

# Environmental and Social Impact Assessment (Esia) Of Nh66

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**ABSTRACT**-The National Highways Authority of India (NHAI) has been entrusted with the 6 laning of Chertalai to Thiruvananthapuram Section of NH47 (new NH-66) (from km 379.100 to km 551.900 under NHDP Phase III in the State of Kerala. The project stretch of NH 47 begins at Thuravoor Junction near Cherthala Town and ends at Kazhakottam Junction near Thiruvananthapuram totalling a length of 172.80 km in Kerala State. Generally, the existing road is two lanes with paved shoulders on either side. This is further widened to 6 lanes of 45m width. The environment and social impact assessments of package 1 (from ThuravoorThekku to Paravur length-37.9 km) is conducted. Physical environmental parameters such as air quality, soil quality and water quality are analysed. Study on vegetation removal is conducted and the effects on the flora and fauna are analysed. Vulnerable groups and communities are identified and the impacts on them is analysed. Impacts are classified into pre-construction, during construction and post-construction phases and mitigation measures are suggested.

Neendakara, Kavanadu (Kollam), Mevaram (Kollam), Kottiyam, Chathanoor, Paripally, Kallambalam, Attingal, Manglapuram, Pallipuram and Kazhakottam. Generally, the existing road is two laned with paved shoulders on either side. At most of the urban locations in the presence of Major Junction, carriageway has been upgraded to 4 lane divided carriageway configuration including the junction with approaches and also along the existing town section.

B. Project location

The project has been divided into the six construction packages. The details are as follows:

TABLE I PACKAGE DETAILS

Package	Design Change		Length (km)	Location	District
	From km	To km			
Package-1	379.100	417.000	37.90	Thuravoor-Paravoor	Alappuzha
Package-2	417.000	454.500	37.50	Paravoor-Kottarakkulangara	Alappuzha
Package-3	454.500	486.000	31.50	Kottarakkulangara-Start of Kollam Bypass	Alappuzha and Kollam
Package-4	486.000	517.250	31.25	Start of Kollam Bypass-Kadambattukoram	Kollam
Package-5	517.250	547.080	29.83	Kadambattukoram-Kazhakottam Jn	Trivandrum
Package-6	547.080	548.801	1.721	Kazhakottam Jn Technopark Jn.	Trivandrum
Total			170.701		

## I. INTRODUCTION

### A. Project description

The National Highways Authority of India (NHAI) has been entrusted with the assignment of preparation of Detailed Project Report for 6 laning of Chertalai to Thiruvananthapuram Section of NH47 (new NH-66) (from km 379.100 to km 551.900 under NHDP Phase III in the State of Kerala. The project stretch of NH 47 begins at Thuravoor Junction near Cherthala Town and ends at Kazhakottam Junction near Thiruvananthapuram totalling a length of 172.80 km in Kerala State. This stretch of road passes through three districts viz. Alappuzha, Kollam and Thiruvananthapuram. The road passes through urban areas viz. Chertalai, MararyKulam, Alappuzha, Ambalapuzha, Purakkad, Thottapally, Haripad, NagiarKulangara, Kayamkulam, Krishnapuram, Oachira, Vavvakavu, Karunagapally, Chavara,

## II. OBJECTIVES

- Assessing environmental impacts
- Study different quality parameters of - air, water, soil
- Assessing Social impacts – questionnaire.
- Conduct study to determine whether EIA is required
- Prediction of long term and short-term impacts
- Evaluate the feasibility of the project.

## III. EIA METHODOLOGY

The EIA procedure carried out simultaneously with design of the project road and methodology is shown in below. The important findings of the assessment provided important feedback to the design team, especially in terms of the

sensitive receptor, Forest and wildlife area, archaeological sites and religious properties. It helped in modification of the designs report and incorporated mitigation measures, wherever the impacts are avoidable.

**Data Review** - draw together and review available data

**Screening** - determine the need for EIA

**Scoping** - identify significant issues, determine the subject matter of the assessment and the methodologies for undertaking the assessment

**Baseline Surveys** - undertake surveys and monitoring to identify existing environmental conditions

**Consultation** - provide information to consultees and the public about the Scheme so that parties can make informed contributions to the development of the Scheme and EIA process, and take account of issues raised by consultees

**Preparation of detailed report** – Final detailed report is prepared based on the above results

TABLE II SOIL QUALITY TEST

No.	parameters	value	limit
1	Moisture	3.21%	-
2	pH	7.92%	6.5 to 9
3	Nitrogen as N	0.14%	5%
4	Phosphorous as P <sub>2</sub> O <sub>5</sub>	0.87%	20% to 50%
5	Potash as K <sub>2</sub> O	0.73%	50% to 60%
6	Calcium as Ca	0.38%	70% to 80%
7	Magnesium as Mg	0.21%	0.05% to 0.5%
8	Iron as Fe	0.07%	0.2% to 55%

#### IV. DESCRIPTION OF ENVIRONMENT

##### A. General

As a precursor for the prediction of various types of environmental impacts likely to arise due to implementation of the project, it is essential to establish the baseline environmental status in the area. Details of baseline environment parameters are required for decision making for the project.

##### B. Study area

The terrain which includes in chainage from 379.100 to 417.000 is plain.

The entire length of the road is passing through built up and commercial areas along with few agricultural areas. There are substantial built-up areas with prominent urban settlements located on the project road.

Field observations, secondary data and Local inquiries indicated that some road stretches get submerged during heavy rains. There are many valleys locations/dip portion where additional culverts are felt necessary for the effective drainage. There are number of culverts in the stretch mainly slab type. Most of the culverts are not visible as there is heavy vegetation on both sides of the road throughout. Many culverts are in fully or partially choked condition due to development of built up are along the road.

The total of existing culverts after compiling the data is found to be 25 (Pipe 1 nos., Slab 17 nos. & Box 7 nos.). Many of these culverts has been found to be partially choked and seem inadequate.

The culverts are also old and seem to be structurally as well as hydraulically poor. Many of these structures shall be replaced preferably by Box Culverts for better hydraulic performance.

##### C. Physical environment

1) Soil characteristics: Soil from random locations are collected and tests are conducted. Various parameters like nitrogen phosphorous, iron, etc, are tested. Excess amount of these parameters can result in fertility loss. It is clearly visible that most of the parameters are present in very less amount. From this we can expect that the widening will not affect the soil characteristics hardly.

Soil organic matter contains an average of about 50 percent carbon and **5 percent** nitrogen.

The total phosphorus content of most surface soils is low, averaging only **0.6%** phosphorus. The main symptom of excessive phosphorus in soil is **stunted plant growth. Amount of phosphorus** slowly drops as time goes on. P will stay in the soil for as long as **four to six months** before plant uptake.

Growers should maintain a calcium percent base saturation level of **70 to 80 percent** for optimum soil conditions and plant performance. Calcium base saturation levels above 80 percent can mean you're short on potassium or magnesium. If present, these deficiencies should be addressed through a fertility program.

Soil usually contains **between 0.05 and 0.5% total Mg** but only a small proportion is in forms available for plant uptake.

Iron is a commonly occurring metallic element, with typical soil concentrations ranging from 0.2% to 55% (20,000 to 550,000 ppm). Iron is essential for plant growth, and is generally considered to be a micronutrient. Iron is considered the key metal in energy transformations needed for syntheses and other life processes of the cells.

2) seismicity: There is no significant confirmed earthquakes in or near Alappuzha during May 2021

##### D. Air environment and quality

TABLE III AIR QUALITY ANALYSIS

PARAMETERS	AMOUNT PRESENT	PERMISSIBLE LIMIT
Ozone	70µg/m <sup>3</sup>	100µg/m <sup>3</sup>
Coarse Particulate matter	10 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>
Fine particulate matter	4 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
Nitrogen dioxide	4 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>
Carbon monoxide	224 µg/m <sup>3</sup>	10 mg/m <sup>3</sup>
Sulphur dioxide	1 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>

An ambient air quality sampling location, Kalarcode, was established for assessment of the existing status of air environment within the study area.

Particulate Matter are inhalable pollutant particles with a diameter less than 10 micrometres. Particles that are larger than 2.5 micrometres can be deposited in airways, resulting in health issues. Exposure can result in eye and throat irritation, coughing or difficulty breathing, and aggravated asthma. More frequent and excessive exposure can result in more serious health effects.

Fine Particulate Matter are inhalable pollutant particles with a diameter less than 2.5 micrometres that can enter the lungs and bloodstream, resulting in serious health issues. The most severe impacts are on the lungs and heart. Exposure can result in coughing or difficulty breathing, aggravated asthma, and the development of chronic respiratory disease.

Presently (19-05-2022) it shows excellent condition but air quality will be severely affected at the time of construction.

Major parameters which will affect at the time of construction are coarse particulate and fine particulate matter because of the emerging of dust. But it is a temporary impact and only lasts for short period.

#### E. Water resources

The existing road is far from existing water bodies, large ponds so there is no chance of affecting severely. However, some branches of rivers and canals are located nearby the highway. The quality of those resources is analysed.

TABLE IV WATER QUALITY ANALYSIS

NO.	PARAMETERS	VALUE	STD LIMIT
1	Colour	3 Hazen units	5 Hazen units
2	Odour	-	-
3	Turbidity	6.1 NTU	5 NTU
4	pH	8	6.5-8.5
5	Total dissolved solids	317.6 mg/L	500
6	Total hardness	130 mg/L	300
7	Calcium hardness	32.04 mg/L	75
8	Magnesium hardness	12.14 mg/L	30
9	Alkalinity	120 mg/L	200
10	Sulphates	16.24 mg/L	200
11	Chlorides	99.26 mg/L	250
12	iron	.58 mg/L	3
13	BOD	6.0 mg/L	0
15	DO	4.3 mg/L	6.5 - 8

Water samples are collected from nearby resources and are tested in the laboratory. From the results, turbidity, iron, BOD & DO does not satisfy the standards. Construction may result in the increase of these parameters beyond their permissible limit. Those parameters which are already above the limit can get more worse. It can also result in loss of soil fertility indirectly.

#### F. Biological Environment

1) Protected areas: A Protected Area is a clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. Protected areas include national parks, wilderness areas, community conserved areas, nature reserves and so on are a mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level. Utmost care must be taken while fixing the alignment near wildlife sanctuaries and National Parks. Such areas are not present in the area under consideration.

2) Population Density: Alappuzha district has a population density of 1,504 inhabitants per square kilometre. It is the second highest population density in Kerala. Its population growth rate over the decade 2001-2011 was 0.88%. Alappuzha has a sex ratio of 1100 females for every 1000 males, and a literacy rate of 95.72%. Out of the total Alappuzha population for 2011 census, 53.96 percent lives in urban regions of district.

3) Tourism: Tourism is one of the fastest growing sectors with highest contribution in State's revenue. The sector has increased the standard of living and provided platform to local artisans. The state has variety of tourist attractions such as handicrafts, wildlife sanctuary, heritage places, and lakes.

Infrastructure assets, particularly road infrastructures are levers for economic growth and development, hence a country's competitiveness heavily depends on the provision and maintenance of infrastructure assets. The tourism sector, which is highly dependent on a good transportation system and mobility, is a source of revenue to many countries. Hence, road infrastructure is pivotal to a thriving and sustainable tourism industry.

A good and effective transportation network is also a good marketing strategy for the traveling agencies that facilitate travels and organise tourism activities for individuals and organisation.

4) vulnerable groups: Vulnerable populations include the economically disadvantaged, racial and ethnic minorities, the uninsured, the homeless, and it may also include rural residents, who often encounter barriers to accessing healthcare services. The vulnerability of these individuals is enhanced by race, ethnicity, age, sex, and factors such as income, insurance coverage (or lack thereof), and absence of a usual source of care. Their health and healthcare problems intersect with social factors, including housing, poverty, and inadequate education.

There are no such vulnerable groups included in the considered area.

## V. ENVIRONMENTAL IMPACTS AND MITIGATION

### A. Urban heat islands

An urban heat island, or UHI, is a metropolitan area that's a lot warmer than the rural areas surrounding it. Heat is created by energy from all the people, cars, buses, and trains. Urban heat islands are created in areas like these: places that have lots of activity and lots of people.

There are many reasons for UHIs. When houses, shops, and industrial buildings are constructed close together, it can create a UHI. Building materials are usually very good at insulating, or holding in heat.

This insulation makes the areas around buildings warmer.

Night time temperatures in UHIs remain high. This is because buildings, sidewalks, and parking lots block heat coming from the ground from rising into the cold night sky. Because the heat is trapped on lower levels, the temperature is warmer.

Urban heat islands can have worse air and water quality than their rural neighbours. UHIs often have lower air quality because there are more pollutants (waste products from vehicles, industry, and people) being pumped into the air. These pollutants are blocked from scattering and becoming less toxic by the urban landscape: buildings, roads, sidewalks, and parking lots.

Water quality also suffers. When warm water from the UHI ends up flowing into local streams, it stresses the native species that have adapted to life in a cooler aquatic environment.

### B. During construction phase

During construction phase environmental impacts are likely to result primarily from operation of heavy machinery and equipment's, vehicular movement and from influx of workforce. The potential pollutant sources for construction phase and their characterization have been discussed in the subsequent section.

### C. Heavy Machineries and Vehicular movement

The operations of construction vehicles, diesel generators and machineries will contribute to Suspended Particulate Matter (SPM), Sulphur and Nitrogen dioxides (SO<sub>2</sub> and NO<sub>x</sub>), Carbon monoxide (CO) and other hydrocarbons (HC). handling and transportation of materials during the construction phase also creates emission.

### D. Noise

During construction phase, noise will be generated from operating heavy machineries and from vehicular movement. All the generator sets will be equipped with exhaust mufflers and acoustic enclosures and subjected to periodic preventive maintenance.

- Provision of Noise barrier
- By maintaining a steady stream flow of traffic and by segregating slow and fast modes
- By removing traffic bottlenecks

### E. Generation of construction waste

Some amount of waste will be generated from the batching plant, hot mix plant and from the demolition of the building and other structures within the proposed ROW. Some of the material will be recycled and used for back filling. Material which cannot be recycled will be considered as Construction

and Demolition waste and has to be disposed off as per the existing rules.

**F. Influx of Workforce**

Sewage effluent will be generated during this phase from construction camps. Solid waste generated during the construction phase from the camps is expected to comprise of food waste and recyclables viz. packaging material etc.

**G. Contamination of Soil**

Oil spillage from heavy machineries can contaminate soil.

**H. Generation of dust**

Mainly dust will be emitted during material transport and during loading-unloading activities which is planned to be controlled by periodic water sprinkling and by adopting good engineering practices.



Fig 1 dust in leaf

**I. Water quality**

Generation of exhaust gases and fluid leakages from vehicles drains to nearby resources which results in contamination.

**J. Animal crossing**

Widening increase's chance of hitting animals while crossing. For crossing wide roads, it takes greater time for them to cross which directly increases the chance of hitting



Fig 2 Animal crossing road

**K. using cold mix asphalt**

Highway industry is also adopting several measures to reduce its carbon footprint. One of such measures is cold mix asphalt technology (CMA). CMA does not require any heating of material. This is achieved by using asphalt emulsion and cutback as binding material. Since these materials are liquid at room temperature, they do not require any heating for mixing and compaction. This gives many environmental and economic benefits to CMA over hot mix asphalt (HMA).

**Benefits of the Cold Mix over Hot-mix Asphalt:**

- Durability and strength equivalent to using hot mix
- Permanent repair compared to traditional cold-mix which is only a temporary fix
- No Priming required
- Works even when water is present
- Works at low ambient temperatures (hot-mix cannot be used in cold weather as the asphalt will cool to much prior to compacting)
- Instantly ready for traffic – and in fact product cures and hardens more quickly with compaction forces. Rapid access over the surface reduces down time where there are time critical schedules
- Limited mess than other brands – product will not stick to or stain hands or shoes even when bucket is freshly opened
- No drift of bitumen to the surface requiring surface preparation prior to any further overlay
- Reduced labour time and therefore cost
- No requirement for special equipment
- Environmentally beneficial as it reduces carbon emission and noxious fumes avoid wastage

Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However, for constructing new roads hot mix technology is better suited. Contractor/Concessionaire shall utilise the same where ever suitable.

**L. Relocation of petrol pumps**

The considered area contains six petrol pumps which needs to be replaced to other location. This process leads to cutting and filling according to the area. Also, there is risk factor in replacing storage tank of fuel.

**VI. SOCIAL IMPACTS**

**A. Social Environment**

**TABLE V PUBLIC STRUCTURES**

property	chainage
school	383.900
mosque	386.500
church	380.700
mosque	381.550
church	385.500

Widening result in the demolition of these structures which creates imbalance in the social activities of adjoining communities.

- Extra care should be taken while dealing with, religious and communal properties.
- By providing underpass for smooth and safe travel of local populace.
- Providing noise attenuation measures along schools and hospitals.
- Avoiding direct impact on sensitive receptors.

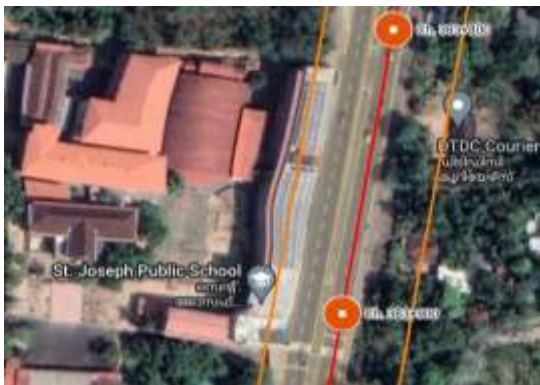


Fig 3 school



Fig 4 Mosque

### B. Social Impact analysis

Social Impact analysis was assessed with a questionnaire. Questionnaires for both commercial properties and residential properties are prepared.

Compensations for the land given to the title holders have been given promptly. But the greater percentage of stakeholders express dissatisfaction in the compensation.

Compensation for tenants have not given and the delay has caused uncertainty among them. Few citizens who are partial to development and growth show satisfaction in the project. The compensation provided to the people is as per land values of 2013, which is significantly less than the present land value. Many of the residents had to migrate and others had to cram into the remaining land. This resulted in disruption of their daily activities and increase in day-to-day travel distance to work and back.

### C. Social Impact Survey Analysis

1) Commercial: Majorities are tenants and a 10% of unregistered small establishments are there which does not have any considerations in providing compensation. 67% reside in the remaining property and 33% have migrated.

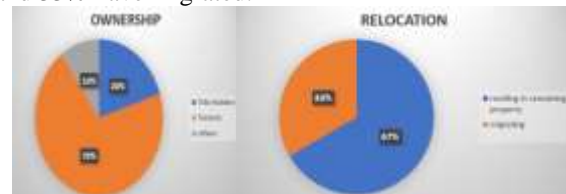


Fig 5 commercial Pie Chart

2) Residential: 69% are title holders and remaining 31% are tenants. Out of 69% of title holders, 64% reside in the remaining property and 36% are migrating to another place.

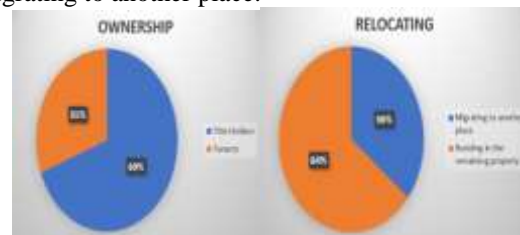


Fig 6 Residential Pie Chart

3) Compensation: 74% of the title holders are unsatisfied with the compensation and remaining 26% satisfied ones are those who value development over compensation.

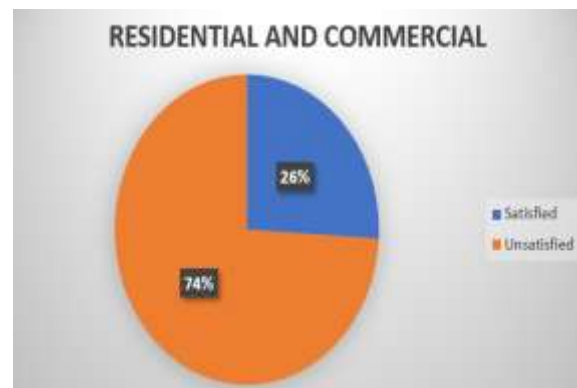


Fig 7 Compensation Pie Chart

## VII. CONCLUSIONS

Impacts of road expansion on environment are identified and Quality parameters of air, water and soil have been analysed.

The project does not seem to be imposing heavy impacts on environmental parameters but it creates a greater impact on title and non-title holders. Financial and psychological impacts on title and non-title

holders are analysed and mitigation measures for the impacts have been introduced.

- Introduction of a wider highway will expand the development opportunities in the adjoining areas.
- The impact on environment will be limited as long as proper construction practices are adopted.
- Majority of residents are unsatisfied with the compensation; some residents have moved forward with litigation.
- People who have owned small commercial establishments for decades have been removed without compensation since their property is not officially registered in government documents.
- Waste materials can be used for landfilling or proper management wants to be done.
- Land value is as of 2013 scheme, significantly less than the present value. It will be more satisfying if the present value is given to the stakeholders.

About 5 petrol pumps, 2 educational institutions, 5 religious places and 3 water tanks are situated very closely to the road. Almost every structure mentioned above are affected by the widening process.

There are 976 trees that must be removed as part of construction. To compensate this, trees must be planted which leads to positive impacts in environment like reduces heat, reduces soil erosion which finally results in less turbidity level of water resources.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- [1]. Mohammed Alamgir, Mason J. Campbell, Sean Sloan, Miriam Goosem, Gopalasamy Reuben Clements, Mahmoud I. Mahmoud, and William F. Laurance, "Economic, Socio-Political and Environmental Risks of Road Development in the Tropics" October 2017
- [2]. B. K. Srinivas & Jayanta Kumar Nayak, "SOCIAL IMPACT ASSESSMENT OF A DISPLACED VILLAGE OF KORAPUT DISTRICT, ODISHA, INDIA", IJRDO- Journal of Social Science and Humanities Research
- [3]. Mohammed jishar, "Report of the joint committee constituted by hon'ble national green tribunal, southern zone, chennai 2020.
- [4]. DRAFT EIA REPORT Bangalore – Chennai Expressway-Phase-III, January 2021
- [5]. KAZ: CAREC Transport Corridor 1 (Zhambyl Oblast Section) [Link to the Western Europe–Western People's Republic of China International Transit Corridor] Investment Program, Project 1 (Taraz–Korday Section in Zhambyl Oblast), October 2013
- [6]. DEPARTMENT OF ANTHROPOLOGY PANJAB UNIVERSITY CHANDIGARH, "Social Impact Assessment (SIA) Project Report 'Land for ROB over X-ing in the area of Sub-Tehsil: Mandi Gobindgarh, District: Fatehgarh Sahib"
- [7]. "Study of Chertalai – Thiruvananthapuram Section of NH-47 (New NH66) (from KM 379/100 to KM 551/900) [Package –KL/NH-47- III] under NHDP Phase III in the State of Kerala", Preparation of Detailed Project Report (DPR) (NHAI)