2	2
4		Puliyai Maram						1	1
Sub Total								5	5
1	61.4-61.6	Veppa Maram						2	2
2		Puliyai Maram						2	2
3		Thoongumoonji						1	1
Sub Total								5	5
1	61.6-61.8	Biscuit						1	1
2		Illupa						1	1
3		Vaagai						2	2
Sub Total								4	4
1	62.0-62.2	Naval						1	1
2		Puliyai Maram						3	3
Sub Total								4	4

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
1	62.2-62.4	Baniyar						1	1
2		Puliyai Maram						3	3
Sub Total								4	4
1	62.4-62.6	Veppa Maram						1	1
2		Puliyai Maram						3	3
3		Vaagai						1	1
Sub Total								5	5
1	62.6-62.8	Badam						1	1
2		Illupa						2	2
3		Puliyai Maram						1	1
Sub Total								4	4
1	62.8-63.0	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	63.0-63.2	Arasan						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						2	2
4		Thoongumoonji						2	2
Sub Total								6	6
1	63.2-63.4	Thaila Maram						2	2
2		Veppa Maram						2	2
3		Thoongumoonji						1	1
Sub Total								5	5
1	63.4-63.6	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	63.6-63.8	Arasan						1	1
2		Maa						1	1
3		Pungai						1	1
4		Puliyai Maram						2	2
Sub Total								5	5
1	63.8-64.0	Puliyai Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	64.0-64.2	Veppa Maram						1	1
2		Pungai						2	2
3		Thoongumoonji						2	2
Sub Total								5	5
1	64.2-64.4	Illupa						2	2
2		Veppa Maram						3	3
3		Pungai						1	1
4		Puliyai Maram						4	4
5		Vaagai						1	1

S. No	Chainage (km)	Tree Name	Fenced/ Private land	Tree Girth (in cm)					
				<30	30-60	60-90	90-120	> 120	Total
Sub Total								11	11
1	64.6-64.8	Puliyai Maram						4	4
2		Thoongumoonji						1	1
Sub Total								5	5
1	64.8-65.0	Veppa Maram						1	1
2		Panai Maram						1	1
3		Puliyai Maram						2	2
4		Thoongumoonji						1	1
Sub Total								5	5
1	65.0-65.2	Illupa						1	1
2		Veppa Maram						1	1
3		Puliyai Maram						2	2
4		Thoongumoonji						1	1
Sub Total								5	5
1	65.2-65.4	Puliyai Maram						3	3
2		Thoongumoonji						2	2
Sub Total								5	5
1	65.4-65.6	Panai Maram						2	2
2		Puliyai Maram						3	3
Sub Total								5	5
1	65.6-65.8	Puliyai Maram						5	5
Sub Total								5	5
1	65.8-66.0	Velivelaan (Pol) (CN)		1					1
Sub Total				1					1
Grand Total			**24**	**4**		**4**	**6**	**688**	**726**

Girth Wise List of Trees within 15m on Either Side from Existing Centerline on Vridhachalam-Bhuvanagiri Road (SH-70)

Left Hand Side

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
1	0.0-0.2	Veppa Maram		1	3		1	5
2		Pungai	5					5
3		Puliyai Maram					1	1
Sub Total			5	1	3		2	11
1	0.4-0.6	Veppa Maram			1			1
2		Pungai		2				2
3		Puliyai Maram					3	3
Sub Total				2	1		3	6
1	0.6-0.8	Arasan					1	1
2		Veppa Maram			1			1
3		Puliyai Maram					8	8
Sub Total					1		9	10
1	0.8-1.0	Aalar					1	1
2		Arasan					1	1
3		Veppa Maram	4			1	2	7
4		Puliyai Maram					1	1
5		Thoongumoonji	3					3
Sub Total			7			1	5	13
1	1.0-1.2	Elumichal	1					1
2		Veppa Maram	1			1	1	3
3		Pungai	1					1
4		Puliyai Maram					3	3
5		Vaagayavattai	1					1
Sub Total			4			1	4	9
1	1.2-1.4	Arasan					1	1
2		Badhai	1					1
3		Thennai					4	4
4		Elumichal	1					1
5		Maa			1	1		2
6		Manjal	1					1
7		Veppa Maram	1				1	2
8		Pungai	1					1
9		Puliyai Maram					2	2
10		Thekku	1					1
Sub Total			6		1	1	8	16
1	1.4-1.6	Veppa Maram	8					8
2		Panai Maram				2		2
3		Puliyai Maram					4	4
4		Velivelaan	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
Sub Total			9			2	4	15
1	1.6-1.8	Thennai	1					1
2		Maa	1					1
3		Manjal	1					1
4		Veppa Maram	3					3
5		Veppa Maram (CN)			1	2		3
6		Panai Maram	2			2		4
7		Puliyai Maram					3	3
8		Thekku	1					1
Sub Total			9		1	4	3	17
1	1.8-2.0	Aalar					1	1
2		Thennai (CN)				1		1
3		Vellai Kathambu					1	1
4		Pungai					1	1
5		Pungai (CN)			1	1		2
6		Puliyai Maram					2	2
7		Thoongumoonji					2	2
8		Vaagai (CN)			1			1
Sub Total					2	2	7	11
1	2.0-2.2	Aalar					1	1
2		Thennai			1	2		3
Sub Total					1	2	1	4
1	2.2-2.4	Thennai			1			1
2		Pungai	3					3
3		Puliyai Maram					4	4
Sub Total			3		1		4	8
1	2.4-2.6	Thennai (Fenced)			2			2
2		Maa (Fenced)				2		2
3		Puliyai Maram					2	2
4		Velivelaan	1					1
Sub Total			1		2	2	2	7
1	2.6-2.8	Ichala (CN)				2		2
2		Veppa Maram	3		1			4
3		Panai Maram				1		1
4		Puliyai Maram					2	2
5		Velivelaan	1					1
Sub Total			4		1	3	2	10
1	2.8-3.0	Ichala (CN)				2		2
2		Ichala (PL) (CN)			3			3
3		Manromunnai	4					4
4		Puliyai Maram					4	4
Sub Total			4		3	2	4	13
1	3.0-3.2	Aalar				1		1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
2		Athi (CN)				1		1
3	3.0-3.2	Ichala			1			1
4		Panai Maram			1			1
5		Panai Maram (CN)			1	3		4
6		Panai Maram (CN) (PL)			6			6
Sub Total					9	5		14
1	3.2-3.4	Maa				1	1	2
2		Mungai				1		1
3		Veppa Maram					1	1
4		Puliyai Maram					5	5
Sub Total						2	7	9
1	3.4-3.6	Arasan	1					1
2		Athi (CN)				1		1
3		Kattankku	1					1
4		Maa		1				1
5		Mungai	1					1
6		Veppa Maram	1		1			2
7		Panai Maram	1					1
8		Panai Maram (CN)				1		1
9		Pungai	2					2
10		Puliyai Maram			1		3	4
11		Velivelaan	1					1
Sub Total			8	1	2	2	3	16
1	3.6-3.8	Puliyai Maram					1	1
2		Velivelaan	15					15
Sub Total			15				1	16
1	3.8-4.0	Thennai (p cot pl)		1				1
2		Mungai	1					1
3		Veppa Maram (P Cot)		1				1
4		Puliyai Maram					1	1
5		Thekku	10					10
6		Thoongumoonji					1	1
7		Velivelaan	1					1
Sub Total			12	2			2	16
1	4.0-4.2	Panai Maram		3	2	1		6
2		Puliyai Maram					1	1
3		Thoongumoonji			1		1	2
Sub Total				3	3	1	2	9
1	4.2-4.4	Thennai (P Cot)			7			7
2		Ichala			1			1
3		Puliyai Maram					2	2
4		Thoongumoonji	1		1			2
			1		9		2	12

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
1	4.4-4.6	Thennai	3					3
2	4.4-4.6	Thennai (PL)			3			3
3		Panai Maram	2			1	1	4
4		Velivelaan					1	1
Sub Total			5		3	1	2	11
1	4.6-4.8	Vaazhai (PL)		6				6
2		Karuvelaan		1				1
3		Veppa Maram		1	1			2
4		Panai Maram				1		1
Sub Total				8	1	1		10
6	4.8-5.0	Thennai				7		7
7		Thennai (PL)				1		1
8		Maa			1			1
9		Mungai	5					5
10		Veppa Maram			1		1	2
11		Thekku		1	1			2
Sub Total			5	1	3	8	1	18
1	5.0-5.2	Thennai (PL)			3			3
2		Manjal	3					3
3		Mungai	1					1
4		Veppa Maram		1	1			2
5		Puliyai Maram					4	4
6		Vaagai					1	1
Sub Total			4	1	4		5	14
1	5.2-5.4	Bougainvilla	1					1
2		Koyyaa	1					1
3		Kolunji	2					2
4		Maa					1	1
5		Maa (P Cot)					2	2
6		Manjal	2					2
7		Mungai	1					1
8		Veppa Maram	7		1	1		9
9		Puliyai Maram					2	2
Sub Total			14		1	1	5	21
1	5.4-5.6	Badam			1			1
2		Thennai (P Cot)		1				1
3		Maa	1					1
4		Mungai	1					1
5		Veppa Maram	5		1			6
6		Panai Maram				1		1
7		Puliyai Maram					5	5
Sub Total			7	1	2	1	5	16
1	5.6-5.8	Ichala	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
2		Vellai Kathambu	1					1
3	5.6-5.8	Maa	5					5
4		Veppa Maram	13					13
5		Panai Maram	25					25
6		Puliyai Maram					1	1
7		Velivelaan	1					1
Sub Total			46				1	47
1	5.8-6.0	Arasan					1	1
2		Maa					1	1
3		Veppa Maram	1					1
4		Panai Maram			2	4		6
5		Pungai	1					1
Sub Total			2		2	4	2	10
1	6.0-6.2	Panai Maram			1			1
2		Puliyai Maram			1	1	2	4
Sub Total					2	1	2	5
1	6.2-6.4	Thennai			3			3
2		Thennai (P Cot)			6			6
3		Mungai	1					1
4		Mungai (P Cot)			1			1
5		Veppa Maram	1	1	3	1	1	7
6		Pappaali	1					1
7		Pungai	1	1				2
8		Pungai (P Cot)				1		1
9		Puliyai Maram					3	3
10		Vaagai					1	1
11		Velivelaan	12					12
Sub Total			16	2	13	2	5	38
1	6.4-6.6	Thennai	1			2		3
2		Thennai (p cot pl)			13	1		14
3		Thennai (PL)			3	2		5
4		Veppa Maram	6	1				7
5		Pungai	3		1			4
Sub Total			10	1	17	5		33
1	6.6-6.8	Thennai (PL)				2		2
2		Vellai Kathambu (CN)				1		1
3		Veppa Maram (CN)				2		2
4		Veppa Maram(CN)			1			1
5		Puliyai Maram				1	1	2
Sub Total					1	6	1	8
1	6.8-7.0	Vellai Kathambu			1			1
2		Veppa Maram	1					1
3		Puliyai Maram			1			1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
		Sub Total	1		2			3
5	7.0-7.2	Puliyai Maram					1	1
6		Thoongumoonji					1	1
		Sub Total					2	2
1	7.2-7.4	Thennai (PL)			8	3		11
2		Veppa Maram (PL)			3	2		5
3		Panai Maram (PL)			1			1
4		Puliyai Maram					5	5
		Sub Total			12	5	5	22
1	7.4-7.6	Kattankku	1					1
2		Veppa Maram	1					1
3		Puliyai Maram					2	2
4		Velivelaan	5					5
		Sub Total	7				2	9
1	7.6-7.8	Puliyai Maram				1	1	2
		Sub Total				1	1	2
1	7.8-8.0	Anali	1					1
2		Arasan (CN)					1	1
3		Mungai (CN)			3			3
4		Veppa Maram	1					1
5		Veppa Maram (CN)			1			1
6		Pappaali	1					1
7		Puliyai Maram				1		1
8		Thekku (CN)			1			1
9		Velivelaan	1					1
10		Velivelaan (many)	1					1
		Sub Total	5		5	1	1	12
1	8.0-8.2	Anali	1					1
2		Moongil	1					1
3		Manjal	1					1
4		Veppa Maram	2			2		4
5		Pungai	1					1
6		Vaagai			1			1
7		Velivelaan	3					3
		Sub Total	9		1	2		12
1	8.2-8.4	Badhai				1		1
2		Thennai (Fenced)			7	1		8
3		Koyyaa	1					1
4		Manjal	1					1
5		Mungai	1					1
6		Veppa Maram (Fenced)			1			1
7		Puliyai Maram (Fenced)					1	1
8		Vaagai	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
9		Velivelaan	2					2
		Sub Total	6		8	2	1	17
1	8.4-8.6	Vaazhai	1					1
2		Thennai (P Cot)			7			7
3		Mungai	1					1
4		Pappaali	1					1
5		Velivelaan (CN)				1		1
		Sub Total	3		7	1		11
1	8.6-8.8	Anali	1					1
2		Vaazhai	1					1
3		Vellai Kathambu (CN)			2			2
4		Veppa Maram		1	1	1		3
5		Veppa Maram (CN)		1				1
6		Pungai (CN)		1				1
7		Puliyai Maram				1	4	5
8		Puliyai Maram (CN)			1			1
		Sub Total	2	3	4	2	4	15
1	8.8-9.0	Moongil	1					1
2		Thennai (PL)			1	1		2
3		Ichala (CN)					1	1
4		Ilavam					2	2
5		Mungai	1					1
6		Veppa Maram	1					1
7		Pappaali	1					1
8		Puliyai Maram	5	1			1	7
9		Thekku	1					1
10		Thoongumoonji	1					1
11		Velivelaan (many)	1					1
		Sub Total	12	1	1	1	4	19
1	9.0-9.2	Thennai (P Cot)				1		1
2		Koyyaa (P Cot)			1			1
3		Jasmine (P Cot)		1				1
4		Maa (P Cot)					1	1
5		Panai Maram (CN)		2				2
6		Puliyai Maram					1	1
7		Puliyai Maram (PL)			1			1
8		Vaagai (PL)			1			1
9		Velivelaan	1					1
10		Velivelaan (Many)	1					1
		Sub Total	2	3	3	1	2	11
1	9.2-9.4	Alamanam					1	1
2		Vaazhai	1					1
3		Mungai	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
4		Veppa Maram	1					1
5		Panai Maram (CN)		1				1
6		Puliyai Maram					1	1
7		Vaagai	1					1
8		Velivelaan	1					1
Sub Total			5	1			2	8
1	9.4-9.6	Alamanam					1	1
2		Arasan (CN)					1	1
3		Thennai			1			1
4		Thennai (PL)			2	1		3
5		Veppa Maram		1				1
6		Puliyai Maram				1	2	3
7		Thoongumoonji (PL)					1	1
Sub Total				1	3	2	5	11
1	9.6-9.8	Vaazhai	1					1
2		Thennai	1					1
3		Puliyai Maram					6	6
4		Vaagai	1					1
Sub Total			3				6	9
1	9.8-10.0	Thennai (PL)			3			3
2		Puliyai Maram					6	6
Sub Total					3		6	9
1	10.0-10.2	Thennai	3					3
2		Mungai	3					3
3		Veppa Maram	3					3
4		Puliyai Maram				2	4	6
Sub Total			9			2	4	15
1	10.2-10.4	Thennai	5					5
2		Ilavampanju		1	1	1		3
3		Veppa Maram	4					4
4		Pungai	5					5
5		Puliyai Maram					5	5
6		Thekku	1					1
Sub Total			15	1	1	1	5	23
1	10.4-10.6	Moongil	1					1
2		Maa	1					1
3		Mungai	4					4
4		Veppa Maram	4	1				5
5		Puliyai Maram					3	3
6		Thekku	2					2
7		Velivelaan	1					1
Sub Total			13	1			3	17
1	10.6-10.8	Thennai (CN)			1			1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
2		Thaila Maram (CN)			1			1
3	10.6-10.8	Mungai	2					2
4		Nadhiyavattai	1					1
5		Veppa Maram	9					9
6		Pungai	4					4
7		Puliyai Maram					2	2
8		Thekku	1					1
9		Velivelaan	2					2
Sub Total			19		2		2	23
1	10.8-11.0	Vaazhai	9					9
2		Veppa Maram	1					1
3		Puliyai Maram					4	4
4		Velivelaan	1					1
Sub Total			11				4	15
1	11.0-11.2	Anali	1					1
2		Arasan (CN)(PL)					1	1
3		Bougainvilla	1					1
4		Thennai	1					1
5		Thennai (Fenced)			2	2		4
6		Koyyaa	2					2
7		Ichala			1			1
8		Elumichal	2					2
9		Veppa Maram	2					2
10		Pappaali	1					1
11		Sempathai	1					1
12		Puliyai Maram					4	4
13		Velivelaan	1					1
Sub Total			12		3	2	5	22
1	11.2-11.4	Vaazhai	2					2
2		Thennai	5					5
3		Thaila Maram	15					15
4		Koyyaa	3					3
5		Elumichal	1					1
6		Maa	2					2
7		Mungai	4					4
8		Veppa Maram	3					3
9		Puliyai Maram					5	5
10		Velivelaan	1					1
Sub Total			36				5	41
1	11.4-11.6	Vaazhai	1					1
2		Veppa Maram	10					10
3		Poorsa	8					8
4		Thekku	10					10

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
5		Thoongumoonji	2					2
6	11.4-11.6	Velivelaan	1					1
Sub Total			32					32
1	11.6-11.8	Arasan					2	2
2		Vaazhai	1					1
3		Veppa Maram	1					1
4		Puliyai Maram					2	2
Sub Total			2				4	6
1	11.8-12.0	Maa	1					1
2		Veppa Maram	1					1
3		Pungai	1					1
4		Puliyai Maram					1	1
5		Velivelaan (Many)	1					1
Sub Total			4				1	5
1	12.0-12.2	Aalar (Fenced)			1			1
2		Ashok (Fenced)			1	1		2
3		Thennai (Fenced)			10	5		15
4		Mungai	1					1
5		Veppa Maram	3					3
6		Veppa Maram (Fenced)			6			6
7		Pungai	4					4
8		Pungai (Fenced)			3			3
9		Thoongumoonji (Fenced)					1	1
Sub Total			8		21	6	1	36
1	12.2-12.4	Arasan					1	1
2		Veppa Maram					1	1
3		Puliyai Maram					3	3
4		Thipai		1		1		2
5		Vaagai				1		1
Sub Total				1		2	5	8
1	12.4-12.6	Arasan					1	1
2		Vaazhai	1					1
3		Vaazhai (PL)		5				5
4		Thennai	5					5
5		Thennai (CN)			1	1		2
6		Thennai (PL)			2	1		3
7		Maa	1					1
8		Mungai	1					1
9		Mungai (PL)			1			1
10		Veppa Maram	1			1		2
11		Veppa Maram (CN)			1			1
12		Veppa Maram (PL)			1			1
13		Thipai					1	1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
Sub Total			9	5	6	3	2	25
1	12.6-12.8	Thennai (Fenced)			1			1
2		Thennai (PL)			5	1		6
3		Elumichal (PL)			1			1
4		Maa	2					2
5		Maa (PL)				1		1
6		Mungai	5					5
7		Mungai (Fenced)			2			2
8		Veppa Maram	7					7
9		Veppa Maram (PL)			2	1		3
10		Thekku (PL)			5			5
Sub Total			14		16	3		33
1	12.8-13.0	Maa	1					1
2		Mungai	1					1
3		Veppa Maram	5					5
4		Puliyai Maram	1				1	2
5		Thekku	2					2
6		Velivelaan	1					1
Sub Total			11				1	12
1	13.0-13.2	Thennai (Fenced)			1	4		5
2		Mungai	4					4
3		Puliyai Maram					4	4
4		Vaagai	3					3
Sub Total			7		1	4	4	16
1	13.2-13.4	Arasan	3					3
2		Badhai	1					1
3		Thennai (Fenced)			1			1
4		Mungai	2					2
5		Veppa Maram	5					5
6		Veppa Maram (Fenced)			1			1
7		Puliyai Maram	2				4	6
8		Thekku (Fenced)			1			1
Sub Total			13		3		4	20
1	13.4-13.6	Koyyaa	2					2
2		Veppa Maram	10					10
3		Pappaali	4					4
4		Puliyai Maram					7	7
Sub Total			16				7	23
1	13.6-13.8	Moongil	1					1
2		Mungai	2					2
3		Veppa Maram	2					2
4		Puliyai Maram					8	8
5		Velivelaan	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
Sub Total			6				8	14
1	13.8-14.0	Puliyai Maram					5	5
2		Velivelaan	1					1
Sub Total			1				5	6
1	14.0-14.2	Thaila Maram	1					1
2		Veppa Maram	1					1
3		Puliyai Maram					7	7
4		Velivelaan	1					1
Sub Total			3				7	10
1	14.2-14.4	Puliyai Maram					7	7
Sub Total							7	7
1	14.4-14.6	Puliyai Maram					2	2
2		Velivelaan	1					1
Sub Total			1				2	3
4	14.6-14.8	Veppa Maram	1					1
5		Panai Maram	2					2
6		Puliyai Maram					4	4
7		Velivelaan	1					1
Sub Total			4				4	8
1	14.8-15.0	Veppa Maram	1					1
2		Puliyai Maram					2	2
3		Velivelaan	1					1
Sub Total			2				2	4
1	15.0-15.2	Thennai (CN)			4	8		12
2		Maa	1					1
3		Veppa Maram	1					1
4		Pungai	1					1
5		Puliyai Maram					1	1
Sub Total			3		4	8	1	16
1	15.2-15.4	Mungai	1					1
2		Veppa Maram	1					1
3		Puliyai Maram					6	6
Sub Total			2				6	8
1	15.4-15.6	Puliyai Maram					8	8
2		Velivelaan	1					1
Sub Total			1				8	9
1	15.6-15.8	Puliyai Maram					1	1
2		Velivelaan	1					1
Sub Total			1				1	2
1	15.8-16.0	Badhai	1					1
2		Manjal	1					1
3		Mungai	1					1
4		Veppa Maram	5					5

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
5		Puliyai Maram				2	4	6
6	15.8-16.0	Velivelaan	1					1
Sub Total			9			2	4	15
1	16.0-16.2	Kattankku	1					1
2		Veppa Maram	1					1
3		Puliyai Maram					4	4
4		Velivelaan	1					1
Sub Total			3				4	7
1	16.2-16.4	Kattankku	1					1
2		Veppa Maram	1					1
3		Veppa Maram (CN)				1		1
4		Pungai	1					1
5		Sempathai	1					1
6		Puliyai Maram					4	4
Sub Total			4			1	4	9
1	16.4-16.6	Arasan	1					1
2		Vaazhai	1					1
3		Thennai (CN)			3			3
4		Koyyaa	1					1
5		Ichala	1					1
6		Ichalamaram					3	3
7		Mungai	1					1
8		Veppa Maram		1		1		2
9		Pappaali	2					2
10		Puliyai Maram	1				4	5
Sub Total			8	1	3	1	7	20
1	16.6-16.8	Arasan	2					2
2		Moongil	1					1
3		Vaazhai	2					2
4		Thennai	3					3
5		Koyyaa	1					1
6		Kattankku	1					1
7		Maa	1					1
8		Veppa Maram	3					3
9		Pappaali	3					3
10		Pungai	1					1
11		Puliyai Maram	1				3	4
12		Thekku	1					1
Sub Total			20				3	23
1	16.8-17.0	Thennai	3					3
2		Puliyai Maram					2	2
3		Velivelaan	1					1
Sub Total			4				2	6

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
1	17.0-17.2	Puliyai Maram					1	1
2	17.0-17.2	Velivelaan	1					1
		Sub Total	1				1	2
1	17.2-17.4	Puliyai Maram					5	5
		Sub Total					5	5
1	17.4-17.6	Puliyai Maram					7	7
		Sub Total					7	7
1	17.6-17.8	Puliyai Maram					7	7
		Sub Total					7	7
1	17.8-18.0	Puliyai Maram					4	4
2		Velivelaan	2					2
		Sub Total	2				4	6
1	18.0-18.2	Puliyai Maram					5	5
		Sub Total					5	5
1	18.2-18.4	Moongil	1					1
2		Veppa Maram		1	1			2
3		Panai Maram			1			1
4		Puliyai Maram					6	6
5		Puliyai Maram (pl p cot)			1			1
6		Vaagai			1			1
7		Velivelaan	1					1
		Sub Total	2	1	4		6	13
1	18.4-18.6	Puliyai Maram					1	1
2		Velivelaan	1					1
		Sub Total	1				1	2
1	18.6-18.8	Vaazhai	1					1
2		Veppa Maram	1					1
3		Veppa Maram (CN)			1			1
4		Thoongumoonji (PL)				1		1
5		Velivelaan	1					1
		Sub Total	3		1	1		5
1	18.8-19.0	Custand apple tree	1					1
2		Veppa Maram (CN)		1	2			3
3		Panai Maram			1			1
4		Pungai	1					1
5		Thoongumoonji					2	2
6		Velivelaan	1					1
		Sub Total	3	1	3		2	9
1	19.0-19.2	Baadhani	1					1
2		Thennai	1					1
3		Elumichal	2					2
4		Mungai	1					1
5		Nadhiyavattai	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
6		Veppa Maram	8		3		1	12
7	19.0-19.2	Veppa Maram (CN)			2	1		3
8		Pungai	1					1
9		Thoongumoonji					1	1
Sub Total			15		5	1	2	23
1	19.2-19.4	Aalar					1	1
2		Arasan					1	1
3		Koyyaa	1					1
4		Manjal	1					1
5		Mungai	1					1
6		Nadhiyavattai	1					1
7		Veppa Maram	1	1		7	4	13
8		Pattasukaai			1			1
9		Pungai					1	1
Sub Total			5	1	1	7	7	21
1	19.4-19.6	Anali	1					1
2		Thennai				11		11
3		Maa	1					1
4		Veppa Maram	1			1	1	3
5		Pungai		1				1
6		Thoongumoonji					2	2
7		Velivelaan	1					1
Sub Total			4	1		12	3	20
1	19.6-19.8	Aalar	1					1
2		Anali	2					2
3		Vaazhai	1					1
4		Thennai (Fenced)				3		3
5		Ichala	1					1
6		Maa	1					1
7		Maa (Fenced)					1	1
8		Manjal	1					1
9		Mungai	1					1
10		Veppa Maram	2			1	1	4
11		Puliyai Maram	1			1	1	3
12		Thekku (Fenced)			1			1
13		Velivelaan	1					1
Sub Total			12		1	5	3	21
1	19.8-20.0	Maa	1					1
2		Mungai	1					1
3		Veppa Maram	3					3
4		Panai Maram (CN)				1		1
5		Pungai	2					2
6		Puliyai Maram					4	4

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
7		Thoongumoonji	1					1
8	19.8-20.0	Velivelaan	2					2
Sub Total			10			1	4	15
1	20.0-20.2	Bougainvilla	1					1
2		Thennai (PL)			1			1
3		Maa (PL)					1	1
4		Nadhiyavattai	1					1
5		Veppa Maram	1				1	2
6		Veppa Maram (CN)			4			4
7		Vaagai				1		1
8		Vaagai (PL)				1		1
9		Velivelaan (CN)			2			2
Sub Total			3		7	2	2	14
1	20.2-20.4	Anali	1					1
2		Thennai	2					2
3		Thennai (PL)			4	1		5
4		Maa	2					2
5		Manjal	1					1
6		Mungai	2					2
7		Veppa Maram	2					2
8		Paneeganut	1					1
9		Pappaali	1					1
10		Puliyai Maram					3	3
11		Puliyai Maram					1	1
12		Thekku	1					1
13		Vaagai	1					1
Sub Total			14		4	1	4	23
1	20.4-20.6	Vaazhai	1					1
2		Mungai	1					1
3		Pungai	1					1
4		Velivelaan	1					1
Sub Total			4					4
1	20.6-20.8	Aalar (CN)					1	1
2		Arasan (CN)					1	1
3		Veppa Maram	1					1
4		Velivelaan	1					1
Sub Total			2				2	4
1	20.8-21.0	Veppa Maram	1					1
2		Panai Maram (CN)					1	1
3		Velivelaan	1					1
Sub Total			2				1	3
1	20.8-31.0	Ichala	2					2
2		Panai Maram		1	5			6

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
3		Velivelaan	1					1
Sub Total			3	1	5			9
1	21.0-21.2	Moongil	1					1
2		Veppa Maram	1					1
3		Panai Maram	4					4
4		Panai Maram (CN)			1	1		2
5		Velivelaan	1					1
Sub Total			7		1	1		9
1	21.2-21.4	Panai Maram (CN)			1			1
Sub Total					1			1
1	21.4-21.6	Puliyai Maram			1			1
2		Velivelaan	1					1
Sub Total			1		1			2
1	21.6-21.8	Panai Maram			1			1
2		Thoongumoonji					3	3
3		Velivelaan	1					1
Sub Total			1		1		3	5
1	21.8-22.0	Badhai	1					1
2		Veppa Maram	1					1
3		Pungai					1	1
4		Velivelaan	1					1
Sub Total			3				1	4
1	22.0-22.2	Thennai	1					1
2		Thennai (Fenced)				1		1
3		Koyyaa (Fenced)		1				1
4		Maa	1					1
5		Mungai(pl p cot)			1			1
6		Veppa Maram				1	1	2
7		Veppa Maram (Fenced)			1			1
8		Pungai		2	2	1		5
9		Puliyai Maram					1	1
10		Velivelaan	1					1
Sub Total			3	3	4	3	2	15
1	22.2-22.4	Aalar					2	2
2		Thennai	1					1
3		Pungai (PL)				1		1
4		Thoongumoonji					1	1
5		Vaagai					1	1
Sub Total			1			1	4	6
1	22.4-22.6	Baadhani	1					1
2		Moongil	1					1
3		Thennai (P Cot)				1		1
4		Thennai (PL)				2		2

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
5		Mungai	1					1
6	22.4-22.6	Mungai(pl p cot)				1		1
7		Veppa Maram	2				1	3
8		Pungai	1			1	1	3
9		Puliyai Maram					1	1
10		Thoongumoonji	1				2	3
11		Vaagai					1	1
12		Velivelaan	1					1
Sub Total			8			5	6	19
1	22.6-22.8	Aalar					1	1
2		Ichala	1					1
3		Veppa Maram	1	1	1			3
4		Puliyai Maram					3	3
5		Thoongumoonji				1	1	2
6		Velivelaan	1					1
Sub Total			3	1	1	1	5	11
1	22.8-23.0	Veppa Maram (CN)				1		1
2		Panai Maram (CN)				1		1
3		Puliyai Maram					1	1
4		Thoongumoonji					2	2
Sub Total						2	3	5
1	23.0-23.2	Puliyai Maram					1	1
Sub Total							1	1
1	23.2-23.4	Veppa Maram				1		1
2		Veppa Maram (PL)					1	1
3		Pungai		1				1
4		Thoongumoonji					1	1
5		Velivelaan	1					1
Sub Total			1	1		1	2	5
1	23.4-23.6	Anali (Fenced)		1				1
2		Arasan (Fenced)					1	1
3		Vaazhai (Fenced)		1				1
4		Thennai (Fenced)			4	1		5
5		Thaila Maram	1					1
6		Maa (Fenced)				1		1
7		Manjal (Fenced)		1				1
8		Veppa Maram (Fenced)			1	3		4
9		Sempathai (Fenced)				1		1
10		Thoongumoonji					1	1
11		Velivelaan	1					1
Sub Total			2	3	5	6	2	18
1	23.6-23.8	Thennai (Fenced)				1		1
2		Mungai	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
3		Veppa Maram	1					1
4	23.6-23.8	Veppa Maram (Fenced)			5	2		7
5		Veppa Maram (PL)			1			1
6		Thoongumoonji	1					1
7		Vaagai (Fenced)				1		1
8		Vaagai (PL)			1			1
9		Velivelaan	1					1
Sub Total			4		7	4		15
1	23.8-24.0	Ashok	2					2
2		Baadhani	1					1
3		Vaazhai	2					2
4		Thennai (CN)				1		1
5		Thennai (PL)			2			2
6		Veppa Maram	6					6
7		Pungai	1					1
8		Puliyai Maram	1				1	2
9		Velivelaan	1					1
Sub Total			14		2	1	1	18
1	24.0-24.2	Arasan (Fenced)					1	1
2		Thennai (Fenced)			2	2		4
3		Maa (Fenced)					2	2
4		Mungai (Fenced)			1			1
5		Veppa Maram	1					1
6		Veppa Maram (Fenced)			3	1		4
7		Pungai	1					1
8		Sempathai (Fenced)		1				1
9		Puliyai Maram (PL)				2		2
10		Vaagai				2		2
11		Vaagai (Fenced)				1		1
12		Velivelaan	1					1
Sub Total			3	1	6	8	3	21
1	24.4-24.6	Puliyai Maram					2	2
Sub Total							2	2
1	24.6-24.8	Puliyai Maram					2	2
2		Velivelaan	1					1
Sub Total			1				2	3
1	24.8-25.0	Pungai	1					1
2		Puliyai Maram					6	6
3		Thoongumoonji					2	2
4		Velivelaan	1					1
Sub Total			2				8	10
1	25.0-25.2	Veppa Maram	3					3
2		Puliyai Maram					1	1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
Sub Total			3				1	4
1	25.2-25.4	Veppa Maram	3			1	1	5
2		Pungai		1				1
3		Thoongumoonji	1					1
4		Vaagai			1			1
Sub Total			4	1	1	1	1	8
1	25.4-25.6	Veppa Maram					1	1
2		Veppa Maram (Fenced)				1		1
3		Puliyai Maram					3	3
4		Puliyai Maram (Fenced)					1	1
5		Thoongumoonji					1	1
6		Vaagai	1					1
7		Vaagai (Fenced)					1	1
8		Velivelaan	1					1
Sub Total			2			1	7	10
1	25.6-25.8	Veppa Maram		1				1
2		Puliyai Maram					2	2
3		Thoongumoonji				1		1
4		Vaagai				1		1
5		Velivelaan	1					1
Sub Total			1	1		2	2	6
1	25.8-26.0	Koenapuliyankai					1	1
2		Veppa Maram		1	1			2
3		Pungai	1					1
4		Puliyai Maram					2	2
5		Thoongumoonji				1		1
6		Vaagai				1		1
Sub Total			1	1	1	2	3	8
1	26.0-26.2	Puliyai Maram					9	9
2		Velivelaan	1					1
Sub Total			1				9	10
1	26.2-26.4	Puliyai Maram					13	13
Sub Total							13	13
1	26.4-26.6	Koenapuliyankai	1					1
2		Puliyai Maram					8	8
Sub Total			1				8	9
1	26.6-26.8	Puliyai Maram					9	9
2		Velivelaan	1					1
Sub Total			1				9	10
1	26.8-27.0	Panai Maram (CN)			3	1		4
2		Puliyai Maram					5	5
3		Velivelaan	1					1
Sub Total			1		3	1	5	10

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
1	27.0-27.2	Pungai			1			1
2	27.0-27.2	Puliyai Maram					5	5
3		Vaagai				1		1
4		Velivelaan	1					1
Sub Total			1		1	1	5	8
1	27.2-27.4	Puliyai Maram					12	12
2		Velivelaan	1					1
Sub Total			1				12	13
1	27.4-27.6	Arasan					1	1
2		Baadhani			1			1
3		Veppa Maram	1					1
4		Pungai		1				1
5		Puliyai Maram					7	7
6		Vaagai				3		3
7		Velivelaan	1					1
Sub Total			2	1	1	3	8	15
1	27.6-26.8	Puliyai Maram					3	3
Sub Total							3	3
1	27.8-28.0	Puliyai Maram					4	4
2		Vaagai			1			1
3		Velivelaan	1					1
Sub Total			1		1		4	6
1	28.0-28.2	Arasan (Fenced)					1	1
2		Veppa Maram (CN)			2			2
3		Veppa Maram (Fenced)				1		1
4		Puliyai Maram				1	4	5
5		Thoongumoonji (CN)				1		1
Sub Total					2	3	5	10
1	28.2-28.4	Pungai	2					2
2		Puliyai Maram				1	2	3
3		Velivelaan	1					1
Sub Total			3			1	2	6
1	28.4-28.6	Aalar					1	1
2		Arasan			1			1
3		Panai Maram				1		1
4		Puliyai Maram					1	1
5		Velivelaan	1					1
Sub Total			1		1	1	2	5
1	28.8-29.0	Vaagai	1					1
2		Velivelaan	1					1
Sub Total			2					2
1	29.0-29.2	Panai Maram (CN)			1			1
2		Pungai	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
3		Velivelaan	1					1
Sub Total			2		1			3
1	29.2-29.4	Aalar (CN)					1	1
2		Arasan					2	2
3		Veppa Maram	1					1
4		Pungai	1					1
5		Thoongumoonji (CN)					1	1
6		Velivelaan	1					1
Sub Total			3				4	7
1	29.4-29.6	Baadhani		1				1
2		Ichala		1				1
3		Ichala (CN)					1	1
4		Pungai	1					1
5		Vaagai			2			2
6		Velivelaan	1					1
Sub Total			2	2	2		1	7
1	29.6-29.8	Ichala			1			1
2		Pungai	1					1
3		Vaagai (CN)					1	1
4		Velivelaan	1					1
Sub Total			2		1		1	4
1	29.8-30.0	Ichala (CN)					1	1
2		Panai Maram	1					1
3		Thoongumoonji	1					1
4		Thoongumoonji (CN)				1	1	2
5		Vaagai	1					1
6		Velivelaan	1					1
Sub Total			4			1	2	7
1	30.0-30.2	Ichala (CN)					1	1
2		Panai Maram		2	1	3		6
3		Panai Maram (CN)			1			1
4		Thoongumoonji			1			1
5		Thoongumoonji (CN)				1	3	4
6		Velivelaan	1					1
Sub Total			1	2	3	4	4	14
1	30.2-30.4	Veppa Maram				1		1
2		Panai Maram	1		2			3
3		Pungai	1					1
4		Pungai (CN)			1			1
5		Thoongumoonji (CN)					1	1
6		Velivelaan	1					1
Sub Total			3		3	1	1	8
1	30.4-30.6	Arasan			1			1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
2		Ichala	1					1
3	30.4-30.6	Veppa Maram	1		1			2
4		Panai Maram				1		1
5		Puliyai Maram	1					1
6		Thoongumoonji	1					1
Sub Total			4		2	1		7
1	30.6-30.8	Panai Maram				1		1
2		Thoongumoonji		1		1	1	3
3		Thoongumoonji (CN)					1	1
4		Vaagai			1	1		2
5		Velivelaan	1					1
Sub Total			1	1	1	3	2	8
1	31.0-31.2	Panai Maram		4	6	2		12
2		Velivelaan	1					1
Sub Total			1	4	6	2		13
1	31.2-31.4	Ichala (CN)					1	1
2		Panai Maram	1		2	1		4
3		Velivelaan	1					1
Sub Total			2		2	1	1	6
1	31.4-31.6	Arasan					1	1
2		Panai Maram			1			1
3		Thoongumoonji				1		1
Sub Total					1	1	1	3
1	31.6-31.8	Ichala	1					1
2		Puliyai Maram					1	1
3		Thoongumoonji	1					1
4		Velivelaan	1					1
Sub Total			3				1	4
1	31.8-32.0	Panai Maram			1	1		2
2		Pungai	1					1
3		Puliyai Maram					4	4
4		Thoongumoonji			1			1
5		Velivelaan	1					1
Sub Total			2		2	1	4	9
1	32.0-32.2	Panai Maram		1	1	1		3
2		Pungai			1			1
3		Thekku	1					1
4		Thoongumoonji	2					2
5		Thoongumoonji (CN)					1	1
6		Vaagai	3					3
Sub Total			6	1	2	1	1	11
1	32.2-32.4	Arasan	1					1
2		Ichala	1					1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
3		Veppa Maram	1					1
4	32.2-32.4	Panai Maram				2	2	4
5		Thoongumoonji	3					3
6		Thoongumoonji (CN)				2	1	3
7		Vaagai	2					2
8		Velivelaan	1					1
Sub Total			9			4	3	16
1	32.4-32.6	Panai Maram			1	3		4
2		Puliyai Maram					1	1
3		Thoongumoonji	2				1	3
4		Vaagai	1					1
5		Vaagai (CN)				1		1
Sub Total			3		1	4	2	10
1	32.6-32.8	Panai Maram			1	2		3
2		Puliyai Maram				1	1	2
3		Thoongumoonji	1			1	1	3
4		Thoongumoonji (CN)				1		1
Sub Total			1		1	5	2	9
1	32.8-33.0	Ichala	1					1
2		Panai Maram		2	4			6
3		Panai Maram (CN)			1			1
4		Pungai	1					1
5		Thoongumoonji	1			1		2
6		Thoongumoonji (CN)					1	1
7		Vaagai	3	1		1		5
Sub Total			6	3	5	2	1	17
1	33.0-33.2	Puliyai Maram					3	3
2		Thoongumoonji				1		1
3		Vaagai		1	2	1		4
4		Velivelaan	1					1
Sub Total			1	1	2	2	3	9
1	33.2-33.4	Panai Maram			2			2
2		Puliyai Maram					4	4
3		Thoongumoonji	1					1
4		Velivelaan	1					1
Sub Total			2		2		4	8
1	33.4-33.6	Panai Maram			1			1
2		Puliyai Maram				1	7	8
3		Thoongumoonji					3	3
4		Velivelaan	1					1
Sub Total			1		1	1	10	13
1	33.6-33.8	Arasan		1				1
2		Veppa Maram					1	1

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
3		Panai Maram (CN)			2			2
4	33.6-33.8	Puliyai Maram					1	1
5		Thoongumoonji		1	1	5	4	11
Sub Total				2	3	5	6	16
1	33.8-34.0	Pungai	1			1		2
2		Thoongumoonji					1	1
Sub Total			1			1	1	3
1	34.0-34.2	Aalar (PL)					1	1
2		Moongil	1					1
3		Mungai	1					1
4		Veppa Maram	1					1
5		Panai Maram			4			4
6		Pungai	1					1
7		Puliyai Maram (Fenced)					1	1
8		Thoongumoonji			1			1
9		Velivelaan	1					1
Sub Total			5		5		2	12
1	34.2-34.4	Vaazhai (Fenced)		6				6
2		Thennai (Fenced)			3	3		6
3		Koyyaa (Fenced)		1				1
4		Mungai (Fenced)		1	4			5
5		Veppa Maram (Fenced)			5			5
6		Panai Maram			1			1
7		Panai Maram (Fenced)			6			6
8		Pungai (Fenced)			1	1		2
9		Puliyai Maram (Fenced)					1	1
10		Velivelaan	1					1
Sub Total			1	8	20	4	1	34
1	34.4-34.6	Baadhani (Fenced)				1		1
2		Thennai (Fenced)			2			2
3		Ichala				1		1
4		Manjal (Fenced)			2			2
5		Mungai				1		1
6		Mungai (Fenced)			5			5
7		Veppa Maram				1		1
8		Veppa Maram (Fenced)			3			3
9		Panai Maram (Fenced)			1		1	2
10		Pappaali (Fenced)			1			1
11		Pungai			1			1
12		Puliyai Maram (Fenced)					1	1
13		Vaagai			1			1
14		Velivelaan	1					1
Sub Total			1		16	4	2	23

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
1	34.6-34.8	Anali (Fenced)		1				1
2	34.6-34.8	Arasan (CN)				1		1
3		Thaila Maram (Fenced)			1			1
4		Koyyaa (Fenced)		1				1
5		Ichala					1	1
6		Manjal (Fenced)		1				1
7		Veppa Maram				1	1	2
8		Veppa Maram (CN)					1	1
9		Veppa Maram (Fenced)			1			1
10		Panai Maram			1	2		3
11		Panai Maram (CN)				1		1
12		Pungai		1				1
13		Pungai (Fenced)			4	4		8
14		Vaagai (Fenced)			2	5		7
Sub Total				4	9	14	3	30
1	34.8-35.0	Ichala			1			1
2		Mungai	1					1
3		Mungai (PL)				1		1
4		Veppa Maram	1			1		2
5		Veppa Maram(PL)					1	1
6		Pungai	1					1
7		Thoongumoonji			1			1
8		Velivelaan	1					1
Sub Total			4		2	2	1	9
1	35.0-35.2	Anali (Fenced)		1				1
2		Vaazhai (Fenced)		1				1
3		Thennai (Fenced)				2		2
4		Mungai (Fenced)			1			1
5		Veppa Maram (CN)				1		1
6		Veppa Maram (Fenced)			5			5
7		Velivelaan (Fenced)		1				1
Sub Total				3	6	3		12
9	35.2-35.4	Thennai (Fenced)			1	1		2
10		Manjal (Fenced)		1				1
11		Mungai (Fenced)			1			1
12		Veppa Maram (Fenced)			4			4
13		Vaagai					1	1
14		Velivelaan	1					1
Sub Total			1	1	6	1	1	10
1	35.4-35.6	Anali	2					2
2		Thennai (Fenced)			8	4		12
3		Veppa Maram	4					4
4		Veppa Maram (Fenced)			13	1		14

Sr No.	Chainage (km)	Tree Name	Tree Girth (in cm)					
			<30	30-60	60-90	90-120	> 120	Total
5		Panai Maram (Fenced)			8	3		11
6	35.4-35.6	Pungai	2					2
7		Pungai (Fenced)			2	2		4
8		Thekku (Fenced)				1		1
9		Velivelaan	1					1
Sub Total			9		31	11		51
1	35.6-35.8	Thennai (Fenced)				2		2
2		Veppa Maram	1		1	3	3	8
3		Veppa Maram (Fenced)			1			1
4		Pungai	2					2
5		Pungai (Fenced)				1		1
6		Thoongumoonji					1	1
7		Vaagai (Fenced)				1		1
Sub Total			3		2	7	4	16
Grand Total			**805**	**91**	**407**	**278**	**556**	**2137**

Girth Wise List of Trees within 15m on Either Side from Existing Centerline on Vridhachalam-Bhuvanagiri Road (SH-70)

Right Hand Side

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	0.0-0.2	Athal		1				1
2		Veppa Maram	2	2				4
3		Pungai	1	1	2			4
4		Vaagai		1				1
Sub Total			**3**	**5**	**2**			**10**
1	0.2-0.4	Manjal	1					1
2		Mungai	3	1		1	1	6
3		Nadhiyavattai	1					1
4		Veppa Maram	1					1
5		Veppa Maram (People Clamming)			4			4
6		Puliyai Maram					1	1
Sub Total			**6**	**1**	**4**	**1**	**2**	**14**
1	0.4-0.6	Puliyai Maram					2	2
Sub Total							**2**	**2**
1	0.6-0.8	Pungai	1					1
2		Puliyai Maram					2	2
3		Vaagai					1	1
Sub Total			**1**				**3**	**4**
1	0.8-1.0	Aalar					1	1
2		Jackfruit					1	1
3		Maa	2					2
4		Nadhiyavattai	2					2
5		Veppa Maram				1		1
6		Pungai			2			2
7		Puliyai Maram					3	3
Sub Total			**4**		**2**	**1**	**5**	**12**
1	1.0-1.2	Arasan					1	1
2		Athal				1		1
3		Koyyaa	1				1	2
4		Elumichal	1					1
5		Maa (CN)				1		1
6		Mungai			1			1
7		Nadhiyavattai	1					1
8		Veppa Maram	1			1	1	3
9		Pungai	1					1
10		Vaagai					1	1
Sub Total			**5**		**1**	**3**	**4**	**13**
1	1.2-1.4	Baadhani					1	1
2		Koyyaa	1					1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
3		Elumichal	1					1
4	1.2-1.4	Veppa Maram	8					8
5		Puliyai Maram					5	5
Sub Total			**10**				**6**	**16**
1	1.4-1.6	Date					1	1
2		Veppa Maram					2	2
3		Panai Maram				1	1	2
4		Puliyai Maram					4	4
5		Thoongumoonji					1	1
6		Vaagai		1				1
Sub Total				**1**		**1**	**9**	**11**
1	1.6-1.8	Thennai			1			1
2		Veppa Maram			2		2	4
3		Puliyai Maram					3	3
Sub Total					**3**		**5**	**8**
1	1.8-2.0	Aalar					1	1
2		Baadhani				1		1
3		Koyyaa	1					1
4		Koluji(CN)		1	1			2
5		Manjal	1					1
6		Mungai				2		2
7		Veppa Maram	3				1	4
8		Pungai	5					5
9		Sapotta	2					2
10		Puliyai Maram					3	3
11		Thoongumoonji	1					1
Sub Total			**13**	**1**	**1**	**3**	**5**	**23**
1	2.0-2.2	Aalar					1	1
2		Thennai				1	1	2
3		Ichala					1	1
4		Vellai Kathambu			1			1
5		Kolunji					1	1
6		Veppa Maram	1		1			2
7		Pungai	3	1				4
8		Puliyai Maram					2	2
9		Velivelaan	1					1
Sub Total			**5**	**1**	**2**	**1**	**6**	**15**
1	2.2-2.4	Pungai	3		1			4
2		Puliyai Maram					1	1
Sub Total			**3**		**1**		**1**	**5**
1	2.4-2.6	Thennai			5			5
2		Eichar			2			2
3		Maa (CN)			3			3

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
4		Veppa Maram	2					2
5	2.4-2.6	Pungai	3					3
6		Puliyai Maram					2	2
7		Velivelaan	1					1
Sub Total			**6**		**10**		**2**	**18**
1	2.6-2.8	Thennai (p cot)(PL)				1		1
2		Ichala	1					1
3		Maa	1					1
4		Maa (CN)				1		1
5		Veppa Maram	1					1
6		Veppa Maram (CN)			2			2
7		Peosan	1	2				3
8		Pungai		1				1
9		Puliyai Maram				1	3	4
10		Vaagai	1	1		1		3
Sub Total			**5**	**4**	**2**	**4**	**3**	**18**
1	2.8-3.0	Thennai	2					2
2		Thennai (CN)			1			1
3		Thennai (PL)				1		1
4		Thaila Maram	17					17
5		Veppa Maram	7					7
6		Pungai	1					1
7		Puliyai Maram					3	3
8		Velivelaan	1					1
Sub Total			**28**		**1**	**1**	**3**	**33**
1	3.0-3.2	Thennai			1	2	1	4
2		Koyyaa	1					1
3		Elumichal	1					1
4		Maa	1		1		1	3
5		Veppa Maram	4		2			6
6		Panai Maram				1		1
7		Puliyai Maram					2	2
8		Thekku	1					1
9		Velivelaan	1					1
Sub Total			**9**		**4**	**3**	**4**	**20**
1	3.2-3.4	Baadhani	1					1
2		Thennai	1	1	8	9		19
3		Thennai(PL)			1			1
4		Koyyaa	1					1
5		Jackfruit	1					1
6		Elumichal	1					1
7		Maa	1	1	1			3
8		Maa (CN)			1			1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
9		Manjal	1					1
10	3.2-3.4	Nadhiyavattai	1					1
11		Veppa Maram (CN)			1			1
12		Puliyai Maram	1					1
13		Thekku	1					1
14		Vaagai	1					1
15		Velivelaan	1					1
Sub Total			**12**	**2**	**12**	**9**		**35**
1	3.4-3.6	Baadhani	1					1
2		Vaazhai	1					1
3		Thennai			8	4		12
4		Elumichal	1					1
5		Maa	1	1	1			3
6		Mungai	1					1
7		Veppa Maram	1	2				3
8		Pappaali	1					1
9		Puliyai Maram					1	1
10		Thekku	1					1
11		Vaagai	1					1
Sub Total			**9**	**3**	**9**	**4**	**1**	**26**
1	3.6-3.8	Arasan	1					1
2		Thennai	1			1		2
3		Thennai (p cot)			3			3
4		Koyyaa	2					2
5		Karuvelaan	1			1		2
6		Maa	1					1
7		Veppa Maram	2	1				3
8		Puliyai Maram				1	4	5
9		Velivelaan	16					16
Sub Total			**24**	**1**	**3**	**3**	**4**	**35**
1	3.8-4.0	Arasan	1					1
2		Baadhani	1					1
3		Vaazhai	1					1
4		Mungai	1					1
5		Veppa Maram	6	1				7
6		Piyamaran		4	3			7
7		Pungai	2					2
8		Puliyai Maram					2	2
Sub Total			**12**	**5**	**3**		**2**	**22**
1	4.0-4.2	Thennai (p cot)(PL)			1			1
2		Elumichal	2					2
3		Mungai	6					6
4		Veppa Maram	14	1	1			16

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
5		Puliyai Maram				1	3	4
6	**4.0-4.2**	Velivelaan	6					6
Sub Total			**28**	**1**	**2**	**1**	**3**	**35**
1	4.2-4.4	Baadhani	2					2
2		Thennai (p cot)		1				1
3		Ichala				1		1
4		Karuvelaan				1		1
5		Mungai	2					2
6		Mungai (p cot)(PL)		1				1
7		Panai Maram					1	1
8		Pungai					1	1
9		Puliyai Maram					2	2
10		Velivelaan	60					60
Sub Total			**64**	**2**		**2**	**4**	**72**
1	4.4-4.6	Arasan			1			1
2		Ichala					1	1
3		Veppa Maram	1	1				2
4		Puliyai Maram					4	4
Sub Total			**1**	**1**	**1**		**5**	**8**
1	4.6-4.8	Aalar					1	1
2		Vaazhai	5					5
3		Thennai	2			1		3
4		Koyyaa	1					1
5		Maa	1				1	2
6		Manjal	1					1
7		Veppa Maram	2		1		1	4
8		Velivelaan	15					15
Sub Total			**27**		**1**	**1**	**3**	**32**
1	4.8-5.0	Thennai				2		2
2		Jackfruit		1				1
3		Maa	1		1	2	1	5
4		Manjal	2					2
5		Mungai		1				1
6		Veppa Maram		1	1	3	1	6
7		Sapotta	5					5
8		Puliyai Maram					2	2
9		Vaagai				1		1
Sub Total			**8**	**3**	**2**	**8**	**4**	**25**
1	5.0-5.2	Ashok	2					2
2		Athal	1					1
3		Koyyaa	1					1
4		Vellai Kathambu			2			2
5		Maa					1	1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
6		Mungai	1					1
7	5.0-5.2	Veppa Maram	2	2	2	2	1	9
8		Pappaali					1	1
9		Puliyai Maram					1	1
Sub Total			**7**	**2**	**4**	**2**	**4**	**19**
1	5.2-5.4	Thennai	8					8
2		Thennai (p cot)			2		1	3
3		Koyyaa	1					1
4		Maa	2					2
5		Maa (p cot)				2		2
6		Manjal	2					2
7		Mungai (p cot)			1			1
8		Nadhiyavattai	1					1
9		Veppa Maram	3	1		1		5
10		Veppa Maram (p cot)			2			2
11		Pungai	3					3
12		Puliyai Maram					1	1
Sub Total			**20**	**1**	**5**	**3**	**2**	**31**
1	5.4-5.6	Moongil	1					1
2		Vaazhai	15					15
3		Kattankku	1					1
4		Elumichal	7					7
5		Maa					1	1
6		Mungai				1		1
7		Veppa Maram	5			1		6
8		Panai Maram			1	2		3
9		Piyamaran			1			1
10		Puliyai Maram					1	1
11		Thekku	1					1
Sub Total			**30**		**2**	**4**	**2**	**38**
1	5.6-5.8	Arasan					1	1
2		Thennai	1					1
3		Thennai (pol)				8		8
4		Mungai				1	1	2
5		Veppa Maram	2					2
6		Panai Maram					1	1
7		Thekku	20					20
Sub Total			**23**			**9**	**3**	**35**
1	6.0-6.2	Moongil	1					1
2		Ichala			1			1
3		Veppa Maram	3	1				4
4		Panai Maram			3	1		4
Sub Total			**4**	**1**	**4**	**1**		**10**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	6.2-6.4	Mungai		1				1
2	6.2-6.4	Veppa Maram			1	1		2
3		Puliyai Maram			1		1	2
4		Vaagai			2		1	3
Sub Total				**1**	**4**	**1**	**2**	**8**
1	6.4-6.6	Veppa Maram			1			1
2		Puliyai Maram				1	5	6
3		Velivelaan	5					5
Sub Total			**5**		**1**	**1**	**5**	**12**
1	6.6-6.8	Moongil	1					1
2		Vaazhai	20					20
3		Thennai	7					7
4		Thennai (p cot)(PL)			2	3		5
5		Veppa Maram	8					8
6		Poochankottai					1	1
7		Puliyai Maram					2	2
Sub Total			**36**		**2**	**3**	**3**	**44**
1	6.8-7.0	Thennai (PL)			5			5
2		Puliyai Maram					2	2
3		Thoongumoonji					1	1
Sub Total					**5**		**3**	**8**
1	7.0-7.2	Puliyai Maram					4	4
Sub Total							**4**	**4**
1	7.2-7.4	Vaazhai	1					1
2		Thennai	1					1
3		Koyyaa	1					1
4		Maa	1					1
5		Mungai	1					1
6		Veppa Maram	1			1		2
7		Poochankottai					1	1
8		Puliyai Maram					3	3
Sub Total			**6**			**1**	**4**	**11**
1	7.4-7.6	Koyyaa	1					1
2		Vellai Kathambu					1	1
3		Mungai	1					1
4		Veppa Maram	1					1
5		Veppa Maram (CN)				1		1
6		Panai Maram			1			1
7		Puliyai Maram					4	4
8		Velivelaan	26					26
Sub Total			**29**		**1**	**1**	**5**	**36**
1	7.6-7.8	Puliyai Maram			1	1	2	4
Sub Total					**1**	**1**	**2**	**4**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	7.8-8.0	Veppa Maram	3					3
2	7.8-8.0	Pungai				3		3
3		Puliyai Maram (PL)					2	2
4		Velivelaan	50					50
Sub Total			**53**			**3**	**2**	**58**
1	8.0-8.2	Baadhani	1					1
2		Vaazhai	1					1
3		Veppa Maram	5					5
4		Pappaali	1					1
5		Pungai	6					6
6		Puliyai Maram					1	1
7		Vaagai					1	1
8		Velivelaan	10					10
Sub Total			**24**				**2**	**26**
1	8.2-8.4	Vaazhai	1					1
2		Thennai			2			2
3		Elumichal	1					1
4		Maa	1					1
5		Mungai	5					5
6		Veppa Maram	4					4
7		Vaagai				1		1
8		Velivelaan	2					2
Sub Total			**14**		**2**	**1**		**17**
1	8.4-8.6	Ashok	1					1
2		Vaazhai	1					1
3		Maa	1					1
4		Mungai	1					1
5		Veppa Maram	2		1	1		4
6		Puliyai Maram					4	4
Sub Total			**6**		**1**	**1**	**4**	**12**
1	8.6-8.8	Thennai (PL)			3	3		6
2		Eachamanam (CN)			1			1
3		Koenapuliyankai (CN)				1		1
4		Mungai	1					1
5		Veppa Maram	3	1			1	5
6		Veppa Maram (CN)				1		1
7		Veppa Maram (PL)		2	3		2	7
8		Puliyai Maram					1	1
9		Thekku	3					3
10		Velivelaan	1					1
Sub Total			**8**	**3**	**7**	**5**	**4**	**27**
1	8.8-6.0	Moongil	20					20
2		Veppa Maram	1					1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
3		Panai Maram			4	1	1	6
4	8.8-6.0	Puliyai Maram					1	1
5		Velivelaan	5					5
Sub Total			**26**		**4**	**1**	**2**	**33**
1	8.8-9.0	Thoongumoonji					3	3
2		Velivelaan	1					1
Sub Total			**1**				**3**	**4**
1	9.0-9.2	Alamanam (pl cn)					1	1
2		Thennai (PL)			2			2
3		Velivelaan	1					1
Sub Total			**1**		**2**		**1**	**4**
1	9.2-9.4	Baadhani	1					1
2		Thennai	5					5
3		Veppa Maram	2					2
Sub Total			**8**					**8**
1	9.4-9.6	Vaazhai	15					15
2		Thennai (PL)			1			1
3		Koyyaa	1					1
4		Manjal	1					1
5		Mungai	6					6
6		Veppa Maram	1					1
7		Pappaali	2					2
8		Puliyai Maram				1	1	2
9		Thekku	1					1
Sub Total			**27**		**1**	**1**	**1**	**30**
1	9.6-9.8	Moongil	1					1
2		Puliyai Maram			2	1	6	9
3		Vaagai	5					5
4		Velivelaan	1					1
Sub Total			7		2	1	6	16
1	9.8-10.0	Puliyai Maram				5	9	14
Sub Total						**5**	**9**	**14**
1	10.0-10.2	Thennai	1					1
2		Mungai	2					2
3		Veppa Maram	2					2
4		Puliyai Maram				4	7	11
5		Velivelaan	1					1
Sub Total			**6**			**4**	**7**	**17**
1	10.2-10.4	Maa	1					1
2		Veppa Maram		1				1
3		Puliyai Maram					1	1
4		Velivelaan	1					1
Sub Total			**2**	**1**			**1**	**4**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	10.4-10.6	Veppa Maram		2				2
2	10.4-10.6	Puliyai Maram					5	5
3		Vaagai				1		1
Sub Total				**2**		**1**	**5**	**8**
1	10.6-10.8	Vaazhai	1					1
2		Thennai	1					1
3		Date	5					5
4		Kattankku	1					1
5		Veppa Maram	1					1
6		Pappaali	1					1
7		Puliyai Maram					4	4
Sub Total			**10**				**4**	**14**
1	10.8-11.0	Thaila Maram				1		1
2		Veppa Maram		3	3	1		7
3		Puliyai Maram	1				4	5
Sub Total			**1**	**3**	**3**	**2**	**4**	**13**
1	11.0-11.2	Puliyai Maram					3	3
2		Puliyai Maram (CN)					1	1
3		Velivelaan	1					1
Sub Total			**1**				**4**	**5**
1	11.2-11.4	Puliyai Maram					6	6
Sub Total							**6**	**6**
1	11.4-11.6	Thennai (CN) (PL)			2	8		10
2		Puliyai Maram					3	3
3		Thekku	5					5
4		Thoongumoonji				2	1	3
5		Vaagai					1	1
Sub Total			**5**		**2**	**10**	**5**	**22**
1	11.6-11.8	Thennai (CN) (PL)			2	4		6
2		Maa (PL)				1		1
3		Veppa Maram			1			1
4		Puliyai Maram					2	2
5		Thekku			1			1
6		Velivelaan	1					1
Sub Total			**1**		**4**	**5**	**2**	**12**
1	11.8-12.0	Baadhani	1					1
2		Veppa Maram	3					3
3		Puliyai Maram					6	6
4		Velivelaan	1					1
Sub Total			**5**				**6**	**11**
1	12.2-12.4	Vaazhai	5					5
2		Mungai (PL)				1		1
3		Veppa Maram (PL)					1	1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
Sub Total			**5**			**1**	**1**	**7**
1	12.4-12.6	Arasan				1		1
2		Baadhani	1					1
3		Kagidha poo	1					1
4		Koyyaa	1					1
5		Manjal	1					1
6		Mungai	1					1
7		Veppa Maram	5		1			6
8		Pungai	3					3
9		Puliyai Maram					1	1
Sub Total			**13**		**1**	**1**	**1**	**16**
1	12.6-12.8	Thennai	1					1
2		Mungai	4					4
3		Veppa Maram	4	3	2	1		10
4		Pappaali	1					1
5		Vaagai			1			1
6		Velivelaan	1					1
Sub Total			**11**	**3**	**3**	**1**		**18**
1	12.8-13.0	Baadhani	1					1
2		Vaazhai	1					1
3		Veppa Maram	2					2
4		Puliyai Maram					5	5
5		Velivelaan	1					1
Sub Total			**5**				**5**	**10**
1	13.0-13.2	Mungai	2					2
2		Veppa Maram	3					3
3		Pungai	2					2
4		Puliyai Maram					5	5
5		Velivelaan	1					1
Sub Total			**8**				**5**	**13**
1	13.2-13.4	Veppa Maram	7					7
2		Puliyai Maram					6	6
Sub Total			**7**				**6**	**13**
1	13.4-13.6	Veppa Maram	5					5
2		Pungai	1					1
3		Puliyai Maram					8	8
4		Velivelaan	1					1
Sub Total			**7**				**8**	**15**
1	13.6-13.8	Puliyai Maram					6	6
2		Velivelaan	1					1
Sub Total			**1**				**6**	**7**
1	13.8-14.0	Puliyai Maram					3	3
2		Velivelaan	1					1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
Sub Total			**1**				**3**	**4**
1	14.0-14.2	Veppa Maram	1					1
2		Pungai	1					1
3		Puliyai Maram					7	7
4		Velivelaan	1					1
Sub Total			**3**				**7**	**10**
1	14.2-14.4	Puliyai Maram					7	7
2		Velivelaan	1					1
Sub Total			**1**				**7**	**8**
1	14.4-14.6	Veppa Maram	1					1
2		Puliyai Maram					4	4
3		Velivelaan	1					1
Sub Total			**2**				**4**	**6**
1	14.6-14.8	Veppa Maram	1					1
2		Puliyai Maram					5	5
3		Velivelaan	1					1
Sub Total			**2**				**5**	**7**
1	14.8-15.0	Veppa Maram	1					1
2		Puliyai Maram					5	5
3		Velivelaan	1					1
Sub Total			**2**				**5**	**7**
1	15.0-15.2	Vaazhai	4					4
2		Thennai	6					6
3		Manjal	1					1
4		Mungai	1					1
5		Veppa Maram	9					9
6		Puliyai Maram					6	6
Sub Total			**21**				**6**	**27**
1	15.2-15.4	Veppa Maram	1					1
2		Puliyai Maram					5	5
3		Velivelaan	1					1
Sub Total			**2**				**5**	**7**
1	15.4-15.6	Puliyai Maram				2	6	8
2		Velivelaan	1					1
Sub Total			**1**			**2**	**6**	**9**
1	15.6-15.8	Puliyai Maram			1	1	2	4
2		Velivelaan	1					1
Sub Total			**1**		**1**	**1**	**2**	**5**
1	15.8-16.0	Puliyai Maram					6	6
2		Velivelaan	1					1
Sub Total			**1**				**6**	**7**
1	16.0-16.2	Veppa Maram (CN)			1	2	1	4
2		Puliyai Maram			1		3	4

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
3		Velivelaan	1					1
Sub Total			**1**		**2**	**2**	**4**	**9**
1	16.2-16.4	Moongil	1					1
2		Thennai (Fenced)			1	2		3
3		Thaila Maram	1					1
4		Koyyaa	1					1
5		Veppa Maram	1					1
6		Pungai	1					1
7		Puliyai Maram					2	2
8		Velivelaan	1					1
Sub Total			**6**		**1**	**2**	**2**	**11**
1	16.4-16.6	Moongil	1					1
2		Puliyai Maram					6	6
3		Velivelaan	1					1
Sub Total			**2**				**6**	**8**
1	16.6-16.8	Moongil	1					1
2		Thaila Maram	1					1
3		Kattankku	1					1
4		Mungai	1					1
5		Veppa Maram	1					1
6		Puliyai Maram					1	1
7		Thekku	1					1
8		Velivelaan	2					2
Sub Total			**8**				**1**	**9**
1	16.8-17.0	Vaazhai	1					1
2		Maa	1					1
3		Mungai	1					1
4		Pungai	1					1
5		Puliyai Maram					1	1
6		Velivelaan	1					1
Sub Total			**5**				**1**	**6**
1	17.0-17.2	Moongil	1					1
2		Puliyai Maram					1	1
3		Velivelaan	1					1
Sub Total			**2**				**1**	**3**
1	17.2-17.4	Puliyai Maram	1				2	3
2		Velivelaan	1					1
Sub Total			**2**				**2**	**4**
1	17.4-17.6	Puliyai Maram				1	7	8
Sub Total						**1**	**7**	**8**
1	17.6-17.8	Puliyai Maram					4	4
Sub Total							**4**	**4**
1	17.8-18.0	Puliyai Maram					8	8

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
Sub Total							**8**	**8**
1	18.0-18.2	Puliyai Maram					3	3
2		Velivelaan	1					1
Sub Total			**1**				**3**	**4**
1	18.2-18.4	Pungai	1					1
2		Puliyai Maram					3	3
Sub Total			**1**				**3**	**4**
1	18.4-18.6	Veppa Maram	1					1
Sub Total			**1**					**1**
1	18.6-18.8	Vaazhai	1					1
2		Mungai	1					1
3		Veppa Maram	1					1
Sub Total			**3**					**3**
1	18.8-19.0	Vaazhai	1					1
2		Veppa Maram	1					1
3		Pungai	1					1
4		Thoongumoonji					2	2
Sub Total			**3**				**2**	**5**
1	19.0-19.2	Arasan	1					1
2		Moongil	1					1
3		Vaazhai	1					1
4		Thennai (PL)			1			1
5		Kattankku	1					1
6		Veppa Maram	10					10
7		Pappaali	1					1
8		Velivelaan	1					1
Sub Total			**16**		**1**			**17**
1	19.2-19.4	Aalar					1	1
2		Arasan	1					1
3		Veppa Maram	7		3	2	1	13
4		Veppa Maram (CN) (PL)					1	1
Sub Total			**8**		**3**	**2**	**3**	**16**
1	19.4-19.6	Vaazhai	1					1
2		Koenapuliyankai	1					1
3		Mungai	1					1
4		Thoongumoonji					1	1
5		Velivelaan	1					1
Sub Total			**4**				**1**	**5**
1	19.6-19.8	Thennai	4					4
2		Thennai (PL)			1			1
3		Mungai	3					3
4		Veppa Maram	1		1			2
5		Panai Maram (CN)			1			1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
6		Pungai	1					1
7	19.6-19.8	Thekku	1					1
8		Vaagai	1					1
9		Velivelaan	2					2
Sub Total			**13**		**3**			**16**
1	19.8-20.0	Arasan (CN)					2	2
2		Vaazhai	1					1
3		Ilavampanju (CN)					1	1
4		Kattankku	1					1
5		Kattankku	1					1
6		Koenapuliyankai	1					1
7		Mungai	5					5
8		Veppa Maram	5					5
9		Pappaali	1					1
10		Pungai	3					3
11		Puliyai Maram					3	3
Sub Total			**18**				**6**	**24**
1	20.0-20.2	Vaazhai	6					6
2		Elumichal	1					1
3		Maa	3					3
4		Maa (PL)			1			1
5		Mungai	5					5
6		Veppa Maram	5				1	6
7		Pappaali	2					2
8		Puliyai Maram					1	1
9		Thekku	1					1
Sub Total			**23**		**1**		**2**	**26**
1	20.2-20.4	Vaazhai	1					1
2		Thennai	1					1
3		Kattankku	1					1
4		Veppa Maram	1					1
5		Panai Maram				1		1
6		Panai Maram (PL)				4		4
7		Puliyai Maram					2	2
8		Puliyai Maram					1	1
9		Puliyai Maram (PL)				1		1
10		Vaagai	4					4
11		Velivelaan	1					1
Sub Total			**9**			**6**	**3**	**18**
1	**20.4-20.6**	Baadhani	1					1
2		Thennai	5					5
3		Veppa Maram	1					1
4		Panai Maram			2			2

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
5		Panai Maram (CN)			2	4		6
6	20.4-20.6	Pungai	1					1
7		Puliyai Maram					5	5
8		Vaagai	2					2
9		Velivelaan	1					1
Sub Total			**11**		**4**	**4**	**5**	**24**
1	20.6-20.8	Panai Maram (CN)			15	15		30
2		Velivelaan	1					1
Sub Total			**1**		**15**	**15**		**31**
1	20.8-21.0	Panai Maram (CN)				1		1
2		Velivelaan	1					1
Sub Total			**1**			**1**		**2**
1	20.8-31.0	Velivelaan	1					1
Sub Total			**1**					**1**
1	21.0-21.2	Panai Maram (CN)			5	8		13
Sub Total					**5**	**8**		**13**
1	21.2-21.4	Vaazhai	3					3
2		Thennai	4					4
3		Mungai	1					1
4		Veppa Maram	1					1
5		Panai Maram			2	2		4
6		Panai Maram (CN)			1			1
7		Thekku	6					6
Sub Total			**15**		**3**	**2**		**20**
1	21.4-21.6	Thennai (PL)			10	6		16
2		Veppa Maram (CN)			1			1
3		Panai Maram (PL)			3	2		5
4		Puliyai Maram	1				1	2
5		Velivelaan	1					1
Sub Total			**2**		**14**	**8**	**1**	**25**
1	21.6-21.8	Veppa Maram	1					1
2		Palar	1					1
3		Panai Maram			2			2
4		Pungai	1					1
5		Velivelaan	1					1
Sub Total			**4**		**2**			**6**
1	21.8-22.0	Veppa Maram	1					1
2		Veppa Maram (CN)		1	1			2
3		Velivelaan	1					1
Sub Total			**2**	**1**	**1**			**4**
1	22.0-22.2	Thennai	1					1
2		Thennai (PL)			4	1		5
3		Kattankku	1					1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
4		Elumichal	1					1
5	22.0-22.2	Mungai	1					1
6		Veppa Maram	2				2	4
7		Pungai	1					1
8		Puliyai Maram					1	1
9		Velivelaan	1					1
Sub Total			**8**		**4**	**1**	**3**	**16**
1	22.2-22.4	Aalar					1	1
2		Baadhani				1		1
3		Vaazhai	1					1
4		Veppa Maram		1				1
5		Veppa Maram (PL)			1	1		2
6		Pungai	1					1
7		Puliyai Maram					1	1
Sub Total			**2**	**1**	**1**	**2**	**2**	**8**
1	22.4-22.6	Pungai	1					1
2		Puliyai Maram					1	1
3		Velivelaan	1					1
Sub Total			**2**				**1**	**3**
1	22.6-22.8	Arasan					1	1
2		Veppa Maram			1			1
3		Velivelaan	1					1
Sub Total			**1**		**1**		**1**	**3**
1	22.8-23.0	Ichala	1					1
2		Thennai	17					17
3		Mungai	3					3
4		Veppa Maram	1					1
5		Puliyai Maram					1	1
6		Thoongumoonji	7					7
Sub Total			**29**				**1**	**30**
1	23.0-23.2	Vaazhai	1					1
2		Mungai	1					1
3		Veppa Maram	1					1
4		Puliyai Maram					3	3
Sub Total			**3**				**3**	**6**
1	23.2-23.4	Thennai	3					3
2		Thennai (PL)				2		2
3		Veppa Maram (CN)				1		1
4		Veppa Maram (PL)					1	1
5		Panai Maram (CN)			2			2
6		Puliyai Maram					1	1
7		Thoongumoonji					1	1
8		Velivelaan	1					1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
Sub Total			**4**		**2**	**3**	**3**	**12**
1	23.4-23.6	Baadhani	1					1
2		Bougainvilla	1					1
3		Thennai	5					5
4		Ilavam panju	1					1
5		Mandhani	1					1
6		Mungai	1					1
7		Nadhiyavattai	1					1
8		Veppa Maram	3					3
9		Pappaali	1					1
Sub Total			**15**					**15**
1	23.6-23.8	Thennai (CN)				1		1
2		Veppa Maram				1		1
3		Puliyai Maram					1	1
4		Thoongumoonji					1	1
5		Velivelaan	1					1
	Sub Total		**1**			**2**	**2**	**5**
1	23.8-24.0	Arasan	1					1
2		Baadhani	1					1
3		Vaazhai	1					1
4		Thennai	6					6
5		Thaila Maram	3					3
6		Koyyaa	1					1
7		Elumichal	3					3
8		Maa	3					3
9		Mungai	1					1
10		Veppa Maram	2					2
11		Thoongumoonji					1	1
Sub Total			**22**				**1**	**23**
1	24.0-24.2	Arasan				1		1
2		Vaazhai	1					1
3		Thennai	3					3
4		Thennai (PL)			2			2
5		Mungai	1					1
6		Veppa Maram	2					2
7		Veppa Maram (PL)				1		1
8		Pungai	1					1
9		Velivelaan	1					1
Sub Total			**9**		**2**	**2**		**13**
1	24.2-24.4	Arasan				1		1
2		Baadhani	4					4
3		Thennai	2					2
4		Veppa Maram	8		1			9

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
5		Pungai	1	1				2
6	24.2-24.4	Puliyai Maram					1	1
7		Velivelaan	1					1
Sub Total			**16**	**1**	**1**	**1**	**1**	**20**
1	24.4-24.6	Thennai	4					4
2		Ichalamaram					1	1
3		Elumichal	1					1
4		Maa	2					2
5		Pungai	1			1		2
6		Velivelaan	1					1
Sub Total			**9**			**1**	**1**	**11**
1	24.6-24.8	Poorsamaram (PL)			2	2		4
2		Puliyai Maram					3	3
Sub Total					**2**	**2**	**3**	**7**
1	24.8-25.0	Thennai (PL)			3			3
2		Puliyai Maram					6	6
3		Thoongumoonji	1				1	2
4		Velivelaan	1					1
Sub Total			**2**		**3**		**7**	**12**
1	25.0-25.2	Mungai	1					1
2		Mungai (CN)			1			1
3		Veppa Maram	2					2
4		Pungai	1					1
5		Puliyai Maram					1	1
6		Puliyai Maram (p cot pl)					1	1
7		Vaagai (CN)		1				1
8		Velivelaan	1					1
Sub Total			**5**	**1**	**1**		**2**	**9**
1	25.2-25.4	Thennai				1		1
2		Elumichal	1					1
3		Veppa Maram	1		1		1	3
4		Veppa Maram (PL)				1	1	2
5		Pungai	7					7
6		Pungai (CN)					1	1
7		Vaagai	1					1
Sub Total			**10**		**1**	**2**	**3**	**16**
1	25.4-25.6	Baadhani	1					1
2		Baadhani (Fenced)				1		1
3		Pungai	1					1
4		Thoongumoonji					7	7
Sub Total			**2**			**1**	**7**	**10**
1	25.6-25.8	Baadhani	1					1
2		Baadhani (Fenced)				1		1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
3		Mungai	1					1
4	25.6-25.8	Veppa Maram	2					2
5		Puliyai Maram					6	6
6		Velivelaan	1					1
Sub Total			**5**			**1**	**6**	**12**
1	25.8-26.0	Moongil	1					1
2		Veppa Maram		1	1			2
3		Pungai			1			1
4		Thoongumoonji		1	1		1	3
5		Vaagai		1	1			2
6		Velivelaan	1					1
Sub Total			**2**	**3**	**4**		**1**	**10**
1	26.0-26.2	Puliyai Maram				1	12	13
2		Velivelaan	1					1
Sub Total			**1**			**1**	**12**	**14**
1	26.2-26.4	Puliyai Maram				1	8	9
Sub Total						**1**	**8**	**9**
1	26.4-26.6	Puliyai Maram					7	7
2		Velivelaan	1					1
Sub Total			**1**				**7**	**8**
1	26.6-26.8	Puliyai Maram					4	4
2		Velivelaan	1					1
Sub Total			**1**				**4**	**5**
1	26.6-28.8	Baadhani	1					1
2		Moongil	1					1
3		Thaila Maram (Fenced)			1			1
4		Veppa Maram (Fenced)			2			2
5		Panai Maram			1			1
6		Panai Maram (CN)			1			1
7		Pungai	1					1
8		Pungai (Fenced)				1		1
9		Thekku (PL)			2	2		4
10		Vaagai (Fenced)					1	1
11		Velivelaan	1					1
Sub Total			**4**		**7**	**3**	**1**	**15**
1	26.8-27.0	Veppa Maram	1					1
2		Pungai	1					1
3		Puliyai Maram					7	7
4		Velivelaan	1					1
Sub Total			**3**				**7**	**10**
1	27.0-27.2	Veppa Maram	1					1
2		Puliyai Maram					7	7
3		Thoongumoonji (CN)					1	1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
4		Velivelaan	1					1
Sub Total			**2**				**8**	**10**
1	27.2-27.4	Puliyai Maram					10	10
2		Velivelaan	1					1
Sub Total			**1**				**10**	**11**
1	27.4-27.6	Veppa Maram	1					1
2		Pappaali	1					1
3		Puliyai Maram					9	9
4		Velivelaan	1					1
Sub Total			**3**				**9**	**12**
1	27.6-26.8	Mungai	1					1
2		Veppa Maram	1					1
3		Panai Maram (CN)				1		1
4		Puliyai Maram					8	8
5		Velivelaan	1					1
Sub Total			**3**			**1**	**8**	**12**
1	27.8-28.0	Baadhani (Fenced)		1				1
2		Vaazhai (Fenced)			1			1
3		Thennai (Fenced)			3			3
4		Elumichal (Fenced)		1				1
5		Maa (Fenced)				1		1
6		Mungai (Fenced)		1				1
7		Veppa Maram (PL)				1		1
8		Puliyai Maram					6	6
9		Velivelaan	1					1
Sub Total			**1**	**3**	**4**	**2**	**6**	**16**
1	28.0-28.2	Anali (Fenced)		1				1
2		Baadhani				1		1
3		Koenapuliyankai				1		1
4		Manjal	1					1
5		Mungai					1	1
6		Mungai (Fenced)			1			1
7		Veppa Maram	1					1
8		Veppa Maram (Fenced)			2			2
9		Pungai	4	1				5
10		Pungai (Fenced)				1		1
11		Sempathai (Fenced)		2				2
12		Puliyai Maram					6	6
13		Vaagai				1		1
14		Vaagai (Fenced)					1	1
Sub Total			**6**	**4**	**3**	**4**	**8**	**25**
1	28.2-28.4	Anali (Fenced)		1				1
2		Arasan (Fenced)					2	2

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
3		Moongil	1					1
4	28.2-28.4	Thennai	3					3
5		Thennai (Fenced)			4			4
6		Thaila Maram (Fenced)			1			1
7		Koyyaa	1					1
8		Koyyaa (Fenced)			1			1
9		Ilavam panju				1		1
10		Elumichal	1					1
11		Mungai (Fenced)			2			2
12		Veppa Maram	1					1
13		Veppa Maram (Fenced)			1	1		2
14		Pungai	1					1
15		Pungai (Fenced)			1			1
16		Puliyai Maram					8	8
17		Puliyai Maram (Fenced)					1	1
18		Thekku	1					1
19		Thekku (Fenced)			1			1
20		Velivelaan	1					1
Sub Total			**10**	**1**	**11**	**2**	**11**	**35**
1	28.4-28.6	Arasan (Fenced)					1	1
2		Vaazhai (Fenced)		1				1
3		Thennai (Fenced)			3	2		5
4		Koyyaa (Fenced)				1		1
5		Ichala (Fenced)			1			1
6		Elumichal (Fenced)		2				2
7		Mungai (Fenced)			1			1
8		Veppa Maram			1		1	2
9		Veppa Maram (Fenced)			2	1		3
10		Panai Maram				2		2
11		Panai Maram (CN)				1		1
12		Pungai				1		1
13		Puliyai Maram					4	4
14		Thekku (Fenced)				1		1
15		Velivelaan	1					1
Sub Total			**1**	**3**	**8**	**9**	**6**	**27**
1	28.8-29.0	Moongil	1					1
2		Veppa Maram	1					1
3		Panai Maram (CN)			2			2
4		Pungai	1					1
5		Puliyai Maram					1	1
6		Velivelaan	1					1
Sub Total			**4**		**2**		**1**	**7**
1	29.0-29.2	Arasan (Fenced)					1	1

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
2		Baadhani			1			1
3	29.0-29.2	Moongil	1					1
4		Thennai			1	1		2
5		Thennai (Fenced)			1			1
6		Mungai	1					1
7		Veppa Maram	1					1
8		Veppa Maram (Fenced)			2			2
9		Pungai	1					1
10		Pungai (Fenced)			1			1
11		Thoongumoonji					1	1
12		Velivelaan	1		2			3
Sub Total			**5**		**8**	**1**	**2**	**16**
1	29.2-29.4	Aalar					1	1
2		Baadhani	1					1
3		Moongil	1					1
4		Vaazhai	1					1
5		Thennai			1			1
6		Thaila Maram	40					40
7		Maa	1					1
8		Veppa Maram	1		1			2
9		Panai Maram			2	6		8
10		Velivelaan	1					1
Sub Total			**46**		**4**	**6**	**1**	**57**
1	29.4-29.6	Vaazhai	1					1
2		Thennai (Fenced)			1			1
3		Koyyaa (Fenced)		1				1
4		Ichala		1				1
5		Veppa Maram			2	1		3
6		Veppa Maram (Fenced)			1			1
7		Panai Maram			4	1		5
8		Puliyai Maram					1	1
9		Vaagai				1		1
10		Vaagai (Fenced)			1			1
11		Velivelaan	1					1
Sub Total			**2**	**2**	**9**	**3**	**1**	**17**
1	29.6-29.8	Veppa Maram	1					1
2		Panai Maram			6	2		8
3		Panai Maram (CN)			1			1
4		Pungai	1					1
5		Puliyai Maram	1					1
6		Thoongumoonji					1	1
7		Velivelaan	1					1
Sub Total			**4**		**7**	**2**	**1**	**14**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	29.8-30.0	Ichala			1			1
2	29.8-30.0	Ichala (CN)				1		1
3		Veppa Maram			1			1
4		Panai Maram			6	3		9
5		Panai Maram (CN)			2	1		3
6		Pungai	1					1
7		Puliyai Maram	1					1
8		Vaagai		2		2		4
9		Velivelaan	1					1
Sub Total			**3**	**2**	**10**	**7**		**22**
1	30.0-30.2	Thennai (CN)			1	1		2
2		Veppa Maram	1					1
3		Panai Maram				35		35
4		Thoongumoonji (CN)				1	4	5
Sub Total			**1**		**1**	**37**	**4**	**43**
1	30.2-30.4	Arasan					1	1
2		Velivelaan	1					1
Sub Total			**1**				**1**	**2**
1	30.4-30.6	Thennai (Fenced)			1			1
2		Thaila Maram (Fenced)			1			1
3		Koyyaa (Fenced)			1			1
4		Veppa Maram (CN)			1			1
5		Veppa Maram (Fenced)			2			2
6		Pungai (Fenced)			1			1
Sub Total					**7**			**7**
1	30.6-30.8	Ichala (Fenced)			1			1
2		Panai Maram		1	1	1		3
3		Piyamaran (Fenced)				1		1
4		Sewakku (Fenced)			12			12
5		Thoongumoonji					1	1
6		Velivelaan	1					1
Sub Total			**1**	**1**	**14**	**2**	**1**	**19**
1	30.8-31.0	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	30.8-31.1	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	30.8-31.2	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	30.8-31.3	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	30.8-31.4	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	30.8-31.5	Panai Maram			1	1		2

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
Sub Total					**1**	**1**		**2**
1	30.8-31.6	Panai Maram			1	1		2
Sub Total					**1**	**1**		**2**
1	31.0-31.2	Ashok	1					1
2		Baadhani	1					1
3		Thennai (Fenced)			6	2		8
4		Ichala	2					2
5		Maa (Fenced)					2	2
6		Mungai (Fenced)			2			2
7		Veppa Maram (Fenced)			3	1		4
8		Panai Maram				2		2
9		Sapotta (Fenced)				1	1	2
10		Thekku	1					1
11		Thoongumoonji	1				1	2
12		Vaagai	1					1
Sub Total			**7**		**11**	**6**	**4**	**28**
1	31.2-31.4	Thennai (Fenced)			5			5
2		Thaila Maram (Fenced)			4			4
3		Mungai (Fenced)			3			3
4		Veppa Maram (PL)			1			1
5		Puliyai Maram					2	2
6		Thoongumoonji					1	1
7		Vaagai					1	1
Sub Total					**13**		**4**	**17**
1	31.4-31.6	Anali (Fenced)		1				1
2		Thaila Maram (Fenced)			1			1
3		Elumichal	1					1
4		Manjal (Fenced)		1				1
5		Mungai (Fenced)			2			2
6		Veppa Maram	1					1
7		Veppa Maram (Fenced)			12			12
8		Thekku (Fenced)				1		1
9		Thoongumoonji	1					1
10		Thoongumoonji (Fenced)					1	1
Sub Total			**3**	**2**	**15**	**1**	**1**	**22**
1	31.6-31.8	Veppa Maram	1					1
2		Pappaali	1					1
3		Thoongumoonji	1					1
4		Velivelaan	1					1
Sub Total			**4**					**4**
1	31.8-32.0	Panai Maram (CN)			2			2
2		Pungai	1					1
3		Puliyai Maram					5	5

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
4		Thoongumoonji	1					1
5	31.8-32.0	Velivelaan	1					1
Sub Total			**3**		**2**		**5**	**10**
1	32.0-32.2	Panai Maram		1	2			3
2		Pungai	3					3
3		Puliyai Maram					6	6
4		Thoongumoonji	1					1
5		Velivelaan	1					1
Sub Total			**5**	**1**	**2**		**6**	**14**
1	32.2-32.4	Panai Maram			2			2
2		Puliyai Maram	8					8
3		Vaagai				2		2
Sub Total			**8**		**2**	**2**		**12**
1	32.4-32.6	Veppa Maram	1					1
2		Panai Maram			1			1
3		Pungai	1					1
4		Vaagai	1					1
5		Velivelaan	1					1
Sub Total			**4**		**1**			**5**
1	32.6-32.8	Panai Maram		1	1	5		7
2		Pungai	1					1
3		Velivelaan	1					1
Sub Total			**2**	**1**	**1**	**5**		**9**
1	32.8-33.0	Panai Maram		1	1	1		3
2		Puliyai Maram	8				1	9
3		Thoongumoonji	1					1
4		Vaagai	2					2
Sub Total			**11**	**1**	**1**	**1**	**1**	**15**
1	33.0-33.2	Panai Maram			1			1
2		Puliyai Maram					2	2
3		Thoongumoonji					1	1
4		Velivelaan	1					1
Sub Total			**1**		**1**		**3**	**5**
1	33.2-33.4	Panai Maram			10	2		12
2		Puliyai Maram					4	4
3		Velivelaan	1					1
Sub Total			**1**		**10**	**2**	**4**	**17**
1	33.4-33.6	Moongil	1					1
2		Panai Maram			1			1
3		Puliyai Maram					7	7
4		Velivelaan	1					1
Sub Total			**2**		**1**		**7**	**10**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	33.6-33.8	Thaila Maram			20	26	7	53
2	33.6-33.8	Koenapuliyankai	1					1
3		Panai Maram			3			3
4		Panai Maram (Fenced)			14			14
5		Pungai	1					1
6		Puliyai Maram					1	1
7		Puliyai Maram (Fenced)					1	1
8		Thekku			9	27	17	53
9		Vaagai					4	4
Sub Total			**2**		**46**	**53**	**30**	**131**
1	33.8-34.0	Moongil	1					1
2		Ichala				1		1
3		Veppa Maram (Fenced)			2	1		3
4		Panai Maram (Fenced)			8	1		9
5		Pungai (Fenced)			3			3
6		Puliyai Maram (Fenced)				1		1
Sub Total			**1**		**13**	**4**		**18**
1	34.0-34.2	Aalar (Fenced)					1	1
2		Anali (Fenced)		1				1
3		Baadhani (Fenced)				1		1
4		Vaazhai (Fenced)		9				9
5		Thennai (Fenced)			8			8
6		Koyyaa (Fenced)			1			1
7		Ichala (Fenced)			2			2
8		Elumichal (Fenced)		1	1			2
9		Manjal (Fenced)		1	1			2
10		Mungai (Fenced)			3			3
11		Veppa Maram	1					1
12		Veppa Maram (Fenced)			3			3
13		Panai Maram				2		2
14		Panai Maram (Fenced)			4			4
15		Pungai	1					1
16		Pungai (Fenced)				1	3	4
17		Thekku (Fenced)			1			1
Sub Total			**2**	**12**	**24**	**4**	**4**	**46**
1	34.2-34.4	Baadhani (Fenced)				4		4
2		Vaazhai (Fenced)		2	1			3
3		Thennai (Fenced)			1	3		4
4		Koyyaa (Fenced)		1	1			2
5		Mungai (Fenced)			3			3
6		Veppa Maram			1			1
7		Veppa Maram (Fenced)			4			4
8		Panai Maram (Fenced)			10	1		11

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
9		Pungai (Fenced)				1		1
10	34.2-34.4	Vaagai				1	1	2
Sub Total				**3**	**21**	**10**	**1**	**35**
1	34.4-34.6	Vaazhai	1					1
2		Ichala	1					1
3		Mungai	3					3
4		Veppa Maram			2		1	3
5		Paala manar	1					1
6		Vaagai (Fenced)			2	1		3
7		Velivelaan	1					1
Sub Total			**7**		**4**	**1**	**1**	**13**
1	34.6-34.8	Panai Maram (Fenced)			2			2
2		Velivelaan	1					1
Sub Total			**1**		**2**			**3**
1	34.8-35.0	Thennai (Fenced)			6	3		9
2		Ichala			1	3	1	5
3		Elumichal	1					1
4		Mungai	1					1
5		Veppa Maram	1			1		2
6		Panai Maram			1			1
7		Vaagai	1	1	1			3
8		Velivelaan	1					1
Sub Total			**5**	**1**	**9**	**7**	**1**	**23**
1	35.0-35.2	Anali	1					1
2		Thennai (Fenced)			4	2		6
3		Nadhiyavattai	10					10
4		Veppa Maram	1					1
5		Veppa Maram (Fenced)			2	2		4
6		Panai Maram (CN)					1	1
7		Pungai (Fenced)			1	1		2
8		Velivelaan	1					1
Sub Total			**13**		**7**	**5**	**1**	**26**
1	35.2-35.4	Baadhani	1				1	2
2		Thennai (Fenced)			5			5
3		Maa (Fenced)			1	3		4
4		Veppa Maram	1					1
5		Veppa Maram (Fenced)			10			10
6		Pungai	2					2
7		Pungai (CN)				1		1
8		Pungai (Fenced)					1	1
9		Vaagai				1		1
10		Velivelaan	2					2
Sub Total			**6**		**16**	**5**	**2**	**29**

Sr. No.	Chainage (km)	Tree Name	<30 cm	30to60 cm	60to90 cm	90to120 cm	Above 120cm	Total
1	35.4-35.6	Baadhani (Fenced)			2	1		3
2	35.4-35.6	Vaazhai (Fenced)		10				10
3		Thennai (Fenced)			1	1		2
4		Koyyaa (Fenced)			2			2
5		Mungai (Fenced)			3			3
6		Veppa Maram (Fenced)			5	4		9
7		Panai Maram (Fenced)			2			2
8		Pungai (Fenced)				2		2
Sub Total				**10**	**15**	**8**		**33**
1	35.6-35.8	Ashok (Fenced)				6	3	9
2		Baadhani (Fenced)					1	1
3		Jackfruit (Fenced)			1			1
4		Mungai (CN)			1			1
5		Veppa Maram		1	2			3
6		Veppa Maram (Fenced)			2			2
Sub Total				**1**	**6**	**6**	**4**	**17**
Grand Total			**1245**	**103**	**530**	**396**	**600**	**2874**

Girth Wise list of trees <30 cm within RoW for Transplantation on Vridhachalam-Bhuvanagiri Road (SH-70)

Left Hand Side

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
1	0.0-0.2	Beech	20	1
2		Beech	25	1
3		Beech	27	1
4		Beech <10		5
5		Erukan<10		2
6		Karuvai<10	-	7
7		Nura		1
Sub Total				18
1	0.4-0.6	Katamuni<10	-	5
2		Kotai Mathu<10		9
3		Veppa Maram<10		3
Sub Total				17
1	0.6-0.8	Beech<10	-	1
2		Veppa Maram		1
3		Veppa Maram<10		1
Sub Total				3
1	0.8-1.0	Erukan<10		4
2		Konai<10	-	8
3		Veppa Maram<10		2
Sub Total				14
1	1.0-1.2	Veppa Maram		1
	Sub Total			1
1	1.2-1.4	Anali	18	1
2		Beech	16	1
3		Erukan<10		3
4		Manjal Arali	19	1
5		Manjal Arali	21	1
Sub Total				7
1	1.4-1.6	Karuvai<10		10
2		Veppa Maram <10	-	1
1.4-1.6 Total				11
1	1.6-1.8	Karuvai<10		6
2		Veppa Maram		1
Sub Total				7
1	1.8-2.0	Athi<10	-	11
2		Beech<10	-	4
3		Veppa Maram		1
4		Veppa Maram<10		2
Sub Total				18
1	2.0-2.2	Athi<10	-	12

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
2		Beech	11	1
3	2.0-2.2	Beech	13	1
4		Beech	18	1
5		Beech	23	1
6		Beech	25	1
7		Beech	27	1
8		Beech<10	-	19
9		Kotai Mathu<10		2
10		Nura		1
Sub Total				40
1	2.2-2.4	Karuvai<10		2
2		Veppa Maram<10		1
3		Ponai	29	1
Sub Total				4
1	2.6-2.8	Kotai Mathu<10		2
Sub Total				2
1	2.8-3.0	Athi<10	-	4
2		Kotai Mathu<10		1
Sub Total				5
1	3.0-3.2	Athi<10	-	19
2		Karuvai<10		12
3		Veppa Maram		1
4		Pappaali	15	1
5		Pappaali	20	1
6		Pappaali	21	1
Sub Total				35
1	3.2-3.4	Karuvai<10		6
2		Kotai Mathu	21	1
3		Kotai Mathu<10		9
4		Pappaali	24	1
5		Pappaali<10	-	2
Sub Total				19
1	3.4-3.6	Amanaku<10		1
2		Custard Apple	26	1
3		Kotaimathu<10	-	4
4		Nura<10	-	2
5		Pappaali	19	1
6		Pappaali	25	1
Sub Total				10
1	3.6-3.8	Karuvai<10		12
2		Katamuni<10	-	9
Sub Total				21
1	3.8-4.0	Beech	28	1
2		Karuvai<10		19

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
		Sub Total		20
1	4.0-4.2	Katamuni<10	-	7
2		Thoongumoonji	25	1
		Sub Total		8
1	4.2-4.4	Karuvai(14)<10	-	1
2		Karuvai<10		7
3		Nura<10	-	2
4		Thoongumoonji	27	1
		Sub Total		11
1	4.4-4.6	Veppa Maram		2
2		Nura		1
		Sub Total		3
1	4.6-4.8	Athi	-	1
2		Athi(20)<10	-	1
3		Veppa Maram		1
		Sub Total		3
1	4.8-5.0	Beech	25	1
		Sub Total		1
1	5.2-5.4	Beech<10	-	1
2		Karuvai<10	-	11
3		Veppa Maram		5
		Sub Total		17
1	5.4-5.6	Veppa Maram<10		1
		Sub Total		1
1	5.6-5.8	Karuvai(14)<10	-	1
2		Karuvai(19)<10	-	1
3		Veppa Maram		2
4		Veppa Maram<10		14
5		Nura<10	-	10
		Sub Total		28
1	5.8-6.0	Erukan<10		3
2		Karuvai(14)<10	-	1
3		Konai<10	-	4
4		Nura		2
		Sub Total		10
1	6.2-6.4	Amanaku<10(Pol)	-	6
2		Beech	17	1
3		Drum Stick	26	1
4		Nura<10	-	2
5		Pappaali<10	-	4
		Sub Total		14
1	6.4-6.6	Beech	17	1
2			23	1
3			26	1

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
4		Beech<10	-	9
	Sub Total			12
1	6.6-6.8	Karuvai<10		4
2		Katamuni<10	-	6
	Sub Total			10
1	6.8-7.0	Karuvai<10		5
2		Katamuni<10	-	4
3		Veppa Maram		1
	Sub Total			10
1	7.2-7.2	Karuvai<10		10
2		Katamuni(16)<10	-	1
	Sub Total			11
1	7.2-7.4	Karuvai<10		3
2		Katamuni<10	-	5
	Sub Total			8
1	7.4-7.6	Katamuni<10	-	6
2		Nura		1
	Sub Total			7
1	7.6-7.8	Karuvai(20)<10	-	1
	Sub Total			1
1	7.8-8.0	Anali	-	1
	Sub Total			1
1	8.0-8.2	Veppa Maram		1
2		Pungai	27	1
	Sub Total			2
1	8.6-8.8	Beech	12	1
	Sub Total			1
1	8.8-9.0	Kotai Mathu	-	1
2		Veppa Maram		1
	Sub Total			2
1	9.0-9.2	Karuvai<10		8
2		Natukaruvai	27	1
3		Veppa Maram		2
	Sub Total			11
1	9.2-9.4	Karuvai(16)<10		1
	Sub Total			1
1	9.6-9.8	Karuvai<10		10
2		Veppa Maram		1
	Sub Total			11
1	9.8-10.0	Karuvai	-	6
	Sub Total			6
1	10.0-10.2	Karuvai	-	4
2		Katamuni	-	1
3		Veppa Maram		1

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
Sub Total				6
1	10.2-10.4	Karuvai(17)<10	-	1
2		Karuvai<10		9
3		Veppa Maram		2
Sub Total				12
1	10.4-10.6	Karuvai(13)<10	-	1
2		Veppa Maram		1
Sub Total				2
1	10.6-10.8	Beech	25	1
2		Karuvai(14)<10	-	1
3		Veppa Maram		2
Sub Total				4
1	10.8-11.0	Karuvai<10		6
Sub Total				6
1	11.0-11.2	Koyyaa	16	1
2		Veppa Maram		2
3		Nura		1
Sub Total				4
1	11.4-11.6	Karuvai<10		1
2		Veppa Maram		4
3		Nura		2
Sub Total				7
1	11.6-11.8	Natukaruvai	24	1
Sub Total				1
1	11.8-12.0	Karuvai(17)<10	-	1
2		Karuvai<10		10
3		Kotai Monaku	-	1
4		Veppa Maram		1
Sub Total				13
1	12.0-12.2	Beech	17	1
2		Beech<10	-	3
Sub Total				4
1	12.2-12.4	Veppa Maram		1
Sub Total				1
1	12.4-12.6	Maa	27	1
2		Veppa Maram		11
3		Veppa Maram<10		2
Sub Total				14
1	12.8-13.0	Karuvai<10		6
2		Veppa Maram		1
3		Nura		1
Sub Total				8
1	13.0-13.2	Natukaruvai	16	1
2		Veppa Maram		1

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
3		Sevandi<10	-	2
Sub Total				4
1	13.2-13.4	Veppa Maram		2
Sub Total				2
1	13.4-13.6	Karuvai(16)<10		1
2		Kotai Mathu<10		4
3		Veppa Maram<10		2
4		Nura		1
Sub Total				8
1	13.6-13.8	Karuvai(13)<10	-	1
2		Veppa Maram<10		3
3		Nura		1
4		Nura<10	-	8
Sub Total				13
1	13.8-14.0	Karuvai(16)<10		1
Sub Total				1
1	14.0-14.2	Veppa Maram		1
Sub Total				1
1	14.2-14.4	Karuvai(16)<10		1
Sub Total				1
1	14.4-14.6	Karuvai<10		10
Sub Total				10
1	14.6-14.8	Veppa Maram		6
Sub Total				6
1	14.8-15.0	Karuvai<10		12
Sub Total				12
1	15.0-15.2	Amanaku(24)<10	-	1
2		Drumstick	26	1
3		Veppa Maram		1
4		Veppa Maram<10		2
5		Nura		1
Sub Total				6
1	15.2-15.4	Karuvai(16)<10		1
2		Veppa Maram		3
3		Veppa Maram<10		2
4		Nura		1
5		Nura<10	-	1
Sub Total				8
1	15.4-15.6	Karuvai(14)<10	-	1
2		Karuvai<10		9
3		Veppa Maram		2
4		Veppa Maram<10		1
Sub Total				13
1	15.8-16.0	Karuvai(14)<10	-	1

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
Sub Total				1
1	16.0-16.2	Kotai Mathu<10		12
	Sub Total			12
1	16.2-16.4	Amanaku<10		12
2		Beech	19	1
3		Unknown	20	1
4		Unknown	23	1
5		Karuvai<10		10
Sub Total				25
1	16.4-16.6	Pappaali	-	1
Sub Total				1
1	16.6-16.8	Murungakki	21	1
2		Pappaali<10	-	1
Sub Total				2
1	16.8-17.0	Karuvai<10		12
2		Povarsan	20	1
Sub Total				13
1	17.0-17.2	Karuvai(14)<10	-	1
Sub Total				1
1	17.2-17.4	Natukaruvai	-	1
Sub Total				1
1	17.4-17.6	(Blank)	(Blank)	
Sub Total				
1	17.6-17.8	Karuvai<10		6
2		Nura		1
Sub Total				7
1	17.8-18.0	Karuvai(16)<10		1
Sub Total				1
1	18.0-18.2	Karuvai<10		8
Sub Total				8
1	18.2-18.4	Veppa Maram		1
2		Nura		1
3		Thiruvachi	26	1
Sub Total				3
1	18.4-18.6	Erukan<10		3
2		Karuvai<10		9
Sub Total				12
1	18.6-18.8	Veppa Maram		2
2		Nura<10	-	10
Sub Total				12
1	18.8-19.0	Alichu<10	-	9
2		Karuvai<10		12
3		Veppa Maram		1
4		Nura<10	-	4

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
5		Thoongumoonji	14	1
6	18.8-19.0	Thoongumoonji	19	1
7		Thoongumoonji	21	1
		Sub Total		29
1		Amanaku<10		11
2	19.0-19.2	Veppa Maram		1
3		Nura		1
		Sub Total		13
1		Beech	21	1
2	19.2-19.4	Beech<10	-	6
3		Veppa Maram		4
		Sub Total		11
1		Maa	11	2
2	19.8-20.0		13	1
3		Nura<10	-	2
4		Pappaali<10	-	3
		Sub Total		8
1		Maa<10	-	1
2	20.0-20.2	Nura<10	-	2
3		Vaagai<10	-	1
		Sub Total		4
1	20.2-20.8	Karuvai(12)<10	-	1
		Sub Total		1
1	20.8-21.0	Karuvai(16)<10		1
		Sub Total		1
1	21.0-21.2	Erukan<10		4
		Sub Total		4
1	21.2-21.4	Karuvai(17)<10	-	1
		Sub Total		1
1	21.4-21.6	Karuvai<10		10
		Sub Total		10
1	21.6-21.8	Karuvai<10		6
		Sub Total		6
1	22.0-22.2	Nura<10	-	4
		Sub Total		4
1	22.4-22.6	Karuvai<10		4
2		Nura		3
		Sub Total		7
1	22.8-23.0	Nura<10	-	3
2		Thoongumoonji<10	-	1
		Sub Total		4
1		Amanaku(20)<10	-	1
2	23.0-23.2	Beech	14	1
3		Karuvai<10		5

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
4		Nura		2
5	23.0-23.2	Nura<10	-	1
Sub Total				10
1	23.6-23.8	Karuvai(16)<10		1
Sub Total				1
1	23.8-24.0	Karuvai(20)<10	-	1
2		Natukaruvai<10	-	1
Sub Total				2
1	24.0-24.2	Beech	20	1
2		Veppa Maram		3
Sub Total				4
1	24.2-24.4	Karuvai<10		3
Sub Total				3
1	24.4-24.6	Karuvai<10		4
Sub Total				4
1	24.6-24.8	Karuvai<10		6
2		Katamuni<10	-	12
Sub Total				18
1	24.8-25.0	Beech<10	-	4
2		Karuvai<10		10
Sub Total				14
1	25.0-25.2	Karuvai<10		6
Sub Total				6
1	25.4-25.6	Beech	14	1
2		Karuvai<10	-	12
3		Maa	13	1
4		Nura		1
Sub Total				15
1	25.6-25.8	Karuvau(20)<10	-	1
Sub Total				1
1	25.8-26.0	Konai	15	1
Sub Total				1
1	26.0-26.2	Beech	19	1
2		Karuvai(14)<10	-	1
3		Karuvai<10		6
Sub Total				8
1	26.2-26.4	Vilampalam	16	1
Sub Total				1
1	26.4-26.6	Karuvai<10		9
2		Vilampalam	14	1
Sub Total				10
1	26.6-26.8	Karuvai(13)<10	-	1
Sub Total				1
1	27.0-27.2	Availi	26	1

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
2		Karuvai(14)<10	-	1
3	27.0-27.2	Karuvai<10		12
4		Veppa Maram		2
5		Nura(20)<10	-	1
		Sub Total		17
1	27.2-27.4	Nura		3
2		Nura(15)	-	1
		Sub Total		4
1	27.6-27.8	Athi<10	-	10
2		Beech<10	-	1
3		Bhir<10	-	1
4		Veppa Maram<10		2
5		Otheyan<10	-	1
		Sub Total		15
1	27.8-28.0	Karuvai<10		6
2		Veppa Maram		1
		Sub Total		7
1	28.0-28.2	Karuvai<10		4
		Sub Total		4
1	28.2-28.4	Beech	19	1
2			23	1
3			28	2
4		Karuvai<10		12
		Sub Total		16
1	28.4-28.6	Bhir<10	-	1
2		Karuvai<10		9
3		Nura<10	-	1
		Sub Total		11
1	28.6-28.8	Karuvai	13	1
		Sub Total		1
1	28.8-29.0	Nura<10	-	4
2		Vaagai	17	1
3		Vaagai	20	1
		Sub Total		6
1	29.0-29.4	Karuvai(25)<10	-	1
		Sub Total		1
1	29.2-29.4	Beech(20)<10	-	1
2		Bhir	17	1
3		Veppa Maram		1
4		Veppa Maram<10		1
		Sub Total		4
1	29.4-29.6	Beech<10	-	3
2		Karuvai<10		18
3		Nura<10	-	5

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
4		Thoongumoonji	20	1
Sub Total				27
1	29.6-29.8	Karuvai(19)<10	-	1
Sub Total				1
1	29.8-30.0	Beech	20	1
2		Karuvai(15)<10	-	1
3		Thoongumoonji	14	1
4		Thoongumoonji	19	1
Sub Total				4
1	30.0-30.2	Beech<10	-	6
2		Karuvai<10		10
3		Nura<10	-	9
Sub Total				25
1	30.2-30.4	Banyan	25	1
2		Beech	12	1
3		Bhir	15	1
4		Bhir	20	1
5		Bhir	27	1
6		Natukaruvai	27	1
7		Thoongumoonji	16	1
Sub Total				7
1	30.4-30.6	Beech	22	1
2		Otheyan	11	1
3		Otheyan	13	1
4		Otheyan	16	1
5		Otheyan	19	2
6		Otheyan	21	1
7		Otheyan	23	1
Sub Total				8
1	30.6-30.8	Beech<10	-	1
2		Karuvai<10		4
3		Thoongumoonji	(Blank)	1
4		Vatha	16	1
Sub Total				7
1	31.0-31.2	Karuvai<10		6
Sub Total				6
1	31.0-32.0	Karuvai<10		6
2		Thoongumoonji<10	-	1
Sub Total				7
1	31.2-31.4	Veppa Maram<10		2
Sub Total				2
1	31.4-31.6	Nura<10	-	1
2		Thoongumoonji<10	-	1
Sub Total				2

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
1	31.6-31.8	Veppa Maram		1
2	31.6-31.8	Veppa Maram<10		1
3		Thoongumoonji<10	-	2
Sub Total				4
1	32.0-32.2	Beech	-	1
2		Karuvai<10		4
3		Nura<10	-	4
4		Thekku	26	1
5		Thoongumoonji	18	1
6		Thoongumoonji	21	2
7		Thoongumoonji	26	1
Sub Total				14
1	32.4-32.6	Thoongumoonji	20	1
2		Thoongumoonji	21	1
3		Thoongumoonji	28	1
Sub Total				3
1	32.6-32.8	Karuvai(21)<10	-	1
2		Thoongumoonji	12	1
Sub Total				2
1	32.8-33.0	Thoongumoonji	18	1
Sub Total				1
1	33.0-33.2	Karuvai<10		9
Sub Total				9
1	33.2-33.4	Karuvai<10		7
Sub Total				7
1	33.4-33.6	Karuvai<10		6
2		Nura<10	-	1
Sub Total				7
1	34.0-34.2	Veppa Maram		1
2		Nura		1
Sub Total				2
1	34.2-34.4	Karuva<10	-	6
Sub Total				6
1	34.4-34.6	Beech<10	-	2
Sub Total				2
1	34.8-35.0	Jack	28	1
2		Karuvai(14)<10	-	1
3		Karuvai<10		6
Sub Total				8
1	35.0-35.2	Karuvai(15)<10	-	1
Sub Total				1
1	35.2-35.4	Athi(20)<10	-	1
Sub Total				1
1	35.4-35.6	Athi<10	-	10

Sr. No.	Chainage	Tree Name	Width In m	No. of Trees
Sub Total				10
1	35.6-35.8	Athi<10	-	2
2		Erukan<10		6
Sub Total				8
Grand Total				1177

Girth Wise List of Trees(< 30 cm) within RoW for Transplantation on Vridhachalam-Bhuvanagiri Road(SH-70)
Right Hand Side

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
1	0.0-0.2	Malai Veampu (Pol)<10	-	1
2		Veppa Maram	21	1
Sub Total				**2**
1	0.2-0.4	Karuvai<10	-	9
Sub Total				**9**
1	0.4-0.6	Arasan	12	1
2		Karuvai<10	-	3
3		Veppa Maram	12	1
4		Vaagai	10	1
5		Vatha	15	1
Sub Total				**7**
1	0.6-0.8	Beech	28	1
2		Nathiya Veatai	25	1
3			27	1
0.6-0.8 Total				**3**
1	0.8-1.0	Karuvai<10	-	3
Sub Total				**3**
1	1.0-1.2	Anali<10	-	1
2		Beech	15	1
3		Beech<10	-	1
4		Karuvai	21	1
5		Konala Marugai	26	1
6		Manjal arali	20	1
7		Veppa Maram	16	1
8		Veppa Maram	19	1
9		Veppa Maram	22	1
10		Nura	11	1
Sub Total				**10**
1	1.2-1.4	Karuvai<10	-	6
Sub Total				**6**
1	1.4-1.6	Nura <10	-	2
Sub Total				**2**
1	1.6-1.8	Nura	28	1
Sub Total				**1**
1	2.0-2.2	Athi<10	-	7
2		Beech<10	-	1
3		Karuvai<10	-	6
4		Nura<10	-	5
Sub Total				**19**
1	2.2-2.4	Karuvai<10	-	10
2		Veppa Maram	27	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
Sub Total				**11**
1	2.4-2.6	Karuvai<10	-	12
Sub Total				**12**
1	2.6-2.8	Ethi<10	-	2
2		Veppa Maram	29	1
Sub Total				**3**
	2.8-3.0	Kotai mathu	-	1
				1
1		Veppa Maram	12	1
2		Veppa Maram	19	1
3		Veppa Maram	23	1
4		Veppa Maram	29	1
5		Veppa Maram<10	-	2
6		Nura	11	1
7		Nura<10	-	4
Sub Total				**11**
1	3.0-3.2	Nura	28	1
2		Vatha	14	1
Sub Total				**2**
1	3.4-3.6	Amanaku<10	-	7
Sub Total				**7**
1	3.6-3.8	Karuvai<10	-	14
Sub Total				**14**
1	3.8-4.0	Beech	26	1
2		Murungakkai	28	1
3		Karuvai<10	-	16
4		Veppa Maram	17	1
5		Veppa Maram	25	1
6		Veppa Maram	29	1
7		Nura	27	2
8		Nura<10	-	3
Sub Total				**26**
1	4.2-4.4	Beech<10	-	2
2		Karuvai(15)<10	-	1
3		Vatha	25	1
4		Vatha	29	1
Sub Total				**5**
1	4.4-4.6	Karuvai<10	-	2
2		Veppa Maram	26	1
Sub Total				**3**
1	4.6-4.8	1/2goose berry	22	1
2		Beech	23	1
3		Beech	26	1
4		Beech	27	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
5		Seethapazham	28	1
Sub Total				**5**
1	4.8-5.0	Murungakkai<10	-	2
2		Otheyan	20	1
3		Pappaali	21	1
Sub Total				**4**
1	5.2-5.4	Beech	19	1
Sub Total				**1**
1	5.4-5.6	Malai Veampu	27	1
Sub Total				**1**
1	5.6-5.8	Kotai mathu	21	1
2		Veppa Maram	19	1
3		Veppa Maram	20	1
4		Nura	17	1
Sub Total				**4**
1	5.8-6.0	Beech<10	-	1
2		Karuvai<10	-	6
3		Nura<10	-	3
Sub Total				**10**
1	6.0-6.2	Karuvai<10	-	6
2		Nura	25	1
Sub Total				**7**
1	6.4-6.6	Karuvai<10	-	12
Sub Total				**12**
1	6.6-6.8	Karuvai<10	-	9
Sub Total				**9**
1	6.8-7.0	Karuvai<10	-	4
2		Nura	27	1
3		Thoongumoonji	-	1
Sub Total				**6**
1	7.2-7.4	Karuvai<10	-	12
Sub Total				**12**
1	7.4-7.6	Karuvai<10	-	2
2		Veppa Maram	25	1
3		Nura	19	1
Sub Total				**4**
1	7.6-7.8	Karuvai<10	-	6
Sub Total				**6**
1	7.8-8.0	Veppa Maram	22	1
Sub Total				**1**
1	8.0-8.2	Amanaku<10	-	2
Sub Total				**2**
1	8.2-8.4	Beech	23	1
2		Karuvai<10	-	9

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
3		Veppa Maram	27	1
	Sub Total			**11**
1	8.4-8.6	Karuvai	-	2
	Sub Total			**2**
1	8.6-8.8	Karuvai<10	-	10
2		Veppa Maram	16	1
	Sub Total			**11**
1	9.0-9.2	Veppa Maram	25	1
	Sub Total			**1**
1	9.2-9.4	Karuvai<10	-	10
	Sub Total			**10**
1	9.4-9.6	Katakaruvai<10	-	6
2		Koduka pali	27	1
	Sub Total			**7**
1	9.6-9.8	Karuvai<10	-	10
2		Veppa Maram	18	1
	Sub Total			**11**
1	9.8-10.0	Karuvai (14)	-	1
2		Veppa Maram	20	1
3		Unknown	22	1
4		Otheyan	27	1
	Sub Total			**4**
1	10.0-10.2	Veppa Maram	19	1
2		Veppa Maram	26	1
	Sub Total			**2**
1	10.2-10.4	Karuvai<10	-	12
2		Katamuni	-	1
3		Nura	23	1
4		Nura<10	-	1
	Sub Total			**15**
1	10.8-11.0	Veppa Maram	21	1
2		Veppa Maram	24	1
	Sub Total			**2**
1	11.0-11.2	Karuvai(16)<10	-	1
	Sub Total			**1**
1	11.2-11.4	Karuvai	-	1
2		Veppa Maram	25	1
	Sub Total			**2**
1	**11.4-11.6**	Kotaimathu<10	-	4
2		Veppa Maram	16	1
	Sub Total			**5**
1	11.6-11.8	Karuvai<10	-	6
2		Kotao monaki	23	1
3		Veppa Maram	21	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
4		Veppa Maram	23	1
5	11.6-11.8	Veppa Maram	25	1
6		Nura	21	1
7		Thekku	12	1
Sub Total				**12**
1	11.8-12.0	Karuvai<10	-	7
Sub Total				**7**
1	12.0-12.2	Veppa Maram	23	1
Sub Total				**1**
1	12.4-12.6	Beech	17	1
2		Seethapazham<10	-	1
3		Veppa Maram	20	1
4		Veppa Maram	-	2
5		Nura	28	1
6		Pappaali	-	2
Sub Total				**8**
1	13.0-13.2	Veppa Maram	25	2
Sub Total				**2**
1	13.2-13.4	Veppa Maram	27	1
Sub Total				**1**
1	13.4-13.6	Karuvai(12)<10	-	1
2		Veppa Maram	28	1
Sub Total				**2**
1	13.6-13.8	Karuvai<10	-	9
2		Nura<10	-	4
Sub Total				**13**
1	13.8-14.0	Karuvai(24)<10	-	1
2		Veppa Maram	19	1
3		Veppa Maram	26	1
4		Thoongumoonji	28	1
Sub Total				**4**
1	14.0-14.2	Veppa Maram<10	-	2
2		Nura<10	-	6
Sub Total				**8**
1	14.2-14.4	Karuvai<10	-	3
Sub Total				**3**
1	14.4-14.6	Karuvai<10	-	4
Sub Total				**4**
1	14.8-15.0	Karuvai<10	-	4
2		Kotaimathu<10	-	2
Sub Total				**6**
1	15.0-15.2	Karuvai<10	-	6
Sub Total				**6**
1	15.2-15.4	Karuvai<10	-	4

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
Sub Total				**4**
1	15.4-15.6	Karuvai<10	-	15
2		Natukaruvai	21	1
Sub Total				**16**
1	15.8-16.0	Karuvai<10	-	9
2		Veppa Maram	12	1
Sub Total				**10**
1	16.0-16.2	Veppa Maram	14	1
2		Veppa Maram	20	1
3		Veppa Maram	24	1
4		Veppa Maram	25	1
5		Veppa Maram	26	1
6		Veppa Maram	27	1
7		Veppa Maram	28	2
8		Veppa Maram<10	-	2
9		Nura<10	-	14
Sub Total				**24**
1	16.2-16.4	Karuvai(19)<10	-	1
2		Veppa Maram	12	1
3		Veppa Maram	16	1
4		Veppa Maram	19	1
5		Veppa Maram	23	1
6		Veppa Maram	26	1
7		Nura	11	1
Sub Total				**7**
1	16.4-16.6	Vaagai	-	1
Sub Total				**1**
1	16.6-16.8	Amanaku<10	-	9
2		Karuvai(14)<10	-	1
3		Pappaali	24	1
Sub Total				**11**
1	16.8-17.0	Karuvai(19)<10	-	1
Sub Total				**1**
1	17.0-17.2	Karuvai<10	-	9
2		Nura<10	-	1
Sub Total				**10**
1	17.2-17.4	Karuvai	-	1
Sub Total				**1**
1	17.4-17.6	(blank)	(blank)	
Sub Total				
1	17.6-17.8	Katamuni(14)<10	-	1
Sub Total				**1**
1	17.8-18.0	Veppa Maram	16	1
2		Veppa Maram	28	1
3		Veppa Maram<10	-	4

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
4		Nura	18	1
Sub Total				**7**
1	18.0-18.2	Karuvai(16)<10	-	1
2		Nura	11	1
3		Nura	13	1
4		Nura<10	-	10
Sub Total				**13**
1	18.2-18.4	Nura<10	-	4
Sub Total				**4**
1	18.4-18.6	Bhir<10	-	1
2		Karuvai<10	-	10
3		Veppa Maram<10	-	1
4		Nura	19	1
5		Nura<10	-	10
Sub Total				**23**
1	18.6-18.8	Veppa Maram	25	1
2		Unknown	28	1
3		Nura	22	1
Sub Total				**3**
1	18.8-19.0	Bhir<10	-	2
2		Veppa Maram	19	1
3		Veppa Maram	21	1
4		Veppa Maram	27	1
5		Veppa Maram	28	2
6		Veppa Maram<10	-	1
7		Nura<10	-	4
8		Thoongumoonji	26	1
9		Thoongumoonji<10	-	2
Sub Total				**15**
1	19.0-19.2	Nura	13	1
Sub Total				**1**
1	19.2-19.4	Karuvai<10	-	13
2		Katamuni(14)<10	-	1
3		Koduka pali	28	1
4		Veppa Maram	16	1
5		Veppa Maram	17	1
6		Veppa Maram	28	1
7		Nura	19	1
8		Nura	0	1
9		Nura	24	1
10		Nura	26	2
11		Nura<10	-	4
Sub Total				**27**
1	19.6-19.8	Veppa Maram	20	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
2		Veppa Maram	21	1
3	19.6-19.8	Veppa Maram	23	1
4		Veppa Maram	25	2
5		Nura	11	1
6		Nura	14	1
7		Nura	15	1
8		Nura	20	1
9		nura	21	1
10		Otheyan	16	1
11		Thoongumoonji	18	1
Sub Total				**12**
1	19.8-20.0	Maa	12	1
2		Maa	14	1
Sub Total				**2**
1	20.2-20.10	Karuvai<10	-	1
Sub Total				**1**
1	20.2-20.4	Pappaali<10	-	2
Sub Total				**2**
1	20.2-20.5	Karuvai<10	-	1
2		Maa	-	1
Sub Total				**2**
1	20.2-20.6	Karuvai<10	-	1
2		Maa	14	1
Sub Total				**2**
1	20.2-20.7	Karuvai<10	-	2
Sub Total				**2**
1	20.2-20.9	Karuvai<10	-	1
Sub Total				**1**
1	20.4-20.10	Karuvai<10	-	1
Sub Total				**1**
1	20.4-20.11	Karuvai<10	-	1
Sub Total				**1**
1	20.4-20.6	Thoongumoonji	11	1
Sub Total				**1**
1	20.4-20.7	Karuvai<10	-	1
2		Pappaali	20	1
Sub Total				**2**
1	20.4-20.8	Karuvai<10	-	1
2		Thoongumoonji	19	1
Sub Total				**2**
1	20.4-20.9	Karuvai<10	-	1
Sub Total				**1**
1	20.8-21.0	Karuvai<10	-	9
Sub Total				**9**

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
1	21.0-21.2	Amanaku<10	-	6
		Sub Total		**6**
1	21.2-21.4	Karuvai(16)<10	-	1
2		Otheyan	27	1
		Sub Total		**2**
1	21.4-21.6	Koyyaa	12	1
2		Koyyaa	24	1
3		Karuvai(20)<10	-	1
4		Otheyan	17	1
		Sub Total		**4**
1	21.8-22.0	Amanaku<10	-	4
		Sub Total		**4**
1	22.0-22.2	Beech	22	1
2		Kotaimathu<10	-	10
3		Veppa Maram	24	1
		Sub Total		**12**
1	22.2-22.4	Availi	14	1
		Sub Total		**1**
1	22.4-22.6	Karuvai<10	-	6
		Sub Total		**6**
1	22.6-22.8	Nura	11	1
		Sub Total		**1**
1	23.0-23.2	Karuvai<10	-	6
		Sub Total		**6**
1	23.6-23.8	Amanaku<10	-	8
2		Karuvai(17)<10	-	1
		Sub Total		**9**
1	23.8-24.0	Maa	28	1
		Sub Total		**1**
1	24.0-24.2	Karuvai<10	-	6
2		Veppa Maram	20	1
3		Nura	24	1
		Sub Total		**8**
1	24.2-24.4	Beech	26	1
2		Karuvai<10	-	6
3		Mathulai	20	1
4		Sewakku	19	1
		Sub Total		**9**
1	24.4-24.6	Karuvai	-	1
2		Natukaruvai	-	1
		Sub Total		**2**
1	24.6-24.8	Karuvai<10	-	12
		Sub Total		**12**
1	24.8-25.0	Karuvai<10	-	11

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
2		Veppa Maram<10	-	1
Sub Total				**12**
1	25.0-25.2	Beech	26	1
2		Erukan	-	1
Sub Total				**2**
1	25.2-25.4	Beech<10	-	4
Sub Total				**4**
1	25.6-25.8	Beech	11	1
2		Beech	12	1
3		Beech	14	1
4		Karuvau(19)<10	-	1
Sub Total				**4**
1	25.8-26.0	Beech<10	-	4
2		Bhir	17	1
3		Murungakkai	16	1
4		Karuvai<10	-	1
5		Nura	26	1
6		Nura<10	-	3
Sub Total				**11**
1	26.0-26.2	Beech<10	-	4
2		Karuvai<10	-	10
Sub Total				**14**
1	26.2-26.4	Karuvai(16)<10	-	1
2		Nura	20	1
Sub Total				**2**
1	26.4-26.6	Karuvai<10	-	4
Sub Total				**4**
1	26.6-26.8	Karuvai(13)<10	-	1
Sub Total				**1**
1	26.8-27.0	Beech	23	1
2		Karuvai(16)<10	-	2
3		Veppa Maram	17	1
4		Veppa Maram	19	1
5		Veppa Maram	21	1
6		Veppa Maram	26	1
7		Veppa Maram<10	-	12
8		Nura<10	-	4
9		Thoongumoonji	20	1
Sub Total				**24**
1	27.0-27.2	Karuvai<10	-	9
2		Veppa Maram	27	1
Sub Total				**10**
1	27.2-27.4	Nura	28	1
Sub Total				**1**

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
1	27.4-27.6	Karuvai<10	-	7
2	27.4-27.6	Veppa Maram	25	1
3		Veppa Maram	-	4
4		Nura	15	1
5		Nura	17	1
6		Nura	20	1
7		Nura	21	1
Sub Total				**18**
1	27.6-27	Karuvai	22	1
2		Nura(20)<10	-	1
Sub Total				**2**
1	27.8-28.0	Otheyan	14	1
Sub Total				**1**
1	28.0-28.2	Beech	21	1
2		Beech	26	1
3		Beech	28	1
4		Veppa Maram	25	1
Sub Total				**4**
1	28.6-28.8	Beech	21	1
2		Veppa Maram<10	-	1
Sub Total				**2**
1	28.8-29.0	Beech	25	1
2		Beech<10	-	2
3		Karuvai<10	-	6
4		Nura	-	4
Sub Total				**13**
1	29.0-29.2	Vaagai	27	1
Sub Total				**1**
1	29.2-29.4	Karuvai<10	-	1
Sub Total				**1**
1	29.4-29.6	Nura	21	1
2		Nura	25	1
3		Nura	27	1
4		Povarsan	27	1
5		Puliyai Maram	28	1
Sub Total				**5**
1	29.6-29.8	Availi	20	1
2		Puliya Maram	20	1
3		Puliya Maram	23	1
4		Puliya Maram	25	1
5		Puliya Maram	28	2
Sub Total				**6**
1	29.8-30.0	Natukaruvai	17	1
2		Puliya Maram	11	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
3		Puliya Maram	15	1
4	29.8-30.0	Puliya Maram	20	2
5		Puliya Maram	22	1
6		Puliya Maram	23	1
7		Puliya Maram	25	1
8		Puliya Maram	26	1
9		Puliya Maram	27	1
10		Puliya Maram	28	2
11		Vaagai	21	1
Sub Total				**13**
1	30.2-30.4	Karuvai(17)<10	-	1
Sub Total				**1**
1	30.4-30.6	Amanaku	17	1
2		Beech	21	1
3		Beech	24	1
Sub Total				**3**
1	30.6-30.8	Karuvai(16)<10	-	1
Sub Total				**1**
1	30.8-31.0	Karuvai<10	-	2
Sub Total				**2**
1	31.0-31.2	Avarasan	28	1
2		Karuvai<10	-	4
Sub Total				**5**
1	31.0-32.0	Veppa Maram	14	1
2		Veppa Maram	20	1
3		Veppa Maram<10	-	1
Sub Total				**3**
1	31.4-31.6	Beech	18	1
2		Beech<10	-	1
3		Veppa Maram	16	1
4		Veppa Maram	23	1
5		Veppa Maram	26	2
6		Nura	21	3
7		Nura	24	1
8		Nura	27	1
Sub Total				**9**
1	31.6-31.8	Veppa Maram	12	1
2		Veppa Maram<10	-	5
3		Thoongumoonji<10	-	1
Sub Total				**7**
1	32.0-32.2	Karuvai<10	-	16
2		Puliya Maram	19	1
3		Puliya Maram	20	1
4		Puliya Maram	21	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
5		Puliya Maram	22	1
6		Puliya Maram	23	1
7		Puliya Maram	25	1
8	32.0-32.2	Puliya Maram	26	2
9		Puliya Maram	27	1
10		Puliya Maram	28	1
Sub Total				**26**
1		Beech	20	1
2		Veppa Maram	21	1
3	32.4-32.6	Puliya Maram	23	1
4		Puliya Maram	24	1
5		Vaaga	24	1
Sub Total				**5**
1		Karuvai(15)<10	-	1
2	32.6-32.8	Puliya Maram	20	2
3		Puliya Maram	21	1
4		Puliya Maram	22	1
Sub Total				**5**
1		Availi	19	1
2		Avalli	24	1
3		Puliya Maram	14	1
4	32.8-33.0	Puliya Maram	16	1
5		Puliya Maram	20	1
6		Puliya Maram	21	1
7		Puliya Maram	24	1
Sub Total				**7**
1	33.0-33.2	Puliyai Maram	16	1
2		Thoongumoonji	12	1
Sub Total				**2**
1	33.2-33.4	Veppa Maram	14	1
Sub Total				**1**
1	33.4-33.6	Nura	26	1
Sub Total				**1**
1	33.6-33.8	Karuvai<10	-	7
Sub Total				**7**
1	33.8-34.0	Karuvai<10	-	4
Sub Total				**4**
1	34.4-34.6	Beech<10	-	3
Sub Total				**3**
1	34.6-34.8	Athi(20)<10	-	1
2		Karuvai(17)<10	-	1
Sub Total				**2**
1	34.8-35.0	Veppa Maram	12	1
2		Nura	17	1

Sl. No.	Chainage	Tree Name	Width in m	No. Of Trees
3		Otheyan	20	1
Sub Total				**3**
1	35.0-35.2	Karuvai<10	-	12
2		Malai Veampu	26	1
3		Veppa Maram	19	1
4		Veppa Maram	20	1
Sub Total				**17**
1	35.2-35.4	Seethapazham	17	1
2		Seethapazham	20	2
3		Seethapazham	21	1
4		Seethapazham	24	2
5		Seethapazham	26	1
6		Veppa Maram	18	1
7		Sempathai	15	1
Sub Total				**9**
1	35.4-35.6	Athi<10	-	3
2		Karuvai<10	-	4
Sub Total				**7**
Grand Total				**990**

ANNEXURE 5.1: PHOTO PLATE OF STAKEHOLDER CONSULTATION & ATTENDANCE FOR PROJECT ROADS

A. CONSULTATIONS AT MADAPATTU-THIRUKOVILUR ROAD

News Paper Clipping of Stakeholder Consultation in Local Daily

தினமலர்
புதுச்சேரி ■ திங்கள் ■ ஜூன் 30, 2014

கடலூார்-சித்தூார் சாலையில் திருக்கோவிலூாரில் அமையவுள்ள பைபாஸ் சாலை குறித்து, சமூக மற்றும் சுற்றுச்சூழல் குறித்த ஆலோசனை கூட்டம் நடந்தது.

பைபாஸ் சாலை அமைப்பு சுற்றுச்சூழல் ஆலோசனை கூட்டம்

திருக்கோவிலூார், ஜூன் 30- கடலூார் - சித்தூார் சாலையில் திருக்கோவிலூாரில் அமையவுள்ள பைபாஸ் சாலை குறித்து, சமூக மற்றும் சுற்றுச்சூழல் குறித்த ஆலோசனை கூட்டம் நடந்தது.

கடலூார் - சித்தூார் சாலையில் முதல் கட்டமாக கடலூாரில் இருந்து திருக்கோவிலூார் வரை சாலையை, அகலப்படுத்தும் பணியை, தமிழ்நாடு சாலை மேம்பாட்டு திட்டம் செயல்படுத்த உள்ளது.

இதற்காக திருக்கோவிலூாரில் பைபாஸ் சாலை அமைக்கப்படவுள்ளது. கொளப்பாக்கத்தில் துவங்கி காட்டுப்பையூர், கச்சிக்குச்சான், எரவலம் கிராம எல்லை வழியாக, அரும்பாக்கம் சென்று ஆற்காடு- துாத்துக்குடி சாலை பைபாசில் இணைகிறது.

சாலை அமைக்க வடிவமைப்பு பணியில் தனியார் நிறுவனம் ஈடுபட்டுள்ளது. இதனால் ஏற்படும் பாதிப்புகள், அதற்கான தீர்வு குறித்து சமூக மற்றும் சுற்றுச் சூழல் ஆலோசனை கூட்டம் கொளப்பாக்கம் ஊராட்சி ஒன்றிய நிதி உதவி நடுநிலைப் பள்ளியில் நடந்தது.

சமூக ஆய்வாளர் சந்திரசேகரன் வரவேற்றார். விருத்தாசலம் கோட்ட நெடுஞ்சாலைத்துறை ஏ.டி.இ., ஸ்டெல்லாமேரி முன்னிலை வகித்தார். சுற்றுச்சூழல் ஆய்வாளர் சீனிவாச வர்மா பேசினார்.

ஊராட்சி தலைவர்கள் சேகர், மூர்த்தி, அலமேலு அம்மாசி, வீரட்டகரம் முன்னாள் தலைவர் பெருமாள் உட்பட பலர் கலந்து கொண்டனர்.

நிகழ்ச்சி ஏற்பாடுகளை சமூக ஆர்வலர்கள் கருணா, சந்திரசேகரன் செய்திருந்தனர்.

Attendance of Stakeholder Consultation at Sarvanapakkam (km 46+600)

TNRSP

தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014

இடம்: சரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
01	V. திருசங்கு	9159182137	V. திருசங்கு
02	T. சுதாகர்	9677421542	T. [illegible]
03	D. ராஜா	9626934639	D Raju
04	M. குமரவேல்	9842484239	M [illegible]
05	K. ஏழுமலை	9943418933	
06	P. Thirumalai	9943831615	[illegible]
07	D. [illegible]	[illegible]	D. [illegible]
08	[illegible]	9751541557	[illegible]
09	S. தங்கவேல்	9047110038	S. Thangavel
10	[illegible]	8220817570	[illegible]

TNRSP

தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: சிரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
11	[illegible]	9751704886	
12	G. PAVADAI	9566387249	
13	N-அம்பலவாணன்.	9943037544	
14	A-பழனிசாமி	7639948665	
15	S. [illegible]	9585068095	
16	[illegible]. ராஜேந்திரன்	9751972970.	
17	பழனி		
18	A. [illegible]		
19	[illegible]		
20	M. MUTHU KUMAR.	9965835775	M. [illegible]

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014	இடம்: சிரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
21	A.குமார்	9629217103	AKumar
22	பதஞ்சைமூர்த்தி		பதஞ்சைமூர்த்தி
23	ஆறுமுகம்	9655229634	ஆறுமுகம்
24	S செல்வராஜ்	9443481350	S. செல்வராஜ்
25	S முருகன்	9786728846	S. முருகன்
26	A. ARUN KUMAR	8695821538	A. Arun Kumar.
27	R.தெய்வநாயகி		R.தெய்வநாயகி
28	V. CHITRA	9786890938	V. Chitra
29	B-செல்வை	9843788224	B-செல்வை
30	தமிழரசி		தமிழரசி

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: சரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
31.	அம்சவள்ளி		அம்பூவள்ளி
32.	P. கலையரசி	9943030295	P. கலையரசி.
33.	S. ஜெயலட்சுமி	9943180854	S. ஜெயலட்சுமி
34.	K ஜமலா	9585928854	K ஜமலா
35.	P. கலையரசி	9655065721	P. கலையரசி
36.	வள்ளியம்மாள்		
37.	அல்லி	9943095176	அல்லி
38.	வள்ளி		வள்ளி
39.	சந்திரா		சந்திரா
40.	ஞானம்	9943858988	ஞானம்

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: சிரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
41.	பூரணி		
42.	C. ஆனந்தன்	9500279414	C. ஆனந்தன்
43.	HARIKRISHNA	9789540303	HARIKRISHNA
44.	C. [illegible]	9942824570	[illegible]
45.	S.M. வெங்கடேசன்	[illegible]	S.M. வெங்கடேசன்
46.	R. நாராயணசாமி	9843795096	R. நாராயணசாமி
47.	S. [illegible]மூர்த்தி	9943858788	S. [illegible]மூர்த்தி
48.	ஜெ. மணிகண்டன்	9976680891	ஜெ. மணிகண்டன்
49.	n. [illegible]	[illegible]	n. [illegible]
50.	[illegible]		[illegible]

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

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ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014	இடம்: சிரவணம்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
51.	சி. அர்ஜுனன்	9751459402	சி. அர்ஜுனன்
52.	ராஜா	8012407527	ராஜா
53.	K. முருகன்	9585822567	[illegible]
54.	K. ராமச்சந்திரன்	9159177550	K. [illegible]
55.	K. சிவயன்		சிவயன்
56.	A சிவயன்	— —	A சிவயன்
57.	K. Amirthalingam	8344813203	K. Amirthalinga
58.	K. கண்முருகன்	8940107812	கண்முருகன்
59.	K. Ramachandran	—	K. Ramachandran
60.	K. Ramesh	9843791343	K. Ramesh

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சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014	இடம்: சரவணப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
61.	Er. K. STELLA ROSELIN MARY ADE(H), TNRSP, Vdm.	9486075496	
62.	A.V. KARUNA Social Expert	9443228088	
63.	K.Chandrasekaran, Social Expert	9840441427	
64.	Manish kumar, Env. Speci	9868098787	
65.	S.N. Varma Environment Specialist	0981122448	
66.	A. Sivagnam Subramanian	9025560054	
67.	V. Chandrasekaran Social Development Specialist	9444001696	

Attendance of Stakeholder Consultation at Kolapakkam (km 65+000)

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ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: ஆதி கொளப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
01	ஜெ. சின்னதுரை, ஆதிகொளப்பாக்கம்	9095859939	ஜெ. சின்னதுரை
02.	R. பரமசிவம் ஆதி கொளப்பாக்கம்	9626965693	R.P-[illegible]
03.	R. முருகன் ஆதி. கொளப்பாக்கம்	9750185747	R. Murug[illegible]
04.	R. IYYAPPAN ஆதி. கொளப்பாக்கம்	9976388179	IYYAPPAN
05.	G. [illegible] = ஆதிகொளப்பாக்கம்	9655606296	
06.	R, [illegible]	ஆதிகொளப்பாக்கம்	9865161164
07.	[illegible]	9750136450	
08.	காசிவேல், கொளப்பாக்கம்		N. காசிவேல்
09.	மகேந்திரன்	9965624214	[illegible]
10	P. [illegible] ஆதிகொளப்பாக்கம்	9047372589 -	P. [illegible]

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

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ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014	இடம்: ஆவி கொளப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
11.	K கோவிந்தன்	9945167491	K கோவிந்தன்
12.	I கேசவன்	9655611818	I கேசவன்
13.	ஜெ.பாலராஜ்	9943776211	ஜெ.பாலராஜ்
14.	E. காத்தவராயன்	9176906169	E. காத்தவராயன்
15.	மாயன்		மாயவன்
16.	V. SIVALINGAM	9176645288	V. [signature]
17.	V. GUNASEKARAN	9445131802	V. Gunase
18.	D. Kanagaraj	9751542227	D. Kanagaraj
19.	V. கண்ணதாசன்	8925291567	V. கண்ணதாசன்
20.	V. பக்தவச்சலம் - வீரப்பட்டு		V. பக்தவச்சலம்

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சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: ஆவி கொளப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
21.	M. சிவபாலன் ஆவி கொளப்பாக்கம்		M. சிவபாலன்
22.	K காந்தி ஆவி கொளப்பாக்கம்	8015499240	K காந்தி
23.	A. அசோக். ஆவி. கொளப்பாக்கம்	9842516810	A. Ashok
24.	P. இராமசாமி வீரபட்டணம்	9443465772	[illegible]
25.	V. சுப்பிரமணி	9965984890	V. சுப்பிரமணி
26.	அ. மணி பெ. வள்ளி	9159575597	-
27.	K. செல்வராஜ்	85246796	[illegible]
28.	M. வரதன்	—	வரதன்
29.	V. பூமிநாதன்	8015392578	V. Boominathan
30.	R. நடராஜன்: ஆவி. கொளப்பாக்கம்	9843021813	R. நடராஜன்

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ஆலோசனைக் கூட்டம்

நாள்: 28-06-2014 | இடம்: ஆவி கொளப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
31.	VEERATTAGARAM D. PERUMAL	9788095473	[illegible]
32.	S. Perumal Veeratigai	9444273769	S. Perumal
33.	[illegible]		A
34.	G. [illegible]	8508516855	[illegible]
35.	[illegible]		
36.	P. [illegible]	8807211052	P. [illegible]
37.	V. Chandrasekaran Social Development Specialist	9444001696	[illegible]
38.			
39.			
40.			

TNRSP

தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய
ஆலோசனைக் கூட்டம்

நாள்: 28.06.2014 | இடம்: ஆதி கொளப்பாக்கம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & ஊர்	தொலைபேசி எண்	கையொப்பம்
41	N. [illegible] தலைவர் [illegible]	98435163[illegible]	N. [illegible]
42	M. [illegible] [illegible] கொளப்பாக்கம்	85261330042	M [illegible]
43	அலமேலு அம்மாள் தலைவர் [illegible]	8012856138	ஜெயமாலா
44	ராஜீவ்காந்தி	9788666485	ராஜீவ்காந்தி
45	K. கோபி		K. கோபி
46.	Er. K. ஸ்டெல்லா ரோஸ்லின் மேரி.	9486075496.	K. Stella [illegible]
47.	A.V. KARUNA Resettlement Expert	9443228088	[illegible]
48.	K. CHANDRASEKARAN Social Expert	9840441427	[illegible]
49.	S.N. Verma Environmental Expert.	09811224458	[illegible]
50.	Manish kumar, Environmental Specialist.	9868098787	[illegible]

B. CONSULTATIONS AT VRIDHACHALAM- BHUVANAGIRI ROAD








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நாள்: 06/05/2014 இடம்: கோபாலபுரம்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & முகவரி	கையொப்பம்
(1)	T. THIRUMURUGAN, M.E., ADE(H) TNRSP II, VRIDHACHALAM	
(2)	B. AMUTHARASU, AE VDM.	
(3)	SHREENIWAS VERMA	
4)	J. Sasidhar	
5	Manish kumar.	
6	A.V.KARUNA 9443228088	
7	K.CHANDRASEKARAN	

8+500.
Gopalapuram Village

TNRSP

தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய ஆலோசனை கூட்டம்

நாள்: 06/05/2014	இடம்: கோபாலபுரம்

வருகைப் பதிவேடு

S.NO. Name & phone no. Signature

வரிசை எண்	பெயர் & முகவரி	கையொப்பம்
1	சக்திவேல். கோபாலபுரம். 9943062489	G. Sakthi
2	poona Govinda Swamy —	கோவிந்தசாமி
3	K. பாலமுருகன் கோபாலபுரம் 8220011774	K. Balamuru.
4	K. [illegible] கோபாலபுரம் 9095441545	R. [illegible]
5	B. செல்வம்	B செல்வம்
6	R. தெய்வசிகாமணி	R. தெய்வசிகாமணி
7	A. Rasa Kumar	A. Rasa Kumar
8	P. மணிக்கவேல்ராஜ்	P. மணிக்கவேல்ராஜ்
9	A. நாகராஜன் 9629191454	A. நாகராஜன்
10	S. சுப்ரமணியன்	S. சுப்ரமணியன்
11	S. Subairaj S/o சந்திரபாண்டி 9751814494	S. Subairaj
12	M. Chinnappan. 9943630401	[illegible]

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய ஆலோசனை கூட்டம்

நாள்: 06|05|2014 இடம்: கோபாலபுரம்

8+500. Gopalapuram.

வருகைப் பதிவேடு

S.No. Name Mobile No: Signature.

வரிசை எண்	பெயர் & முகவரி	கையொப்பம்
13	வைத்திலிங்கம்	வைத்திலிங்கம்
14	S. அருள்சவரி 8098543060	[illegible]
15	S. Baskar 8220713666	S. Baskar
16	P. Balamurugan	P. Balu
17	R. Rajadurai	[illegible]
18	M. Raja mani	M. Raja mani
19	R. Sankaran	R. Sankaran
20	R. Jayalakshmi	[illegible]
21	G. Thailnayagi	[illegible]
22	N. Anbazhagan	N. Anbazhagan
23	E. Alphonse	E. Alph
24	A. Margarette Sheela	A. Margarette Sheela

6-May-2014

Vridhachalam - Parangipettai Road No: 5.

TNRSP

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சமூக மற்றும் சுற்றுச்சூழல் பற்றிய ஆலோசனை கூட்டம்

நாள்: 06/05/2014 இடம்: கோபாலபுரம்

8+500
Gopalapuram.

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & முகவரி	கையொப்பம்
25.	S. Alphonse Mary	மே. அல்போன்ஸ் மேரி
26.	M. Mary Raja Kumari	மை. மேரிராஜகுமாரி
27.	(G. Poonthendral (9884314551)	G. P. Th
28	S. சங்கர்	S. சங்கர்
29.	G. ROY . 9626151923	G. Roy

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தமிழ்நாடு சாலை மேம்பாட்டுத் திட்டம் – II

சமூக மற்றும் சுற்றுச்சூழல் பற்றிய ஆலோசனை கூட்டம்

நாள்: 06/05/2014 | இடம்: எறும்பூர்

வருகைப் பதிவேடு

வரிசை எண்	பெயர் & முகவரி	கையொப்பம்
(1)	T. THIRUMURUGAN, M.E., ADE(H) TNRSP II, VRIDHACHALAM	[signature]
2)	B. AMUTHARASU. B.E AE, VDM	[signature]
3	SHREENIWAS VERMA	[signature]
4	J. Sasidhar	[signature]
5	MANISH KUMAR.	[signature]
6	A.V. KARUNA 9443228088	[signature]
7	K. CHANDRASEKARAN	[signature]

ANNEXURE 8.1: GUIDELINES FOR AGGREGATE QUARRY MANAGEMENT

A.OVERVIEW

A quarry is a type of open-pit mine from which rock or minerals are extracted for building materials, such as dimension stone, construction aggregate, sand, and gravel. Quarrying causes lot of environmental damages like air and noise pollution, water logging etc and requires permission from regulatory authorities like mining department. It requires a careful approach in the site selection process, scientific method of quarrying and appropriate measures to redevelop it.

B.CRITERIA FOR LOCATING THE SITE/S

The selection of a quarry is the sole responsibility of the Contractor and should be undertaken in adherence to the rules & regulations of the authorities. Following criteria should be followed while selecting a quarry site:

To the extent possible barren land or waste lands shall be preferred during site selection and fertile land and agricultural land shall be avoided.

There shall be no quarrying of sand in any river bed or adjoining area or any other area which is located within 500 meters radial distance from the location of any bridge, water supply system, infiltration well or pumping installation of any of the local bodies or Central or State Government Department or any area identified for locating water supply schemes by any of the Government Department or other bodies.

Quarry site shall be located at a minimum distance of: 500 m from any human settlements, public road, railway line, national highway, state highway or major district road.

Stone quarry shall be located at a minimum distance of 50 m from any water body.

Locate the quarry and crusher at a minimum distance of 500 m away from forests / wildlife habitats / mangroves / ecologically sensitive areas.

The minimum distance between two stone crushers should be 1km to avoid dust pollution influence of one over the other.

Stone crushing unit should be distanced for 500 m from the NH or SH or residential area or places of public and religious interests.

Access roads to quarry sites must be wide enough for heavy vehicle movement without inconvenience to local traffic.

After identification of the site, the Contractor should fill up the prescribed reporting format and submit the same for approval to the CSC without which any activity shouldn’t be started on the site.

C.FINALIZATION OF SELECTED SITE/S

After identification of the site, the Contractor should fill up the prescribed reporting format provided in EMAP and submit the same for approval to the CSC. The selected site/s shall be approved by Environmental Engineer of CSC, after considering the compliance with the EMP clauses. No agreements or payments shall be made to the land owner/s (in case of a leased or rented out land) prior to receipt of a written approval from the CSC. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost. After obtaining a written approval from the CSC for the selected site, the Contractor has to enter into an agreement with the landowner to obtain his/her consent before commencing any operation / activities in the land. The agreement should also mention its type, duration, amount and mode of payment as well as the preferences of the owner regarding site maintenance and redevelopment.

D.SETTING UP OF QUARRYING AND STONE CRUSHER

Quarrying involves not only extraction of material (rock) but also crushing and screening that makes the rock suitable for use as construction material. Following are the major parameters to be considered before the start of quarrying and stone crushing operations:

(i)Site preparation: The stripping, stacking and preservation of top soil will be mandatory and absolutely no activity should be allowed prior to the satisfactory completion of this conservation measure as per guidelines in EMAP. The boundary of the quarry should be demarcated using barbed wire fencing in order to avoid the future dispute over land as well as to avoid accidental trespassing of people. There should be recorded documents of exact no of trees cut. Green belt should be provided all along the quarry site to function as both noise attenuators and dust collectors and number of trees planted should not be less than ten times the number of trees cut. Contour trenches should be dug along the borrow area boundary and at any other appropriate places considering the topography to reduce the surface runoff and conserve soil and water. Side slopes shall be constructed with slope drains at applicable locations, to provide drainage and avoid any landslides. All the drainage constructed should be linked to existing drainages in order to avoid flooding and water logging.

(ii)Setting up of a quarry site: The layout of a quarry should provide a gravity flow of material from the face to the crusher, from the crusher to the storage bin and from the bin to the hauling equipment. Adequate arrangements should be made for avoiding fugitive emissions from quarry and crusher premises. This will include (i) housing the noise and dust producing units of the crusher unit in a building with wall of minimum 23 cm thickness and with suitable roofing, (ii) control of air pollution through provision of in-built dust extraction systems in the crusher unit and all transfer points, (iii) a chimney of appropriate height for the DG set (as specified by TNPCB), (iv) water sprinkling facilities for the camp premises, (v) facilities to store water required for 3 days use.

Consent to operate the crusher unit should be obtained from TNPCB under Air (Prevention and Control of Pollution) Act, 1981 before starting the operation.

(iii) Safety aspects: Blasting timings in quarry should be fixed avoiding the rush hours and these timings should be adhered to in order to avoid the conflict between the surrounding communities or population. Provide warning sirens 10 before each explosion as a warning alarm to people in and outside the quarry. Damaged explosives must be disposed off in a safe manner away from the operational area. Speed of the vehicles around the quarry should be restricted to a low speed in order to reduce the noise pollution and dust generation. Workers should not be exposed to sound of more than 85 – 90 dB for more than eight hours a day and shall be provided with adequate safety wears and personal protective equipments like ear muffs / plugs etc as detailed out in EMP. Fire extinguishers should be provided in the site office.

Traffic movements should be restricted along the access road around times that children walk to and from school. Proper first aid facilities should be provided within the site office and in case of an accident, quick access to nearby hospital /clinic should be provided.

(iv) Facilities for workers: Potable drinking water should be provided in the site office in a hygienic environment sufficient for all the people. Adequate no. of toilets shall be provided for the workers with adequate water supply, proper drainage and effluent treatment system like septic tank with soak pit. Soak pit should have a sealed bottom, honey comb wall and 75 cm. thick, 2mm sand envelope around that. The sewage system for the camp must be properly sited, designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place.

(v) Waste Disposal: The Contractor should provide separate garbage bins for biodegradable, non- biodegradable and hazardous wastes in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner. No incineration or burning of wastes shall be carried out by the Contractor. The disposal of any biodegradable matter shall be carried out in pits covered with a layer of earth within the camp site. Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipe scrubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or sold /given out for recycling. POL (petroleum, oil and lubricants) waste shall be disposed off by transfer only to recycler/ re-refiners possessing valid authorization from the Tamil Nadu Pollution Control Board and valid registration from the Central Pollution Control Board. Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.

Quarry areas should be protected from illegal dumping of waste by third parties. The overburden should be kept as minimum to maximize the commercial efficiency of the quarry, it can be utilized for creating earth bunds to mitigate the noise and visual impacts and also for the site rehabilitation process. No quarry waste shall be dumped within a 100 m on either side of the road. The overburden should be reused or disposed properly. Site for overburden disposal should be planned within the quarry site or any other appropriate site.

(vi) Training to workers: Workers shall be trained in smooth and safe operation of plants and equipments, their regular maintenance and various safety measures to be followed as well as about the need and importance for adherence to these measures. All the drivers should be trained about safe driving and should be made aware about the need to observe caution while plying through access roads, especially during the time when children walk to and from school. Conduct education programs with the locals regarding the potential impacts of blasting, blasting warning systems, schedules etc.

(vii)Information dissemination: There should be a sign board of size 6' x 4' mentioning the project details and Contractor's details to disseminate the information to the public. There should be a second sign board displaying the latest air and noise monitoring date and data against the standards specified. Warning sign boards should be set up at the entrance gate for the public as well as at other required places for the workers to alert them about the nature of operation being undertaken.

Other mitigation measures: The quarry should not damage any building, work, property or rights of other persons. The quarry should not alter any right of way, well or tank. Roads inside the crusher premises should be tarred or concreted. Water course, if any, from a higher slope should be properly drained out. Strom water drainage shall be provided to prevent water logging and flooding in and around the area. The possibility of collecting the storm water in a pit or a tank should be explored so that it can be reused for dust suppression and the dependence on other water sources could be reduced. If this is not possible, the water should be safely channeled out of the quarry without disturbing any nearby human settlement. A register should be provided in the camp site for public to record their grievances if any. Environmental monitoring should be conducted as per suggested frequency.

The concerned authority – CSC/ PIU should regularly review the environmental, health and safety aspects. If any adverse effect on environment, habitat and concern of safety is noticed, appropriate measures should be taken as suggested by CSC or should arrange an alternative for road construction materials. In the case of existing quarries and additional quarries, the Contractor has to ensure that all actions in these quarries are in compliance with EMP.

Child Labour: The CSC Environmental Engineer and TNRSP Environmental Specialist will ensure that Contractor does not employ any child labour for quarry operations**.**

E.OPERATION OF QUARRY SITE AND STONE CRUSHING UNIT

No quarrying operation shall be done without the approval from the concerned authority. The equipment used in quarry should be wear faced, which extends the equipment life and reduce the demand for spare parts. Adopt controlled blasting techniques and conduct quarrying in a skillful, scientific and systematic manner. All units should operate only between 6 am and 10 pm. or as specified by TNPCB in the consent letter.

Accessory facilities to be provided in the quarry includes sprinklers to spray water for dousing the dust generation, noise suppressers and rubberized mounting to reduce noise and vibration and tarpaulins or covers over material transporting vehicles. Provide sufficient water storage facility for 2 days' use. Measures have to be taken to reduce the dust generation during drilling operation. Deep wetting of drilling zones also to be done by water sprinkling and drilling machine shall be fitted with dust suppression, collection and disposal arrangements. In case of blasting, the storage and the operation should be as per the regulations. To avoid spillage of fuel and lubricants, the vehicles and equipment should be properly maintained and repaired. Maintenance should be carried out on impervious platforms with spill collection provisions.

Following conditions regarding sound generation should be complied with in a quarry / crusher unit:

The sound level (Leq) measured at a distance of 1 m from the boundary of the site shall not exceed 55 dB(A) during day time (6am - 6pm) and 45 dB(A) during night time (6 pm - 6am).

The DG set shall be provided with exhaust muffler /acoustic enclosure/acoustic treatment with an insertion loss of minimum 25 dB(A) and its emission levels should be within relevant TNPCB guidelines.

A proper, routine and preventive maintenance procedure for the DG set shall be set and followed in consultation with the DG set manufacturer.

F.PREPARATION OF QUARRY MANAGEMENT AND REDEVELOPMENT PLAN

The Contractor after getting approval from the competitive authority for the selected site should submit a detailed Quarry Management Plan comprising the following details:

Section–1: Details of site: Copy of the approved site identification report along with a location plan on a village map or an FMB, showing the site, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use like residences, agricultural land, water bodies etc., photograph of the site showing the topography and other existing features.

Section-2: Site preparation: Activities that should be undertaken for preparing the site based on EMP and this guideline.

Section-3: Arrangements/ facilities within the camp: List of facilities to be set up within the site like site office, store room, rest room, sanitation facilities, etc. and a layout plan showing all these details along with vehicular movement path, green belt, locations were digging of contour trenches should be undertaken etc.

Section-4: Mitigation measures that will be undertaken as per the EMP and this guideline while setting up of the camp and operation of the camp should be separately listed out.

Sectoin-5: Other details: Any other relevant detail like list of awareness camps to be provided to workers, details of information dissemination, etc. date of the quarry license obtained from the Dept of Mines, its validity, additional conditions laid down in it etc. should be included in the quarry management plan. Species wise no. of trees to be cut and the details of topsoil to be removed and conserved like quantity, location of storing etc. shall also be provided.

Section 6: redevelopment plan: which should indicate following points: (i) List of structures to be demolished and a list of the cleanup activities that need to be undertaken, (ii) Proposed use of the land in the post construction phase, if it is a public property, (iii) Presence of existing facilities that could be put in use by the landowner if it is a leased out private land or by the community in case of a public property.

Section-7: Annexure-(a) Working drawings: Electrical plan showing the electrical network planned for the site, location of generators, master switch boards, etc. (b) Copy of permissions obtained from local governing body / community, etc. as applicable, (c) Copy of agreement entered with site owner, in case of leased out sites.

All the drawings should have north direction marked on it along with the prevailing wind direction. Necessary dimensions and specifications should be provided where ever necessary. The quarry and crusher unit management plan should be submitted to the CSC for a written approval before any physical work (includes storage of materials, equipment etc.) is undertaken on a particular site. The CSC will carefully examine the proposals in light of the various EMP and regulatory provisions and provide suggestions, as necessary to the Contractor who will implement it within the stipulated time period.

The contractor needs to prepare this document for each different site identified and CSC shall undertake a thorough analysis of the said management and redevelopment plan through a site investigation and suggest additional mitigation measures depending on the site and as demanded by the features of the specific site.

G.REDEVELOPMENT OF QUARRY AREA

The main objective of the redevelopment of quarries is to make the area a safe and secure place and adapt it to a suitable land use like a leisure place or fishing place, etc. which is suitable for the physical environment as well as for the community around. Along with the preparation of quarry and crusher management plan the Contractor should also prepare a re-development plan, which will be submitted for approval to CSC who in turn will be responsible for approving and monitoring these plans. The redevelopment plan should indicate following points:

List of structures to be demolished and a list of the cleanup activities that need to be undertaken.

The presence of existing facilities that could be put in use by the landowner if it is a leased out private land or community in case of a public property.

The proposed use of the quarry site with a layout plan showing the proposed facilities / improvement measures, list of local plant species that could be planted etc.

Photographs of the site before, during and after the quarrying process.

Possible re-development options include the following:

Re-vegetation of the quarry to merge with the surrounding landscape with reuse of topsoil mixed together with farmyard manure.

Development of exhausted quarries, as water bodies, where the quarry pit is developed into a pond or a rainwater harvesting structure.

Pits created as a result of blasting could be filled with overburden which are removed and stockpiled in other areas or with construction debris. Top soil should be spread back and trees should be planted along the boundary.

Tree plantation where ever possible depending on the proposed use, erosion control measures, etc. should be taken up as part of the redevelopment plan.

The Contractor should clear all temporary structures; dispose all debris, garbage, night soils and any other waste as per the approved debris management plan. All disposal pits or trenches should be filled in, disinfected and effectively sealed off. Residual topsoil, if any, will be distributed or spread evenly in plantation sites, on adjoining/nearby barren land or affected agricultural land adjacent to the RoW that has been impacted on account of any accidental spillage. The entire camp area should be left clean and tidy, in a manner keeping the adjacent lands neat and clear, at the Contractor's expense, to the entire satisfaction of the landowner and the CSC.

These activities should be completed by the Contractor prior to demobilization. Once the Contractor finishes his job, he needs to obtain a certificate from the owner, stating that the site has been re- developed to his/her satisfaction and in tune with the agreement. Then, following document needs to be submitted to the CSC by the Contractor:

Copy of approved site identification report

Photographs of the concerned site 'before' and 'after' setting up the camp.

A certificate from the owner stating his/her satisfaction about the status of re-development of the site, this is applicable only in the case of a site to be returned to the owner.

CSC shall ensure, through site verification that all cleanup and restoration operations are completed satisfactorily and a written approval should be given to the Contractor mentioning the same before the 'works completion' certificate is issued/recommended. The PIU shall ensure through site inspection that the Contractor and CSC have complied with all these provisions. The site can then be handed over to the concerned owner or local bodies or for local communities as the case may be.

Certification/documentation pertaining to approval for cleanup and restoration operations and thereafter handing-over to the owner shall be properly maintained by the Contractor, Supervision Consultant and PIU.

ANNEXURE 8.2: GUIDELINES FOR BORROW AREA MANAGEMENT

A.BORROW AREA SELECTION

A borrow describes an area where material (usually soil or sand) has been dug for use at another location, for example, the soil might be excavated to fill an embankment for a highway. In some cases, the borrow pits may become filled with ground water, posing a danger to the surrounding community. If properly redeveloped, it can be turned into recreational areas or sustainable wildlife habitats. In other cases, borrow pits may be used for landfill and waste disposal also.

B.CRITERIA FOR SITE SELECTION

The Contractor in addition to the established practices, rules and regulation shall also use the following criteria before finalizing the locations of borrow areas:

The borrow area should not be located in agricultural areas, especially in the paddy fields unless unavoidable i.e. barren land is not available. In case borrowing needs to be done on an agricultural land, topsoil stripping, stacking and preservation is a must.

Borrow pits shall not be located within a distance of 100 m from any NH, SH or other roads.

The site shall be located 30m away from the toe of the embankment along the road side.

The site should be located not less than 30m from the toe of the bank along the river side or the irrigation tank Bund.

Borrow area shall be located at a minimum distance of 30m from the toe of the irrigation tank bund.

Borrow site shall be located at a minimum distance of 500 m in the down - wind direction of villages and settlements.

No borrow pits shall be located within 250 m from schools, colleges, playgrounds, religious structures and health centers.

No borrow area shall be opened within 500 m from a reserved or protected forest area/sites, wildlife movement zone and cultural heritage site.

Loss of vegetation shall be almost nil or minimum.

Borrow area near any surface water body will be at least 100m away from the toe of the bank or high flood level, whichever is maximum. After identification of borrow area location/s, the Contractor will fill the prescribed reporting format and submit the same for approval to the “Site Engineer” at least 7 working days before commencement of earth works. A written approval from CSC shall be necessary before any activity/work is commenced.

Borrow pit location shall be located at least 0.8km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

C. FINALIZATION OF THE SELECTED AREA

After identification of the site, the Contractor should fill up the prescribed reporting format provided in EMAP and submit the same for approval to the CSC. The selected site/s shall be approved by Environmental Engineer of CSC, after considering the compliance with the EMP clauses. No agreements or payments shall be made to the land owner/s (in case of a leased or rented out land) prior to receipt of a written approval from the CSC. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost. After obtaining a written approval from the CSC for the selected site, the Contractor has to enter into an agreement with the land owner to obtain his/her consent before commencing any operation / activities in the land. The agreement should also mention its type, duration, amount and mode of payment as well as the preferences of the owner regarding site maintenance and redevelopment.

D.BORROW AREA MANAGEMENT

Before the start of operations, the area to be borrowed shall be marked by the Contractor with wooden or stone pegs to ensure that the land required for slope stabilization or bund creation is maintained. Construction Supervision Consultant has to ensure that this marking is done on the ground to avoid issues at a later date. Any disregard of this condition shall be made good at the Contractor's and/or consultant's own expense.

After receiving the approval, the Contractor will begin operations, keeping in mind the following points.

Top soil conservation is to be undertaken only if its reuse is envisaged for the proposed activity in the borrow area rehabilitation. Top soil that cannot be re-used in rehabilitation of borrow areas shall be used in the plantation belt/zone along the road.

Damage to productive and fertile areas has to be minimum. This includes appropriate planning of haul roads.

No excavated acceptable material other than surplus to the requirements of the Contract shall be removed from the site. Contractor should be permitted to remove acceptable material from the site to suit his operational procedure, and then be shall make good any consequent deficit of material arising there from.

Where the excavation reveals a combination of acceptable and un-acceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carryout the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the un-acceptable materials. The acceptable material shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

The following principles shall be adhered to during borrow area operations:

A 15 cm topsoil layer will be stripped off from the borrow pit and this will be preserved in stockpiles in a designated area with a height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

Borrowing of earth will be allowed up to a depth of 1.5 mtr from the existing ground level only.

Ridges of not less than 8m width will be left at intervals not exceeding 300m.Small drains will be cut through the ridges, if necessary, to facilitate drainage.

The slope of the edges will be maintained not steeper than 1:4 (vertical: Horizontal).

Rehabilitation shall be satisfactorily undertaken immediately after the use has ceased and at least three weeks prior to monsoon.

If the rehabilitation plan envisages re-use of top soil, then preserved top soil has to be spread uniformly over the land used as a borrow area.

Bunds and temporary fencing (using barbed wire) along with plantation should be provided in case the borrow area is developed as a pond to ensure safety of the residents and the cattle. However, the depth shall not exceed 1.5 m.

E. PREPARATION OF BORROW AREA MANAGEMENT AND REDEVELOPMENT PLAN

The Contractor after getting approval from the competitive authority for the selected site should submit a detailed Borrow Area Management and Redevelopment Plan comprising the following details:

Section–1: Details of site: Copy of the approved site identification report along with a location plan on a village map or an FMB, showing the site, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use like residences, agricultural land, water bodies etc., photograph of the site showing the topography and other existing features.

Section-2: Site preparation: Activities that should be undertaken for preparing the site based on EMP and this guideline.

Section-3: Layout plan: A layout plan showing all these details along with vehicular movement path, green belt, locations were digging of contour trenches should be undertaken etc.

Section-4: Mitigation measures that will be undertaken as per the EMP and this guideline while setting up of the camp and operation of the camp should be separately listed out.

Sectoin-5: Other details: Any other relevant detail like list of awareness camps to be provided to workers, details of information dissemination, etc. date of the quarry license obtained from the Dept of Mines, its validity, additional conditions laid down in it etc. should be included in the quarry management plan. Species wise no. of trees to be cut and the details of topsoil to be removed and conserved like quantity, location of storing etc. shall also be provided.

Section 6: redevelopment plan: which should indicate following points: (i) proposed use of the land in the post construction phase, (ii) preferences of landowner with respect to redevelopment, (iii) Presence of existing facilities that could be put in use by the landowner if it is a leased out private land or by the community in case of a public property, (iv) Extent of community involvement.

Section-7: Annexure-(a) Copy of permissions obtained from local governing body / community etc. as applicable, (b) Copy of agreement entered with site owner, in case of leased out sites.

All the drawings should have north direction marked on it along with the prevailing wind direction. Necessary dimensions and specifications should be provided where ever necessary. The management plan should be submitted to the CSC for a written approval before any physical work (includes storage of materials, equipment etc.) is undertaken on a particular site. The CSC will carefully examine the proposals in light of the various EMP and regulatory provisions and provide suggestions, as necessary to the Contractor who will implement it within the stipulated time period.

Contractor needs to prepare this document for each different site identified and CSC shall undertake a thorough analysis of the said management and redevelopment plan through a site investigation and suggest additional mitigation measures as demanded by the features of the specific site and its surroundings.

F.REHABILITATION OR RE-DEVELOPMENT OF BORROW AREAS

The objective of the borrow area rehabilitation is to return the borrowing sites to a safe and environmentally sound condition. The concept entails enhancing benefits (including those linked to livelihood) for the community and individuals. Top soil preservation (and its re-use) and proper stabilization of slopes are the fundamental requirements of the rehabilitation process. Re-development plan shall be prepared and submitted along with reporting format by the Contractor before the borrowing operation is permitted by the CSC. The redevelopment is to be prepared in consultation with land owner/s (whether public, private or institutional) and by within the environmental and safety requirements of the EMP. Some key points on borrow area rehabilitation are presented in the table provided below. However, the Contractor is free to prepare other rehabilitation scheme/s subject to the approval by the Environmental Engineer of the Supervision Consultant

Type/Form of Rehabilitation	Re-Use of Top Soil	Actions Required for Rehabilitation
Farm land	Yes	Levelling Slope Stabilization along the edges if there is a level difference
Ponds including creation of new ones and enhancing capacity of existing ones (for irrigation; pisciculture and general uses by people and/or cattle)	No	Slope Stabilization (angle/benching) Access / Approach Ramp Bund creation and Temporary Fencing Plantation in the periphery
Water recharging areas/percolation tanks (depth up to one meter)	No	Slope Stabilization Small bund creation
Levelled lands that can be developed later for various uses (such as residential areas, parking lots, community grounds etc.)	Generally, no	Levelling Top soil re-use depends on the type of developmental work envisaged
Construction waste disposal sites (for non-toxic/non-hazardous wastes) (reinstated with topsoil with plantation over the rehabilitated site)	No	Depression after filling-in of wastes to be levelled-up Top soil re-use depends on the type of developmental work envisaged
Plantation Zones	Yes	Levelling Selection of Species as per OSRP Project Guidelines
Water holes for animals and birds (outside forest and protected areas)	No	Gentle Slopes on all sides Plantation in the periphery Depth upto 1.5 m.

Rehabilitation works shall be undertaken immediately upon the exhaustion of the approved quantity and shall not be delayed. The Supervision Consultant shall take appropriate action in case delays are observed.

These activities should be completed by the Contractor prior to demobilization. Once the Contractor finishes his job, he needs to obtain a certificate from the owner, stating that the site has been re- developed to his/her satisfaction and in tune with the agreement. Then following documents needs to be submitted to the CSC by the Contractor:

Copy of approved site identification report

Photographs of the concerned site 'before' and 'after' setting up the camp.

Certificate from the owner stating his/her satisfaction about status of re-development of the site.

CSC shall ensure, through site verification that all clean-up and restoration operations are completed satisfactorily and a written approval should be given to the Contractor mentioning the same before the 'works completion' certificate is issued/recommended. The PIU shall ensure through site inspection that the Contractor and CSC have complied with all these provisions. The site can then be handed over to the concerned owner or local bodies or for local communities as the case may be.

Certification/documentation pertaining to approval for cleanup and restoration operations and thereafter handing-over to the owner shall be properly maintained by the Contractor, Supervision Consultant and PIU.

ANNEXURE 8.3: GUIDELINES FOR TREE FELLING

TREE FELLING

- Use hard hats during tree felling
- Ensure safe use and storage of tools such as axes, power chain saw, hand saw of different types, HDPE ropes of approved thickness to drag felled trees and logs.
- Keep the saw blades in proper lubrication and sharpened state for efficient workability.
- Determine proper foot and body position when using the implements for felling, cutting and dragging.
- Wear appropriate foot protection Avoid cutting branches overhead. Keep first aid kits ready at the site.
- Determine possible hazards in the area, e.g. electrical or telephone or other utility lines, buildings, vehicles and domestic cattle that may create unsafe work situations.
- Prior to felling, determine the safest direction of fall and orient fixing of ropes and Cutting positions accordingly.
- Determine the proper hinge size before directing the fall.
- Keep machineries and workers ready for speedy removal of the tree from the main traffic movement area.
- Keep flag men and warning signal, signage at either end of the felling area to control movement of traffic and warn passersby.
- Use loud noise signals for warning bystanders and workmen about the impending fall, so as they move away from the direction of fall.

ANNEXURE 8.4: GUIDELINE FOR DEBRIS DISPOSAL SITES

A.OVERVIEW

Construction of highways generates huge quantity of debris, which needs to be disposed off in previously identified sites suitable for such an activity. This process entails close scrutiny of the sites with respect to their location and this section details out the criteria to be followed in doing so. Moreover, it also guides the Contractor as to how to prepare the site without causing much impact on the surrounding environment.

B.CRITERIA FOR LOCATING THE SITE/S

The locations of waste disposal have to be selected such that:

- The said site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, topsoil stripping, stacking and preservation should be undertaken prior to initiation of any activities.
- The debris disposal site shall be at least 200 m away from surface water bodies[4].
- No residential areas shall be located within 100 m downwind side of the site.
- The site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies, wetlands, protected areas, forests, wildlife habitats / Mangroves / Ecologically sensitive areas, seasonal streams, rivers, canals, flood plains, educational institutions, medical centers, religious sites, cultural or heritage sites and play grounds.
- The local governing body and community shall be consulted while selecting the site.
- The selected site shall meet with the local regulatory requirements (including those of TNPCB, Municipalities etc.).
- The site shall preferably be owned by the government so that there is no need to acquire the land for the same.

After identification of the site the Contractor should fill up the prescribed reporting format and submit the same for approval to the CSC. Any activity on the site can be initiated only after obtaining permission from the CSC.

C.FINALIZATION OF SELECTED SITE/S

The selected site/s shall be approved by CSC and PIU, after considering compliance with the EMP clauses and this guideline. No agreements or payments shall be made to the landowner/s prior to receipt of a written approval from the CSC and PIU. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost.

D. SETTING UP OF DEBRIS DISPOSAL SITE

The following steps have to be undertaken while setting up a debris disposal site:

- Top soil conservation has to be undertaken as per the guidelines given in EMP.
- Considering the topography of the site contour trenches as detailed in EMP should be made along the site boundary to prevent soil erosion.

[4] In the absence of site meeting the stipulated criteria, an alternate site can be selected specifying the reasons. In such a case, the construction camp management plan should incorporate additional measures specific to the site as suggested by the CSC.

- Fencing should be provided for the debris disposal site to prevent trespassing of humans and animals in the area as well as to prevent spread of the waste material through the action of wind, water, scavengers or rag pickers.
- Number of trees cut should be recorded and ten times the same should be planted as green belt development or elsewhere as part of the project.
- Provide proper drainage facility so that the runoff from the site doesn't contaminate any nearby water sources or rivers.

E. PREPARATION OF DEBRIS DISPOSAL SITE MANAGEMENT AND REDEVELOPMENT PLAN

The Contractor after getting approval from the competitive authority for the selected site should submit a detailed Debris Disposal Site Management and Redevelopment Plan comprising the following details:

- Section–1: Details of site: Copy of the approved site identification report along with a location plan on a village map or an FMB, showing the site, its survey no., access road, project stretch, and distance from the project stretch, surrounding features and land use like residences, agricultural land, water bodies etc., photograph of the site showing the topography and other existing features.
- Section-2: Site preparation: Activities that should be undertaken for preparing the site based on EMP and this guideline.
- Section-3: Arrangements within the site: A layout plan showing the existing trees, green belt, locations were contour trenches should be dug etc.
- Section-4: Mitigation measures that will be undertaken as per the EMP while preparing the site and dumping the waste should be separately listed out.
- Sectoin-5: Other details: Any other relevant details like copy of approvals / clearances obtained, species wise no. of trees to be cut and the details of top soil to be removed and conserved like quantity, location of storing etc. shall also be provided.
- Section 6: Re-development plan: which should indicate following points: (i) species wise no of tree to be planted, (ii) Proposed use of the land in the post construction phase, if it is a public property, (iii) Presence of existing facilities that could be put in use by the land owner if it is a leased out private land or by the community in case of a public property and (iv) Other site specific mitigation measures to be undertaken as recommended by the CSC.
- Section-7: Annexure-(a) Copy of permissions obtained from local governing body / community etc. as applicable, (c) Copy of agreement entered with site owner, in case of leased out sites.

All the drawings should have north direction marked on it along with the prevailing wind direction. Necessary dimensions and specifications should be provided where ever necessary. The debris site management plan should be submitted to the CSC for a written approval before any physical work is undertaken. The CSC will carefully examine the proposals in light of the various EMP and regulatory provisions and provide suggestions, as necessary to the Contractor who will implement it within the stipulated time period.

The contractor needs to prepare this document for each different site identified and CSC shall undertake a thorough analysis of the said management and redevelopment plan through a site investigation and suggest additional mitigation measures as demanded by the features of the specific site and its surroundings.

F.REDEVELOPMENT OF WASTE DISPOSAL SITES

Along with the format seeking permission/approval for the disposal site/location from the Engineer/Supervision Consultant, the Contractor shall also submit a rehabilitation plan for the area. Following points have to be kept in view while undertaking the rehabilitation measure:

- The dump sites shall be suitably rehabilitated by planting local species of shrubs and other plants. The species (region specific) shall be chosen from the list suggested in the EA/EMP. Local species of trees should be selected so that the landscape is coherent and is in harmony with the surrounding environment.
- Rehabilitation can also include conversion into farm land, playground, parking area, block plantation area etc.
- Some of the dumpsites could be used either for plantation or for growing agricultural products such as ginger, turmeric or oranges etc.
- Care should always be taken to maintain the hydrological flow in the area.

ANNEXURE 8.5: GUIDELINE FOR SITING & LAYOUT OF CONSTRUCTION CAMP

A.OVERVIEW

Construction camp accommodates a mix of activities, which are highly polluting in nature causing considerable environmental impact and its proper siting, management and redevelopment is crucial to avoid, minimize and mitigate those impacts. The EMAP clearly distinguishes between various impacts that may occur at various stages of the camp like

- Siting,
- Setting up,
- Operation and
- Closure / redevelopment and provide respective mitigation measures to some extent.

In addition to that, this guideline has been prepared to provide the Contractor with comprehensive and systematic information on various steps to be undertaken during these four stages, so that s/he can execute his/her role in an environmentally sound manner. Various mitigation measures have been synthesized into this guideline so that it serves as a single and stand alone document for the Contractor.

B.CRITERIA FOR SITING THE CAMP

To the extent, possible barren land or wastelands shall be preferred during site selection and fertile land and agricultural land shall be avoided. All such sites must be above the HFL with adequate drainage facility. In areas prone to floods, cyclones, cloudbursts or heavy rainfall, selection of the site should be made keeping in mind the safety of the camp and the workers. In addition, the Contractor should take care of the following criteria for locating the site:

- A minimum of 250 m away from any major settlement or village in downwind direction.
- A minimum of 200 m of any major surface water course or body
- Not within 500 m from ecologically sensitive areas like wild life sanctuary, mangroves etc.
- Sufficiently wide access roads (at least 5.5 m Wide) for heavy vehicle movements

After identification of the site the Contractor should fill up the prescribed reporting format and submit the same for approval to the CSC without which any activity shouldn’t be started on the site.

C.FINALIZATION OF SELECTED SITE/S

After identification of the site, the Contractor should fill up the prescribed reporting format provided in EMAP and submit the same for approval to the CSC. Environmental Engineer of CSC shall approve the selected site/s, after considering the compliance with the EMP clauses. No agreements or payments shall be made to the land owner/s prior to receipt of a written approval from the CSC. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost. After obtaining a written approval from the CSC for the selected site, the Contractor has to enter into an agreement with the landowner to obtain his/her consent before commencing any operation / activities in the land. The agreement should also mention its type, duration, amount and mode of payment as well as the preferences of the owner regarding site maintenance and redevelopment.

D.DESIGNING OF CAMP / PREPARATION OF LAYOUT PLAN

The Contractor should design a layout plan of the camp with adequate space for (i) site office along with store room, rest area and sanitary facilities, (ii) plants, machineries, (iii) workshops, (iv) vehicle washing area, (v) fuel handling area, (vi) room for raw material unloading and stocking, (vii) space for storage and handling of solid wastes (viii) security cabin etc. The laying out of these should be undertaken in such a manner that it facilitates smooth functioning of both man and machine. Fuel pumps, storage facility for inflammable and hazardous chemicals/ materials shall be provided inside the camp, but at a safe distance from office. Electric safety practices shall be integrated/ incorporated during the lay-out plan preparation.

Prevailing wind direction shall be kept in mind while planning out the lay-out of internal facilities. Cutting of trees should be bare minimum and the existing ones need to be integrated into the lay-out plan with proper planning. The roads within the camp should be well planned with adequate space for movement of vehicles and their parking.

E.SETTING UP OF CONSTRUCTION CAMP

(i)Site preparation: The stripping, stacking and preservation of top soil will be mandatory in case of farm lands and fertile areas and absolutely no material stacking or equipment installment or vehicle parking or any other activity should be allowed prior to the satisfactory completion of this activity as per guidelines in EMP. Thereafter, the site should be graded and rendered free from depressions such that the water does not get stagnant anywhere. A compound wall of 2.4 m height should be constructed all around the camp to prevent the trespassing of humans and animals. Green belt should be provided along the boundary and as detailed in the EMP, it should be integrated with storm water drain and sedimentation trenches as given in annexure in EMAP. No. of trees planted should not be less than ten times the number of trees cut. The approved layout plan should be strictly adhered to while setting up the camp.

(ii)Setting up of plants and machineries: Adequate arrangements should be made for avoiding fugitive emissions from plants and camp premises. This will include (i) control of air pollution through provision of in-built dust extraction systems like bag filter, damper and cyclone filter for bitumen hot mix plant, (ii) a chimney of appropriate height (as per TNPCB guideline) from ground level attached with dust extraction system and scrubber for the hot mix plant, (iii) a chimney of appropriate height for the DG set (iv) water sprinkling facilities for the concrete batching plant, wet mix macadam plant as well as in the camp premises and (v) garden net to prevent fugitive emissions from storage place of cement and aggregates. It has to be also ensured that effluent from the sludge tank of the scrubber is recycled and reused and the sludge is used for land filling with top soil spread on it.

To ensure that noise levels are within the limit, all plants and machineries should have their own silencers or any other noise control devices. All pollution control devices should be provided with backup power. Following conditions should be complied regarding the sound level conditions:

The sound level (Leq) measured at a distance of 1 m from the boundary of the site shall not exceed 55dB (A) during day time (6am - 6pm) and 45 dB(A) during night time (6 pm - 6am).

The total sound power level of the DG set shall be less than 96+10 log 10 (kVA) dB(A) where kVA is the nominal power rating of DG set.

The DG set shall be provided with acoustic enclosure/acoustic treatment with an insertion loss of minimum 25 dB (A).

The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).

A proper, routine and preventive maintenance procedure for the DG set shall be set and followed in consultation with the DG set manufacturer.

Concrete flooring with slope drains and oil interceptors should be proposed for hot mix plant area and workshop, vehicle washing and fuel handling area as per EMP, so that oil and lubricants that may spill on the floor does not contaminate any soil or water body. In case of any oil spills, it should be cleaned properly. There shall also be provisions for storage of used oil until it is disposed as per comprehensive waste management plan prepared by Contractor and approved by CSC.

(iii) Sanitation Facilities: Adequate no. of toilets shall be provided separately for males and females (depending on their strength), screened from those of men and provided with markings in vernacular language. All such facilities must have adequate water supply with proper drainage and effluent treatment system like septic tank with soak pit. Soak pit should have a sealed bottom, honeycomb wall and 75 cm. thick, 2 mm sand envelope around that. The sewage system for the camp must be properly sited, designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses take place.

Portable toilets may be brought to use and the night soil from such units has to be disposed through designated septic tanks so as to prevent pollution of the surrounding areas. In the construction camp, no night soil or sewerage shall be disposed of at any place other than the septic tanks constructed at the site.

(iv) Waste Disposal: While preparing the layout plan, the Contractor should allocate adequate space for storage and handling of various wastes generated until they are disposed off in pre-identified disposal sites. The Contractor should provide separate garbage bins for biodegradable, non-biodegradable and domestic hazardous wastes in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner. No incineration or burning of wastes shall be carried out by the Contractor. The disposal of any biodegradable matter shall be carried out in pits covered with a layer of earth within the campsite. Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipe scrubber and polyurethane foam, automobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or sold /given out for recycling. POL (petroleum, oil and lubricants) waste shall be disposed off by transfer only to recycler/ re-refiners possessing valid authorization from the Tamil Nadu Pollution Control Board and valid registration from the Central Pollution Control Board. Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.

(v)First aid / safety facilities: At every camp site, a readily available first-aid unit, including an adequate supply of sterilized dressing materials, appliances and basic medicine should be provided. Workplaces which are remote and far away from regular hospitals should have indoor health units with one bed for every 250 workers. Details of nearest clinics as well as major hospitals like their location, distance from camp, phone number facilities offered by the hospital should be displayed in the camp office at clearly visible location in a legible manner. Suitable transport should be provided to facilitate taking injured and ill persons to the nearest hospital. Adequate personal protective equipments and fire fighting equipments as detailed out in EMP should be made available in the camp and provided to the staff / workers. Operation manuals and training should be provided to machine operators. Warning signs should be placed at accident prone areas as well as at the entrance of the site.

(vi)Training to workers: Workers shall be trained in smooth operation of plants and machines, their regular maintenance and various safety measures to be followed as well as about the need for adherence to these measures.

(vii)Information dissemination: There should be a sign board of size 6' x 4' mentioning the project details and Contractor's details to disseminate the information to the public. There should be a second sign board displaying the latest air and noise monitoring data against the standards specified.

Warning signboards should be set up at the entrance gate for the public as well as at other required places for the workers to alert them about the nature of the operation being undertaken at those respective places.

Once the construction camp is set up, the date of commissioning of the camp should be intimated to the Head Office and the concerned District Office of the TNPCB.

F.OPERATION OF CONSTRUCTION CAMP

During the operation phase of the camp it is important to ensure that all vehicles and machineries are maintained regularly and their PUC certificates are renewed at regular intervals. All pollution control devices should be monitored and maintained properly at regular intervals. In case of process disturbance/ failure of pollution control equipments, the respective units should be shut down and should not be restarted until the control measures are rectified to achieve the desired efficiency. All units should operate only between 6 am and 10 pm. or as specified by TNPCB in the consent letter.

Oil and grease waste generated from garages in construction camps should be drained out through oil interceptors and they should be maintained properly. Necessary arrangements should be made for regular sprinkling of water for dust suppression. Raw materials and products should be transported with proper cover to prevent spreading of dust.

Hygienic environment must be ensured by (i) provision of safe drinking water, (ii) proper maintenance of toilets including daily cleaning and disinfection using proper disinfectants, (iii) regular cleaning of drains by removing the silt and solid waste, (if any) and iv) appropriate waste management practices. While it is of utmost importance to ensure that fire fighting equipments like fire extinguishers are in working condition, it should also be monitored that construction workers use the personal protective equipment provided to them and they are replaced when necessary. All these facilities should be inspected on a weekly basis to achieve the desired levels of safety and hygiene standards.

Environmental monitoring should be undertaken by the Contractor as stipulated in the EMP. If any standard is set by TNPCB for hot mix plant emissions, the Contractor should collect samples of emission from all the chimneys and analyse for the parameters at least once in a month. The Consent to Operate (CTO) certificate from TNPCB should be renewed at regular intervals and the same should be intimated to CSC.

A register should be maintained at the site office which provides (i) a one page format for each migrant laborer which will give their personal profile (including name, age, sex, educational qualification, address, blood group and any major illness), along with a copy of any ID proof and an original photograph, (ii) a copy of the ID card of local laborers. A copy of the details of the migrant laborers should be submitted to the local police station.

G. PREPARATION OF CONSTRUCTION CAMP MANAGEMENT AND REDEVELOPMENT PLAN

After the site for the construction camp has been finalized and approved by CSC, the Contractor should prepare a construction camp management plan to be submitted to CSC for approval prior to setting up of the camp and it should comprise the following details:

Section–1: Details of site: Copy of the approved site identification report along with a location plan on a village map or an FMB, showing the site, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use like residences, agricultural land, water bodies etc., photograph of the site showing the topography and other existing features.

Section-2: Site preparation: Activities that will be undertaken for preparing the site based on EMP and this guideline.

Section-3: Arrangements/ facilities within the camp: List of plants / machineries to be set up within the camp like hot mix plant, batching plant, DG set etc., and other facilities to be provided like site office, store room, rest room, toilet room, material stocking yard etc, layout plan showing all these details along with vehicular movement path, green belt etc. Species wise no. of trees to be cut shall be provided.

Section-4: Mitigation measures that will be undertaken as per the EMP and this guideline while setting up of the camp and operation of the camp should be separately listed out here.

Sectoin-5: Other details: Any other relevant detail like list of trainings to be provided to workers, details of information dissemination, date of CTE certificate from TNPCB, its validity, additional conditions laid down in it etc. should be included.

Section 6: Re-development plan, which should indicate the following points: (i) List of structures to be demolished and list of the cleanup activities that needs to be undertaken, (ii) Proposed use of the land after demobilizing and (iii) Presence of facilities that could be put in use by the land owner if it is a leased out private land or community in case of a public property.

Section-7: Annexure-(a) Working drawings: Electrical plan showing the electrical network planned for the site, location of plants, generators, master switch boards etc. and plumbing drawing showing the network of water supply lines, sewerage line and drainage line, (b) Copy of certificates / permissions obtained from regulatory authorities / local governing body /community etc. as applicable, (c) Copy of agreement entered with the owner of the site if it is a leased out land.

All the drawings should have north direction marked on it along with the prevailing wind direction. Necessary dimensions and specifications should be provided where ever necessary. The construction camp management plan should be submitted to the CSC for a written approval before any physical work (includes storage of materials, equipment etc.) is undertaken on a particular site. The CSC shall carefully examine the proposals considering the specific conditions of each site as well as various EMP and regulatory provisions and provide suggestions, as necessary to the Contractor who shall incorporate it in the management plan.

The contractor needs to prepare this document for each different site identified and CSC shall undertake a thorough analysis of the said management and redevelopment plan through a site investigation and suggest additional mitigation measures depending on the site and as demanded by the features of the specific site.

H.DEMOBILIZATION AND REDEVELOPMENT OF THE SITE

The Contractor should clear all temporary structures; dispose all building debris, garbage, night soils and POL waste as per the approved debris management plan. All disposal pits or trenches should be filled in, disinfected and effectively sealed off. All the areas within the campsite should be leveled and spread over with stored top soil. Residual topsoil, if any, will be distributed or spread evenly in plantation sites, on adjoining/nearby barren land or affected agricultural land adjacent to the RoW that has been impacted on account of any accidental spillage. The entire camp area should be left clean and tidy, in a manner keeping the adjacent lands neat and clear, at the Contractor’s expense, to the entire satisfaction of the landowner and CSC.

These activities should be completed by the Contractor prior to demobilization. Once the Contractor finishes his job, he needs to obtain a certificate from the owner, stating that the site has been re- developed to his/her satisfaction and in tune with the agreement. Then, following document needs to be submitted to the CSC by the Contractor:

Copy of approved site identification report

Photographs of the concerned site ‘before’ and ‘after’ setting up the camp.

A certificate from the owner stating his/her satisfaction about the status of re-development of the site.

CSC shall ensure, through site verification that all cleanup and restoration operations are completed satisfactorily and a written approval should be given to the Contractor mentioning the same before the 'works completion' certificate is issued/recommended. The PIU shall ensure through site inspection that the Contractor and CSC have complied with all these provisions. The site can then be handed over to the concerned owner or local bodies or for local communities as the case may be.

Certification/documentation pertaining to approval for clean-up and restoration operations and thereafter handing-over to the owner shall be properly maintained by the Contractor, Construction Supervision Consultant and PIU.

ANNEXURE 8.6: CONSTRUCTION SAFETY CHECKLIST FORMAT

Sl. No.	Safety Issues	Yes	No	Non compliance	Corrective Action	Penalty	Remarks
Safety during Construction Stage							
1	Appointment of qualified Construction safety officers						
2	Approval for Construction Safety Management Plan by the Engineer.						
3	Approval for Traffic Management/control Plan in accordance with IRC: SP: 55-2001						
4	Maintenance of the existing road stretches handed over to the Contractor.						
5	Provision of Temporary Traffic Barriers/Barricades/caution tapes in construction zones						
6	Provision of traffic sign boards						
7	Provision for flags and warning lights						
8	Provision of metal drum/empty bitumen drum delineator, painted in circumferential strips of alternate black and white 100mm wide 2 coats fitted with reflectors 3 No's of 7.5cm diameter						
9	Providing plastic crash barrier						
10	Provision of adequate staging, form work and access (ladders with handrail) for works at a height of more than 3.0 m						
11	Provision of adequate shoring / bracing / barricading / lighting for all deep excavations of more than 3.0 m depth.						
12	Demarcations (fencing, guarding and watching) at construction sites						
13	Provision for sufficient lighting especially for night time work						
14	Arrangements for controlled access and entry to Construction zones						
15	Safety arrangements for Road users / Pedestrians						
16	Arrangements for detouring traffic to alternate facilities						

Sl. No.	Safety Issues	Yes	No	Non compliance	Corrective Action	Penalty	Remarks
17	Regular Inspection of Work Zone Traffic Control Devices by authorized contractor personnel						
18	Construction Workers safety - Provision of personnel protective equipments						
19	A. Helmets						
	B. Safety Shoe						
	C. Dust masks						
	D. Hand Gloves						
	E. Safety Belts						
	F. Reflective Jackets						
	G. Earplugs for labour						
20	Workers employed on bituminous works, stone crushers, concrete batching plants etc. provided with protective goggles, gloves, gumboots etc.						
21	Workers engaged in welding work shall be provided with welder protective shields						
22	All vehicles are provided with reverse horns.						
23	All scaffolds, ladders and other safety devices shall be maintained in as safe and sound condition						
24	Regular health check-up for Labour/ Contractor's personnel						
25	Ensuring the sanitary conditions and all waste disposal procedures & methods in the camps.						
26	The Contractor shall provide an adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers and flag persons for traffic control						
27	Provision of insurance coverage for the contractor's personnel						