

AMENDED EIA REPORT

4/6 laning of package II, Km 43.000 to 96.714 from
Kerala/Tamilnadu border to Kanyakumari of NH-47 and
Nagercoil-Kavalkinaru section of NH-47B

LIST OF CONTENTS

1.0	EXECUTIVE SUMMARY	1
1.1	Description of Project	1
1.2	Objectives	1
1.3	Major Negative Impacts and Their Mitigation	1
1.4	Significant Findings	2
2.0	INTRODUCTION AND PROJECT DESCRIPTION.....	4
2.1	Introduction	4
2.2	Description of the Project.....	4
2.3	Salient features of the project	4
2.4	Background of the Present Report.....	5
2.5	Environmental & Social Screening Study and Application to EIA	5
2.6	Scope of the EIA/EMP Study	5
2.7	Objectives	5
2.8	Policy Context for Environmental Assessment in India	6
2.9	Public Consultation.....	6
2.10	Environmental & Social Impacts of Road Widening	6
3.0	POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK.....	8
3.1	Institutional Setting for Project	8
3.2	Institutional Setting in Environmental Context.....	8
3.3	Government of India - Acts and Regulations.....	8
3.4	Institutional Strengthening and Arrangement.....	9
3.4.1	Organizational arrangements.....	9
3.4.2	Environmental Training.....	9
3.4.3	Environmental Monitoring	9
4.0	APPROACH AND METHODOLOGY	10
4.1	Preparation of Questionnaires for Environmental Parameters	10
4.1.1	Field Observation on Questionnaire.....	10
4.1.2	Screening, Testing & Monitoring of Physical Environmental Factors.....	10
4.1.3	Secondary Available Data	11
4.2	Preparation of Strip Maps	12
4.3	Analyses, Compilation and Preparation of Report	12
5.0	EXISTING ENVIRONMENTAL SCENARIO	13
5.1	Natural Environment Setting.....	13
5.1.1	Climate	13
5.1.2	Temperature.....	13
5.1.3	Rain Fall and Humidity.....	13
5.1.4	Pressure and Winds	14
5.2	Physical Features	14
5.2.1	Kanyakumari Region	14
5.3	Natural Vegetation.....	15
5.3.1	Flora and Fauna	15
5.4	Water Resources.....	16

5.5	Environmental Analysis	16
5.5.1	Soil Analysis	16
5.5.2	Water Analysis.....	17
5.5.3	Ambient Air Quality.....	17
5.5.4	Noise Level.....	18
5.6	Land Use.....	18
5.6.1	Agriculture	18
5.6.2	Irrigation	19
5.7	Ecological Features	19
5.7.1	Major Wild Life Migration Routes	19
5.7.2	Wetlands	19
5.8	Structures, Health Centres and Hot Spots	19
5.8.1	Religious structures	19
5.8.2	Commercial Structures/ Shops	20
5.8.3	Residential Structures.....	20
5.8.4	Health Centres, Police Stations	20
5.8.5	Forests	20
5.8.6	Identification of 'Hot Spots'	20
5.9	Demography of the Region.....	21
5.9.1	Potential Model and Rural Population.....	21
5.9.2	Density Pattern	21
5.10	Human Settlements	22
5.11	Occupational Structure	22
5.12	Religious Composition.....	22
5.13	Linguistic and Socio – Cultural Characteristics	22
5.14	Some Other Demographic Characteristics.....	22
5.14.1	Age and Sex Structure.....	22
5.14.2	Literacy.....	22
6.0	ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS	23
6.1	Environmental Issues Which Do Not Affect the Project.....	23
6.2	Potential Impacts on Soil	23
6.2.1	Loss of Productive Soil	23
6.2.2	Erosion	24
6.2.3	Contamination of Soil.....	24
6.3	Impacts on Water Resources	24
6.3.1	Modification of the Surface Water Flow	24
6.3.2	Modification of the Groundwater Flow.....	25
6.3.3	Use of Local Water Supply	25
6.3.4	Water Quality Degradation.....	25
6.4	Impact on Air Quality	25
6.5	Impact on Noise Levels	26
6.6	Impact on Flora, Fauna and Ecosystem	26
6.6.1	Removal of Trees	26
6.6.2	Removal of Herbal Cover	27
6.7	Impact on Protected Monuments and Cultural Heritage Sites.....	27
6.8	Impacts on Social Environment	27
6.9	Impacts on Road Safety and Human Health.....	27

7.0	ANALYSIS OF ALTERNATIVES	29
7.1	Analysis of Alternatives for NH-47	29
7.1.1	Alternate-I for NH-47 Section.....	29
7.1.2	Alternate-II for NH-47 Section.....	29
7.2	Analysis of Alternatives for NH-47B.....	30
7.2.1	Alternative-I for NH-47B Section.....	30
7.2.2	Alternative-II for NH-47B Section.....	30
8.0	MITIGATION MEASURES	32
8.1	Topography and Soil Characteristics	32
8.2	Water Resources.....	32
8.3	Ambient Air Quality.....	34
8.4	Noise Level	34
8.5	Human Health and Safety.....	34
8.6	Biological Characteristics.....	35
8.7	Land Use.....	35
9.0	PUBLIC CONSULTATION.....	36
9.1	Introduction	36
9.2	Methodology Followed For Public Consultation	36
9.3	List of Issues Involved	36
9.4	Observation on Some Most Important Issues	37
10.0	ENVIRONMENTAL ENHANCEMENT.....	38
10.1	Introduction	38
10.2	Enhancement of Natural Environment	38
10.2.1	Plantation of Trees, Shrubs and Herbs along the Road	38
10.2.2	Enhancement of Water Bodies	39
10.3	Physical Environment.....	39
10.3.1	Enhancement of Bus Stops	39
10.3.2	Developing Truck Parking Areas	39
10.3.3	Enhancement of Major Road Intersections	39
10.3.4	Enhancement of Cultural Properties	40
11.0	ENVIRONMENTAL MANAGEMENT PLAN (EMP).....	41
11.1	Introduction	41
11.2	Supportive Information on Management Of Environment	41
11.2.1	Environment Monitoring Programme	41
11.2.2	Suggested Tree Plantation Scheme	42
11.2.3	Environmental Cost of the Project.....	43

LIST OF TABLES

Table 1.1: Negative Impacts and their Mitigation Measures	2
Table 1.2: 'Hot Spots' identified during Environmental / Social Screening Analysis	2
Table 3.1: Details of Acts and Regulations	8
Table 4.1: Details of Secondary Data Sources	12
Table 5.1: Effect of Wind on Surrounding Areas	14
Table 5.2: Soil Quality	16
Table 5.3: Water Quality	17
Table 5.4: Ambient Air Quality for Winter Season	17
Table 5.5: National Ambient Air Quality Standards	18
Table 5.6: Measured Noise Level	18
Table 5.7: List of 'Hot Spots' Identified During Environmental / Social Screening Analysis	21
Table 6.1: Type and Scale of Soil Impact	23
Table 8.1: Impacts and Mitigation Measures for Soil retaining its Characteristics	32
Table 8.2: Impacts and Mitigation Measures for Water Resources	32
Table 8.3: Impacts on Air and Mitigation Measures for Maintaining its Quality	34
Table 8.4: Noise Impacts and Mitigation Measures	34
Table 8.5: Impacts on Human Health & Safety and its Mitigation Measures	35
Table 8.6: Impacts on Biological Characteristics and its Mitigation Measures	35
Table 8.7: Impacts on Land Use and its Mitigation Measures	35
Table 11.1: Estimated Cost on Environmental Management	43
Table 11.2: Environmental Management Plan	45
Table 11.3: Environmental Monitoring Plan	54
Table 12.1: Amended list of water bodies	56
Table no 12.2 - Design proposal over surface water Source	57

1.0 EXECUTIVE SUMMARY

1.1 Description of Project

The existing NH 47 from Thiruvananthapuram to Kanyakumari is 2-Lane carriageway and presently the traffic on this road is much more than the capacity. Most of the road length has continuous built-up area very close to the road. The existing NH 47B from Nagercoil to Kavalkinaru is also 2-Lane carriageway. Geometrics of both the road sections are not up to the standards (for design speed of 100kmph) as per IRC for National Highways.

The project road starts at Kerala/Tamil Nadu Border at Karode village at design chainage km 43/000. It continues further in Tamil Nadu state and rejoins the existing NH 47 at km 626/187 (existing chainage) and deviates at 627/000 (existing chainage) bypassing Chungankadai, Nagercoil and Suchindram rejoining the existing NH 47 at km 642/800. From km 642/800 it follows the existing road up to km 646/238 and deviates on RHS for bypassing Kottaram built-up area and joins NH 7 Bypass for Kanyakumari at km 231/653.

NH 47B from Nagercoil to Kavalkinaru where it joins the NH 7 has been provided with a new alignment except initial length of 600m starting just before the junction of Nagercoil Bypass (km 82/181 of NH 47) and existing NH 47B.

M/s. SECON Pvt. Ltd has been entrusted for preparation of Detailed Project Report for both stretches as a combined project.

Environmental Impact Assessment (EIA) report includes Environmental Management Plan and environmental issues within ROW, though their impacts have been assessed up to the aerial distance of 10 km on both the sides of road.

1.2 Objectives

The objectives of the EIA include:

- Collection of baseline data on various components of the environment.
- Determination of magnitude of environmental impacts so that due consideration is given to them during planning, construction and operational phases of the project.
- Assessment of the socio-economic conditions of the project affected persons and suggestions for their improvement.
- Identification of areas and aspects, which are environmentally or socio-economically significant.
- Submission of Environmental Enhancement Plan and Environmental Management Plans for enhancing and mitigating the negative impacts.
- Development of the road alignment in such a way that the environment and settlements are least affected.
- Presentation of public view on various environmental and socio-economic aspects of the project.

1.3 Major Negative Impacts and Their Mitigation

The major direct environmental impacts and their mitigation measures required to be implemented are given in **Table 1.1** below:

Table 1.1: Negative Impacts and their Mitigation Measures

Negative Impacts	Mitigation Measures
Loss of trees	<ul style="list-style-type: none"> • Three trees to be planted in place of one removed, ensuring their survival rate • Stretches which are devoid of trees at present, will be developed by planting trees
Loss of properties	<ul style="list-style-type: none"> • Providing relocation sites • Giving compensation/assistance • Attempts to generate income restoration
Loss of surface water sources	<ul style="list-style-type: none"> • Elevated structures in the form of bridges are proposed in locations where road alignment passes through water bodies. • Adequate deepening of water bodies to be undertaken for the volume of water bodies to be occupied by bridge / culvert structural elements.
Ambient Air/Noise Quality	<ul style="list-style-type: none"> • Plantation of trees, especially those which are known as pollution sink near market place • Improving the maintenance of vehicles
Relocation of religious structures	<ul style="list-style-type: none"> • The new sites of relocation will be properly developed

1.4 Significant Findings

Based on the study and analysis of the environmental parameters, the following important observations have been made:

1. There will be no loss of bio-diversity as no rare endangered plant or animal species will be affected by the present project.
2. There is no major wildlife migrant route within the study area, which could be affected.
3. No Sanctuary or National Park is located within 10 km radius of the road.
4. The two most significant issues involved are (i) cutting of trees existing in the corridor of the highway, and (ii) acquisition of land.
5. No historical monument, protected by Archaeological Survey of India (ASI) is affected due to proposed widening.
6. Soils along the proposed road are red in colour.
7. The most important factors, which need continuous attention and assessment during the construction phase, are the ambient air quality, the water quality and the noise level.
 - (i) The ambient air quality of the study area is good except SPM/RPM, which exceeds the permissible limits near intersections.
 - (ii) The quality of the ground water is good for drinking as well as other household purpose.
 - (iii) Noise levels in the area particularly at crossing points of road exceed the limits due to heavy vehicular movement.
8. The proposed alignment of the road should be such that built-up area should be least affected. Based upon this criteria and social screening analysis, hot spots have been identified and represented as under:-

Table 1.2: 'Hot Spots' identified during Environmental / Social Screening Analysis

Sl. No.	Design Chainage (km)	Remark
NH 47		

Sl. No.	Design Chainage (km)	Remark
1	43.000 – 45.000	Coconut plantation, rubber estate
2	45.000 – 50.000	Rubber estate, Tambraparni River at km 48.186, Tambrakulam Pond at km 49.450 & km 49.825
3	50.000 – 55.000	Rubber Estate, coconut Plantation, Pudukalam Pond in Nattalm village at km 54.625
4	55.000 – 60.000	Big pond, Nesarapuram, Nattalam at km 55.525, built up area of Palliyadi at km 56.500
5	60.000 – 65.000	Rubber Estate and coconut Plantation, Ponds at km 63.375, 64.250 & 64.525
6	65.000 – 70.000	Coconut Plantation, Valliyar River at km 66.850, Pond at km 65.300, 65.550, 66.325, 68.000 & 68.475
7	70.000 – 75.000	Ponds at km 70.694, 71.300, 71.600, 72.000, 72.300, 73.500 & 73.920
8	75.000 – 82.200	Big Tank at km 77.650 & 79.750, Palayar River at km 80.706 & pond at km. 75.800
9	82.200 – 90.000	Ponds at km 88.950 & 89.150
10	90.000 – 95.000	Ponds at km 90.150, 91.500, 92.450, 92.700, 93.500 & 94.800
11	95.000 – 96.714	Ponds at km 95.200, 96.100 & 96.250
NH 47B		
12	0.000 – 5.000	Coconut Plantation, Ponds at km 0.600, 1.050, 1.500 & 2.200
13	5.000 – 16.376	Pond at km 5.250 & 12.500

The EMP is prepared for avoidance, mitigation and management of the negative impacts of the project. It also covers remedial measures required to be taken for hot spots. EMP includes the list of all the project related activities, their chainage wise impacts at different stages of project during pre-construction phase / design phase, construction phase and operational phase on environment and remedial measures to be undertaken to mitigate these impacts.

The Environmental Monitoring Programs are suggested to provide information on which management decisions may be taken during construction and operational phase. The objectives of these programs are:

- (i) To evaluate the efficiency of mitigation and enhancement measures.
- (ii) Updating the actions & impacts of baseline data and adaptation of additional mitigation measures (if the present measures are insufficient).
- (iii) Generation of the data that may be incorporated in the EMP in future projects.

2.0 INTRODUCTION AND PROJECT DESCRIPTION

2.1 Introduction

Govt. of India has entrusted National Highways Authority of India (NHAI) to take up the development of important highways in the country in a phased manner. The road project between TN/KL border and Kanyakumari (NH 47) & Nagercoil to Kavalkinaru (NH 47B) falls is a part of NHDP Phase III. The consultancy services for widening or new construction of these road stretches has been awarded to SECON Private Limited, Bangalore. As a part of this consultancy, the Environmental Impact Assessment report including Environmental Management Plan has been prepared. The works have been awarded to M/s Larsen and Toubro Ltd and the works are commenced.

2.2 Description of the Project

The project road starts at Kerala/Tamilnadu Border at Karode village at design Chainage of km 43/000. It continues further in Tamilnadu state and rejoins the existing NH 47 at km 626/187 (existing chainage) and deviates at 627/000 (existing chainage) bypassing Chungankadai, Nagercoil and Suchindram rejoining the existing NH 47 at km 642/800. From km 642/800 it follows the existing road up to km 646/238 and deviates on RHS for bypassing Kottaram built-up area and joins NH 7 Bypass for Kanyakumari at km 231/653.

NH 47B from Nagercoil to Kavalkinaru where it joins the NH 7 has been provided with a new alignment except initial length of 600m starting just before the junction of Nagercoil Bypass (km 82/181 of NH 47) and existing NH 47B.

2.3 Salient features of the project

- (i) The project alignment of NH 47 traverses from latitude 08° 41' N (chainage 552.00km) to 08° 11' N (chainage 655.00km) and longitude 76° 51' E (chainage 552.00 km) to 77° 30' E (chainage 655.00km).
- (ii) The package starts from village Methukummel (Design chainage km 43.000) and ends at village Kottaram (km 96.714). Package-II also includes NH 47B which starts from Nagercoil (km 0.000) and ends at village Perungudi (Design chainage km 16.376).
- (iii) The major rivers, which cross the present section, are Tambirabarani (km 48.186) and Palayar (km 80.706). This alignment also crosses few ponds along the proposed alignment at following locations:
 - Tamaraikulam pond at km 49.500
 - Pudukalam pond at km 54.625
 - Valliyar River at km 66.850
 - Big Tank at km 77.650 & 79.750
 - Other ponds and tanks as per table 12.1 &12.2
- (iv) Existing road is 2 (two) lane National Highway. Project aims for construction of new 4/6 lane divided road and widening the existing road to 4/6 lanes with divided carriageway wherever feasible.
- (v) The proposed alignment passes through the following villages viz. Methukummel, Kulapuram, Kunnathoor, Nattalam, Valavacha gotham, Kappiara, Thiruvithamcode, Eraniel, Kalkulam, Villukuri, Aloor, Vadassery, Thirupathisarant, Nagarcoil, Theroor, Eraviputhur, Kulasekharapuram, Thamaraiikulam, Kottaram along the NH-47 in Tamilnadu state and Nagercoil, Thirupathi sarant, Theroor, Thovala, Tekkumalai RF, Aralvaymoli, Perungudi along the NH-47B in Tamilnadu state.
- (vi) Area is densely planted (Coconut, Rubber, Tapioca and Banana plantation) all along the new alignment. New alignment also passes through stone quarries, Canals, water bodies and agricultural field.

2.4 Background of the Present Report

As per EIA notification no S.O.2559 dated 22 August 2013, environmental clearance is not required for this project. However in compliance of the Hon. NGT order dated 14 September 2016, reappraisal of this project is being undertaken and as part of this reappraisal, EIA is being revised and presented herewith.

2.5 Environmental & Social Screening Study and Application to EIA

The Environmental Impact Report has been prepared in consultation with the Design Team for the project, so that the negative impacts on the environment and human population could be avoided as far as possible. Some of the important findings of the study are as follows: -

1. There will be no loss of bio-diversity as no rare plant or animal species are going to be affected by the present project.
2. There is no major wildlife migrant route, which could be affected.
3. No Sanctuary or National Park is located within 10 km radius of the road.
4. The two most significant issues involved are:
 - (i) Cutting of Coconut and rubber plantation in the corridor of the highway.
 - (ii) Acquisition of land and relocation of PAPs.
5. No monument protected by the Archaeological Survey of India (ASI) is located within the ROW of highway.
6. The most important factors, which need continuous attention and assessment during the construction phase, are the ambient air quality, the water quality and the noise level. The ambient air quality of the study area is good except SPM/RPM, which exceeds the permissible limits near major crossings. The quality of the ground water is good for drinking as well as other daily use purpose. Noise levels in the area, particularly at crossing points and in the urban settlement, exceed the limits due to heavy vehicular movement and commercial activities.
7. The proposed alignment of the road has been judiciously finalized, so that it has minimum impact on physical and social environment. Based upon physical and social screening analysis of proposed section, Hot Spots have been identified.
8. Elevated structures in the form of bridges are proposed in the road alignment, wherever road passes through water bodies.

2.6 Scope of the EIA/EMP Study

The scope of the EIA/EMP study involves: -

- Identification and categorization of the potential impacts during pre-construction, construction and operation at phases.
- Developing mitigative measures to sustain and maintain the environmental scenario.
- Providing compensatory developments wherever necessary, including plans for highway side tree plantation.
- Designing and monitoring the Environmental Management Plan.
- Suggesting the Environmental Enhancement Scheme and its monitoring.
- Environmental Screening and consultations with public, experts in various fields and nongovernmental organizations (NGOs), etc.
- Review of policies and legal framework.

Identification of 'sensitive areas' and 'hot spots' of critical nature and suggestion for their avoidance and mitigation

2.7 Objectives

The objectives of the EIA include:

- Collection of baseline data on various components of the environment.

- Determination of the magnitude of environmental impacts so that due consideration is given to them during planning, construction and operational phases of the project implementation.
- Assessment of the socio-economic conditions of the project affected persons and suggestions for their improvement.
- Identification of areas and aspects, which are environmentally or socio-economically significant.
- Submission of Environmental Enhancement Plan and Environmental Management Plan for enhancing the positive and mitigating the negative impacts.
- Development of the road alignment in such a way that the environment and settlements are least affected.
- Presentation of public view on environmental and socio-economic aspects.

2.8 Policy Context for Environmental Assessment in India

The policy of the Government of India with regard to environmental assessment on different kinds of projects are laid down in 'The Environmental Impact Assessment Notification', 1994 (as amended up to 2002), issued by the Ministry of Environment & Forests, New Delhi. With regard to this notification an EIA report must be prepared and its approval must be obtained for the present 4 lane widening and new construction project. The State Pollution Control Boards (SPCB) has been assigned the responsibility for implementing (i) The Air (Prevention and Control of Pollution) Act, 1981 and (ii) The Water (Prevention and Control of Pollution) Act, 1977. With regard to cutting of trees, etc., the Forest (conservation) Act 1980: Rules and Guidelines are applicable.

2.9 Public Consultation

Public consultation at all stages of planning and implementation of a project is necessary. It helps in making the project more environment-friendly and easy to implement. Public consultation in this project is done by field-testing and questionnaires for various environmental/socio-economic parameters and interviews with the Project Affected Persons.

2.10 Environmental & Social Impacts of Road Widening

Transport facilities including roads bring development. They not only facilitate transportation and movement, but, as a whole, bring significant economic growth and social benefits. It is a well-known fact that the economy and human welfare activities of an area depend on its proximity to the road. Be it health, hygiene or education, be it agriculture or business, almost all shades of human life change once a road is developed in an area. The road allows cultures to mix and interact.

In regions where roads already exist, they need to be strengthened at regular intervals. The highways need widening in view of the growing traffic pressure, Road safety, travel time and the vehicle operating costs. It also increases the access to markets, jobs, education and health services. Obviously, with this intention the Government of India through the National Highways Authority of India (NHAI) undertook the required widening of NH 47.

However, all is not rosy in road development. Whether a new road is laid or an existing road is widened, it disturbs and destroys many more things. The widening/new construction of the road may result in loss of productive agricultural land, damage to sensitive ecosystems, removal of trees, dislodgment of large number of people, disruption of local economic activities and accelerated urbanization. The properties and people in many cases may fall in the direct path of road widening. The livelihood of people is often disrupted. Such a developmental project may cause soil erosion, interfere with animal and plant species, and change the level of underground water.

People may lose accustomed travel paths and community linkages and can be culturally affected. The exhaust emissions will also grow significantly leading to increase in respiratory and other health problems. Some of the negative impacts may even have far-reaching consequences. One has to be very careful and cautious in assessing these impacts and then find viable solutions to mitigate them.

In fact, it is easy to quantify the magnitude of physical impacts such as land clearance, trees removed and homes affected; but difficult to quantify effects on the biological and aesthetic environment such as physiological alteration on flora & fauna, reproductive and behavioral changes in organisms etc. The study therefore has been carried out with utmost care to analyze, predict and mitigate the environmental and social aspects of the region in consequence to the proposed highway widening.

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Institutional Setting for Project

Considering the growing need of better road transport the Government of India, through Ministry of Shipping Road Transport and Highways (MoSRTTH) has decided to undertake four laning of National Highway–47 between TN/KL border and Kanyakumari and NH 47B from Nagercoil to Kavalkinaru. Since the planning, development and Management of National Highways is controlled by the National Highways Authority of India (NHAI), New Delhi, operating under the MoSRTTH, the present project is under direct control of NHAI.

3.2 Institutional Setting in Environmental Context

The primary responsibility of administration and implementation of the Government of India's policy with respect to environmental management, conservation, ecologically sustainable development, and pollution control rests with the Ministry of Environment and Forests (MoEF). The MoEF has a number of agencies and institutions to implement the environmental polices, such as:

- **Central Pollution Control Board (CPCB):** It is a statutory authority attached to Ministry of Environment and Forests (MoEF)
- **MoEF Regional Offices:** The country is divided into several regions, with each region having a Regional Office.
- **State Pollution Control Board (SPCB):** These play the role in environmental management at the state level, with emphasis on air and water qualities.
- **State Department of Environment and Forests:** These perform functions similar to MoEF at the state level.

3.3 Government of India - Acts and Regulations

The Government of India has laid down various policy guidelines, regulations, acts and legislations pertaining to sustenance of environment. **Table 3.1** gives the relevant environmental legislations and implementing agencies.

Table 3.1: Details of Acts and Regulations

Sl. No	Act/Regulation	Main Objective	Implementation Agency
1.	Air (Prevention and Control of Pollution) Act, 1981	To control and monitor air quality as per prescribed limits	Tamil Nadu Pollution Control Board.
2.	Indian Motor Vehicles Act, 1988	To check vehicles for air and noise pollution	Motor Vehicles Department, Govt. of Tamil Nadu
3.	The Water (Prevention and Control of Pollution) Act, 1977	To control and monitor water pollution as per prescribed limits	Tamil Nadu Pollution Control Board.
4.	The Forest Conservation Act, 1980	To check deforestation	<ul style="list-style-type: none"> • Tamil Nadu forest - upto 5 ha. • Regional Chief Conservator of Forest - 5 to 20 ha • MoEF – Above 20 ha
5.	National Forest Policy, 1988	To preserve and restore biological diversity	Forest Department, GOI and Government of Tamil Nadu
6.	Wild Life (Protection) Act, 1972	To protect and improve the overall wild life	Chief Conservator Wild Life, Forest Dept., Tamil Nadu.
7.	Environment Protection Act,	To protect and improve	Dept. of Environment and

Sl. No	Act/Regulation	Main Objective	Implementation Agency
	1972	the overall environment	Forest, Tamil Nadu
8.	Ancient Monuments and Archaeological Sites and Remains Act, 1958	Preservation of culture and historical remains	Indian Heritage Society, and Indian National Trust for Art and Cultural Heritage
9.	EIA Notification, January 27, 1994 amended up to 22 August 2013	For all Development Projects	Tamil Nadu Pollution Control Board, MoEF
10.	National Environmental Appellate Authority Act, 1997	For Grievance Redressal	Ministry of Environment and Forest

3.4 Institutional Strengthening and Arrangement

Though rich in legal and regulatory instruments, the implementing agencies are unable to regulate and monitor a sound environmental management plan due to lack of enforcement capacity. Therefore, violations or missed mitigation commitments often go unreported. The gaps and deficiencies pointed out can be removed by proper arrangements. Institutional strengthening component has accordingly been identified. As such, the overall arrangement is as follows.

3.4.1 Organizational arrangements

An Environmental Unit will be established in each construction package with a manager to address the environmental issues. The Environmental Unit will have proper staff to ensure the implementation of EMP and related measures. The Manager (Environment) will be familiar with the Indian environmental legislation, will have proper training of the environment of the region, and will be able to coordinate with NGOs, community groups, and Government Departments.

3.4.2 Environmental Training

Training of staff will be done at various levels. Some short-term training is required for the Environment Manager, other staff members of the Environmental Unit and the contractor staff to raise their levels of environmental awareness. The Environment and Natural Resources Division and the State Pollution Control Boards conduct the training programmes, and their help will be sought in this regard. In the long-term training, the specialized training or special environmental issues will be examined and provided to the Environment Unit

3.4.3 Environmental Monitoring

In order to ensure that the prescribed environmental norms are maintained during the constructional and operational phases, regular monitoring is one of the most important components of the institutional arrangement. Regular monitoring of Air pollution, Water quality, Noise pollution, and maintenance of trees, etc. will be done at regular intervals. The field reports of various environmental components will be received on quarterly basis, and any lapse has to be taken care of.

Some awareness training will be provided to the contractors and their personnel to ensure that the EMP is implemented effectively. The project co-coordinator will assess the contractor's practices and, if high pollution levels are suspected, government or private sector laboratories will check them.

4.0 APPROACH AND METHODOLOGY

In order to understand the environmental impacts due to the proposed road widening, observations were made by repeated field visits. The relevant secondary data were also collected. The methodologies adopted may be classified in the following way:

- Preparation of questionnaire for environmental surveys.
- Field observations of these questionnaires including public consultation.
- Screening, testing and monitoring of environmental factors like air, water, soil and the noise level.
- Collection of secondary data from various departments.
- Compilation, analysis and presentation of the report.

4.1 Preparation of Questionnaires for Environmental Parameters

Questionnaires were prepared after thoroughly studying the environmental guidelines and conditions of the Ministry of Environmental and Forests (MoEF), World Bank and Asian Development Bank. Questionnaires for Environmental appraisal for other Road / Highway projects by MoEF were also taken into account while preparing Questionnaire for the project. Total three sets of Questionnaires were prepared for field survey/data collection. The details of these are as follows:

- Environmental screening information like national parks, wild life sanctuary, forests, archeological, cultural, religious structures etc. within 10 Kms on both sides of the road.
- Environmental screening survey, effects on environment, views of the community.
- The survey of features within Right of Way (ROW) on both the sides of the Road.

4.1.1 Field Observation on Questionnaire

A team under the leadership of a senior Environmental Engineer was constituted to undertake the field survey of the questionnaire. The team members were appraised of the comprehension of the work emphasis on public consultation.

4.1.2 Screening, Testing & Monitoring of Physical Environmental Factors

The entire stretch of present section was surveyed and screened. The collection of water samples, soil samples and other data pertaining to air quality and noise were done within ROW.

4.1.2.1 Ambient Air Quality

Ambient air quality was monitored along the road at selected sites. The locations selected were those of the city / town area, the market place and the rural areas. The details of locations and monitoring results are discussed in Chapter 5. Air quality parameters considered for the study include Respirable Particulate Matter (RPM) Suspended Particulate Matter (SPM), Nitrogen Oxides (NO_x) Sulphur Di-oxide (SO₂), Hydrocarbon (HC), Carbon monoxide (CO) and lead (Pb).

a) Particulate Matters (SPM & RPM)

SPM was monitored using a Respirable Dust Sampler (RDS). A pre-conditioned and weighted glass fiber filter paper is placed on top of the RDS. A known quantity of the air was sucked through the filter paper in a prescribed sampling time. The flow was noted from the manometer. The multiplication of time with rate gave the total quantity of air passed through the filter paper. After sampling, the filter paper was removed, conditioned and weighed finally. From the weight of dust collected on the filter paper (RPM) and the cup below the cyclone (NRPM) and total quantity of air sucked, the concentration of Particulate Matter is calculated.

b) Sulphur Di-Oxides (SO₂)

A known quantity of the air was bubbled through impingers containing tetrachloromercurate. SO₂, formed a disulfiltomercurate complex, which gave a pinkish blue colour with p-rosaniline and formaldehyde solution. The intensity of colour produced was proportional to concentration of sulfur dioxide. The measurement was made by using spectrophotometer at the wavelength of 560 nm.

c) Nitrogen Di-Oxides (NO_x)

A known quantity of air was passed through impingers containing sodium hydroxide-sodium arsenite solution. The estimation of NO_x was done colorimetrically using hydrogen peroxide, sulfanilamide, NEDA, etc. The intensity of the colour was measured at 540 nm using a spectrophotometer.

d) Carbon Monoxide (CO)

Indicator tube method was used for measurement of CO in ambient air. Known volume of air was passed through the tube by the aspirator provided. Concentration was calculated by comparing the developed colour in the tube with the standard colour chart.

e) Hydrocarbon (HC)

Organic vapour sampler was used to collect the sample for HC from ambient air in HC tubes containing carbon as adsorbent. The collected samples were analysed using gas liquid chromatograph.

f) Lead (Pb)

Samples were collected using APM 2000 filter papers by passing known volume of air through them and concentrations were analysed by using gas liquid chromatograph.

4.1.2.2 Water Quality

Samples of ground water were collected from handpumps, wells and Tubewells whereas samples of surface water were collected from ponds & tanks. To assess the water quality of the area samples were tested for physico-chemical parameters. The details of sampling locations and testing results are discussed in Chapter – 5.

4.1.2.3 Soil Quality

The samples were collected from 60 m corridor of the road, at 5-10 cm depth. Besides studying their particle size (sand/silt/clay ratio) they were monitored for physico-chemical parameters to assess the soil quality of the area. The details of sampling locations and testing results are discussed in Chapter - 5.

4.1.2.4 Noise Level

The noise level (Leq) was measured using noise meter at various sites along the entire stretch of road during day (6.00 am to 10 pm) and night (10 pm to 6.00 am). The noise level is expressed as an equivalent noise level (Leq) which is the measurement duration of sound pressure level as the averaging time. It is calculated as follows:

$$L_{eq} = 10 \log \left(\sum_{i=1}^n f_i \times 10^{L_i/10} \right)$$

Where f_i = Fraction of time for which the constant Sound Pressure Level Persists
 L_i = Sound Intensity Level dB ; n = No. of observations

The details of noise monitoring locations and results are discussed in Chapter –5.

4.1.3 Secondary Available Data

The secondary data from various sources are listed in **Table 4.1** below.

Table 4.1: Details of Secondary Data Sources

Sl. No.	Details	Sources of Details
1.	General information	District Collector/Gazetteer Office, Nagercoil (Tamil Nadu)
2.	Meteorological data	Indian Meteorological Department
3.	Statistical data	District Statistical Office, Nagercoil (Tamil Nadu)
4.	Irrigation and hydrogeology data	Central Ground Water Board
5.	General Land use and Cropping Pattern	Asst. director of Agriculture,
6.	Relief and slope	Survey of India
7.	Rocks and minerals	Geological Survey of India
8.	Industries	District Industries Center
9.	Maps and Topo sheets	Survey of India
10.	Forests/Wild life/Bio-diversity	District Forest Office, Nagercoil (Tamil Nadu)
11.	Flora and Fauna	District Forest Office, Nagercoil (Tamil Nadu)
12.	Archaeological Data	Archaeological Survey of India

4.2 Preparation of Strip Maps

Strip maps of 1 km each have been used in the process of conducting the screening survey. All types of structures have been mapped in the Road Inventory prepared by the Engineering Team..

4.3 Analysis, Compilation and Preparation of Report

The data collected by survey teams were compiled. Along with the field monitoring studies and secondary data, these were used to identify the environmental problem spots or 'Hot Spots'. The following analyses were carried out based on compiled information,

- The levels of environmental parameters were compared with the prescribed limits suggested by Central Pollution Control Board (CPCB). This gave a clear idea of areas requiring special attention, where the level of pollution is higher than desirable. Those stretches, where the pollution level does not exceed the desired limits despite widening of the road may not require further studies.
- The sites where the impacts are minimum or nearly absent have been identified. This may help in selection of major storage sites during construction work.
- The mitigation measures have been suggested to reduce the adverse impacts due to the proposed widening and detailed EMP have been prepared covering both the phases i.e. construction and operation of highway.

5.0 EXISTING ENVIRONMENTAL SCENARIO

5.1 Natural Environment Setting

5.1.1 Climate

In order to analyze all the important climatic parameters like rainfall, temperature, humidity, wind etc, which play a vital role in atmospheric dispersion of pollutants, nature and amount of these parameters have been studied. The climatic condition in the study region is healthy as a whole and characterized by general dryness except during the monsoon season. In summer, the climate is very hot. From climatic point of view the year may be divided in to four seasons they are:

- (i) The summer season from March to May, when there is a steady increase in the temperature, with maximum temperature of the year occurring in April.
- (ii) The South West monsoon season which lasts from June to September, when the humidity is very high
- (iii) Post-monsoon season - October and November constitute the post-monsoon or retreating monsoon season, when humidity decreases to the minimum and the evening air begins to be cool. Light fog gathers soon after sunset and towards the morning. For sometime after sunrise, the region is surrounded by mist.
- (iv) The cold season lasts from December to February, when the night temperature is at its minimum. The sky is generally clear, or lightly cloudy.

5.1.2 Temperature

Significant variation in temperature of the study region has been recorded in the study area. There is steady increase in temperature after February. April is generally the hottest month in the region, with the mean daily maximum at 35.0°C and the mean daily minimum at 17.5 °C.

During the summer season, the day temperature occasionally rises up to 41.5°C. Afternoon thundershowers, which occur on some days bring welcome relief though only temporarily. With the onset of the south-west monsoon into the region early in June, there is an appreciable drop in the day temperature. From September, there is a slight increase in the day temperature during the post monsoon period and the maximum day temperature of this period occurs in October. During the period from December to February the minimum temperature on individual days may go to about 18.0°C.

5.1.3 Rain Fall and Humidity

The variation in the annual rainfall as a whole from year to year is not large. But in the eastern parts of the region where the rainfall is comparatively less than in the rest of the region, the variation from year to year is large. The average rainfall in the region is 1029.2 mm. The rainfall is high in the southwestern parts of the region in the close proximity of the Western Ghats and decreases very rapidly towards east. About 70% of the annual rainfall is received during the monsoon months from June to September, July being generally the rainiest month.

On an average, there are 98 rainy days in a year in the region. This number varies from 42 days to 104 days at different places of the region. The heaviest rainfall in 24 hours recorded in the region was 413.3 mm.

The Relative Humidity depends not only on the amount of water vapor in the atmosphere, but also on temperature. The humidity is generally high being over 89% in the monsoon season and decreases in the post-monsoon period.

5.1.4 Pressure and Winds

The vapor pressure in the region increases from January to May and reaches maximum in May. Strong winds blow during the monsoon season.

The winds blow mainly from the south-west and west during the period from April to September. In October, winds blow commonly between North and East directions, but on some days they are from Southwest or West. During November and December, the winds are mostly Northeasterly or Easterly. Southwesterly and Westerly winds appear in January and from February onwards the Easterly wind decreases in frequency and the afternoon winds begin to blow more & more from Southwest and West directions. By April, the winds blow predominantly from West and Southwest directions. The details of the wind effects are presented in **Table 5.1** below.

Table 5.1: Effect of Wind on Surrounding Areas

Range (km/hr)	Effect	Comments
< 1	Smoke rises vertically	Calm
1 – 3	Smoke drifts with wind	Light Air
4 – 6	Wind felt on face, leaves rustle	Light breeze
7 – 10	Leaves and small twigs in motion	Gentle breeze
11 – 16	Dust & loose papers raised, small branches move	Moderate breeze
17 – 21	Small trees sway	Breeze
22 – 27	Large branches move, telegraph wires whistle	Light gale
28 – 33	Whole trees way, walking becomes difficult	Moderate gale
34 – 40	Twigs break off	Gale
41 – 47	Slight structural damage	Strong gale
48 – 55	Trees uprooted, structural damage	Whole gale
56 – 63	Widespread damage	Storm gale
64 – 71	Widespread severe damage	Hurricane

5.2 Physical Features

5.2.1 Kanyakumari Region

Kanyakumari District is surrounded by Majestic Hills and the plains bordered by colourful sea-shore, fringed with coconut trees and paddy fields. There are few elevated patches of red cliffs with undulating valleys and plains between the hills and the sea – coast. Kanyakumari is one of the smallest districts in the state of Tamil Nadu having an area of 1584 sq.km, out of which 1541-3 sq.km is rural and 42.7 sq. km is urban. Kanyakumari occupies 1.29% of the total extent of Tamil Nadu. The District lies between 77°15' and 77°36' of the eastern longitudes and 8°3' and 8°35' of the northern Latitudes. The district is bound by Tirunelveli district on the North and the East. The South Eastern boundary is the Gulf of Mannar. On the South and the South West, the boundaries are the Indian Ocean and the Arabian Sea. On the North and North-West Kanyakumari is bound by Kerala state. The coastline extends over 58 km, and is almost regular except for some points and land projecting in to the sea at Kanyakumari.

Based on the agro-climatic and topographic conditions the district can be divided into three regions, The Upland, the middle land and low lands.

The Upland: Comprising of hills and bases suitable for Growing crops like Rubber, Cloves, Nutmeg, Pepper, Pineapple and cashew.

The Middle Land: Comprising of plains and valleys fit for growing crops like Paddy, Tapioca, Banana, Coconut etc,

The Low Land: Comprising the coastal belt ideal for growing Coconut, paddy and sugarcane.

5.2.1.1 Soil

Soil in the District is mostly of the red loam variety. However on the sea coasts, the sandy type of soil prevails and, near the mountain ranges, gravelly soil is generally seen. In low lands there is neither white sand nor sandy loam, while in the midlands and high lands there prevails fairly fertile soil of the fine type. The valley in the midland has loamy clay soil with high sand content. In the midlands, in general, the soil is clay-loam of laterite origin with an admixture of gravel and sand. In Kalkulam and Vilavancode taluks, the gravel content is low.

5.2.1.2 Geological Structure

The geological formation of the district is made up of marine and alluvial soils, raised beaches and alluvium, sand stones, clays and lignite. The beach deposits at Manavaalakurichi, Kanyakumari and other coastal areas contain such heavy minerals of Industrial use as Ruttle, Iluminite, Zircon, Monozite etc.

5.3 Natural Vegetation

The vegetation of the region is of two distinct types. Coconut and rubber tree dominate the area.

Vegetation cover consists of soaring and lofty trees of *Mesua Ferrea*, *Bischofia Javanica*, *Vitex Altissima*, to smaller trees of *Dillini* a species festonning climber, shrubs, valuable herbs, variety of orchids, 2 types of canes, many indigenous palms and cycas. The important timber yielding trees are Teak, Rosewood, Vengai and Aini. Various type of forest produces like Bamboos, Reeds, Canes, Soft Wood, Tamarind, Lemon Grass, Rubber, Coconut, Arecanut, Kadukai, Cinnamum bark, Nelli, Cardamom, Mango are harvested in this District.

Some of the most common natural vegetation of the study region include Cloves, Nutmeg, Pepper, Pineapple, Tapioca, Banana, Cashew, Mango (*Mangifera Indica*), Shisham (*Dalbergia Sissoo*), Ker (*Semccarpus Anocardium*), Bel (*Aeglemarmelos*), Shivan (*Gmelinia Arborze*), Neem (*Melia Azadirachta*), Wad (*Ficus Bengalensis*) etc.

5.3.1 Flora and Fauna

The region is endowed with a rich and varied fauna. This District is rich in wild life with at least 25 types of mammals, about 60 species of birds many species of fishes, reptiles and amphibians. Animals are dependent directly or indirectly upon plants for their survival. Among domestic animals, cows and buffaloes, goats, mules, cats, dogs and fowls are prominent.

Among the wild animals, the common Langoor (*Presbytis Entellus*) is found all over the region occurring in groves, river banks and wood-lands. Tigers (*Panthera Tigris*) are rare in the region. The jungle cat (*Felis Chaus*) and the toddy cat are common all over the region. The Indian Civet (*Viverricula Indica*) is found in forest areas.

Among birds, *Otogyps Calvus* are common everywhere and more in forest areas. The Brahminy Kite (*Haliaster Indus*) is found near all large ponds and reservoirs. The common Paraiah Kite (*Milvuis Migrans*) is very common in fair weather and found in small numbers during rainy season. The Indian Screech Owl (*Strix Javanica*) is common in forest areas and the Rock-Horned Owl (*Bubo bengalensis*) is common in plains. The Wire-tailed Swallow (*Hirundo filifera*) is common in plains.

Some of the other species found in the region are Grey Hornbill (*Tockus Birostris*), Golden Beaked Woodpecker (*Crysocolapets Delesserti*), Green Barbets (*Magalaima Zeylanica*), Koel (*Eudynamys*), Small Minivet (*Pericrocotus Perigrinus*), Red Whiskered Bulbul (*Pycnonotus Jocosus*), Bulbul (*Pycnonotus Cafer*), White Cheeked Bulbul (*Pycnonotus Leucogenys*), Shama (*Cercotrichas Macrura*), Indian Tailor Bird (*Orthotomus Sutorius*), Carrion Crow (*Corvus Macrorhynchus*) etc.

Among amphibians, the common Toad (*Bufo Melanosticus*) the Wrinkled Frog (*Rana Curtipes*), Chanum Frog (*Rhacophorus Maculatus*), Green Frog (*Hyla Arborea*) are common. Among reptiles, Indian Chameleon (*Chameleon Calcartus*), Garden Lizard (*Calotes Varicolor*), Blood sucker (*Calotrs Versicolor*), Cobra (*Naja Naja*), Viper (*Echis Carinata*), Rat Snake (*Ptyas Mueosus*) and Semi-aquatic Snake (*Natrix Stolaus*) are prominent. Lizards are insectivorous and snakes are carnivorous and feed on rats, mice, frogs, toads, lizards, worms, insects etc.

Large waterbeds such as ponds, rivers, etc in the region present a number of different ecological habitats and accordingly more diverse species of fresh water fish and other species live in them.

5.4 Water Resources

Water resources studied in the project include

- (i) Under ground water
- (ii) Surface water bodies include ponds and tanks.

The level of groundwater in the study area varies from 60 ft. to 100 ft. Most of the water is drawn by tube-wells and hand pumps. The groundwater yield varies from 1 – 10 l/sec.

The major rivers, which cross the proposed alignment, are Tambirabarani (km 48.186), Palayar (km 80.706) and Valliyar River (km 66.850). The ponds and the tanks through which our alignment crosses are listed in Table 12.1 & 12.2.

5.5 Environmental Analysis

Environmental studies are completed in the winter season, 2004 – 2005. During this period sampling & monitoring of environmental parameters (soil, water, air, noise, etc) was completed.

During the study, water samples were collected from the surface as well as ground water simultaneously. Soil samples were also collected to examine the physico-chemical characteristics of the soil sample.

Ambient air was monitored at various locations of the proposed highway. Parameters monitored were SPM, RPM, NOx, CO, HC and Pb.

5.5.1 Soil Analysis

The physico-chemical analysis of the soil for various parameters including pH, Nitrogen, Phosphorous, Potassium and particles size composition (Percentage of clay, sand, lime) is given in the **Table 5.2**:

Table 5.2: Soil Quality

Location	pH	Clay, %	Sand, %	Silt, %	Phosphorous, %	Nitrogen, %	Potash, %
Vadasseri	6.3	14	67	19	0.025	0.2	0.035
Nagercoil	6.4	17	63	20	0.023	0.21	0.031

Location	pH	Clay, %	Sand, %	Silt, %	Phosphorous, %	Nitrogen, %	Potash, %
Vellamadam	6.1	19	63	18	0.031	0.3	0.09
Veramartandanpudur	6.3	15	68	17	0.028	0.1	0.10
Devasagai Malai	6.2	17	59	24	0.019	0.2	0.03
Thovalai	6.1	16	61	23	0.017	0.2	0.02

5.5.2 Water Analysis

The fresh water bodies like rivers, canals, ponds etc. are the medium for all life processes. The data on the physical characteristics of surface water and ground water bodies such as pH, Total Dissolved Solids (TDS), Alkalinity, Chloride and Conductivity shows variations at different sites. pH of all the water samples vary from 6.5 to 7.4 which is in the range of acceptable standards for drinking water. Hardness is high and exceeds acceptable limit for drinking water. BOD & COD are nil in ground water, which indicates no contamination on ground water. In general, water except hardness is good and can be used for drinking purpose. The water quality test results are presented in **Table 5.3** below.

Table 5.3: Water Quality

Location	pH	Alkalinity mg/l	Total Hardness mg/l	Conductivity μ mho / cm	Chloride mg/l	TDS mg/l	COD, mg/l	BOD, mg/l	Sulphate, mg/l
Vadasseri (Hand Pump)	6.7	88	135	1236	51	321	8.5	-	75
Tiruppatisaram Pond	7.2	95	161	935	52	281	18.6	3.0	249
Karaiyankudi Pond	6.8	89	143	969	46	317	20.3	4.0	283
Tambraparni	6.7	85	174	1135	49	564	6.8	2.0	98
Vadasseri (Hand Pump)	6.7	88	135	1236	51	321	8.5	-	75

5.5.3 Ambient Air Quality

The ambient air quality parameters namely, Suspended Particulate Matter (SPM), Respiratory Particulate Matter (RPM), SO₂, NO_x, CO, Pb and HC were tested at selected places and results are given in **Table 5.4** for winter season, 2004 – 2005.

Table 5.4: Ambient Air Quality for Winter Season

Station		SPM μ g/m ³	RPM μ g/m ³	SO ₂ μ g/m ³	NO _x μ g/m ³	CO μ g/m ³	Pb μ g/m ³	HC μ g/m ³
Takkalai	I	223	72	16	24	1200	BDL	1300
	II	173	55	18	18	1200	BDL	1100
Nagercoil	I	261	78	22	30	1600	BDL	2000
	II	217	54	18	24	1200	BDL	1600
Tovalla	I	195	69	13	29	BDL	BDL	BDL
	II	199	68	14	31	700	BDL	BDL

* BDL = Below Detection Limits

The result shows that all parameters are within the limits except SPM, which exceed the limits, prescribed by CPCB at one place. **Table 5.5** shows the National Ambient Air Quality Standards.

Table 5.5: National Ambient Air Quality Standards

Pollutants	Time Weighted Average	Sensitive Area	Industrial Area	Residential Rural & Other Area
Sulphur Dioxide (SO ₂) (µg/m ³)	Annual 24 hours	15 30	80 120	60 90
Oxides of Nitrogen (Nox) (µg/m ³)	Annual 24 hours	15 30	80 120	65 90
Carbon Monoxide (CO) (µg/m ³)	8 hours 1 hour	1000 2000	5000 10000	2000 4000
Lead (Pb) (µg/m ³)	Annual 24 hours	0.50 0.75	1.0 1.5	0.75 1.00
RPM Size less than 10 µm (µg/m ³)	Annual 24 hours	50 75	120 150	60 100
SPM (µg/m ³)	Annual 24 hours	70 100	360 500	140 200

5.5.4 Noise Level

The sources of the road noise may be due to

- Vehicles
- Friction between vehicles & road surface
- Drivers attitudes
- Construction & maintenance activity, etc.

The measured noise levels at various places are presented in **Table 5.6** below.

Table 5.6: Measured Noise Level

Location	Equivalent Noise Level dB (A)	
	Day	Night
Takkalai (Commercial Market)	73	43
Nagercoil (At Church)	70	46
Tovalla (Residential)	59	43

Acceptable limits Day-65 dB(A)
Night-55 dB(A)

The above tables show that the Noise levels are exceeding the prescribed limits at some places during the daytime due to heavy vehicular movement.

5.6 Land Use

Land use has a strong impact on environment of any region. The clearing of plantation for settlements, agriculture, transport and communication networks and consequent disappearance of wild animals have adversely affected the ecological balance. Land use analysis of a region plays vital role in decision-making process of any proposed activity / project. Specifically in road/highway projects the impact may be very significant. Thus, the land use study has been done in order to evaluate the regional land for the present project of road construction and widening.

5.6.1 Agriculture

Kanyakumari District is famous for its vast stretches of paddy fields. Apart from this, the district also produces tapioca, oilseeds (Groundnut & coconut), besides commercial crops like Cashew, Rubber, fruits and spices. The important feature of this District is the

production of off season Mangoes. Nearly 16,000 hectares of lands were under paddy cultivation during 1999-2000.

Paddy is the main crop of the District and is raised in two seasons i.e. Kannipoo (April – June) and Kumbapoo (September – October) respectively.

Tapioca is raised as a subsidiary food crop in this District. The main planting season is April – May. In some pockets, September – October planting is also done as second season crop. It is purely raised as rain-fed crop in Kalkulam and Vilvancode Taluks and as irrigated crop in some area of Agastheeswaram Taluk.

Coconut is an important cash crop of this District. The main planting season is May – July.

Pulses are raised in rice-fallow and as intercrop in Tapioca. The important pulses are Blackgram, Greengram, Horsegram, Cowpea and Redgram. In the months of April – May and September – October pulses are grown as intercrop with Tapioca. In the months of February – March pulses are raised as pure crop in rice-fallows.

Banana is cultivated mainly during March – May and September – October. Groundnut is raised during March – April and October – November as rain-fed crop in small extent. Vegetables are cultivated during January – February and July – August.

Vegetables are also grown as 3rd crop after the harvest of 2nd crop paddy in some pockets of this district. It's proximity to equator, topography and other climate factors favour the cultivation of varied crops. In addition, Pepper, Cloves, Arecanut, Betelvine, Cocoa, Gingelly, Ginger, turmeric, Arrowroot etc. are also grown.

5.6.2 Irrigation

Since the rainfall is variable, the region needs supplement water requirements for agricultural purposes. In the study area number of pond and canal network is good and it fulfils the irrigation requirement of the area.

Kanyakumari is receiving a fairly good rainfall from both South-west and North-East Monsoons. Rivers provide the important source of irrigation in Kanyakumari District. The major river in the district is Thambarparni locally known as Kuzhithuraiar. This river has got two major distributaries namely Kodayar and Palayar.

5.7 Ecological Features

5.7.1 Major Wild Life Migration Routes

The data collected from forest department and District Gazetteer did not show any major wildlife migration route within 10 km on either side of the highway through out its entire stretch.

5.7.2 Wetlands

No Wetlands are identified on either side of the highway through out its entire stretch.

5.8 Structures, Health Centres and Hot Spots

5.8.1 Religious structures

Religious structures falling in the ROW include small temples, mosques, tombs, prayer halls and small churches. Besides this, there is no major religious structure falling in the proposed ROW of highway.

5.8.2 Commercial Structures/ Shops

Main commercial shops along the road are at Palliyadi, Manavilai, Kottaram bypass end point, etc. The shops falling in ROW are mostly semi-permanent/permanent in nature. It is observed that relocation of pucca structure is more difficult than the kuccha /semi pucca ones.

5.8.3 Residential Structures

Roadside land offers very good sites for human settlements. The important settlements that come along the road are Manavilai, Vivekanandpuram, Kottaram, Kanyakumari, etc. Majority of the population are Hindus followed by Christians. Most of the residential buildings are of permanent and semi permanent in nature. Households are normally male headed.

5.8.4 Health Centres, Police Stations

No hospital, health centres and police station will be affected by the proposed widening of the road.

5.8.5 Forests

The present sections of the road pass through Reserved Forest at following locations.

1. Chainage : KM 6+240 to KM 6+430 of NH-47 B
2. Chainage : KM 6+900 to KM 7+050 of NH-47 B

5.8.6 Identification of 'Hot Spots'

On the basis of screening survey analysis, some areas along the Highway have been identified as areas of concern from environmental point of view. Such areas are called as 'Hot Spots'. These are the areas, which are more sensitive from physical / social/ environmental point of view. In the EIA report these spots are given a greater degree of importance. The parameters used in identifying the 'Hot Spots' include

- Existing Built-up Area
- Degree of Soil Erosion
- Ambient Air Quality
- Noise Levels
- Drainage Pattern
- Surface Water Bodies
- Existing Religious Structures
- Adjoining Land-use, etc.

The list of identified 'hot spots' is presented in **Table 5.7**.

Table 5.7: 'Hot Spots' Identified During Environmental / Social Screening Analysis

Sl. No.	Design Chainage (km)	Remark
NH 47		
1	43.000 – 45.000	Coconut plantation, rubber estate
2	45.000 – 50.000	Rubber estate, Tambraparni River at km 48.186, Tambrakulam Pond at km 49.500
3	50.000 – 55.000	Rubber Estate, coconut Plantation, Pudukalam Pond in Nattalm village at km 54.625
4	55.000 – 60.000	Big pond, Nesarapuram, Nattalam at km 55.520, built up area of Palliyadi at km 56.500
5	60.000 – 65.000	Rubber Estate and coconut Plantation, Ponds at km 63.440, 64.250 & 64.550
6	65.000 – 70.000	Coconut Plantation, Valliyar River at km 66.850, Pond at km 68.000 & 68.510
7	43.000 - 96.000	List of ponds and tanks as per Table 12.1 &12.2
NH 47B		
12	0.000 – 5.000	Coconut Plantation, Ponds at km 1.050, 1.500 & 2.200
13	0.000 – 16.376	List of ponds and tanks as per Table 12.1 &12.2

5.9 Demography of the Region

The population distribution of a region depends on the following

- Impact of physical environment
- Economy
- Culture & society
- Physical and social disasters
- Social and political decisions, etc.

The demographical characteristics of study region have been studied to evaluate the impact on the socio-economic status of the region.

5.9.1 Potential Model and Rural Population

Multiple dot method has been used for showing the distribution pattern of the population. The region clearly indicates general uniformity in distribution owing to the homogeneous nature of the terrain and level topography. Factors like soil fertility, rainfall, ruggedness of topography by stream erosion, depth of groundwater, irrigation, means of transport & communication and urbanism have merely restricted local effects.

Another method of analyzing the distribution of rural population in the region is based on population potential model. The influence of any point with reference to another point is proportional to the mass exerting the influence and inversely proportional to the distance between the points. The sum of all influences at any point is termed as potential. The West-East axis of equipotential lines clearly indicates the influence of Thiruvananthapuram – Kanyakumari and Kanyakumari–Nagercoil rail lines on the Highway.

5.9.2 Density Pattern

The region has an average density of about 1476 persons per km². The influence of physical factors like topography, soil fertility, rainfall etc., on the distribution pattern of population is significant. Additional advantages are, however, provided by transport and communication lines and proximity of urban center and newly emerging centers in the vicinity of Tehsil and Block Headquarters and along the trunk routes.

5.10 Human Settlements

The important human settlements falling in the ROW are Manavilai, Kanyakumari, Agastheeswaram, etc. To get an idea of the population in these settlements, number of houses and household of the study area, village wise census data has been analyzed. During the previous decade, the population of the study region has increased.

5.11 Occupational Structure

The working population dominated by male, the non-working group is dominated by the females. Though no appreciable changes at Tehsil level are observed in the percentage of male workers to total males, the percentages of female workers record wide fluctuations in different parts of the region. It, thus, presents an example of traditional Indian economy where females are still confined to indoors domestic work leaving the entire burden of earning livelihood to the male members of the family. This results in problem of under-employment amongst the females.

5.12 Religious Composition

The religious composition shows the predominance of Hindus. Christians constitute the second largest religious community.

5.13 Linguistic and Socio – Cultural Characteristics

Mother tongue of the population in the study region is Tamil. Rural society, which is distinct from its urban counterpart, generally consists of simple, orthodox and God-fearing people in whom is seen the greatest spirit of cooperation and communal harmony. It is less amenable to new changes and innovations, a characteristic responsible for the preservation of ancient local culture.

5.14 Some Other Demographic Characteristics

Among other demographic characteristics, age and sex structure, marital status, and literacy rate and migration pattern were considered and analysed as follows.

5.14.1 Age and Sex Structure

Age composition is an index of potential labour supply as well as the possible growth-trend of the population in the region. More than half of the region's population is in the working age group (15-60 years). Females record greater percentage of their population below 39 years of age, while reverse trend is noticed in case of males who have larger percentage above 39 years of age. The sex ratio is in favour of male owing to high mortality rates in females.

5.14.2 Literacy

Total literacy (excluding the population in the age group of 0-6 years) is 88.12% of the total population of Kanyakumari District. The literacy percentage of males is higher than that of females, showing a comparatively lesser gap in comparison to state figure.

6.0 ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project. The analysis predicts the nature and significance of the expected impacts. The magnitude and duration (short-term or long-term) of impacts are also discussed.

In the following pages impacts on each biophysical environmental component (like soil, water, air, noise, flora and fauna) and socio-economic environmental component (like removal of property, land acquisition, etc.) are discussed.

6.1 Environmental Issues Which Do Not Affect the Project

- There is no loss of bio-diversity since no rare species of plants or animals are found in the region.
- No National Park or Wildlife Sanctuary is located within a radius of 10 km from the Highway. As such, the project is free from such environmentally sensitive issues.
- The chemical composition of the soil is not going to be affected by and large.

6.2 Potential Impacts on Soil

Soil is one of the most important components of the natural environment. For road development, soil is primarily needed for formation of road embankment. The baseline data on soil characteristics of the Highway and adjoining areas indicate that the soil is red loam variety. However, on the coast sandy type of soil prevails and, near the mountain ranges, gravelly soil is generally seen. From the pH values, it is observed that the soil is slight acidic.

Table 6.1 shows assessment of some of the impacts on soil.

6.2.1 Loss of Productive Soil

The potential impacts include:

- Loss of productive soil is considerable as the proposed new alignment is passing through paddy fields and covers approx. 25–30 km. Portion of the proposed project is passing through coconut plantation/banana plantation/rubber estate/tapioca plantation.
- The productivity of crops in the region will not be affected.
- The local economy is not going to be affected badly.

Table 6.1: Type and Scale of Soil Impact

Location	Type of Impact		Scale of Impact	Mitigation measures suggested
	Loss of productive soil	Erosion / Contamination		
Road side open stretches	No Loss; Beneficial	Very less	May be negative impact during construction	More trees plantation to enhance environment and for soil conservation.
Market and congested areas	No Loss; Beneficial	No		Not needed
Borrow pit area	No Loss of productive soil; Beneficial	No	-	Can be developed into pond for fisheries
Near Bridges	No significant Loss of productive soil	Soil erosion due to high embankment	-	By turfing, retention systems like RE wall, retaining wall, soil nailing.

6.2.2 Erosion

The soil along the proposed road is of red colour, due to presence of Fe_2O_3 and Sandy content has been found less. The erosion factor of present soil is less, as sandy soil is more prone to erosion.

The two important eroding agents are, (i) the run-off water, and (ii) the wind. The run-off dynamics are affected by the degree of slope, extent of deforestation and the amount of water stored for irrigation. Grasses and other herbaceous plants limit the surface erosion effectively.

The potential impacts include:

- (i) The ROW of the proposed road is covered by wide range of plantation (Coconut, rubber, banana, tapioca etc). Even in areas of high embankment the slopes are stable due to vegetation and other physico-chemical features. The degree of soil erosion is noted to be higher mostly in those stretches, which have very less vegetation.
- (ii) Once trees are removed and the herbal cover is cleared on the proposed road, the problem of soil erosion is going to be severe. Mitigation measures as suggested below shall be adopted,
 - cutting of trees in phases
 - taking advantage of the period of monsoon
 - developing not too high and steep slopes
 - improving drainage
 - replantation of trees
 - Turfing of the new embankment
 - Retention systems like RE wall, retaining wall and soil nailing for retaining high fill and cut locations.

These steps will reduce the severity of the issue and by the time the road starts operating, the ecosystem will restore itself.

- (iii) Excavation of soil borrow areas may lead to higher degree of erosion. However, care has been taken that
 - Most borrow areas are located on raised lands, earth mounds and heaps
 - in some cases the owner or villagers want to develop the area into pond for rearing fishes
 - Replantation in borrow pit areas will minimize the soil erosion.

6.2.3 Contamination of Soil

Soil contamination may occur due to presence of heavy metals like chromium, lead and zinc, etc. Pollutants setting in roadside soil can hamper the growth of vegetation and soil organisms. These effects are, however, confined to the sides of the road usually and their impact is negligible. In the present project, the contamination of the soil is negligible.

6.3 Impacts on Water Resources

Road development can lead to three types of modifications to the natural hydrological environment. These are discussed in the subsequent paragraphs.

6.3.1 Modification of the Surface Water Flow

The surface water flow in the existing two-lane carriageway is largely from north-east to south-west. The expansion and 4/6 laning of the present Highway and construction of

new road will in no way alter the existing course of the surface water flow. However, the existing drainage problem will be mitigated in the present project, by construction of roadside drains and cross drainage works.

The widening of minor bridges, irrigation canals and culverts in the proposed design in the project will be aligned in conformity with the expanding roadway. As such, the surface water flow in these streams and canals will be least affected.

6.3.2 Modification of the Groundwater Flow

Water table along the proposed road ranges between 60 ft. and 100 ft. during summer. Since the proposed carriageway is higher or same height as compare to existing one, the groundwater flow is not going to be affected.

6.3.3 Use of Local Water Supply

No local water supply will be used for construction purposes. Water will be taken from nearby surface water sources. New hand-pumps will be bored to take out underground water at construction sites if required. As the underground water table is moderate, the crisis of water will not be there.

6.3.4 Water Quality Degradation

Some important parameters like pH, Chlorides, alkalinity etc. were compared with the acceptable standard for drinking water. No direct impact on water quality is predicted.

6.4 Impact on Air Quality

The concentration of particulate matters in the ambient air of the stretch is higher than the prescribed limit at several junctions on the existing highways (NH – 47 and 47B). This poor ambient air quality is likely to affect the human health and therefore should be properly addressed. Some important observations in the Ambient Air quality are:

- Since no major industry is located along the project corridor, most of the pollution is vehicular.
- The emissions of individual vehicles, their monitoring and regular checks are important. The fuel composition, maintenance of engines, and engine temperature must be properly regulated for improved scenario.
- As there is no structure of archaeological importance affected by the proposed alignment, the impact does not need an assessment from this point of view.
- By and large (**Table 5.4**) the pollution level with regard to Suspended Particulate Matter (SPM) at few monitoring sites were slightly high. The other parameters of air quality measurements, namely, NO_x, HC, SO₂ and Carbon Monoxide at all selected sites were recorded to be within the prescribed limits.
- The mitigative measures suggested include the policies, regulation and enforcement programmes covering vehicle standards and maintenance requirement, fuel quality and technology, management of traffic efficiency and removing the high-pollution vehicles besides plantation of tall, leafy, and dense vegetation to filter and adsorb some pollutants.
- Sensitive areas will be taken care of especially in this regard.

The degradation of air quality because of construction, transportation of material and earth, the erection of temporary structures, and pathway during construction phase are considered as negative impacts. The values assigned to these components are subjective. On the other hand, the enhancement and mitigative wearies by plantation of trees will improve the air quality. The lesser degree of friction created by new project

road, the regulated bus and truck stoppage sites and the proper maintenance of vehicles will additionally help the mitigative measures.

6.5 Impact on Noise Levels

The assessment of potential road noise impacts helps in understanding one of the most significant pollution, the noise pollution. Some salient features related to potential noise impact of a road development include: (i) the road noise impact is greatest where busy road passes through densely populated areas, townships and markets (ii) the range of noise level should be understood in relation to the habitation type also; for example, road noise in industrial area is not likely to be problematic but at sensitive location like schools and hospitals, its impact will be significant, (iii) mitigation of noise in urban areas is rather difficult, specially at the road intersections.

During construction phase the noise level is bound to increase by the use of asphalt plants and generators. The increase is assessed to be between 10-20%. However, during operation phase, with improved road conditions and properly maintained vehicles, the level is likely to decrease.

6.6 Impact on Flora, Fauna and Ecosystem

Some important positive and negative impacts on flora, fauna and ecosystem of the present road-widening project are: -

- There will be no loss of bio-diversity since no rare/endangered plant or animal species is going to be eliminated due to the proposed widening.
- There will be no loss of habitat by the road itself, borrow pit areas and quarry sites.
- The proposed road widening and construction of new road will not affect migratory path of animal breeding zone, wetlands or important ecosystems.
- The aquatic habitat will not be damaged. The part filling of ponds will have only minimal impact considering at the long stretch of road
- The most important negative impact will be due to the cutting of dense commercial plantation of coconut, rubber, tapioca, banana etc.
- The loss of herbal cover, at least during the construction phase, is likely to produce some negative impacts.

6.6.1 Removal of Trees

A large number of trees (coconut, rubber etc) will be affected by the present project. However, the cutting of trees has been minimized due to integration of this factor exclusively in designing the proposed road expansion. The impacts of tree cutting on the environmental quality will be as follows.

- The loss of trees will lead to higher degree of soil erosion. This has to be compensated by replantation of trees in the first priority, at the pre-construction stage.
- The loss of trees will reduce the ambient air quality since trees act as adsorbent of air pollutants thereby improving the air quality.
- The reduction in number of trees, especially in or near congested market places will enhance the raising of noise level.
- The other benefits of such trees such as shade, availability of fruits etc. will be worst affected till the new trees grow up and compensate.

However, a careful and proper planning of replantation of trees right at the commencement of construction and the phase wise removal of existing trees will

mitigate the negative impacts. Apart from replantation for uprooted trees, 1% of the project cost is earmarked for green highway mission undertaken by MoSRTTH.

6.6.2 Removal of Herbal Cover

The removal of herbaceous plants from the widening side, will lead to soil erosion. However, the degree of erosion will be of smaller magnitude since the soil type has greater stability. Yet, the loss of soil by erosion could be mitigated by regular watering and replantation of herbal cover, i.e., turfing.

6.7 Impact on Protected Monuments and Cultural Heritage Sites

It has been observed that no archaeological site or monument and cultural heritage site exists close to highway. Therefore there would not be any kind of significant impact on any cultural heritage site.

6.8 Impacts on Social Environment

The economic and social interaction of communities will be improved by the road project. However, widening of the existing road and new alignment will cause disruption to local interactions. In fact, at few places over the years people have occupied the open space of the Right of Way (ROW) encroaching upon it. The encroachments are most common in market places, road crossings and in midsections. The local community activities go on the roadside, the footpath, the bus stops and even the road surface itself. These activities may take many forms, for example,

- Development of dhabas, tea shops, café and repair shops catering to the needs of trucks and truck drivers besides other automobiles.
- Make-shift shops in market places catering to the need of travelers and passengers besides the drivers of the vehicles.
- Uncontrolled stops by buses, taxis and informal public transport

Some important observations during the field visits are:

- The ROW is squatted and encroached at few places of the Highway
- Public consultation reveals that people are aware of their illegal occupancy and are willing to support the project. Still, their stand at the time of project implementation cannot be predicted.
- One of the topmost priorities in designing the alignment was to save as many properties as possible.
- Way side amenities are planned in the project corridor at strategic locations for social and economic interaction of communities.

6.9 Impacts on Road Safety and Human Health

The planning and designing of the new road is in accordance with the improved safety measures and better health conditions. The chances of accidents could be minimized by

- Widening of existing carriageway
- Strengthening the pavements
- Improving the curves and road geometrics
- Proposing the service lanes in market places and near villages, schools, etc
- Providing proper median
- Improving upon road crossings
- Putting right signals and signboards
- New under passes
- Fly-overs and grade separators

The human diseases caused by the contamination of water, increase in air pollutants and noise may go up by 5-10% but proper mitigation can take care of the situation.

7.0 ANALYSIS OF ALTERNATIVES

7.1 Analysis of Alternatives for NH-47

Various alternatives have been considered for the proposed widening and construction of new road. Normally, widening is considered based on existing built-up area, location of sensitive areas and proposing bypass in heavily built-up areas. The first alternative is to widen the existing NH 47. This option could not be feasible considering the following

- The area is heavily built-up all along the highway. The major towns and villages, which continuously exist, are Kuzhithurai, Suchindram, Marthandam, Takkalai, Chungankadai, Nagercoil, Tovalla etc. The average houses, commercial shops, which are going to be affected due to the proposed widening will be on an average 200-250 per km and practically, there is no space for widening.
- There are a large number of sensitive religious structures like mosques, temples and churches (eg. at Nagercoil, Idichakkaplamadu) all along the existing stretch. Most of them are 30-50 years old. Replacement of these is very difficult.
- There are number of educational institutions all along the stretch, which will be affected due to widening.
- Most of the structures all along the highway are commercial and directly affect the livelihood of the local people.
- There are number of old trees, girth >1 m and commercial coconut trees, which will require removal.
- During public consultation, it is revealed that most of the people are settled there more than thirty years back and do not want to shift, even if proper compensation is given.

7.1.1 Alternate-I for NH-47 Section

As mentioned earlier, the existing NH47 passes through heavily builtup areas with no space for widening. Widening the existing NH47 would lead to large scale resettlement and demolition of residential and commercial structures. Hence, bypassing the existing NH47 with use of the alignment wherever possible has been proposed in this alternative.

A new formation has been proposed on the Eastern side of the existing NH47, connecting the diversion from Thiruvananthapuram Bypass at the Kerala-Tamil Nadu Border. The alignment mostly follows a cross country alignment bypassing all the major towns and builtup area with connections to the existing NH47 at the following locations.

Chainage (km)		Location	Side Suggested for Widening*
Existing	Design		
626.15-626.60	71.25-71.70	Before Chungankadai builtup area	Left hand side
642.60-646.20	88.60-92.15	Naraynapur, Ilagamanipuram and Potraiyardi villages	Right side with curve improvements to cater to design speed of 100 kmph

7.1.2 Alternate-II for NH 47 Section

Alternate-II was primarily investigated to examine the possibility of utilizing existing Tamil Nadu Coastal Highway between Kanyakumari and Tamil Nadu – Kerala Border.

However, site investigation reveals that existing Tamil Nadu Coastal highway is narrow having land width between 10 – 15 m with poor geometrics and fishermen hamlets. Moreover at places, the road runs close and parallel to the coast. Any further widening will violate CRZ regulations.

The advantages and disadvantages, considering the environmental and social angle of both the above two alternatives are examined and alternative-I is recommended considering the following reasons:-

- a. Alternative passes nearer to coastal area and at some places it may violate the CRZ regulations.
- b. This alignment is far away from the major towns and therefore from social point of view the advantage of better highway will not be available to the residents of these towns.

The other environmental and social factors are as follows: -

1. There will be no loss of bio-diversity as no rare plant or animal species are going to be affected by the present project.
2. There is no major wildlife migrant route, which could be affected.
3. No Sanctuary or National Park is affected due to the proposed widening.
4. No monument protected by the Archaeological Survey of India (ASI) are affected due to the proposed widening.

In order to provide better geometrics for a design speed of 100kmph and to avoid large scale demolitions **Alternative I** has been adopted.

7.2 Analysis of Alternatives for NH-47B

Two alternatives have been considered for the proposed link road (NH-47-B).

7.2.1 Alternative-I for NH-47B Section

The Alternative-1 is to widen the existing NH-47 B provided with bypasses at Vellamadam & Aralvaymoli village. This option could not be feasible considering the following facts:-

- The area is heavily built-up all along the NH-47 B. The major towns and villages, which continuously exist, are Teraikkalpudur, Vellamadam, Krishnanpudur, Visvasapuram, Pandarapuram, Tovola, Muttunagar, aralavaymol, Bharati nagar, Mupandal. The average houses, commercial shops, training centre which is going to be affected due to the proposed widening will be on and average 100 - 150 per km and practically, there is very less space for the widening.
- There are a number of sensitive religious structures, particularly Churches, all along the existing stretch. Most of them are 30-50 years old. Replacement of these structures will be a sensitive issue.
- There are several school buildings all along the stretch, which are also going to be affected due to proposed widening.
- Most of the structures all along the highway are commercial and directly affect the livelihood of the local people.
- There are number of old trees, girth >1 m and commercial coconut trees, which will require removal
- During public consultation, it is revealed that most of the people settled long back and do not want to shift from there, even if proper compensation is given.

7.2.2 Alternative-II for NH-47B Section

Alternative-II utilises the existing Nagercoil-Tirunelveli Road for the initial 600m and then follows a cross country alignment on Eastern side bypassing all builtup areas and the

proposed agricultural market. A site investigation reveals that loss of properties along the alternative -II is very less as compared to alternative-I.

The advantages and disadvantages, considering the environmental and social angle of both the above two alternatives are examined and alternative-2 is recommended considering the following reasons:-

- The alternative-II is far away from the major towns and therefore from social point of view loss of properties in minimum. Only few structures will be affected near Devasagai Malai.
- There will be no loss of bio-diversity as no rare plant or animal species are going to be affected by the present project.
- There is no major wildlife migrant route, which could be affected.
- No Sanctuary or National Park is affected by the proposed alignment.

In order to provide better geometrics for a design speed of 100kmph and to minimize resettlement issues **Alternative II** has been adopted.

8.0 MITIGATION MEASURES

The project is likely to bring some negative impacts on the environment and socio-economic structure of the region. While avoidance and analysis of the alternatives for deciding the alignment from environment point of view were the first priority, some negative potential impacts are unavoidable. In such cases, adoption of mitigation measures is the only solution. A brief description of the approach to mitigation measures on environmental issues is enumerated below:

8.1 Topography and Soil Characteristics

The soil in the entire stretch is sandy red loam variety. However on the sea coasts, sandy type of soil prevails and, near the mountain ranges, gravelly soil is generally seen. The topography of the area is undulating. The potential impacts, their mitigation, and the phases of implementation were assessed and presented in **Table 8.1** below.

Table 8.1: Impacts and Mitigation Measures for Soil retaining its Characteristics

Potential Impacts	Mitigation	Implementation Phase
A. Altered embankment	<ul style="list-style-type: none"> Action confined within ROW Good engineering & construction practices to be followed Stabilization and turfing (revegetation) to be done 	Pre-constructional phase & constructional phase
B. Borrow pit excavation	<ul style="list-style-type: none"> IRC standards to be followed Borrow areas to be identified as close as possible to the road, but away from the proposed toe line Non-productive land will be used Good engineering & construction practices to be followed 	Pre-constructional phase & constructional phase

8.2 Water Resources

The potential impacts, their mitigation and phase of implementation regarding water sources were assessed with regard to surface water bodies, like ponds, irrigation channels and underground water tables with reference to wells, tube wells and hand pumps.

Table 8.2: Impacts and Mitigation Measures for Water Resources

Potential Impacts	Mitigation	Implementation Phase
A. Surface water bodies	<ul style="list-style-type: none"> Provision of proper drainage Construction camps to be properly located Elevated structures in the form of bridges are proposed to be constructed in locations wherever road alignment passes over water bodies. 	Pre-constructional, constructional, post-constructional and operational phases
B. Underground water	<ul style="list-style-type: none"> No appreciable impacts Water to be used for construction should have separate source 	Pre-construction and constructional phase

8.3 Ambient Air Quality

The impact to the ambient air due to the project and its mitigation measures are presented in **Table 8.3** below.

Table 8.3: Impacts on Air and Mitigation Measures for Maintaining its Quality

Potential Impacts	Mitigation	Implementation Phase
Air pollution due to construction activities and transport of material	<ul style="list-style-type: none"> • Machinery to be fitted with pollution control device • Asphalt plant will be equipped with dust collectors • Sensitive places like schools and hospitals to be avoided (at least 500 m away) for Asphalt plants and generators 	Pre-construction, constructional and post-constructional phases
Air pollution due to additional traffic, specially in market places	<ul style="list-style-type: none"> • Plantation of pollutant adsorbing trees 	Operational phase & constructional phase

8.4 Noise Level

The noise level on the Highway is primarily attributed to the vehicular traffic and frequent use of loud speakers, etc. in the busy market places. The details of mitigation measures to reduce the noise level are presented in **Table 8.4** below.

Table 8.4: Noise Impacts and Mitigation Measures

Potential Impacts	Mitigation	Implementation Phase
Noise level higher due to construction equipment	<ul style="list-style-type: none"> • Good and properly maintained equipment to be used 	Constructional phase
Noise level during the operational phase may decrease due to improved roads and reduction of congestion	<ul style="list-style-type: none"> • Not needed 	Operational phase
Noise level in sensitive areas like schools and hospitals	<ul style="list-style-type: none"> • Erection of wall between the road and the sensitive area • Developing tree barriers between the road and sensitive areas • Declaring such areas as "silence zone" 	Constructional and operational phases

8.5 Human Health and Safety

Due to inadequate width of the road, heterogeneous nature of traffic, congested market places, accidents are not uncommon. Besides this the truck-drivers may carry contagious diseases, which might spread in the area if proper care is not taken.

Table 8.5: Impacts on Human Health & Safety and its Mitigation Measures

Potential Impacts	Mitigation	Implementation Phase
Increase in accidents due to increased speed and increase in the number of vehicles	<ul style="list-style-type: none"> • Proper provision of service roads, junctions, fly-over, under passes to be provided at appropriate places • Truck parking places to be identified • Medical facility to be provided at every 25 km (an ambulance fitted with all medical equipments and a Doctor) 	<p>Constructional and operational phase</p> <p>Constructional and operational phases Operational phase</p>
Sexually Transmitted Diseases (STDs)	<ul style="list-style-type: none"> • Affected persons to be taken to the nearest city hospital • Preventive measures should be taken to check the spreading of STDs 	Operational phase

8.6 Biological Characteristics

The most important negative impact that the project will cause is the loss of large number of trees, leading to

- Enhanced degree of soil erosion
- Loss of shade, fruits, timbers and other economic activities
- Effects on the Ecology of the ecosystem

However, if replantation scheme is launched vigorously, it will restored gradually.

Table 8.6: Impacts on Biological Characteristics and its Mitigation Measures

Potential Impacts	Mitigation	Implementation Phase
Loss of trees	<ul style="list-style-type: none"> • Five new trees to be planted at the loss of one tree 	Pre-constructional, constructional and operational phases
No loss of bio-diversity No loss of fauna No loss of wildlife reserve	<ul style="list-style-type: none"> • Not needed 	

8.7 Land Use

Popularly known as the granary of former Travancore State, Kanyakumari District is famous for its vast stretches of paddy fields. Nearly 16,000 hectares of lands were under paddy cultivation during 1999-2000. Paddy is raised in two seasons i.e. Kannipoo and Kumbapoo respectively. It's proximity to equator, topography and other climate factors favour the cultivation of varied crops. Besides paddy, other important crops grown are pulses, Tapioca, Banana, Coconut, Rubber, Cashew, Mango, Arecanut, Cloves, Cardamom, Pepper etc.

Table 8.7: Impacts on Land Use and its Mitigation Measures

Potential Impacts	Mitigation	Implementation Phase
Negligible difference in regional land use	<ul style="list-style-type: none"> • Not needed 	Not needed

9.0 PUBLIC CONSULTATION

9.1 Introduction

Public involvement is one of the most important methods for the success of any project. It is useful for gathering environmental baseline data, understanding likely impacts, determining community and individual preferences, selecting the alternatives and for designing sustainable mitigation and compensation plans.

The guiding principles include

- *Dissemination of information:* Information regarding the proposed road project should be disseminated to the project affected people directly and indirectly.
- *Soliciting information:* Basic information regarding various environmental and socio-economic issues is solicited.
- *Consultation:* The consultation involves engaging people in dialogue. It is a religious process. There has to be a continuous dialogue between the components of the project and the public.
- *Application of the gathered information:* The aforementioned three components of public involvement should be applied throughout the EIA process.

The public consultations are held at all the stages, namely, inception, screening, feasibility, and EIA preparation.

9.2 Methodology Followed For Public Consultation

In order to make the project sustainable and effective, communication with the stakeholders, other affected people and interviews with individuals was made.

The methods used for public consultation were as follows:-

- Questionnaires regarding the impact of various environmental factors due to the project and suggestion on their mitigations were field tested by a group under the leadership of two supervisors.
- The data were recorded at the screening and feasibility stages.

9.3 List of Issues Involved

During public consultation, individually and field testing of questionnaire an effort was made to create an awareness amongst the people about the proposed project. The positive and negative impacts were explained so that affected people could raise their problems and suggest some better alternatives in mitigating the negative impacts and make the project successful.

The following benefits resulting from the project were pointed out:

- Improvement of the road shall result in less travel time requirement for people and goods. This will benefit the public in general and shall lower the cost of commodities.
- The problem of traffic jams will be reduced.
- Due to the improved transport fruits, vegetables and other perishable goods could be saved from early decay.
- The availability of consumer items shall be ensured.
- This improvement shall result in reduction in fuel consumption which, in turn shall result in saving valuable foreign exchange
- Road accidents shall decrease as a result of widening.
- There shall be general economic improvement of the area and the living standard of people will improve.

The following negative effects and mitigative measures of the project were explained for PAPs awareness:

- The implementation of the project shall result in necessary land acquisition and dislocation of the people. Dislocated PAPs shall be paid compensation as admissible and shall be consulted to know their priorities regarding the mode of compensation, for e.g., land for land, cash compensation, etc.
- People below poverty line, or belonging to scheduled caste and scheduled tribes, or physically handicapped, shall be given due care while planning for their resettlement.
- A general attempt shall be made to safeguard the sources of earning of the affected.
- Efforts shall be made to save as many trees as possible. The proposal for dense tree plantation shall be suggested in consultation with the people to improve the environment.
- The problem arising due to the shifting of electricity, telephone lines and other utilities shall be solved with the co-operation of the respective departments.

The above points were raised to create awareness about the project. Suggestions were sought from PAPs for improving the road alignment by raising following questions:

1. Do they agree with this project or disapprove it?
2. Whether central widening or one side expansion is preferred?
3. If trees are cut, how many trees for one tree should be planted?
4. What kind of trees do they want along the road?
5. What do the people living on ROW want in assistance?
6. Do they want to have some training for earning their livelihood?
7. Are they willing to allow relocating the religious structures?
8. Do they want their road should be expanded or want a bypass?
9. Are they aware about the environmental impact?
10. Do they want some more facilities?

9.4 Observation on Some Most Important Issues

The PAPs views on some important issues are discussed in RAP.

10.0 ENVIRONMENTAL ENHANCEMENT

10.1 Introduction

Some additional measures needed to improve the environment are proposed to be undertaken during the project implementation. Such measures are known as environmental enhancements. These relate to improvement of natural, physical and aesthetic environment of roadside. The 'enhancement measures', in fact, differ from 'mitigation measures'. While the former aims at improving the already degraded or mundane ambience, the latter intends to reduce the negative impacts due to the project.

The objectives of enhancement measures include: -

- To enhance the appeal of the project road,
- To improve the environmental quality, and
- To generate goodwill amongst local community

To achieve these objectives, some suggested measures include:

- Enhancement of roadside facilities (bus stops, rest areas, etc.)
- Improvement of aesthetic qualities along the project road
- Improvement of the local natural resources for local population
- Enhancement of cultural properties and access to them
- Management of some existing problems
- Way side amenities at strategic locations in the project corridor.

10.2 Enhancement of Natural Environment

The natural environment can be improved by plantation of ornamental and shade providing avenue trees on the road side, shrubs and some important herbs in the median besides developing ponds and providing bore wells along the roadside.

10.2.1 Plantation of Trees, Shrubs and Herbs along the Road

The plantation of trees can be done in different densities depending on the

- Habitat and soil type
- Water table depth
- Availability of indigenous species
- Survival rate of plants and
- People's choice

The physical growth characteristics like the form and shape i.e. canopy types, branching patterns, growth rate, colour of flowers, foliage and root characteristics, etc. are also the major criteria in the selection of plantation type and densities.

Since natural forests are lacking in the region, the ecological importance of the strip linear roadside forests becomes still greater. But, the kind of tree species to be selected for such plantation has been a debated issue. The acute shortage of forest products provided support to the viewpoint that the strip plantation along the road should be managed primarily to meet the requirement of the local people and industries for various forest products. However the consideration of comfort to travelers was given the top priority.

10.2.2 Enhancement of Water Bodies

There are several ponds and tanks along the project corridor. In order to make these water bodies more accessible and enhance the waterfront landscape, following measures has been suggested.

Ponds and Tanks

The ponds and tanks are the water bodies used for various purposes including bathing, washing, fishing, growing water-fruits, livestock drinking and often irrigating the agricultural fields. The landscape treatment includes

- Provision of stepped access to the edge of water
- Providing flat boulders for washing
- Stone pitching for slope stabilization towards roadside
- Plantation of trees and shrubs for stabilization of pond edge

10.3 Physical Environment

10.3.1 Enhancement of Bus Stops

The existing bus stops along the entire corridor are shabby, poorly maintained and insufficient in providing comfort to travelers. Following improvement in design of bus stops are suggested

- Provision of bus bays to prevent the bus from stopping in the carriageway
- Provision of covered, semi-covered and open spaces with seating areas
- Plantation of shade trees to improve the microclimate
- The bus stop should be aesthetically pleasing
- Provision of adequate sight distances

10.3.2 Developing Truck Parking Areas

In view of the heavy truck parking activities in midsections, truck stoppage site is suggested at the appropriate locations along the highway.

The requirements of truck stoppage complexes are:

- Acquisition of land for developing the complex
- Each complex should have some shops covering public telephone boots, repair shops, medicine shops, restaurants and recreation facilities
- The location of petrol pumps should be close to such complexes
- Ornamental and shade trees and shrubs to be planted in order to develop the area aesthetically

10.3.3 Enhancement of Major Road Intersections

The road intersections are the main nodal spaces along the corridor. Proper landscaping of these areas by flowering trees and shrubs will improve the area aesthetically.

10.3.4 Enhancement of Cultural Properties

The cultural properties should be viewed as assets contributing towards meaningful and pleasurable traveling experience. These are the sites of community and individual sentiments. The landscape and design improvements include:

- Providing and improving access to cultural properties
- The precincts of such properties should be defined or redefined
- Provision of parking should be made to avoid haphazard parking activities
- Seating space and rest areas around the cultural properties to be developed
- Plantation of trees and shrubs for shade and aesthetics

11.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

11.1 Introduction

Environmental Management Plan is the synthesis of all proposed mitigative and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. It contains all the information for the proponents, the contractors and the regulatory agency to implement the project within a specified time frame.

- The EMP is a plan of action for avoidance, mitigation and management of the negative impacts of the project. Environmental Enhancement is also an important component of EMP.
- The EMP refers to all implementable task at different stages of project, namely,
 - Design Phase
 - Construction Phase, and
 - Operation Phase
- The EMP includes a list of all project-related activities and impacts and a clear reporting schedule.
- The EMP is divided into two broad components, (i) dealing with natural environment, and (ii) dealing with action plan for resettlement and rehabilitation (RAP). While the mitigative measures of the natural environment and their management have been incorporated in the present volume, the management of issues related with resettlement and rehabilitation of human communities has been provided in Resettlement Action Plan.

Details of Environmental issues, their impact and remedial measures suggested are presented in **Table 11.2**.

11.2 Supportive Information on Management Of Environment

The following information is being presented in order to help the implementers of the EMP.

- Information on environmental monitoring
- Suggested tree plantation scheme

11.2.1 Environment Monitoring Programme

The Environmental Monitoring Programme provides such information on which management decisions may be taken during construction and operational phase. It provides basis for evaluating the efficiency of mitigation and enhancement measures, and suggested actions that need to be taken to achieve the desired effect. The monitoring includes:

- Visual observation,
- Selection of environmental parameters at specific locations, and
- Sampling and regular testing of these parameters.

The objectives are:

- Evaluation of the efficiency of mitigation and enhancement measures
- Updating of the actions and impacts of baseline data
- Adoption of additional mitigation measures if the present measures are insufficient

- Generating the data which may be incorporated in Environmental Management Plan in future projects

Table 11.3 provides details of the monitoring of various components.

11.2.2 Suggested Tree Plantation Scheme

The objectives of the roadside plantation may vary as widely in detail as the locations where such plantations are to be raised, but these may broadly be stated as following

- Provision for comfort to travelers
- Aesthetic and landscape improvement
- Stabilization of the roadside
- Improvement of ecological conditions and
- Maximization of the productivity to meet the requirement of local people.

Some basis norms to be followed in tree plantation scheme are:

- The pH of the soil along the road is in between 6.0 – 6.6, which shows slightly acidic character. Besides Coconut, Rubber and Banana plantation, Neem, Mango, Jackfruit, etc. are fit for this type of soil.
- Pure avenues with one species only planted for a number of kilometers (or, the stretch between two market places) provide harmonious and pleasing look, and a regular and wavelike skyline. This row of trees forms the first and innermost line.
- If more than one row of trees is to be planted, the outer rows should have trees valuable from economic point of view, to cater the need of local people.
- The ornamental flowering trees should be planted for half of kilometer or so before the start of the market place and for nearly the same distance from the end of the market. In such areas, an alternating combination of foliage tree and flowering tree can be made. The flowering trees should also be planted near ponds.
- There is a remarkable coordination between the topography and shape of tree and the sky. Accordingly, the umbrella-like acacias and gulmohars and semi-umbrella like neem, banyan, mango, pipal are admirably suited to the region.
- Selections of tree species in outer rows (where multiple rows are to be grown) were considered from economic point of view. Therefore, trees that provide fuel and fruit as well as small timber for agricultural implements have been suggested. Some fuel and small timber producing trees like babul and fruit producing trees like mango, jamun and guava are suggested.
- Near market places, habitated areas and other congested areas, the trees known for behaving as 'pollution sink' have been proposed. Though, trees in general absorb the pollutants, filter the air from pollutants, act as noise barrier, but some trees like neem (*Azadirachta Indica*), mango (*Mangifera Indica*), Ashok (*Polyalthia Longifolia*), *Putranjiva Roxburghii*, moulshree (*Mimusops Elengi*), *Ficus Retusa*, shisham (*Dalbergia Sisso*), imli (*Tamarindus Indica*) can do it in a better way.
- Near sensitive areas like schools and hospitals, tall trees with thick canopies can create a windscreen through which the air can be filtered and the noise level can be considerably reduced like Ashok (*Polyalthia Longifolia*).
- Some of the trees like neemchameli (*Millingtonia Hortensis*) gular (*Ficus Golmerata*), jamun (*Syzygium Jambolana*) have very weak wood and consequently break easily in a windstorm. The result is that after the storm roads become blocked and traffic is stopped for a long time. Such trees are unsuitable for roadside avenues. If at all, they should be planted in outer rows.
- In order to prevent glare from the headlights of incoming vehicles various kinds of shrubs and undertrees and proposed in the median. The object is to prevent glare without blocking vision. Some recommended species are: Casuarina (*Casuarina*

Equisetifolia), Chandani (*Tabernemontana*), Kachnar (*Bauhinia Purpurea*), *Plumeria Rubra*, *Plumeria Alba*, *Hamelia Patens*, *Thespesia Populnea*, *Jackaranda Mimosaefolia*, Kaner (*Thevetia Nerifolia*), etc.

- The distance between two trees of the same row ranges between 20-25 m and between two rows, 10-20 m. The distance of first row of trees from the edge of the road should be 3-6m.
- Developing herbal cover and turfing with grasses reduce the degree of soil erosion. The most important grasses recommended at the outmost boundary of the ROW include khas, kans, and sarpat. The khas has an added advantage since its roots produce the scented oil, used in perfumaries. As such, small cottage industries of perfumary can be developed in certain areas. Some other shrub/herb species include *Capparis*, *Proposis*, *Juliflora*, *Jatropha* and *Lpomea*.
- The plantation of trees according to different densities may be:
 - Sparse plantation: one linear row of trees plantation
 - Medium density plantation: two rows of tree plantation with the flowering shrub plantation
 - Dense plantation: more than two rows of tree plantation with dense shrubs.

11.2.3 Environmental Cost of the Project

The cost estimate on environment for present package is provided in **Table 11.1**.

Table 11.1: Estimated Cost on Environmental Management

Sl. No.	Parameters	Unit	Unit Rate (Rs.)	Quantity	Cost (Rs.)
1	Cost due to environmental consideration in design				
1a	Replantation of trees in borrow areas	m ²	25	2500	62500.00
1b	Enhancement & beautification of ponds	per pond	150000	25	3750000.00
1c	Roadside plantation	/km	2500	70.36	175900.00
1d	Turfing of embankment with grasses and herbs	m ²	20	281440	5628800.00
2	Cost due to environmental consideration in construction				
2a	Developing borrow areas by tree plantation and fisheries	m ²	100	2500	250000.00
2b	Cost of management of air pollution at construction site	per site	30000	3	90000.00
2c	Cost on management at noise level at construction site	per site	25000	3	75000.00
2d	Cost on compensatory afforestation	/km	90000	70.36	6332400.00
2e	Cost on compaction of vegetation	m ²	90	281440	25329600.00
2f	Cost on accident risks from construction activities	Lump sum	1000000	1	1000000.00
2g	Cost involved on health issues	Lump sum	1200000	1	1200000.00

Sl. No.	Parameters	Unit	Unit Rate (Rs.)	Quantity	Cost (Rs.)
2h	Cost on management to cover accidents, for e.g. compensation, putting light arrangement, etc.	Lump sum	1500000	1	1500000.00
2l	Roadside amenities, for example Truck stoppage site, rest shed etc.	No.	200000	7	1400000.00
3	Environment consideration in operation				
3a	Management of oil spills due to accidents, etc.	Lump sum/year	200000	1	200000.00
3b	Management of dust	Lump sum/year	200000	1	200000.00
3c	Management of air and noise pollution	Lump sum/year	600000	1	600000.00
3d	Management of safety measures	Lump sum/year	1000000	1	1000000.00
4	Monitoring cost of environmental parameters				
4a	Air quality	per location	4000	3	12000.00
4b	Noise quality	per location	2000	3	6000.00
4c	Water quality	per location	4000	4	16000.00
4d	Vegetation	per location	60000	2	120000.00
5	Institutional arrangement for environment				
5a	Environmental training	Lump sum/year	200000	1	200000.00
5b	Maintenance of office of Environmental Unit	No.	1600000	1	1600000.00
Total					50748200.00

Table 11.2: Environmental Management Plan

Environmental Issue/Component	Impact Description	Remedial Measure
PRE-CONSTRUCTION/DESIGN PHASE		
1. ALIGNMENT		
Constricted sections / settlements	<ul style="list-style-type: none"> The local traffic will mix up with fast moving vehicles leading to accidents Communities on two sides in market are unable to cross the road easily Loss of property & income source Increased traffic jams 	<ul style="list-style-type: none"> Erecting the service lanes Developing underpasses in markets Developing resettlement sites Modify designs to save settlements trees and other env. Components Road widening to remove traffic jams
2. LAND		
Embankment slopes	<ul style="list-style-type: none"> Some degree of soil erosion on newly constructed embankment The issue of water logging in adjoining area will improve due to the raising of the road 	<ul style="list-style-type: none"> Turfing of the slopes to check soil erosion with grasses, etc. The raising of slopes of the road ranges between 0.6 to 1.5 m from the existing road in market places to avoid flooding
Borrow areas	<ul style="list-style-type: none"> Soil and land use will be changed 	<ul style="list-style-type: none"> Borrow pits shall not be dug continuously. The location, shape and size of the designated borrow areas shall be as approved by the Engineer. No borrow area shall be opened without permission of the engineer. If borrow pits along the road is permitted by the Engineer, these shall not be dug continuously and shall confirm to MOST specifications. Borrow pits shall be redeveloped as per MoEF guidelines. Spoils shall be dumped with an overlay of stockpiled topsoil (as per EMAP Clauses 1.1 and 1.2), in accordance with compliance requirements with respect to MoEF guidelines.
3. WATER		
Water source	<ul style="list-style-type: none"> No appreciable impact on underground water sources No loss of surface water bodies or canals 	<ul style="list-style-type: none"> Cross drainage structures for canals and elevated structures in the form of bridges for water bodies are proposed. Relocation of water sources like wells and hand pumps
Drainage	<ul style="list-style-type: none"> The areas get water logged due to heavy 	<ul style="list-style-type: none"> Raising the road level

Environmental Issue/Component	Impact Description	Remedial Measure
	downpour in monsoon	<ul style="list-style-type: none"> Provision for drainage on the side of road
4. FLORA AND FAUNA		
Protected forest/sensitive areas	<ul style="list-style-type: none"> No loss of protected forests No sensitive areas exist in the corridor 	<ul style="list-style-type: none"> Not needed
Private plantation	<ul style="list-style-type: none"> Heavy loss of private trees leading to increase in air and noise pollution; the loss of ecological and economic activities 	<ul style="list-style-type: none"> Trees will be removed as per design with prior approval
5. ENVIRONMENTAL QUALITY		
Air quality	<ul style="list-style-type: none"> There will be slight increase in the pollution level of the air in a few places 	<ul style="list-style-type: none"> Widening and strengthening of the road will allow optimum speed of fast moving vehicles Tree plantation scheme to be implemented
Noise level	<ul style="list-style-type: none"> The noise level might slightly increase in market places 	<ul style="list-style-type: none"> Widening and strengthening of the road will allow optimum speed of fast moving vehicles Tree plantation scheme to be implemented
6. UTILITIES		
Relocation of utility lines/community utilities	<ul style="list-style-type: none"> Short time negative impact during transitory phase of shifting of utility lines No impact on shifting wells, hand-pumps etc. 	<ul style="list-style-type: none"> All utilities to be relocated with prior approval of the concerned agencies All community utilities such as sources of water to be relocated to suitable places
7. CULTURAL HERITAGE		
Relocation of cultural properties	<ul style="list-style-type: none"> Most of the temples being small the issue is not a sensitive one 	<ul style="list-style-type: none"> Community meetings to be held before relocation or shifting Provision of enhancement of religious structures, and access road
8. ENVIRONMENTAL SAFETY		
Accidents	<ul style="list-style-type: none"> Frequency of accidents due to curves in the road Movement of fast moving & slow moving vehicles in market places will enhance chances of accidents Poor visibility causes more accidents 	<ul style="list-style-type: none"> Improvement of curves in the designs Segregating the slow moving traffic in the market places by developing the service lanes Provision of wider median in rural stretches and plantation of shrubs/under trees in it to avoid the glare of vehicles moving in opposite direction Signals to be erected to reduce speed

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> • Proper light arrangement to be made
CONSTRUCTION PHASE		
1. SOIL		
Soil Erosion	<ul style="list-style-type: none"> • Removal and cleaning of tree line, herbaceous and shrubby covers from embankment will increase soil erosion • Excavations of borrow pits will increase soil erosion 	<ul style="list-style-type: none"> • Turfing of road embankment slopes with herbs, strubs and grasses • In borrow pits, the depth of the pit should be regulated so that the sides of the excavation will have a slope not steeper than 1 vertical to 4 horizontal from the edge of the final section of bank • The device for checking soil erosion include the formulation of sediment basins, slope drains etc. Such works and maintenance thereof will be deemed as incidental to the earthwork • Cutting of trees in phases
Loss of topsoil	<ul style="list-style-type: none"> • The loss of topsoil is considerable as the proposed new alignment is passing through paddy fields and covers approx. 25 – 30 km. 	<ul style="list-style-type: none"> • The borrow pit areas could be developed into ponds for fisheries • Land taken for borrow area should be infertile
Compaction of soil	<ul style="list-style-type: none"> • the excavations in borrow areas may lead to marginal loosening of soil • The compaction of soil may not be affected largely 	<ul style="list-style-type: none"> • It should be ensured that the stability of excavation of fills is maintained • Construction vehicles, machinery and equipment shall move, or be stationed in the designated area • If operating from temporarily hired land, it will be ensured that the topsoil for agriculture remains preserved & not destroyed by storage, material handling or any other construction related activities • The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2 m • Cut and fill should be equalized as per design • Earth, if required, should be dumped in selected area approved by the engineers.

Environmental Issue/Component	Impact Description	Remedial Measure
Borrowing of earth	<ul style="list-style-type: none"> Large quantities of earth is needed for raising the level of road, its expansion and embankment 	<ul style="list-style-type: none"> No earth should be borrowed from within the ROW If new borrow areas are selected, there should be no loss of productive soil, and environmental considerations are met with If vehicles are passing through some villages, the excavation and carrying of earth will be done during day time only The borrow areas should not be dug continuously, and the size and shape of borrow pits to be decided by the engineer Borrow pits should be redeveloped by dumping of spoils; by creating a pond for fisheries, etc. or by leveling an elevated, raised earth mound.
Contamination of soil from fuel and lubricants	<ul style="list-style-type: none"> The impact will be negligible since the chemical nature of the soil will not change much Negligible impact on the growth of vegetation 	<ul style="list-style-type: none"> Vehicles and machines are maintained and refilled in such a fashion that old diesel spillage does not contaminate the soil Fuel storage and refilling sites should be kept away from cross drainage structure and important water bodies Spoils shall be disposed off and the site shall be fully cleaned before handing over
Contamination of soil from construction wastes	<ul style="list-style-type: none"> The impact will be marginal on the soil quality The growth of vegetation will be partially disturbed 	<ul style="list-style-type: none"> The construction wastes should be dumped in selected pits, developed on infertile land Follow the norms of SPCB Borrow pits to be filled by such wastes
2. WATER		
Water bodies	<ul style="list-style-type: none"> Effect on surface water. 	<ul style="list-style-type: none"> Any source of water for the community such as ponds, wells, tube-wells etc. lost incidentally shall be replaced immediately All desired measures will be taken to prevent temporary or permanent flooding Cross drainage structures for canals and elevated structures in the form of bridges for water bodies shall be

Environmental Issue/Component	Impact Description	Remedial Measure
		<p>constructed.</p> <ul style="list-style-type: none"> Adequate deepening of water bodies shall be undertaken for the volume of water bodies to be occupied by culverts and bridge structures.
Other water sources	<ul style="list-style-type: none"> The lost sources of water like wells and tube-wells are going to affect the community adversely Loss of source of irrigation 	<ul style="list-style-type: none"> Any source of water for the community such as ponds, wells, tube-wells etc. lost incidentally shall be replaced immediately All desired measures will be taken to prevent temporary or permanent flooding
Drainage and run-off water	<ul style="list-style-type: none"> The flow of runoff water will not be affected largely, excepting certain stretches where the drainage problem already exist 	<ul style="list-style-type: none"> At cross drainage channels, etc. the earth, stone or any other construction material should be properly disposed of so as not to block the flow of water All necessary precaution shall be taken to construct temporary or permanent device to prevent water pollution (due to increased stagnation and turbidity)
Contamination of water from construction waste	<ul style="list-style-type: none"> The construction wastes may increase the suspended matter and clay in stagnant water bodies There will be very little increase in toxicity The community dependent on such water used for purposes other than drinking may be affected 	<ul style="list-style-type: none"> Construction work close to the streams or other water bodies shall be avoided, especially during monsoon period All waste arising from the project is to be disposed of, as per norms of SPCB Waste products must be collected., stored and taken to approved disposal site
Contamination of water from fuel and lubricants	<ul style="list-style-type: none"> The fuel and lubricants may affect water bodies The community may be slightly affected 	<ul style="list-style-type: none"> The slopes of embankment landing to water bodies should be modified and rechannelised so that contaminant may not enter the water body To avoid contamination from fuel and lubricants the vehicles and equipment shall be properly maintained and refilled
Sanitation and waste disposal in construction camps	<ul style="list-style-type: none"> The absence of sanitation may lead to many human diseases which are mostly water-borne No communicable diseases are going to be spread 	<ul style="list-style-type: none"> The construction laborers camp shall be located away from the habitation The sewage system for such camps shall be properly designed and built so that no water pollution takes place to any water-body or water course

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> The workplace shall have proper medical approval by local medical health or municipal authorities
Use of water for construction	<ul style="list-style-type: none"> The use of water from sources, already in use by local community may cause scarcity of water for community The easy availability of underground water will not affect the water table 	<ul style="list-style-type: none"> Arrangement for supply and storage of water will be made by the contractor in such a way that the water availability and supply to nearby communities remain unaffected. If a new tube-well is to be bored, proper sanction and approval by Underground Water Department is needed Waste of water during construction should be avoided
3. AIR		
Emission from construction vehicles and machinery	<ul style="list-style-type: none"> Effect on human health Dust settled on leaves may reduce growth rate of the plants Crowded market places and construction sites will have higher degree of emission 	<ul style="list-style-type: none"> All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that the pollution emissions levels are as per norms of SPCB Monitoring of suspended particulate matter to be conducted at least once a month at the sites where crushers are used The human settlements should be at least 500 m downward wind direction of asphalt mixing plant
Dust and its treatment	<ul style="list-style-type: none"> The impact of dust at construction sites is rather adverse, but localized in nature No serious health problem is likely to be caused 	<ul style="list-style-type: none"> All precautions to reduce the level of dust emissions from the hot mix plants shall be taken The hot-mix plants be sited at least 500 m from the nearest habitation. They should be fitted with dust extraction unit Water should be sprayed in the earth mixing sites, asphalt mixing site and service roads. In filling subgrade, water spraying is needed to solidify the material. After the earth filling, water should be sprayed regularly to prevent dust Vehicles delivering material should be covered
4. NOISE LEVELS		
Noise from vehicles, asphalt plants and equipments	<ul style="list-style-type: none"> The activities of using heavy machinery and equipments are localized and intermittent No serious impact on human health like loss of 	<ul style="list-style-type: none"> The parts and equipments used in construction shall strictly conform to CPCB noise standards Vehicles and equipments used should be fitted with

Environmental Issue/Component	Impact Description	Remedial Measure
	hearing ability though some sleep disorders may result	silencer <ul style="list-style-type: none"> • Noise standards of industrial enterprises will be strictly enforced to construction workers from damage • In construction sites within 150 m from human settlements, noisy construction should be stopped between 10:00 pm and 8:00 am • Noise to be monitored at construction sites
Noise from blasting operations	<ul style="list-style-type: none"> • The sudden and loud noise of blasting is disturbing and irritating • The intense noise may cause partial deafness 	<ul style="list-style-type: none"> • People living near such sites should have prior information of operational hours • Blasting should not be undertaken in midnight or late-night hours • Regulation of material haulage routes • Providing earplugs to workers at site
Loss of damage to vegetation	<ul style="list-style-type: none"> • The loss of trees, shrubs and herbal cover may lead to higher degree of soil erosion • The loss of shade and other benefits due to loss of trees • The air quality especially in market places, will decline • There will be no loss or damage to hydrophytes 	<ul style="list-style-type: none"> • Areas of tree plantation cleared will be replaced according to Compensatory Afforestation Policy under Forest Conservation Act-1980 • Trees should be removed in phases
Compaction of vegetation	<ul style="list-style-type: none"> • The effect of compaction will not be much severe • There will be no loss of biodiversity 	<ul style="list-style-type: none"> • The removal of vegetation is confined along the proposed project alignment. • The saving of trees at the design phase has not reduced compaction much • Replantation of tree species along new ROW • Plantation of shrubs and undertrees in the median
Loss, damage or disruption to fauna	<ul style="list-style-type: none"> • There will be no loss, damage or disruption to fauna 	<ul style="list-style-type: none"> • Construction workers should be educated not to disrupt or damage the fauna • Hunting is strictly prohibited
Accident risk from construction activities	<ul style="list-style-type: none"> • The type of accidental risks may be due to ill-maintained machines and vehicles, due to poor light conditions at the work place, or due to carelessness and poor management of the 	<ul style="list-style-type: none"> • To ensure safe construction in the temporary accesses during construction, lighting devices and safety signal devices shall be installed. Traffic rules and regulations to be strictly followed

Environmental Issue/Component	Impact Description	Remedial Measure
	work involved	<ul style="list-style-type: none"> • At blasting sites – the blasting time, signal and guarding will be regulated. Prior to blasting, the site should be thoroughly inspected. Blasting should not be carried out during rush hours • Safety of workers undertaking various operations during construction should be ensured by providing them helmets, masks, safety goggles etc • The electrical equipment should be checked regularly to avoid risks to workers • At every work place, a ready available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), nursing staff and an attending doctor shall be provided
Health issues	<ul style="list-style-type: none"> • Presence of unhygienic conditions at work place of construction workers • Non-availability of good drinking water 	<ul style="list-style-type: none"> • At every workplace, good and sufficient water supply shall be maintained to avoid waterborne diseases and securing the health of workers • Adequate drainage, sanitation and waste disposal to be provided at workplace • Medical care to be provided to workers falling ill
Damage or loss of cultural properties	<ul style="list-style-type: none"> • No existence of archaeological relic is likely • No monument exists in the corridor 	<ul style="list-style-type: none"> • Relocation of cultural properties • All necessary and adequate care should be taken to minimize the impact on cultural properties • If valuable or invaluable articles such as fabrics, coins, artifacts, structures or other geographic or archaeological rare discovered, the excavation should be stopped and archaeology department shall be contacted • Archaeologist will supervise the excavation to avoid any damage to the relics
Roadside landscape development	<ul style="list-style-type: none"> • The positive impact will be on bioaesthetis and beauty • Landscaping and beautification of ponds, and access roads will improve aesthetic considerations 	<ul style="list-style-type: none"> • Avenue plantation of foliage shade trees mixed with flowering trees and scented plants as per detailed designs • The treatment of ponds as the sites for rests for tourists at specified chainages be developed

Environmental Issue/Component	Impact Description	Remedial Measure
Roadside amenities	<ul style="list-style-type: none"> • People will be largely benefited by the comfort and use, provided by these amenities 	<ul style="list-style-type: none"> • Restoration and improvement of bus shelters, bus bays and truck stoppage sites as per detailed design • Road furniture including footpaths, railing, traffic signs, speed zone signs etc. shall be erected as per design
Cultural properties	<ul style="list-style-type: none"> • The enhancement of cultural properties will bring harmony, goodwill and coherence amongst communities 	<ul style="list-style-type: none"> • Enhancement of all cultural properties and access road shall be completed as per design
Contamination from spills due to traffic and accidents	<ul style="list-style-type: none"> • The chance of accidents is likely to be reduced with improved width and quality of the road. The contamination of soil and water due to spills will be minor 	<ul style="list-style-type: none"> • Cleaning of the spills at accident sites by a separate workforce. The left over spill may be scrapped to a small nearby pit within the ROW
Dust generation	<ul style="list-style-type: none"> • Though dust is a common feature of tropical climate, yet the situation will improve by developing new vegetation 	<ul style="list-style-type: none"> • Roadside tree plantation to be restored and maintained • New sites (for example, Gram Panchayat land etc) near the road to be discovered for afforestation
Air pollution	<ul style="list-style-type: none"> • The degree of air pollution is likely to be on a lower scale with improvement in road surface and with better maintenance 	<ul style="list-style-type: none"> • Vehicular emissions of SPM, RSPM, CO, SO₂, NO_x to be checked • Roadside tree plantation to be maintained • Atmospheric pollution to be managed and monitored • Public awareness programme to be launched
Water	<ul style="list-style-type: none"> • Due to improved and elevated road, the water logging during monsoon will not take place • Improved drainage on roadside will also better the water flow at settlement sites 	<ul style="list-style-type: none"> • The drainage system should be periodically cleared • Public awareness programmes to be launched for maintaining clean drinking water
Flora and Fauna (key stone species)	<ul style="list-style-type: none"> • The loss of trees, shrubs and herbs will not affect the keystone species and bio-diversity 	<ul style="list-style-type: none"> • The replantation scheme, containing keystone species should be strictly implemented • Improvement of density of vegetation by planting such species
Accidents involving hazardous materials	<ul style="list-style-type: none"> • The chances of such accidents will be minimum, yet not unavoidable 	<ul style="list-style-type: none"> • The rules as defined in Environmental (Protection) Act, 1986 should be complied • For delivery of hazardous substances, three certificate issued by transportation department, namely permit license, driving license and guarding license are required

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> • Vehicles delivering hazardous substances will be printed with unified signs • Public security, transportation and fire fighting departments will designate a special route for these vehicles • The delivery, storage and use of hazardous substances will be administrated by highway management department registration system • In case of spillage, the report to relevant department is made and instructions followed
Safety measures	<ul style="list-style-type: none"> • The chances of accidents would be reduced in view of improved road conditions 	<ul style="list-style-type: none"> • Traffic management plan to be developed, especially in congested locations • Traffic control measures including speed limits to be enforced strictly • Further growth of encroachment and squatting on ROW to be discouraged • Widening and strengthening of the existing carriageway will reduce accidents • Improving the curves and other road geometrics • Proposing service lanes in markets and near schools • Providing proper median • Improving road junctions • Putting warning signals and signboards

Table 11.3: Environmental Monitoring Plan

Components	Action to be Taken	Implementing Agency	Monitoring Agency	Approximate Unit Cost
AIR	<p>Parameters: SPM, RPM, SO₂, NO_x, CO, Pb, HC</p> <ul style="list-style-type: none"> • Monitoring Frequency <p><i>Operational Phase:</i> Four locations (Chakkai, Martandam, Takkalai, Nagercoil, Tovalla) once in a fortnight</p> <p><i>Construction Phase:</i> Same locations once in a fortnight for construction period</p> <ul style="list-style-type: none"> • Monitoring Standard: 	NHAI	SPCB	Rs. 3,000/- per location

Components	Action to be Taken	Implementing Agency	Monitoring Agency	Approximate Unit Cost
	Existing National Ambient Air Quality Standard issued by the CPCB			
NOISE	<p>Parameters: Noise measurement in dB(A) for day & night</p> <ul style="list-style-type: none"> Monitoring Frequency: <i>Operational Phase</i> : Twice a year for 24 hours period Monitoring Points <i>Construction Phase:</i> Adhoc only if complaint is lodged <i>Operational Phase</i> : Two locations (Chakkai-Junction, Marttandam, Takkalai, Nagercoil, Kazhakuttam, Kallikavilai, Parassala, Tovola) Monitoring Standard: Existing Noise standard issued by the CPCB 	NHAI	SPCB	Rs. 5,000/- per location
WATER QUALITY	<p>Parameters: pH, BOD, COD, DO, Oil & Grease, Chloride</p> <ul style="list-style-type: none"> Monitoring Frequency <i>Construction Phase</i> : One time per season in a year for 24 hour period during bridge construction activity Monitoring Points: Tambaparni River At water crossings, where bridges are to be constructed Monitoring Standard : Water quality standard issued by the CPCB 	NHAI	SPCB	Rs. 2,000/- per location
FLORA	<p>Parameters: No of trees surviving after 1.5 yr. And 2 yrs. in relation to total number of trees planted Re-vegetation success, in terms of survival of plantings</p> <ul style="list-style-type: none"> Monitoring Points: Throughout the stretch Monitoring Standards: 100% newly planted trees, shrubs and brushes 	NHAI	SPCB	Rs. 40,000/- for inspector every time counting is done

Table 12.1: List of water bodies

Sl no	Project Chainage	Name of the Pond/Tank	Length of water body over which road alignment crosses
1	49.450	Thamaraikulam	100
2	49.825	Pottakulam	75
3	54.550	Pudukulam	150
4	55.525	Nattalam marudhakulam	50
5	63.375	Mampallyullam pond	75
6	64.250	Chettikulam	60
7	64.525	Bagavathikulam	50
8	65.225	Rettaikulam	50
9	65.55	Arasumuthukulam	100
10	65.95	Pillanjerikulam	50
11	66.325	Vilayakulam	53
12	68	Pambatikulam	67
13	68.475	Thamaraikulam	75
14	0+500	pond	220
15	1+300	pond	70
16	2+050	pond	82
17	5+000	pond	505
18	12+500	pond	162
19	70+694	Chellakulam pond	60
20	71+825	pond	550
21	72+205	pond	500

Sl no	Project Chainage	Name of the Pond/Tank	Length of water body over which road alignment crosses
22	72+505	pond	110
23	73+500	Panakulam pond	140
24	73+920	pond	70
25	75+800	Nilapparai kulam	78
26	77+650	Tank	317
27	79+600	Putteri tank	490.00
28	79+750		
29	79+850		
30	80+706	Pazhayar river	45
31	88+964	Purindheneri kulam	135
32	89+150	Purushotamaneri kulam	215
33	90+150	Thanumalaiyan kulam	0
34	91+500	Kandukrisi kulam	75
35	91+800	Pallakulam	175
36	92+450	Rajendhrikulam	190
37	92+700	Mandarampudhur kulam	336
38	93+500	Devakulam pond	204
39	94+800	Kavarkulam pond	166
40	95+200	Agastiarkulam pond	102
41	96+100	Ponds between rocks	225
42	96+200	Pannigundukulam	215

Table no 12.2 - Design proposal over surface water Source

SI No	Name of Taluk/Village	Survey No.	Type of surface water source	Original design proposal	Revised design Proposal
NH-47					
1	Kulapuram	27, 31 & 32/13	Canal	Minor Bridge	Minor Bridge
2		36/12, 36/13 & 37/1, 38 , 42	Drain	Hume Pipe Culvert	Hume Pipe Culvert
3		72, 73/20, 74-3, 75, 76-6	Canal	Nil	Minor Bridge
4		39/2	Drain	Hume Pipe Culvert	Hume Pipe Culvert
5	Methukummal	97/12	Canal	Nil	Box Culvert
6	Kulapuram	85/10, 86-19, 86-21	Canal	Hume Pipe Culvert	Hume Pipe Culvert
7		99-10, 101-21, 104/11, 105-06, 105-09	Canal	Box Culvert	Box Culvert
8		244-1, 245-1, 254-1, 205-1	Drain	Nil	Box Culvert
9		258	Drain	Nil	Hume Pipe Culvert
10		264-19, 265-17, 265-18, 267-15, 268-26	Drain	Nil	Minor Bridge
11		466/2	Drain	Hume Pipe Culvert	Hume Pipe Culvert

12		480-10, 496-16	Drain	Box Culvert	Box Culvert
13		634/1	Thamarabharani River	Major Bridge	Major Bridge
14	Kunnathoor	275-1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
15		287/3, 287-4	Thamaraikulam	Nil	Major Bridge
16		300-5, 303-1	Drain	Nil	Box Culvert
17		300-17, 305-6	Canal	Nil	Minor Bridge
18		410/10, 410/3A	Drain, Tank	Hume Pipe Culvert	Hume Pipe Culvert
19		411/3E1	Tank	Nil	Major Bridge
20		411/2, 420-3	Filed Channel	Nil	Hume Pipe Culvert
21		421/15	Filed Channel	Nil	Hume Pipe Culvert
22		39/2	Drain	Hume Pipe Culvert	Hume Pipe Culvert
23	84/12	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
24	139/7	Nala	Hume Pipe Culvert	Hume Pipe Culvert	
25	270/1A1	Drain	Box Culvert	Box Culvert	
26	368/6A	Nala	Box Culvert	Box Culvert	
27	365/5	Nala	Box Culvert	Box Culvert	
28	464/15	Nala	Box Culvert	Box Culvert	
29	968/11	Pond	Nil	Major Bridge	
30	1003/7	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
31		Nala	Nil	Hume Pipe Culvert	
32	1042/18	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
33	Valavacha Goshtam	611/11A1	Drain	Box Culvert	Box Culvert

34		607/3	Nala	Hume Pipe Culvert	Hume Pipe Culvert	
35		608/19	Nala	Hume Pipe Culvert	Hume Pipe Culvert	
36		652	Nala	Hume Pipe Culvert	Hume Pipe Culvert	
37		662	Canal	Minor Bridge	Minor Bridge	
38		655, 656	Nala	Minor Bridge	Minor Bridge	
39	Kappiara	91/20	Canal	Hume Pipe Culvert	Hume Pipe Culvert	
40		98/8	Canal	Hume Pipe Culvert	Hume Pipe Culvert	
41		107-11 & 108-13	canal	Nil	Minor Bridge	
42		263-1, 263-20	canal, Tank	Nil	Minor Bridge	
43	Valavacha Goshtam	830/6	Drain	Box Culvert	Box Culvert	
44		856/1B1	Drain	Box Culvert	Box Culvert	
45	Kappiara	222/3	Pond	Box Culvert	Box Culvert	
46	Thiruvithamcode	267-9	Drain	Nil	Box Culvert	
47		287-16	Tank	Nil	Minor Bridge	
48		382-4	Tank	Nil	Minor Bridge	
49		382-10	drain	Nil	Hume Pipe Culvert	
					Nil	Box Culvert
50		403-1, 410-1, 411-6, 422-6, 423-1, 423-5 & 424-1	drain			
51		424/3	Canal	Aqueduct	Aqueduct	
52	408/15B	Nala	Hume Pipe Culvert	Hume Pipe Culvert		
53	Eraniel	287-6	Tank	Major Bridge	Major Bridge	

54		288-6	Canal	Nil	Minor Bridge
55		288-11	Tank	Nil	Minor Bridge
56		292-1, 293-4	Canal	nil	Box Culvert
57		307-22	tank	nil	Minor Bridge
58		382-10	Canal	Minor Bridge	Minor Bridge
59		382-4	Tank	Major Bridge	Major Bridge
60		307/5	Pond	Major Bridge	Major Bridge
61		298/9	Drain	Hume Pipe Culvert	Hume Pipe Culvert
62		342-6	Pond	Nil	Major Bridge
63		343/7, 341/1, 344/10, 365/5	Drain	Hume Pipe Culvert	Hume Pipe Culvert
64		377-2,	Pond	Major Bridge	Major Bridge
65		378/12, 392/6,	Nala	Box Culvert	Box Culvert
66		396/1, 397/1, 398/2	CANAL	Nil	Box Culvert
67		656-17, 657-15, 659-3, 660-16	CANAL	Nil	Box Culvert
68	Kalkulam block no 5	23-15	Pond	Nil	Major Bridge
69		387-1	Nala	Nil	Hume Pipe Culvert
70		393-8, 394-17	Drain	Nil	Hume Pipe Culvert
71		423, 424	Drain	Nil	Hume Pipe Culvert
72		426-7	Tank	Nil	Minor Bridge
73		426-15	Drain	Nil	Box Culvert
74		388/3, 404	Valliyar River	Minor Bridge	Minor Bridge
75	Eraniel	663/9	Pambattikulam Pond	Box Culvert	Box Culvert
76		664/2, 665/4	Nala	Nil	Hume Pipe Culvert
77		691/12	Tamarakulam Pond	Minor Bridge	Minor Bridge
78		695-20,	CANAL	Nil	Box Culvert

79		697/7	TANK	Nil	Box Culvert
80		698/8	tank	Nil	Box Culvert
81		788-5, 789-23	canal	Nil	Box Culvert
82		791	tank	Nil	Box Culvert
83		855/6	Channel	Hume Pipe Culvert	Hume Pipe Culvert
84		861/1	Canal	Minor Bridge	Minor Bridge
85	Villukuri		Chellakulam Pond	Nil	Major Bridge
86		545/13	Drain	Box Culvert	Box Culvert
87			Pond	Nil	Major Bridge
88			Pond	Nil	Major Bridge
89		684	Pond	Nil	Major Bridge
90		676	Pond	Nil	Major Bridge
91		678/10	Drain	Box Culvert	Box Culvert
92		662	Pond	Nil	Major Bridge
93		657/5	Drain	Hume Pipe Culvert	Hume Pipe Culvert
94		821/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
95			Pond	Major Bridge	Major Bridge
96		817/6	Pond	Box Culvert	Box Culvert
97		831/1	Pond	Minor Bridge	Minor Bridge
98		833/1	Pond	Box Culvert	Box Culvert
99		832/5	Drain	Box Culvert	Box Culvert
100	Aloor	17/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
101		19-7	Tank	Nil	Minor Bridge
102		19/19	Drain	Hume Pipe Culvert	Hume Pipe Culvert
103		29-5, 29-7	Tank	Nil	Minor Bridge
104		34/3, 34/5	Field Channel	Box Culvert	Box Culvert

105	Vadasery	706/3A	Drain	Box Culvert	Box Culvert	
106		692,693	Canal	Minor Bridge	Minor Bridge	
107		673/1	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert	
108			Pond	Nil	Major Bridge	
109		663/1	Canal	Minor Bridge	Minor Bridge	
110			Pond	Nil	Major Bridge	
111		298/1	Tank	Hume Pipe Culvert	Hume Pipe Culvert	
112		302/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
113		324/5	Canal	Minor Bridge	Minor Bridge	
114		376/2	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert	
115		387/6	Tank	Hume Pipe Culvert	Hume Pipe Culvert	
116		620/1	Putteri Tank	Nil	Major Bridge	
117		589/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
118		591/1	Field Channel	Box Culvert	Box Culvert	
119		Thirupathi Saram	50,51	Palayar River	Minor Bridge	Minor Bridge
120			54/3, 55/8, 56/1, 63/5, 64/1, 65/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
121			74/1, 76/10	Nala	Hume Pipe Culvert	Hume Pipe Culvert
122		Nagercoil	8/7	Drain	Hume Pipe Culvert	Hume Pipe Culvert
123	3/1		drain	Nil	Box Culvert	
124	16/6		Field Channel	Nil	Hume Pipe Culvert	

125		22/2, 28/5 & 30/2	Field Channel	Nil	Hume Pipe Culvert
126		99/3	tank	Nil	Minor Bridge
127		130/1, 131/7, 132/1, 133/5	Field Channel	Nil	Hume Pipe Culvert
128		139/6, 140/3	Field Channel	Nil	Hume Pipe Culvert
129		146	tank	Nil	Minor Bridge
130		49/7	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
131		91/6	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
132	Theror	943/4	Drain	Hume Pipe Culvert	Hume Pipe Culvert
133		942/7	Drain	Box Culvert	Box Culvert
134		947	Nala	Box Culvert	Box Culvert
135		956/3	Drain	Box Culvert	Box Culvert
136		1042/1	Drain	Box Culvert	Box Culvert
137		1097/3	Drain	Box Culvert	Box Culvert
138		1154/9	Drain	Hume Pipe Culvert	Hume Pipe Culvert
139		1167/13	Nala	Minor Bridge	Minor Bridge
140	Eraviputhur	60/4	Drain	Box Culvert	Box Culvert
141		15/7, 16/1, 18/7, 21/1, 24/5, 24/7, 24/10	Field Channel	Nil	Hume Pipe Culvert
142		60/5, 61/3	Field Channel	Nil	Hume Pipe Culvert
143		78/7, 79/2	Field Channel	Nil	Hume Pipe Culvert
144		85/1, 86/6	Field Channel	Nil	Hume Pipe Culvert
145		83,84	Nala	Nil	Box Culvert

146		92/9, 92/10 , 93/2	Field Channel	Nil	Hume Pipe Culvert
147		185/1, 186/4, 187/1	Field Channel	Nil	Hume Pipe Culvert
148		78/2	Drain	Box Culvert	Box Culvert
149		19	Pond	Nil	Major Bridge
150			Pond	Nil	Major Bridge
151		79/3	Drain	Existing BC	Existing BC
152	Kulasekharapuram	14-1	Tank	Box Culvert	Box Culvert
153		18-2	Tank	Nil	Minor Bridge
154		22	Tank	Nil	Minor Bridge
155		24-2	Channel	Nil	Hume Pipe Culvert
156		61-1, 62-1, 64-1, 68-1	Channel	Nil	Hume Pipe Culvert
157		69	Drain	Nil	Box Culvert
158		74/8, 92/1, 94/5, 103-3	Channel	Nil	Hume Pipe Culvert
159		187-11,	Channel	Nil	Hume Pipe Culvert
160		728-4, 730-3,	Tank	Nil	Minor Bridge
161		732-4, 736-2	Channel	Nil	Hume Pipe Culvert
162			Pond	Nil	Major Bridge
163		103/6A1	Drain	Existing HPC	Existing HPC
164			Drain	Existing HPC	Existing HPC
165		184	Drain	Existing HPC	Existing HPC
166			Pond	Nil	Major Bridge
167		735	Pond	Existing BC	Existing BC
168		18/1	Canal	Box Culvert	Box Culvert
169	Thamaraikulam	68	tank	Nil	Minor Bridge

170		70-4	Field Channel	Nil	Hume Pipe Culvert
171		74-1, 77-10, 81-7, 81-8	Field Channel	Nil	Hume Pipe Culvert
172		85-3, 85-8, 85-14, 85-15, 85-17, 85-34	Field Channel	Nil	Hume Pipe Culvert
173		183	Tank	Nil	Minor Bridge
174		220	Drain	Nil	Box Culvert
175	Kottaram	8/2,	Canal	Nil	Box Culvert
176		21	Pond	Nil	Box Culvert
177		24/6,	Canal	Nil	Box Culvert
178		26/2	Field Channel	Nil	Hume Pipe Culvert
179		450/19, 457/1,	Drain	Nil	Box Culvert
180		450/19	Pond	Nil	MAJOR BRIDGE
181		453/4, 454/5, 456/8	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
182		457.6	Field Channel	Box Culvert	Box Culvert
183		494	Pond	Nil	MAJOR BRIDGE
184		515	Pond	Nil	MAJOR BRIDGE
185		514-14	Field Channel	Nil	Hume Pipe Culvert
186		524/1, 524/3, 524/5, 524/17, 526/3,	Field Channel	Nil	Hume Pipe Culvert
187		528/1	Drain	Nil	Box Culvert
188		529/8, 535/1, 535/10, 536/10	Field Channel	Nil	Hume Pipe Culvert
189		583/3	Canal	Nil	Box Culvert
190		579/5	Field Channel	Box Culvert	Box Culvert
191		589/1	Kavarkulam Pond	Hume Pipe	Hume Pipe

				Culvert	Culvert
192		700/5	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
193		715/4	Pond	Nil	Major Bridge
194		694/5, 694/15, 695/5, 695/17	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
195		685/1, 689/1, 691/2, 691/16, 691/22	Field Channel	Hume Pipe Culvert	Hume Pipe Culvert
196		722/2, 722/3,	Pond	Nil	Major Bridge
197		731/1,	Canal	Box Culvert	Box Culvert
198	NH-47B				
199	Thirupathi Saram	80-1, 81-1, 84, 86-8, 92-5, 92-7	Field Channel	Nil	Box Culvert
200		81/4	Pond	Nil	Major Bridge
201		85/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
202		84	Nala	Minor Bridge	Minor Bridge
203		181/8, 181/10	Pond	Nil	MAJOR BRIDGE
204		132/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
205		146	Pond	Nil	Major Bridge
206		360/4, 361/1, 361/6, 363-1, 363/7, 364/3, 365/2365/3	Field Channel	Nil	Box Culvert
207		364/4	Drain	Box Culvert	Box Culvert
208		373	Drain		
209		376/6	Field Channel	Nil	Box Culvert

210		384-3, 389-1, 390/6, 392/21, 393/2, 394/1, 394/3	Field Channel	Nil	Box Culvert	
211		395/4	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
212	Theroor	41, 42	Putthanar Channel	Minor Bridge	Minor Bridge	
213		21/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
214		20/4	Nala	Minor Bridge	Minor Bridge	
215		19/2	Drain	Box Culvert	Box Culvert	
216		16,17	Drain	Minor Bridge	Minor Bridge	
217			395/1	Drain	Hume Pipe Culvert	Hume Pipe Culvert
218		409/1	Pond	Nil	Major Bridge	
219		467/4	Pond	Hume Pipe Culvert	Hume Pipe Culvert	
220		490/1	Thovalai Channel	Minor Bridge	Minor Bridge	
221		500/5	Drain	Box Culvert	Box Culvert	
222		562	Drain	Box Culvert	Box Culvert	
223	Thovala	596/4	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
224		595, 599	Drain	Box Culvert	Box Culvert	
225		605/2, 615/3	Drain	Box Culvert	Box Culvert	
226		606/3	Drain	Hume Pipe Culvert	Hume Pipe Culvert	
227		613/1, 625/6	Drain	Box Culvert	Box Culvert	
228		731/3	Nala	Minor Bridge	Minor Bridge	
229		728, 729	Nala	Minor Bridge	Minor Bridge	
230		795/1	Nala	Box Culvert	Box Culvert	
231		Aralvaymoli	153/5	Tank	Nil	Minor Bridge

232	212	Drain	Nil	Box Culvert
233	214	Drain	Nil	Box Culvert
234	218/2B1A	Drain	Hume Pipe Culvert	Hume Pipe Culvert
235	224/1	Drain	Nil	Box Culvert
236	226	Drain	Nil	Box Culvert
237	227/17, 231, 292	Drain	Nil	Box Culvert
238	295/13	Drain	Box Culvert	Box Culvert
239	292	Nala	Minor Bridge	Minor Bridge
240	335/1	Drain	Box Culvert	Box Culvert
241	334	Pond	Nil	MAJOR BRIDGE
242	352/1	Drain	Box Culvert	Box Culvert
243	693/6	Field Channel	Nil	Hume Pipe Culvert
244	700/20, 701/2, 701/10, 705/5	Field Channel	Nil	Box Culvert
245	706/1B, 707/3B	Channel	Nil	Box Culvert
246	745-5, 751-5	Drain	Nil	Box Culvert
247	753/7	Pond	Nil	Minor Bridge
248	754/2	Drain	Box Culvert	Box Culvert
249	701/11	Drain	Box Culvert	Box Culvert
250	550,541	Nala	Box Culvert	Box Culvert