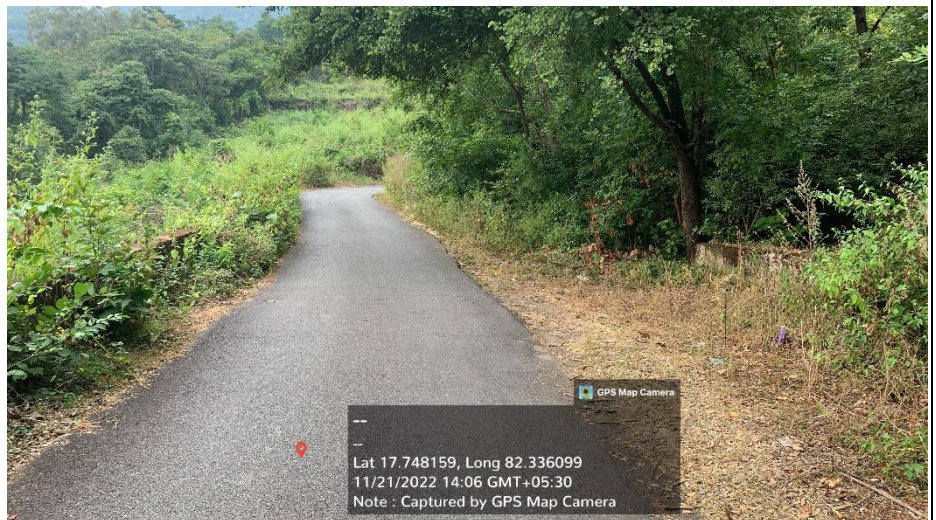




BIODIVERSITY IMPACT ASSESSMENT and Wildlife Mitigation Plan

FOR THE PROPOSED PROJECT ON

**Rehabilitation and Upgradation to 2-lane
with paved shoulders configuration of
Koyyuru to Paderu section (Km 120+000
to Km 253+974) of NH-516E in the State
of Andhra Pradesh.**



**Location: Visakhapatnam District (erstwhile) presently
Alluri Seetharama Raju District of Andhra Pradesh and
starts from Koyyuru and ends near Paderu connecting
Rajahmundry to Vizianagaram Highway**

STUDY PERIOD: OCTOBER AND NOVEMBER, 2022

ACKNOWLEDGMENTS

We acknowledge the support from the Principle Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, Govt. of Andhra Pradesh and Chief Conservator of Forest, Visakhapatnam, Divisional Forest Officer, Chinthapalli Divisional Forest Officer, Paderu and the field staff during our field survey. We are thankful to Forest department for all required permissions and extending necessary support during our field survey.

1. TABLE OF CONTENTS	
1.1. IMPORTANCE OF BIOLOGICAL SURVEY AND NEED FOR THE PRESENT STUDY	5
1.2. PROJECT BACKGROUND	5
1.3. PROJECT DESCRIPTION	6
1.4. GUIDELINES FOR WILDLIFE ISSUES DURING LINEAR EXPANSION PROJECTS	12
1.5. SCOPE OF THE STUDY:	14
1.6. THE KEY OBJECTIVES OF THE STUDY:	14
2. STUDY AREA	17
2.1. BIOGEOGRAPHIC DESCRIPTION OF THE STUDY AREA	17
2.2. PROTECTED AREAS & ECO-SENSITIVE AREAS IN THE CORE AND BUFFER ZONES (UPTO TO 10 KM RADIUS)	22
2.3. IMPORTANCE TO THE COUNTRY, REGION	27
3. METHODS ADOPTED	31
3.1. SOURCES OF DATA COLLECTION:	31
3.2. EQUIPMENT / INSTRUMENTS DEPLOYED	31
3.3. VEGETATION SURVEY METHOD	31
3.4. FAUNAL SURVEY METHOD:	32
4. SURVEY RESULTS	33
4.1. KEY FINDINGS OF BIODIVERSITY MONITORING	33
4.2. VEGETATION FOUND DURING THE FIELD STUDY:	33
4.3. FAUNA OF THE STUDY AREA	37
5. IMPACTS OF PROJECT ACTIVITIES AND MITIGATION PLAN	39
5.1. JUSTIFICATION OF THE PROJECT:	39
5.2. SPECIES-SPECIFIC IMPACTS:	39
5.3. WILDLIFE RELATED ISSUES:	43
5.3.1. <i>Impact study for Direct habitat loss:</i>	44
5.3.2. <i>Impact on barrier effect:</i>	44
5.3.3. <i>Impact on disturbance leading to displacement of animal groups:</i>	51
5.3.4. <i>Impact on collision risk:</i>	52
5.4. IMPACTS VS MITIGATION MEASURES OF THE REGION	56
5.5. PROJECT CONTRACTORS CONDITIONS DURING CONSTRUCTION PHASE:	69
5.6. UNDERPASSES FOR WILDLIFE MOVEMENT	70
6. PROJECT SPECIFIC MITIGATION PLAN WITH FINANCIAL OUTLAY	72
6.1. MITIGATION MEASURES	72
6.1.1. <i>Plantation and other habitat improvement activities within the forest areas.</i>	73
6.1.2. <i>Development of infrastructure</i>	75

6.1.3.	<i>Habitat enrichment works</i>	75
6.1.4.	<i>Wildlife research and monitoring works</i>	75
6.1.5.	<i>Protection of wildlife</i>	76
6.1.6.	<i>Publicity and Awareness</i>	76
6.1.7.	<i>Species specific general mitigation measures</i>	76
6.1.8.	<i>Under passes</i>	77
6.2.	FINANCIAL PLAN	80
7.	REFERENCES	85
8.	ANNEXURES	86
8.1.	ANNEXURE A	86
8.2.	ANNEXURE -B: LIST OF FLORA	94
8.3.	ANNEXURE -C: LIST OF FAUNA	98
8.3.1.	<i>Mammals</i>	98

1.1. IMPORTANCE OF BIOLOGICAL SURVEY AND NEED FOR THE PRESENT STUDY

Roads especially highways have been recognized as arteries providing a range of services and carrying vital goods and people that are key drivers of the growing economy. Roads are known to boost economic growth in many sectors, like the farm sector through faster and timely of farm produce to markets and the tourism sector, particularly to remote locations, India has also embarked on developing and expanding the road network, as part of infrastructure development for its growing needs.

1.2. PROJECT BACKGROUND

Ministry of Roads and Transportation and Highways (MoRTH) has been entrusted to implement an ambitious plan for the development of various national highway corridors to augment their capacity adequately for safe and speedy movement of traffic taking into account the traffic growth in such corridors in future decades. Such a network of good national highways is projected to be the minimum basic requirement for providing a level playing field for the producers and manufacturers in different regions of the country.

The primary objective of the project road widening is to cater to the increased demand of traffic and address the safe & efficient movement of the traffic in forthcoming years. The other objective of widening and strengthening of project road is to promote economic development in the project region.

The Ministry of Road Transport & Highways, (User Agency), Government of India intended to develop and maintain National Highway 516E connecting Koyyuru - Paderu Road Section (Km 120+000 to Km 253+974) in the State of Andhra Pradesh.

Name of the project: "Rehabilitation and Upgradation to two lane with paved shoulder configuration of Koyyuru to Paderu section (Km 120.000 to Km 253.974) of NH-516E in the state of Andhra Pradesh under Green National Highways Corridor Project (GNHCP) with the loan assistance of World Bank on EPC mode."

1.3. PROJECT DESCRIPTION

The Project road is located in erstwhile Visakhapatnam district (presently in Alluri Seetharama Raju and Anakapalli Districts) of Andhra Pradesh and starts from Koyyuru (17°38'9.47"N Latitude, 82°13'58.49"E Longitude) and ends near Paderu (18° 5'58.52"N Latitude, 82°40'20.65"E Longitude) connecting to Rajahmundry to Vizianagaram highway. The length of project highway is 133.974 Km. While the project stretch traverses through rolling plain and hilly terrain and has mostly poor geometry, a few locations may not require curve improvement. .

The Project road connects the important towns / villages like Koyyuru, Krishnadevipeta, Chintapalli, Lambasingi, G. Madugula and Paderu. The project alignment has merged SH-38, Panchayat Roads and other roads passing mainly through Koyyuru, Krishnadevipeta, Nallagonda and Chaprathipalem town forming an important arterial route for the

movement of goods from Rajamundry and Vijayawada towards the States of Tamilnadu, Odissa and West Bengal. The length of project highway is 133.974 Km. The road corridor covers 3 packages (i.e., I to III) from Koyyuru to Paderu in Andhra Pradesh passing through 53 villages in all, of which 50 are tribal villages in Alluri Seetharamaraju District (distributed in Packages - I, II & III) and the 3 are non tribal villages in Anakapalli District (distributed only in Package - I).

To reduce traveling time and to ensure faster movement of perishable farm produce (fruits and vegetables), better roads are the only feasible alternative resulting in greater utilization of resources and socio-economic development of the people. The success of the various investments by the government in the different sectors depends to a great extent on the adequacy of the transport infrastructure i.e. road network in the state.

The roads identified for the development in this stretch in Andhra Pradesh under GNHCP are shown in the Table.

Roads identified in 3 packages

Construction package stretch	Package	Length(km)	District
Koyyuru to Chaprathipalem	Package I	45.500	Erstwhile Visakhapatnam (presently Alluri Seetharama Raju and Anakapalli District)
Chaprathipalem to Lambasinghi	Package II	39.500	Erstwhile Visakhapatnam (presently Alluri Seetharama Raju) District
Lambasinghi to Paderu	Package III	48.974	Erstwhile Visakhapatnam (presently Alluri Seetharama Raju) District

The aim of the project is to provide connectivity between important towns with high quality roads which will have a significant impact on

mobility, livelihoods, valuation of assets, communication systems, establishment of agriculture infrastructure etc. of the people living in these areas. The settlements the project road is passing through are mostly tribal villages.

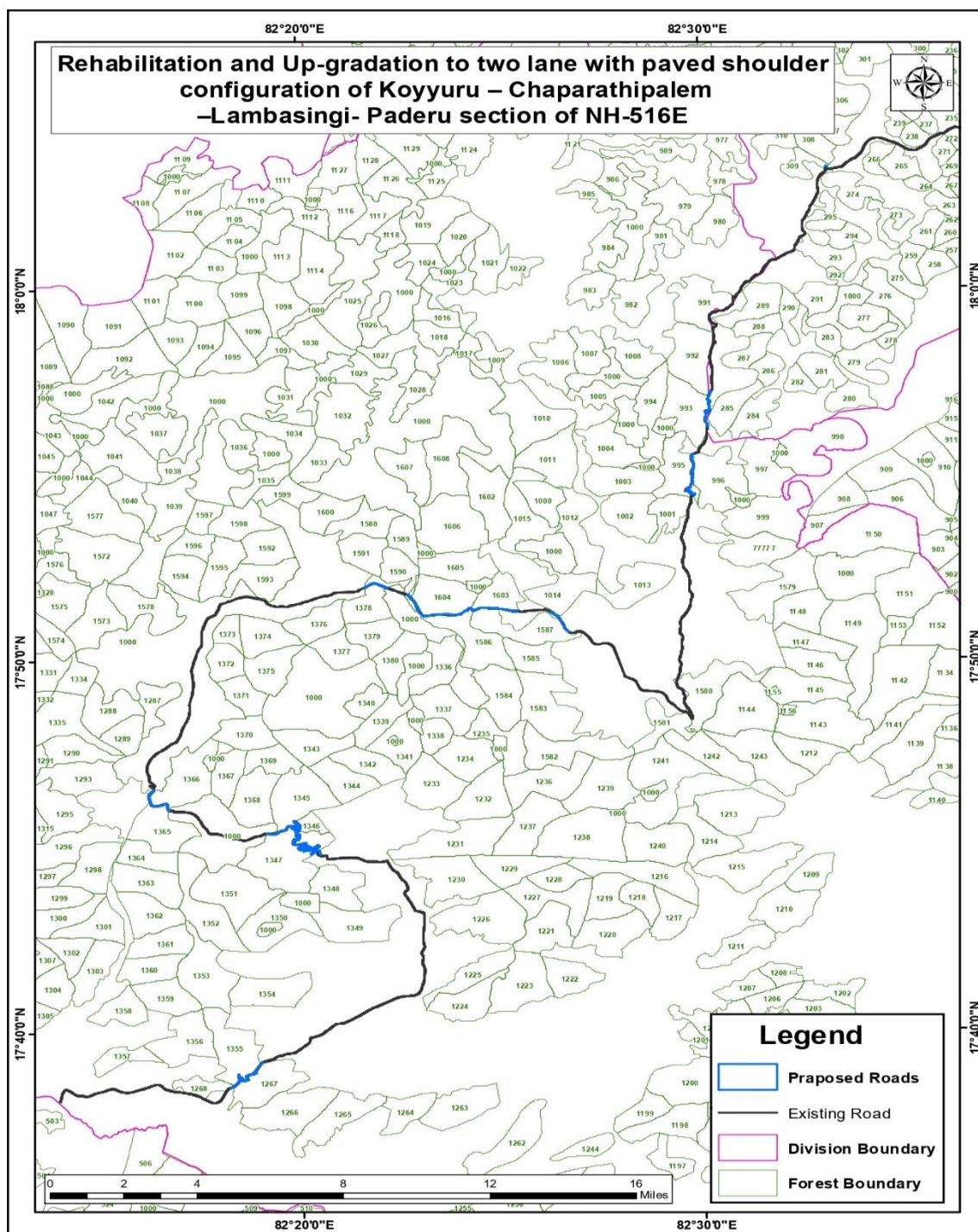
At present the existing road forms the main connectivity between Narsipatnam and Krishnadevipeta, and between Koyyuru, Lambasingi and Paderu town. The road is categorized as State Highway (SH) and Other District Road (ODR) by highway specification. The proposal is to upgrade the existing Highway to National Highway (NH) specifications. In addition to that the project road development will require up gradation/Reconstruction/widening to 2-lane/4 lane with paved shoulder configuration.

The project road is having a total 262 number of structures, out of which there is 1 no major bridge and 21 no of Minor Bridges, 105 no of slab culverts and 135 no of pipe culverts. Most of the structures have to be widened as per provision in the Indian Road Congress (IRC) code. The details of existing cross drainage structures are given in table below.

Summary of Existing Structures

S. No	Type of Structures	Numbers
1	Major bridge	1
2	Minor bridge	21
3	slab culvert	105
4	Pipe culvert	135
TOTAL		262

3. Forest jurisdiction: The project road covers two (2) Forest Divisions viz., Paderu and Chinthapalli Divisions. The total forest land required for the project is 60.06 ha, which comprises 59.82 ha in Chinthapalli (Erstwhile Narsipatnam) Division and 0.24 ha in Paderu Division. The total forest land of the project is in Alluri Seetharamaraju District and rest of the area is in non-forest land (revenue land and private lands) in Alluri Seetharamaraju and Anakapalli Districts.



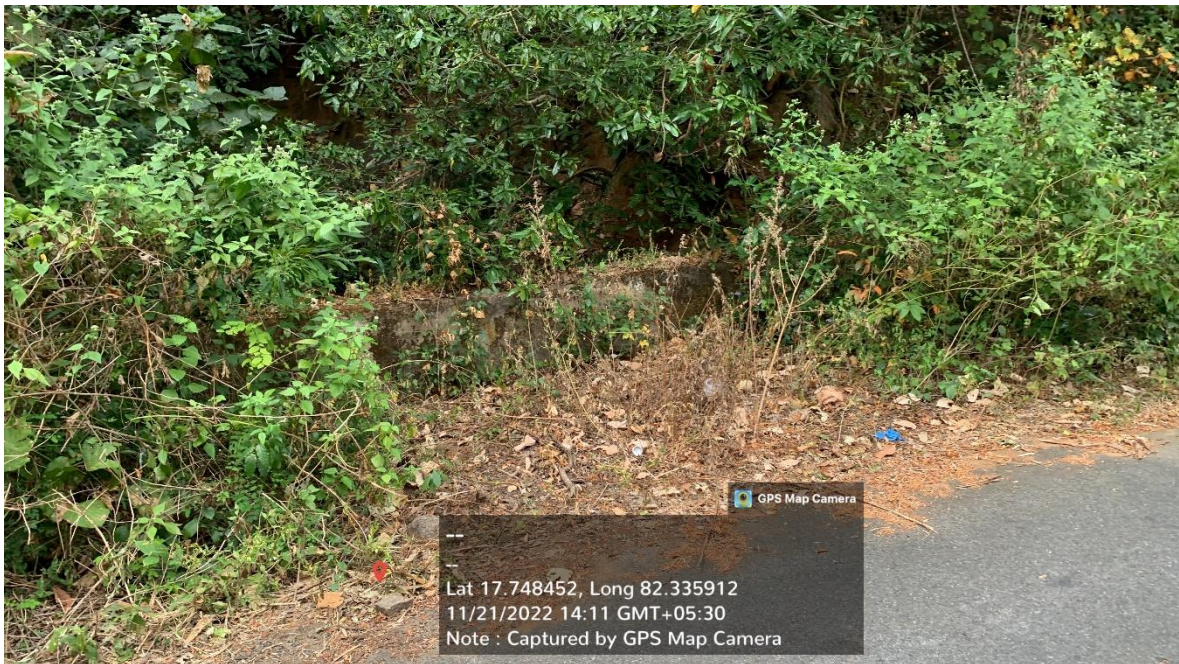
Sl. no	Range	Beat	Name of RF	Compt. No.	Bit no.	Area (ha)	Length (m)	Avg. width (m)
1	K.D.Peta	Bangarampeta	Bointhi	1355	1	6.58	3291.26	20.00

2	K.D.Peta	Balaram	Sarugudu-VI	1267				
3	K.D.Peta	Bangarampeta	Bointi	1347	2	23.58	11812.68	19.96
4	Chintapalli	Sarabhannapalem	Bointi	1345				
5	Chintapalli	Sarabhannapalem	Bointi	1365, 1366	3	4.02	1986.16	20.25
6	Chintapalli	Chintapalli South	Bointi	1378	4	1.51	2118.34	20.77
7	Chintapalli	Chintapalli North	Chinthapalli	1590	5	6.30	8722.46	21.37
8	Chintapalli	Lammasingi North	Lammasingi-I	1586, 1587				
9	Chintapalli	Wangasara	Wangasara	1604				
10	Chintapalli	Lammasingi North	Lammasingi-I	1587	6	1.08	1404.03	7.72
11	Chintapalli	Krishnapuram	Krishnapuram RL	995	7	9.90	2906.55	34.05
12	Chintapalli	Tajangi	Krishnapuram RL	996				
13	Chintapalli	Krishnapuram	Krishnapuram RL	993	8	6.85	2317.98	29.55
14	Paderu	G Madugula	Sirasapalli	309	9	0.24	100.00	24.00

Wildlife encompasses both animals and plants. Wildlife conservation is not just aiming to protect Rare, Endangered, and Threatened species but also to achieve well-recognized means of achieving ecological security, human well-being, and sustainable development in any country. Wildlife habitat is considered the environment used by an animal and is essential for food, mating, cover, and other requirements for survival. Whereas, linear projects such as roads are important to the country for economic growth and to meet the transportation needs of the people. Hence, incorporating ecological considerations into modern design techniques will result in a favorable win-to-win approach to safeguard the interests of both wildlife and people.

Through this mitigation plan, we could be able to minimize long-term impacts on flora and fauna of the region and also useful for habitat improvement activities, afforestation, research works, wildlife monitoring, awareness programs, and forest protection activities. Few

potential infrastructure facilities proposed in this plan would certainly enrich conservation activities within the forest core areas. In this plan certain direct and indirect impacts were identified under different phases of the proposed activity and suggested certain mitigation measures. Certain guidelines are also given to persons involved in the construction activities which can be monitored by forest authorities.



1.4. GUIDELINES FOR WILDLIFE ISSUES DURING LINEAR EXPANSION PROJECTS

Mitigation strategies:

Mitigation strategies should be considered and applied in the planning stages of the project cycle.

Data collections and survey guidelines:

For existing facilities, which generally undergo enlargement or upgrading, the focus should be on any necessary repair or rehabilitation of prior environmental damage. For example, a road/railway passing near or through a wildlife area, special attention would be paid to the provision of wildlife mitigation measures.

Site-specific issues: Consideration of habitats, geographical location, topography, and vicinity of the existing road line to sites of high biodiversity value.

Species-specific issues: Surveys should be targeted to species of flora and fauna of high biodiversity value, those with a special international or national conservation status, endemic species, and species that are at elevated risk of impact from the proposed project facilities. For example, species with a relatively high collision risk of Carnivores and Herbivores of the region.

- ❖ Species with a relatively high risk of crossing the roads shall be listed out.
- ❖ Some species may be attracted to feeding areas, which could further increase the potential for collision. The habitats for food and water for animals on both sides of the track shall be considered. The areas having meagre food resources must be treated under critical habitat zones.
- ❖ Species at risk of habitat fragmentation and associated structures.
- ❖ Species with a relatively high risk of disturbance from noise (traffic movement and horn sound).

Season-specific issues: Surveys should take into consideration certain periods during the year when the project site may have a greater or different ecological function or value (e.g., migration, breeding season, or winter seasons). Surveys should usually be conducted for at least one season when at-risk wildlife is identified. Panther and other major carnivore's breeding and mating seasons shall be considered.

Longer surveys may sometimes be necessary for areas with exceptional aggregations of at-risk migratory animals and where existing biodiversity data are limited. This would be determined during the project construction phase by the forest department. Surveys should be designed and implemented to adequately guide the underpasses to minimize collision risks to wild species. This is normally expected to entail gathering relatively precise information on the spatial patterns of site utilization by at-risk wildlife species as well as consideration of the locations of certain topographic, ecological, or other landscape features that may attract or otherwise concentrate the activity of movement of wildlife within the project area and its surrounding landscape.

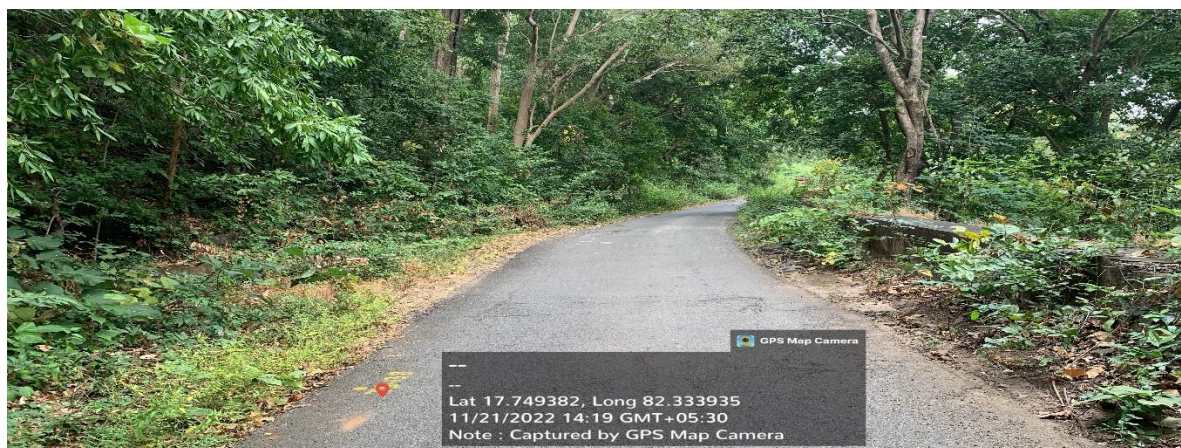
1.5. SCOPE OF THE STUDY:

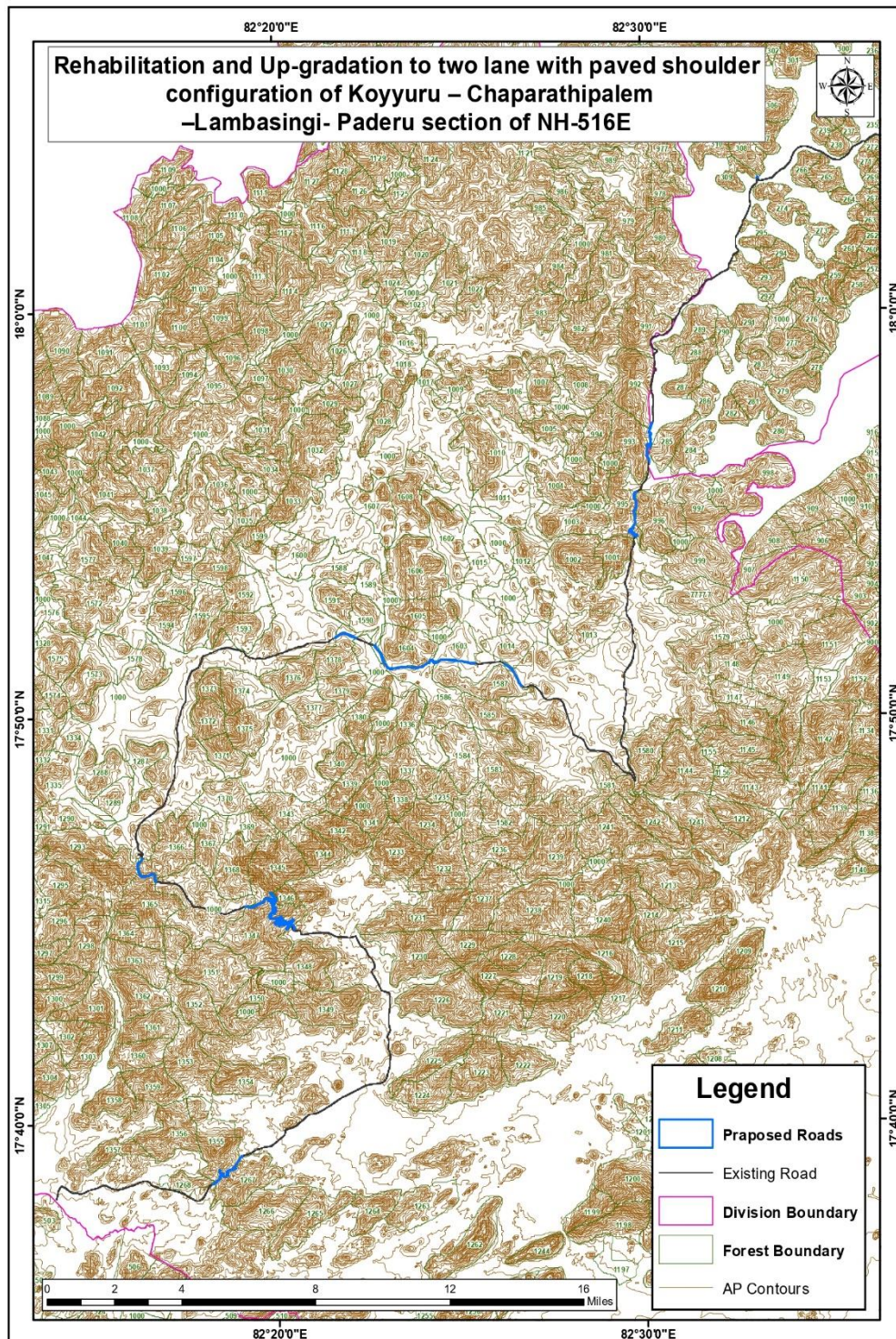
To prepare a wildlife mitigation plan by conducting a rapid assessment survey (one season Flora and fauna monitoring survey) in and around the proposed project area up to 10 km radius to identify REET (Rare, Endangered, Endemic, and Threatened) species of the area through direct and indirect methods.

1.6. THE KEY OBJECTIVES OF THE STUDY:

The objectives of the Mitigation plan are as follows:

- ✓ To conduct the biodiversity monitoring study in and around 10 km radius of the proposed project and quantify the biodiversity indices and identify the Rare, endangered, endemic, and threatened wildlife for IUCN and Scheduled- I species of the region.
- ✓ To predict impacts of the proposed project on direct habitat loss, barrier effect, disturbance leading to the displacement of animal groups, and collision risk in the study area.
- ✓ To assess potential animal crossing zones along the existing and proposed road track and to suggest wildlife crossings (Underpasses) at suitable places, which are comfortable and conducive for wildlife movement across the proposed road.
- ✓ To identify areas to build structures such as crossings, culverts, water holes, etc so as not to disrupt the wildlife behaviour and its activities.
- ✓ To suggest mitigation measures to minimize/avoid adverse impacts due to project-specific, site-specific and species-specific issues.
- ✓ To prepare budgetary on each component identified/suggested by the forest department for the next 10 years from project implementation.

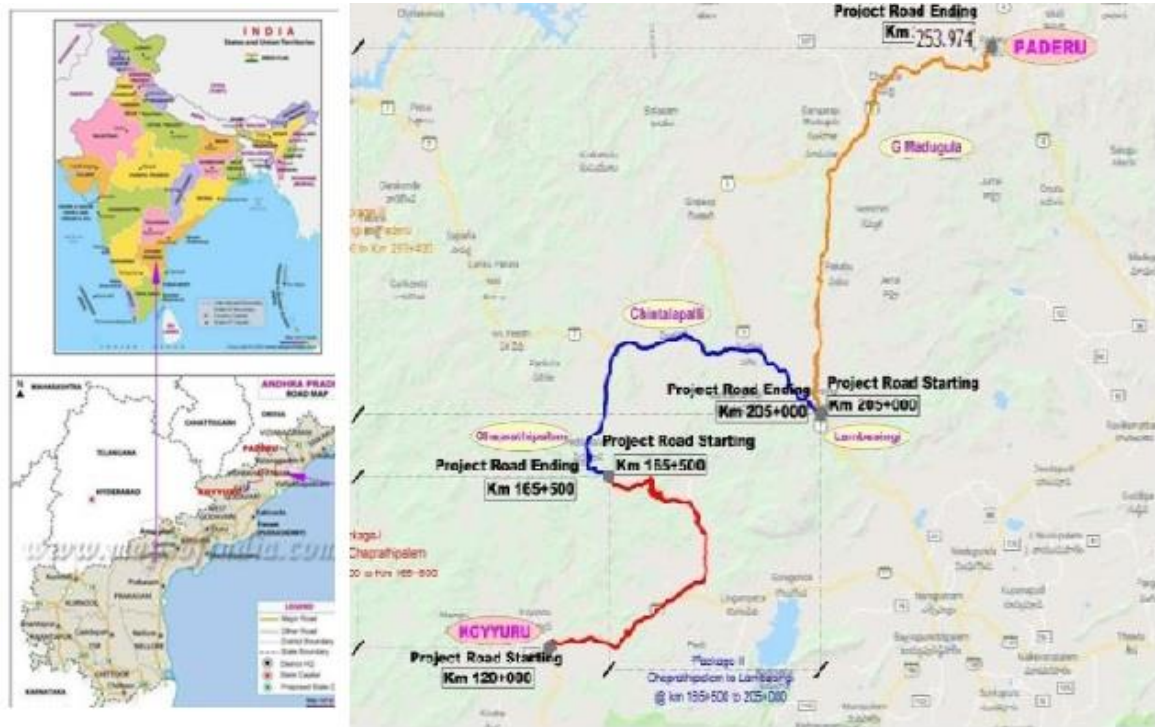




2. STUDY AREA

Chapter 2

FIGURE 2 1: LOCATION OF THE PROJECT SITE



2.1. BIOGEOGRAPHIC DESCRIPTION OF THE STUDY AREA

The project road covers two (2) Forest Divisions viz., Paderu and Chinthalapalli Divisions. The total forest land required for the project is 60.06 ha, which comprises 59.82 ha in Chinthalapalli (Erstwhile Narsipatnam) Division and 0.24 ha in Paderu Division. Rest of area is non-forest land (revenue land and private lands in Alluri Seetharamaraju District. The density of the forest in the nearby vicinity of the proposed road is in between 0.4 to 0.7.

I) LOCATION:

Proposed area for diversion of 60.06 ha of Forest land (59.82 ha falls in Chinthapalli Division and 0.24 ha falls in Paderu Division) for Rehabilitation and up-gradation to two lane with paved shoulder configuration of Koyyuru- Chaparathipalem - Lammasingi - Paderu section of NH-516E including construction of culverts in Chinthapalli and Paderu divisions passing through Bointhi, Sarugudu-VI Chinthapalli, Lammasingi-I, Wangasara RFs and Krishnapuram RL of Pedavalasa (erstwhile K.D. Peta) and Chintapalli Ranges in Chinthapalli Divisions.

Climate

The project area is mostly in agency area with a tropical climate with specific winter and rainy seasons, and summers are rainier than normal compared to other surrounding regions. Average rainfall is 1376 mm and temperature varies with minimum at 10°C and maximum 40°C.

Rocks and Soils

The project road stretch traverses through rolling and hilly terrain and have mostly poor geometry except a few locations. The Red soils with sandy to loamy, lateritic soils and black soils.

Red soil is considered to be soil that generally develops in warm temperatures and moist climates. They are developed under deciduous conditions and are generally found in mixed forests. They have thin organic and mineral layers overlying a yellowish-brown leached layer which can be seen resting on an illuvial red layer. Red soils are generally formed from sedimentary rocks which are rich in iron. These soils are not suitable for cultivating because they are low in nutrients, making them poor growing soil.

Red laterite soil is a type of soil that is considered as a brick also. This type of soil is rich in iron and aluminium. They are usually formed in

hot and wet tropical areas. These soils are red because of the iron oxide content; this mineral gave the soil a red colouration. These soils are developed when the underlying parent rock starts intensive and prolonged weathering. The areas where you can find the majority of laterites are situated between the tropics of cancer and the tropics of Capricorn. Laterites are considered to be a source of aluminium ores.

RAINFALL:

The division gets rains from both the monsoons. However the precipitation is more during the South - West monsoon. The principal rainy season is from June to November.

The North -East monsoon lasts for 2 months; October and November. Alluri Sitarama Raju district falls part of Agro - climatic zone VI supports dry deciduous forests with canopy densities of 0.1 to 0.4

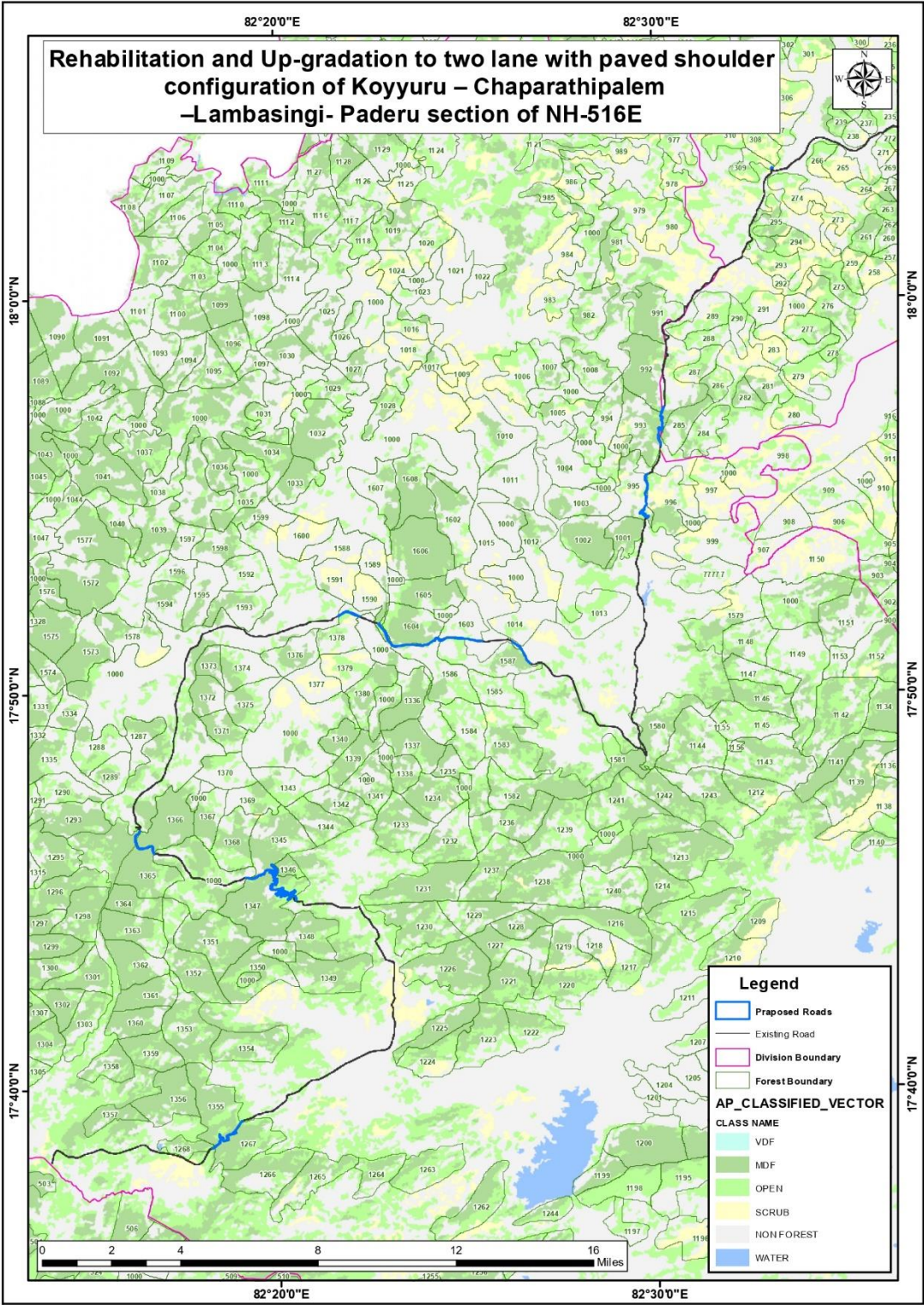
The rainfall is not uniform and is erratic and precarious. The normal rainfall for the district is about 690 mm and the average rainfall is 764 mm. The number of rainy days in the division is 45. The post rainy season up to onset of winter (November) is quite hot and oppressive. Winter commences in December and lasts up to end of January. The maximum and minimum temperatures in the month of December vary between 28.99°C and 16.15°C

Respectively. The area experiences dry conditions for about 8 months in a year. But if the monsoon fails or if it is inadequate, the conditions become very dry leading to drought.

The relative humidity is highest during July - August and lowest in March. In the forests, night dew helps to replenish the moisture to a meagre extent in the sheltered valleys.

General conditions of plant growth are most favourable from mid-June to mid-November. During the drought years, apart from the drinking water problem, the wild animals also suffer from lack of sufficient feed. It therefore becomes necessary that more number of water harvesting

structures to be developed for tapping rainwater to the maximum, which would improve the vegetation and the availability of feed for wild animals.



Flora and fauna of the region:

Champion and Seth (1968) classified the forest types of India under 16 type groups. But, due to heavy physical and anthropogenic influences the degraded stages of original climax vegetation types are hardly distinguishable. The following types were recognized in the study area. It has been estimated that there are 1581 taxa spread over 149 families occurring in Reserve Forest which include 19 grass species and 128 medicinal species. Over 40 species of mammals, 103 species of Birds, 34 species of reptiles, 20 amphibians, 35 fishes, 91 Butterflies, 27 species of Moths, 25 species of Coleopterans, 35 species of Odonata and numerous other forms of insects are found in the area.

There are many important species like Yegisa (*Pterocarpus marsupium*), Bandaru (*Adina cordifolia*), Maddi (*Terminalia elliptica*), Tamarind (*Tamarindus indica*), Hill mango (*Mangifera indica*) including many vines of Adda aku (*Bauhinia vahlii*) existing all along the proposed road. The main mammals in the reserve are: Panthers, Bisons, Sloth bears, Deers, Wild boars etc.,

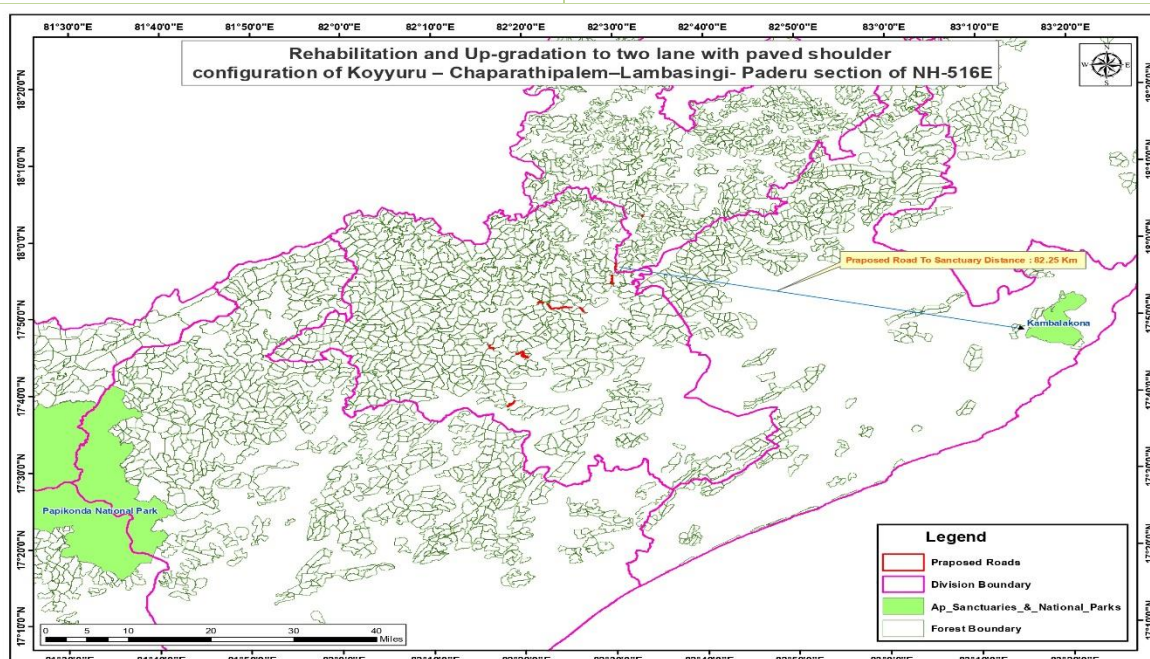
2.2. PROTECTED AREAS & ECO-SENSITIVE AREAS IN THE CORE AND BUFFER ZONES (UPTO TO 10 KM RADIUS)

The present study carried for the presence of important wildlife habitats and protected areas, breeding and nesting habitats of fauna and grassland area from core area. These important areas such as Protected areas (National Park, Wildlife Sanctuaries, Conservation Reserves etc. Wetlands of national importance, Ramsar sites, Important Bird Areas (IBAs), classified by the Birdlife International and Bombay Natural History Society etc. Data collected and information gathered from primary and secondary sources on flora, fauna, protected area, natural habitats, wildlife species etc., were analysed and results are presented as follows.

Details of protected areas, forests & ecologically sensitive areas

Ecological sensitive habitat	Direction and Distance from the project site.
National Parks/ Wildlife Sanctuary/ Biosphere reserves/ Elephant Reserve/ Any Other Reserve	82.25 km from Kambalakonda Wildlife Sanctury.
Reserved Forests	<ol style="list-style-type: none"> 1. Bointhi RF notified under Section-15 of A.P. Forest Act, 1967. 2. Sarugudu - VI RF notified under Section-15 of A.P. Forest Act, 1967. 3. Chinthapalli RF notified under Section-15 of A.P. Forest Act, 1967. 4. Wangasara RF notified under Section-15 of A.P. Forest

	<p>Act,1967.</p> <p>5. Lammasingi -I RF notified under Section-15 of A.P. Forest Act,1967.</p> <p>6. Krishnapuram RL notified under Section-15 of A.P. Forest Act,1967.</p> <p>7. Sirasapalli RF notified under Section-15 of A.P. Forest Act, 1967.</p>
Wildlife Corridors & Routes	Nil
Wetlands / Water bodies	Nil
Ramsar Site	Nil within the study area
Important Bird Habitats	Nil within the study area
Breeding/nesting areas of endangered species	Nil within the study area
Mangroves	Nil within the study area



Details of Forest Areas

The details of forest blocks are presented in Table-2.2. The major composition of degraded forest is *Acacia leucophloe*, *Acacia horrida*, *Boswellia serrata* *Dalbergia sisoo*.

TABLE 2.2 : DETAILS OF FORESTS IN STUDY AREA

S. No.	Details Forests
1	Bointhei RF
2	Sarugudu - VI RF
3	Chinthapalli RF
4	Wangasara RF
5	Lammasingi -I RF
6	Krishnapuram RF
7	Sirasapalli RF

Chinthapalli Division Jurisdiction:

Forest area to an extent of 59.82 ha is required in Chintapalli Division for rehabilitation and up-gradation to two lane with paved shoulder configuration of Koyyuru-Chaparathipalem-Lammasingi-Paderu section of NH-516E including construction of culverts.

Total length of the project is 133.974 km, length falling in RF is 34.56 km and 62 culverts and 1 minor bridge (existing structures) in the proposed road.

- The density of the forest in the nearby vicinity of the proposed road is between 0.4 to 0.7.
- There are 7,340 no. of trees (324 Teak and 7,016 no. of Non-teak/Misc.) and 1254 no. of Coffee (*Coffea Arabica*), 116 of Jafra (*Bixa orellana*) and 69 Pepper (*Piper nigrum*) are falling within the proposed width of the road.

- There is less vulnerability of forest area to erosion, as the area is having almost plain to gentle slope except in small patches.

Out of 59.82 ha of area proposed for NH road diversion, an area of 2.27 ha (Bit no.4 - 0.45 ha and Bit-no.5 -1.82 ha) is passing through 12 coffee plantations raised by the AP Forest Development Corporation Limited (leased forest areas) in Chintapalli Range.

There are 7,340 no. of Trees (324 no. of Teak and 7,016 no. of Non-Teak/Misc.) falling within the proposed width, value of the trees is Rs.11,38,59,805/-.

Out of total 7,340 no. of trees , 303 no. of forest tree species (28 no. of Teak and 275 no. of Non-teak /Misc.) are existing in 11 coffee plantations to an extent of 2.27 ha and the value of the trees (303 no.) comes to Rs.1,70,58,438/-.

Paderu Jurisdiction.:

Forest area to an extent of 0.24 ha in compartment no.309 of Sirasapalli RF is required in Paderu division for rehabilitation and up-gradation to two lane with paved shoulder configuration of Koyyuru-Chaparathipalem-Lammasingi-Paderu section of NH-516E in the state of Andhra Pradesh.

- The density of the forest is 0.5.
- There is 17 no. of trees there in the area proposed for diversion
List of the trees is enclosed herewith.
- The area is moderate to steep slope and there is little scope of soil erosion as the proposed area for diversion is very little.
- The area proposed for diversion is inside RF with in a distance of 5-10 m from the boundary.

- The proposed alignment does not form a part of National Park, Wildlife Sanctuary, Biosphere reserve, Tiger reserve, Elephant corridor etc.
- No Rare / endangered/ unique species of flora and fauna are found in the area.
- No protected archaeological heritage sites / defense establishment or any other important monument is located in the area.
- The requirement of forest land proposed by the user agency is un-avoidable and barest minimum for the project.

2.3. IMPORTANCE TO THE COUNTRY, REGION

The aim of the project is to provide connectivity between important towns with high quality roads which will have a significant impact on mobility, livelihoods, valuation of assets, communication systems, establishment of agriculture infrastructure etc. of the people living in these areas. The settlements the project road is passing through are mostly tribal villages.

At present the existing road forms the main connectivity between Narsipatnam and Krishnadevipeta, and between Koyyuru, Lambasingi and Paderu town. The road is categorized as State Highway (SH) and Other District Road (ODR) by highway specification. The proposal is to upgrade the existing Highway to National Highway (NH) specifications. In addition to that the project road development will require up gradation/Reconstruction/widening to 2-lane/4 lane with paved shoulder configuration.

It is also found that some sections of existing project road has improper earthen shoulders and road top level is below the existing ground level. In such sections the road requires to be further raised and be reconstructed.

- The project corridor passes through tribal dominated areas. The road improvement in the project area will impact structures and land of about 1885 sample HHs who have been covered during the assessment. The total sample households are 1885, among them 1301 households (69%) belong to ST families. The remaining is 14 OBC, 1% SC and 15% is others.

- Under the land category, the total household survey is done 663 HHs, out of it 88% is ST families losing their land, remaining 10% & 1% OBC and other categories respectively. In structures category 60% STs, 18% others, 16 % OBC, 3% and 2 % is belongs to general category. The sample size of the structure category is 1282 HHs. In this category, STs are 60%, OBC is 16% and general & other category is 21%.

The National Highway will be access-controlled and ensure high-speed traffic movement. The proposed alignment is selected to cover one of the most important south arterial connectivity in the country, further interspersed with feeder highways on either side.

The new proposed National Highway shall bring down the travel time distance. Moreover, the new National Highway facility is access controlled and hence will provide good riding quality, better safety, and reliable infrastructure. All of these elements will result in cost savings and efficiency improvement.

The Project will further have the following benefits at the national and regional levels:

- ❖ High-speed connectivity and access: The projected National Highway is a proposed 2-lane with a paved shoulder. This will avoid traffic congestion and speed up the freight movement. It is expected that overall, the proposed National Highway will reduce the travel time.
- ❖ Aiding economic growth: The seamless connectivity will provide better access to vehicles as a link to the National Highways. The Project will reduce travel time and provide a boost to trade and

commerce linked to the regions connected through this National Highway.

- ❖ Growth of backward areas: The biggest strength of the alignment is that it plans to cover backward districts of Andhra Pradesh. As a result of connectivity and access to other parts of the country, these backward areas will be aided to integrate with other parts of India. Further, freight and passenger traffic on the National Highway will help promote the ancillary economy of these regions.
- ❖ Decongestion of existing National and State Highways: The proposed National Highway will take away traffic pressures from Roads. Also, long-distance traffic will shift to the proposed National Highway, thereby leaving the SH for regional and local usage.
- ❖ Usage shift: Long-distance traffic will shift from existing road to the proposed National Highway, resulting in lesser congestion on these highways
- ❖ Improved safety: Due to access control, the Roadway & Travel Safety of the traffic connecting the cities will be enhanced as there will be minimum distractions & conflict zones
- ❖ Support to industry: Different types of industries like Manufacturing, Tourism, etc. along the proposed National highway will be facilitated in their business operation and reachability.

The following major types of traffic load are expected on the Project:

- ❖ Commercial and Industrial: Traffic on the existing roads is driven by local, commercial and industrial traffic. Industries such as cement, chemicals, and minerals are present along and around

the proposed National Highway. These industries are expected to benefit from the National Highway.

- ❖ Tourist: Passenger traffic will be generated due to many places of tourist interest in the districts connected by the National Highway. Apart from places of historical importance such as forts and palaces, traffic would be augmented due to several famous religious places.
- ❖ Health and Education: Faster connectivity and accessibility to AP will help in a higher flow of traffic from Telangana state, especially for higher education, tertiary healthcare, and specialized treatments. Reduction in travel time will allow patients to avail OPD / other medical services from the capital region.



3. METHODS ADOPTED

Chapter 3

3.1. SOURCES OF DATA COLLECTION:

- ❖ Primary field survey of flora and fauna near Core (up to 1 sq. km) and buffer (up to 10 sq. km radial distance) zones during site visit.
- ❖ Secondary data sources from forest department staff, road staff working in the track side, authentic websites, publications etc.

3.2. EQUIPMENT / INSTRUMENTS DEPLOYED

- ❖ Digital Camera (NIKON 42 X zoom)
- ❖ GPS (Available in Mobile and inbuilt camera)
- ❖ Binoculars (OLYMPUS 10 X 50 DPSI)
- ❖ Field observation book, Field guides, Pen, Measuring tape etc

The site visit was undertaken from October and November 2022 by experts from M/s Greentech Enviro, and accompanied by the staff members of Forest Department. Seven sampling locations are studied in the study area and collected list of flora and fauna by using quadrant method and belt transect method.

3.3. VEGETATION SURVEY METHOD

Vegetation in the seven sampling locations has been estimated by direct counting of Tree species, their number, GBH value and distance and direction in Row. The status of each identified species was given in terms of three categories such as “Common”, “Sporadic”, and “Rare”.

This status is mainly based on Density, Frequency and Abundance estimated during the field visit for Trees, Shrubs and Herbs.

Number of quadrates or belt transects are finalized based on the Area - Species graph. 20 m X 20 m for tree species, 5 m X 5 m quadrates for shrubs and 1 m X 1 m quadrates for herbs. In locations where the quadrants are not possible such as hilly areas and agricultural, plantation areas a belt transects of 100m X 10m are applied.

The above parameters are used to determine the following.

- ❖ Determining frequency, abundance, relative frequency, relative density, relative dominance and importance value indices using Mueller-Dombois-Ellenberge [1974] Method.
- ❖ The flora data collected from 7 sampling points are analysed quantitatively from MS Excel and PAST softwares.
- ❖ The biodiversity indices such as Shannon Index, Simpson index, A/F value, Dominance and Evenness e^H/S are statistically analysed and interpreted the data on ecosystem quality.

3.4. FAUNAL SURVEY METHOD:

Mammalian surveys were conducted by using line transect method in all major habitats and recorded the species through direct and indirect evidences. Bird surveys were carried out through **Point count method** preferably during **dawn and dusk**. Secondary data collected from forest department and local people in the study area.

4. SURVEY RESULTS

Chapter 4

4.1. KEY FINDINGS OF BIODIVERSITY MONITORING

- ❖ The present study was carried out in Winter season for the direct observation in the selected habitats of the study area and analysed the possible impacts on animals of the proposed road expansion and suggested mitigation measures.
- ❖ The entire study area was analysed on hypothetical cluster-based analysis.
- ❖ Mammals monitoring plan relay on direct field observations, indirect evidence, authentic information and desktop study of available relevant literature as well as subject expert's professional judgment. After a review of relevant secondary information available for the area habitat and point surveys were undertaken in Monitoring surveys up to 10 km radius of the project area.

4.2. VEGETATION FOUND DURING THE FIELD STUDY:

Trees:

Mangifera indica, *Grevillea robusta*, *Pinus sabiniana*,
Semecarpus anacardium, *Dalbergia latifolia*, *Xylocarpus*,
Schleichera oleosa, *Syzygium cumini*, *Eucalyptus tereticornis*,
Artocarpus heterophyllum, *Pterocarpus marsupium*, *Ailanthus excelsa*,
Bombax ceiba, *Kydia calycina*, *Ficus benghalensis*, *Pongamia pinnata*,
Terminalia arjuna, *Terminalia chebula*, *Tamarindus indica*,
Garuga pinnata, *Butea monosperma*, *Albizia odoratissima*,
Mallotus philippensis, *Terminalia bellirica*, *Gmelina arborea*,

Acrocarpus fraxinifolius, *Phyllanthus emblica*, *Lagerstroemia parviflora*, *Manilkara hexandra*, *Acacia chundra*, *Cassia fistula*, *Tectonagrandis*, *Anacardium occidentale*, *Ficus religiosa*, *Lannea coromandelica*, *Anogeissus latifolia*, *Sapindus emarginatus*, *Grewia tiliaefolia*, *Strychnos potatorum*, *Psidium guajava*, *Chloroxylon swietenia*.

Shrubs

Calotropis gigantea, *Acacia pinnata*, *Adathoda vasica*, *Capparis sepiara*, *Carissa carandus*, *Cassia auriculata*, *Cassia montana*, *Erythroxylum monogynum*, *Glycosmis pentaphylla*, *Jatropha glandulifera*, *Lantana indica*, *Lawsonia alba*, *Randia dumetorum*, *Toddalia aculeata*, *Woodfordia floribunda*, *Zizyphus mauritiana*, *Zizyphus oenoplea*.

Herbs

Achyranthus aspera, *Tephrosia purpurea*, *Tribulus terrestris*, *Crotan bonplandianum*, *Datura metel*, *Eclipta alba*, *Boerhavia diffusa*, *Tephrosia purpuria*, *Achyranthes aspera*, *Cassia tora*, *Abutilon indicum*, *Ipomoea macrantha*.

Climbers/ Creepers

Abrus precatorius, *Acacia concinna*, *Acacia intia*, *Asperagus racemosus*, *Bauhinia vahlii*, *Mucuna pruriens*, *Butea superba*, *Caesalpinia bonducella*, *Dioscorea esculenta*, *Hemidesmus indicus*, *Piper longum*.

Grasses:

Aristida setacea, *Cymbopogon coloratus*, *Cymbopogon martini*, *Cynodon dactylon*, *Ischaemum pilosum*, *Imperata arundinacea*, *Vetiveria zizanioides*

Fig 4.2: Habit wise number of flora present in the study area:

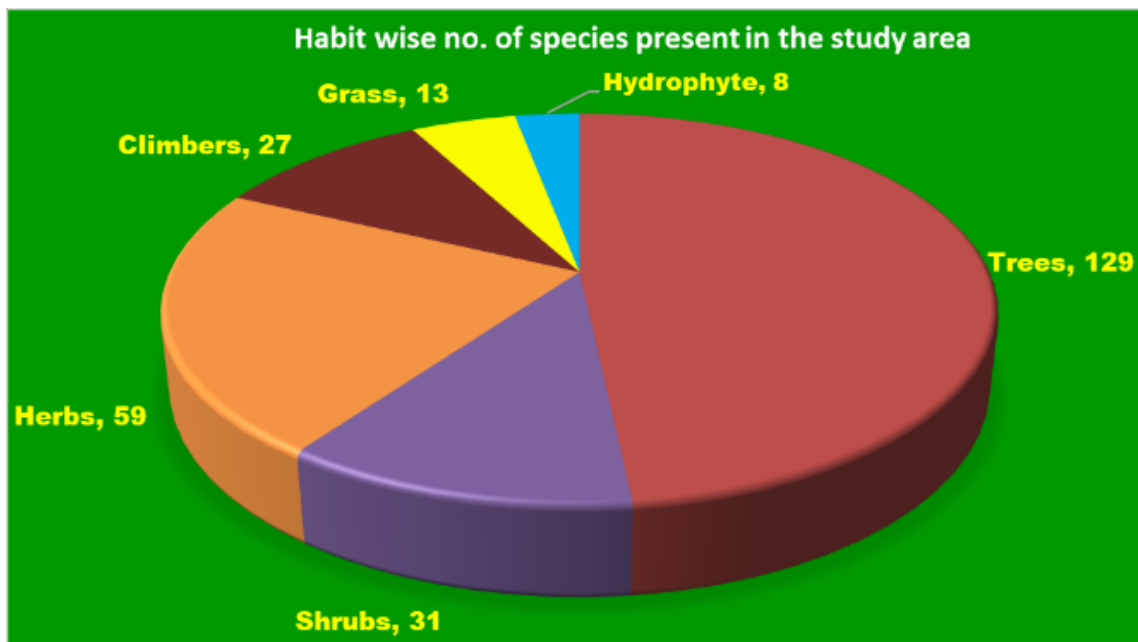


Fig 4.3: Zone wise number of flora present in the study area:

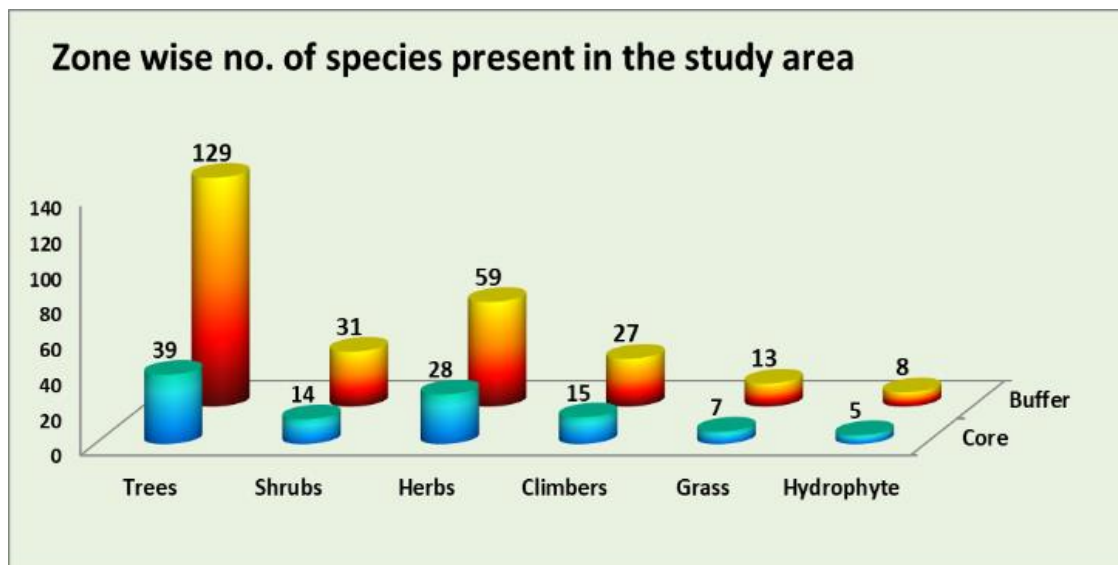


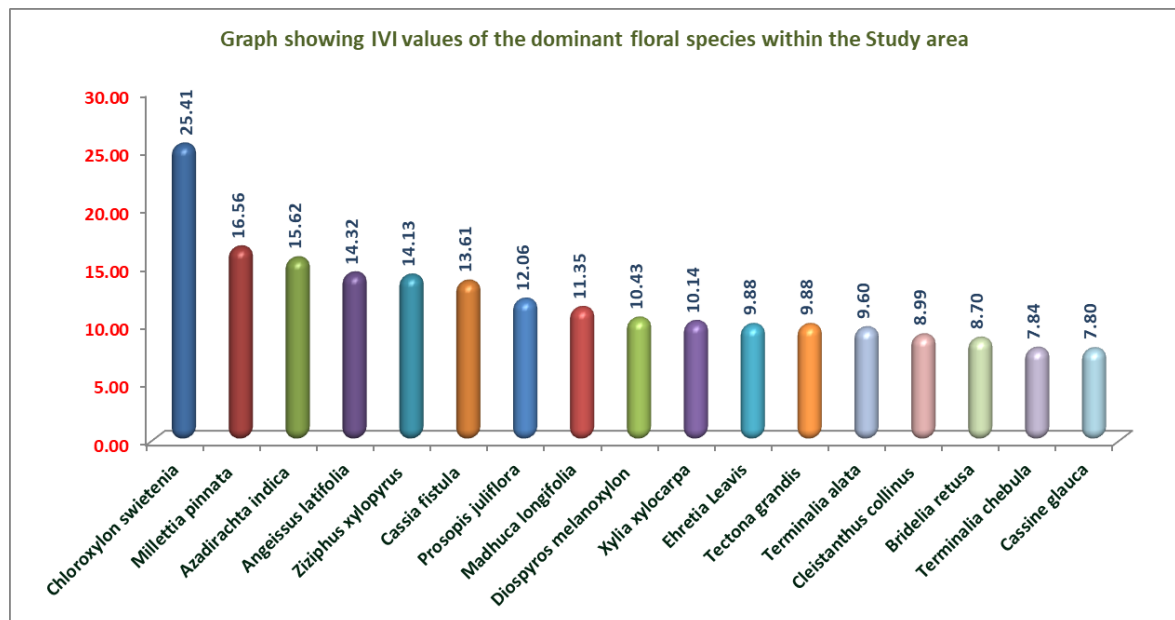
Table 4.1: Data interpretation of Biodiversity indices values of the sampling sites in buffer zone:

Biodiversity indices	Value	Indication and reason	Relevance to present mitigation plan
Shannon indices	3.253	Good diversity (Normal diversity in ecological studies is 1.5 to 3.5 range (Kerkhoff, 2010). Reason: Presence of reserve forests and adjoining to Reserve Forest	Contractor shall follow instructions given by forest department during entire working period.
Evenness $e^{H/S}$	0.968 (96.8%)	Indicates the species are evenly distributed in core and buffer zones .	All the species present in the core zone are also present in the buffer zone. Hence impact on vegetation present near core zone shall be compensated through afforestation activities of the similar species in the buffer zone as per guidelines taken from forest department.

4.3. FAUNA OF THE STUDY AREA

From the secondary data and indirect evidence during the site visit, the predominant species found are Sloth bears, Deers, Wild boars etc, Bonnet macaque (*Macaca radiate*), Rhesus macaque (*Macaca mulatta*), Wild boar (*Sus scrofa*), , Indian hare (*Lepus nigricollis*), Grey House shrew (*Suncus murinus*) and Indian Tree shrew (*Anatha elioti*). Birds are very common near the aquatic habitats and terrestrial habitats. Peafowls are found near the ponds. Among the reptiles, Skinks, Geckos, lizards are commonly sighted. Snakes such as Krait, Common Tree Snake, Saw scaled wiper, Russell's earth boa, Johns earth boa, Common wolf snake, Indian Cobra, Common Rat snake and Green pit viper are present.

Fig : 4.4 Graph showing Important Value Index of dominant tree species within study area



Distribution pattern (A/F ratio): The ratio between abundance and frequency was used to interpret the distribution pattern of species

(Whitford, 1949). The distribution pattern of species in the study area is identified as **random distribution** as the value of A/F ratio is **0.043**. This random distribution of species is mainly due to various ecosystems present in the buffer zone. The Shannon indices value of the study area is **3.253** indicates **Good diversity** (Normal diversity in ecological studies is 1.5 to 3.5 range (Kerkhoff, 2010). Population size and Dominance of the species is **3%** and Evenness is around **97%** (Indicates the species are evenly distributed in core and buffer zones). This might be due to contiguous patches of *Chloroxylon swietenia* species and natural species such *Azadirachta indica*, *Phoenix*, *Prosopis juliflora* (near the villages), *Peltophorum pterocarpum* and *Delonix regia* (near roadside). The present study indicates $A < B < C > D > E$ in frequency classification and as per the Raunkiaer's law of frequency classification indicates that species diversity is distributed maximum for 40 to 60%. This result indicates that most of the species frequency is more or less equal due to some of the plant species such as *Xylia xylocarpa*, *Syzygium cumini*, *Phoenix sylvestris*, *Dalbergia sissoo*, *Prosopis juliflora*, *Tectona grandis*, *Mangifera indica*, *Terminalia alata* and *Lantana camara* are **frequently found** floral species throughout the region.

5. IMPACTS OF PROJECT ACTIVITIES AND MITIGATION PLAN

Chapter 5

5.1. JUSTIFICATION OF THE PROJECT:

The proposed road widening has been aligned along the existing road line within the available road land boundaries as far as possible to minimise the forest land diversion/ acquisition. There is no alternative route to this alignment hence doubling line is proposed along the existing line in the forest corridor with limited vegetation removal.

5.2. SPECIES-SPECIFIC IMPACTS:

Impact of few animals found in this region:

Sloth Bears: Sloth bears are expert hunters of termites and ants, which they locate by smell. On arriving at a mound, they scrape at the structure with their claws till they reach the large combs at the bottom of the galleries, and disperse the soil with violent puffs. The termites are then sucked up through the muzzle, producing a sucking sound which can be heard 180 m away. Their sense of smell is strong enough to detect grubs 3 ft below ground. Unlike other bears, they do not congregate in feeding groups. Sloth bears may supplement their diets with fruit, plant matter, carrion, and very rarely other mammals. In March and April, they eat the fallen petals of mowha trees and are partial to mangoes, sugar cane, jackfruit, and the pods of the golden shower tree. Sloth bears are extremely fond of honey. When feeding their cubs, sows are reported to regurgitate a mixture of half-digested jack fruit, wood apples, and pieces of honeycomb. This sticky

substance hardens into a dark yellow, circular, bread-like mass which is fed to the cubs. This "bear's bread" is considered a delicacy by some of India's natives. Rarely, Sloth bears can become addicted to sweets in hotel waste visiting rubbish bins even inside populated towns all year long.

Impact: Very few populations are present near the study area. The loss of habitat due to the proposed project is limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Wild boar: The Indian boar differs from its European counterpart by its large mane which runs in a crest along its back from its head to lower body, larger, more sharply featured and straighter skull, its smaller, sharper ears and overall lighter build. It is taller and more sparsely haired than the European form, though its back bristles are much more developed. The tail is also more tufted, and the cheeks hairier. Adults measure from 83.8 to 91.4 cm (33 to 36 in) in shoulder height (with one specimen in Bengal having reached 38 inches) and five feet in body length. Weight ranges from 90.7 to 136.1 kg (200 to 300 lb). Since 2008, it is IUCN Red Listed as Least Concern as it accommodates to a broad range of habitats.

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Deer:

This social and arguably the most aesthetically captivating deer is found in India. With a lifespan of 15 to 25 years, these golden-rufous colored deers are the state animal of Telangana. Ranging from the lower parts of Himalayas to south and eastwards till the Gangetic plain, these subtle creatures are widely found in the Indian Subcontinent, and prefer to stay in the grasslands, swampy meadows and scrublands. Male spotted deer have three pronged lyre-shaped antlers which can grow upto three feet long.

Commonly called as Chital, these elegant ungulates can be seen in a herd of 10 to 50 individuals and are known to associate with langurs, as it helps them to feed on the dropped fruits and leaves. Also their mutually beneficial relationship acts as a warning system if the predator is lurking around. They are adept in warning each other with their alarm calls. Chitals are known to be the robbers of the cultivated fields as they love to feed on the lush green leaves. Rutting season of chitals differs from area to area, and their rutting calls resound deep in the jungle. Male stags are often seen fighting for their doe and this could turn out to be quite a fierce sight. As deers are the favoured food of predators, their breeding cycle is quite fruitful. They give birth to young ones, after every six months.

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Wild Cats: Wildcat species are largely nocturnal and solitary, except during the breeding period and when females are young. The size of home ranges of females and males varies according to terrain, the

availability of food, habitat quality and the age structure of the population. Male and female home ranges overlap, though core areas within territories are avoided by other cats. Females tend to be more sedentary than males, as they require an exclusive hunting area when raising kittens. Wildcats usually spend the day in a hollow tree, a rock crevice or in dense thickets. It is also reported to shelter in abandoned burrows of other species such as red fox (*Vulpes vulpes*).

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Spectacled Cobra: The Indian cobra inhabits a wide range of habitats throughout its geographical range. It can be found in dense or open forests, plains, agricultural lands (rice paddy fields, wheat crops), rocky terrain, wetlands, and it can even be found in heavily populated urban areas, such as villages and city outskirts. Preferred hiding locations are holes in embankments, tree hollows, termite mounds, rock piles and small mammal dens.

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Geochelone elegans is a terrestrial species and inhabits scrub forests, grasslands, and some coastal scrublands of arid and semi-arid regions, but also commonly inhabits human-dominated landscapes including fields, hedgerows, and plantations.

Impact: This is rarely seen near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

5.3. WILDLIFE RELATED ISSUES:

The construction of proposed road can have a substantial impact on the degradation and loss of vegetation, natural ecosystems and habitats, fragmentation of habitats. Pollution and dust accumulation on vegetation, noise and vibration impact on wild animals are during operation state. The other major impacts are given in the table.

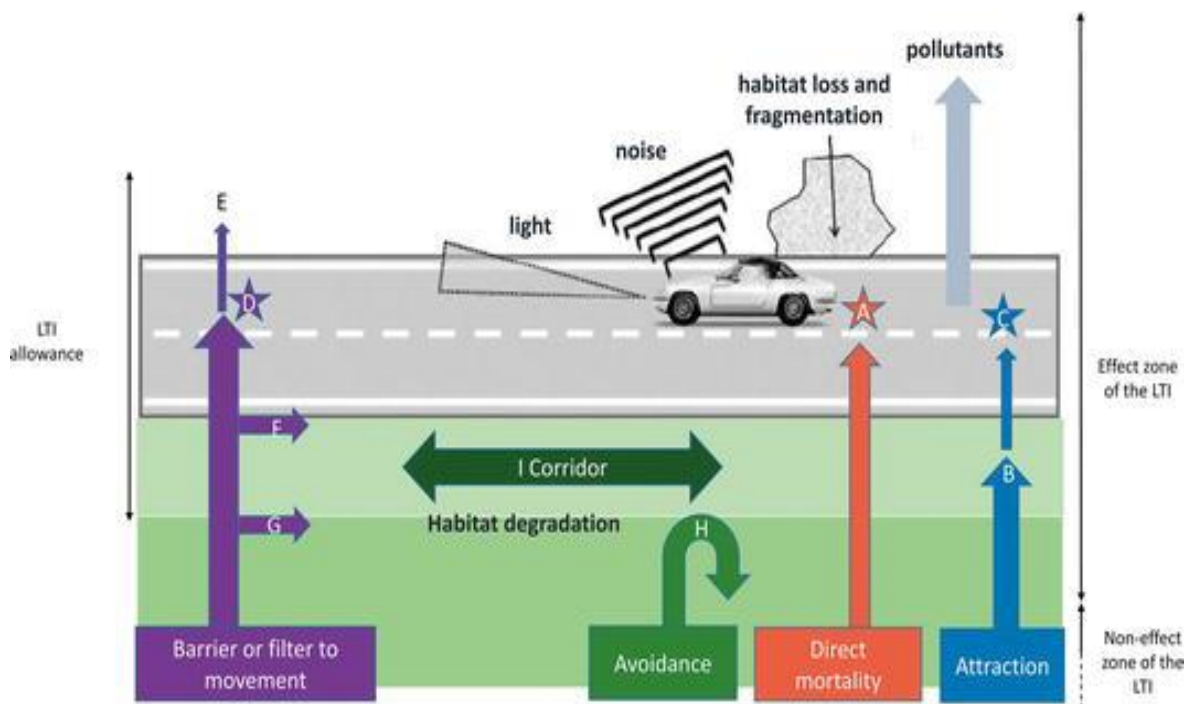


Fig 5.1 Schematic view of environmental effects of a linear transport infrastructure

The building of the LTI and the traffic induced a set of direct and indirect impacts on the biodiversity, in the effect zone of the LTI. (A) Direct mortality via collision with vehicles; (B) attraction (e.g. scavengers

for crushed fauna); (C) potential mortality of attracted animals; (D) direct mortality of crossing individuals; (E) successful crossing; (F) avoidance of the LTI; (G) avoidance of the LTI allowance degraded habitat; (H) avoidance of the LTI allowance; (I) corridor effect.

5.3.1. IMPACT STUDY FOR DIRECT HABITAT LOSS:

Due to the proposed project the major trees that are going to be removed are *Chloroxylon swietenia*, *Cleistanthus collinus*, *Cochlospermum religiosum*, *Dalbergia lanceolaria*, *Tectona grandis*, *Diospyros melanoxylon*, *Gardenia turgida*, *Ehretia Leavis*, *Givotia moluccana*, *Haldinia cordifolia*, *Lagerstroemia parviflora*, *Prosopis juliflora* etc. There are no Rare and endangered floral species that are going to remove from the activity area. Moreover, all the species present in the expansion area and predominantly available throughout the buffer region.

The loss of other shrubs, herbs, climbers and grass species will also play a major role in habitat loss for small vertebrates and invertebrates on a large scale. Apart from the direct removal of vegetation, long-term impacts due to traffic on surrounding flora also need to be considered. The dust and vehicular emissions also impact microfauna of the region. The effect on flowering will also impact on butterfly's species habitat.

5.3.2. IMPACT ON BARRIER EFFECT:

The proposed road expansion project would create more barrier effects on both nocturnal and diurnal animals. Diurnal animals are active during the daytime, with a period of sleeping or inactivity at night. The timing of activity by an animal depends on a variety of environmental factors such as the temperature, the ability to gather food by sight, the risk of predation, and the time of year. Commonly classified diurnal

animals include mammals, birds, and reptiles. Most of the primates are diurnal. In this region, the diurnal wild animals are Langurs, Sloth bears, Varanus, Squirrels, Butterflies etc. The barrier effect on these animals is limited due to daylight and other ecological parameters. Nocturnal animals are active at night. They often have special adaptations for nocturnal living, including large eyes for low-light vision, and heightened senses of hearing and smell. Examples of nocturnal animals include Tigers, Panthers, Civets, bats, moths, owls, and wolves. The barrier effect is high in these animals and proper mitigation measures must be taken. Crepuscular animals are active at dawn and dusk. Especially deers, foxes, wolves, hats etc. The barrier impact on these animals is moderate and proper mitigation steps are to be taken while expansion work is undertaken.

Restriction on movement of animals due to movement of vehicles 24x7:

The vehicle movement in the reserve forest is throughout the day (24X7). Hence animals of both diurnal and nocturnal animals cannot cross the road all the time. Hence certain mitigation steps need to be taken in this regard. These steps are discussed in detail in next chapters.

Sound & light pollution due to vehicles and its impact on animal behaviour:

The noise and vibrations are also major causes of disturbances to natural wildlife and sensitive species such as Reptiles and birds. Short-term exposure of noise levels can affect the behaviour and physiology of birds, the reproductive system as birds avoid reproduction in noisy places. Animals also suffer human-like disabilities like hearing loss, loss of responsiveness, dizziness and disturbance. Traffic noise reduced foraging efficiency in most bats. Monkeys also live in noise-

free areas as exhibited by a study in which continuous noise was supplied in the habitat of the monkeys. The common effects on animals are hearing loss, increased heart rate, increased risk of death, habitat loss, trouble in finding prey, trouble in finding mates as in frogs etc. (Source: Vehicular Noise Pollution: Its Environmental Implications and Strategic Control | Intech Open). Artificial light has several general effects on wildlife: Attracts some organisms (moths, frogs), resulting in them not being where they should be, concentrating them as a food source to be preyed upon, or just resulting in a trap that exhausts and kills them. Studies show that light pollution is also impacting animal behaviours, such as migration patterns, wake-sleep habits, and habitat formation. Bright lighting also affects the feeding patterns of some bat species and makes them more vulnerable to predators or likely to crash into buildings.

Impact on the movement of reptiles and amphibians:

Roads are one of the most widespread human-caused habitat modifications that can increase wildlife mortality rates and alter behaviour. Roads can act as barriers with variable permeability to movement and can increase the distances wildlife travel to access habitats. The home range sizes of herpetofauna vary considerably in size. Some species may travel hundreds of feet and up to several miles in one day. Individuals may travel large distances to access habitat used for breeding, feeding or sheltering. These areas can become bisected by roads. Animals may avoid roads causing a barrier effect or not avoid roads resulting in reduced survivorship from road mortality. When roads act as barriers, this results in habitat fragmentation effects.

A study to evaluate road avoidance behaviour of reptiles at large spatial scales and the first to estimate energetic consequences of road avoidance in reptiles' results suggest that turtles avoid crossing roads,

but do not avoid habitats adjacent to roads. Turtles expend more energy on movement in home ranges containing more roads, but the increased energetic expenditure is small compared with energetic investment in reproduction. Overall, our results suggest that reptiles avoid road crossings. However, the additional energy expenditure of reptiles interacting with roads is unlikely to negatively affect fitness through reduced reproductive output, and road crossing avoidance may have positive effects by reducing mortality risk. Mitigation of road impacts on reptile populations should continue to focus on reducing mortality from vehicle strikes.

(Source: <https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.5515>)

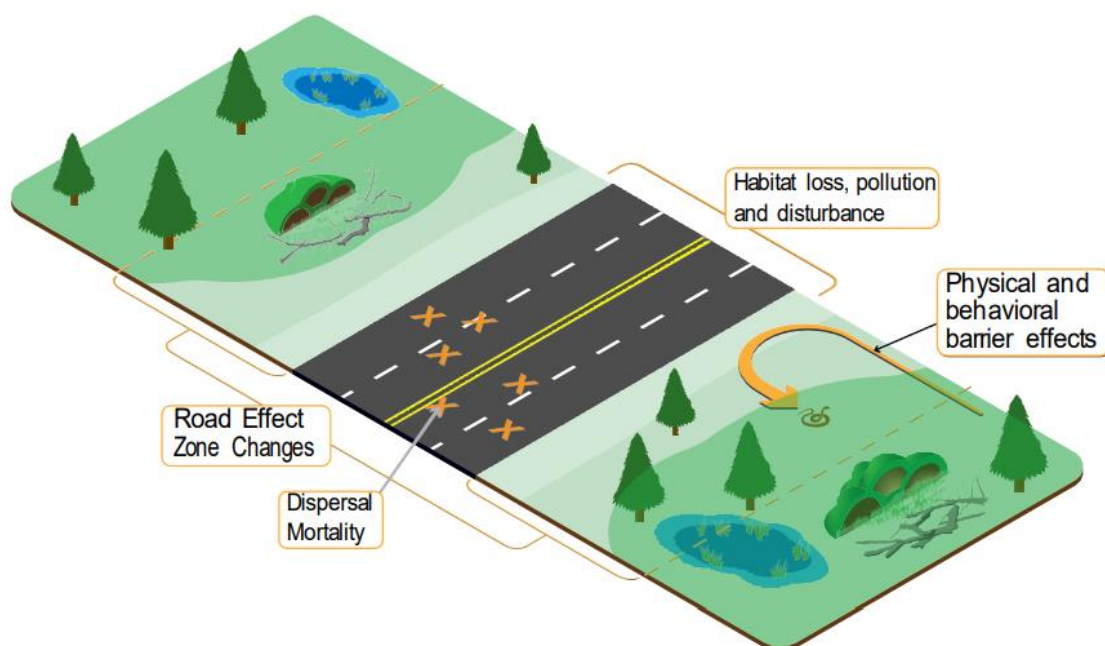


Fig 5.2 Schematic representation of influences within the Road Effect Zone (REZ).

Attraction to roadside habitat, and implications for amphibians and reptiles:

Roads and roadside habitats often attract amphibians and reptiles, to their detriment. Snakes and toads can be attracted to paved roads for thermoregulation (basking) and will linger on the warm surfaces to raise their body temperature, which increases the time they are at risk of being run over. Large snakes may be attracted to paved road surfaces for thermoregulation but also have wide home ranges or move long distances between winter hibernacula and summer feeding grounds. Long foraging movements within aquatic habitats also contributed to the snakes falling within the highest road risk categories.

Frogs become sexually mature around four years of age. They emerge from hibernation from February to March to seek out breeding grounds. Females lay their eggs in shallow water. Road mortality of amphibians is much higher during the breeding season as individuals migrate to breeding ponds (Beebee, 2012).

Fahrig and Rytwinski (2009) identified four situations in which roads create negative impacts on organisms:

- 1) Species are attracted to roads but are unable to avoid individual cars,
- 2) species have high levels of movement, low reproductive rates, and low densities regardless of their reaction to roads,
- 3) Small animals avoid roadside habitat, and
- 4) Small animals not impacted by road-affected predators, who have no road/traffic avoidance, are unable to avoid oncoming traffic.

Habitat fragmentation impacts faunal breeding and reproductive complications:

Fragmentation means a splitting of contiguous areas into smaller and increasingly dispersed fragments. With an increasing degree of fragmentation, the individual fragments may become too small and too isolated from each other to support the species that depend on the fragmented habitat. Fragmentation reduces the amount of habitat available to wildlife in the landscape and thereby diminishes population sizes and the number of species that can live in the landscape. In situations where roads cannot be removed or closed, or where traffic cannot be reduced, technical measures such as fauna passages and Eco ducts may be necessary to mitigate fragmentation and reconnect wildlife habitats.

Impact due to loss of termite mounds:

Recent work has shown that termite mound abundance and distribution both in space and time may be modulated by variation in abiotic and biotic resources. Termite mound communities can vary with changes in soil type, rainfall, ecosystem productivity, and herbivore presence, and termite mounds appear to increase in density with availability of dietary resources such as tree density, and decrease with intensive human land use. Some evidence also suggests that termite diets may shift in response to changing availability of plant resources. Due to present project proposal, in the core project area few termites mound is present near the road side. Due to removal of these termites' mounds, impact on both biotic and abiotic features of the area. Certain mitigation measures proposed in the next chapter for the removal of termite mounts in the unavoidable conditions.

Mitigation measures for reducing barrier effect to wild animals:

- ❖ The breeding sites of animals/amphibians, nesting sites of birds, thermoregulation surface sites of snakes will be avoided for any type of construction.
- ❖ Construction/modification of ponds will be done to provide breeding sites to amphibians.
- ❖ The construction of strips of surfaces (next to the road where high mortality of snakes are reported) that may attract snakes for the thermoregulation will be done.



Fig 5.3 Constructing strip of surface for thermoregulations for snakes.

- ❖ Construct more number of underpasses where animal crossings are more.
- ❖ Creation or improvement of water bodies will be done so that the animals have access to water.
- ❖ Plantation along the water body will be done to attract the animals towards it.
- ❖ The saltlicks areas will be protected from the reach of human beings. Limit the construction activity within the designated areas.

- ❖ Check the site for turtles trapped in, or in danger from civil works and use a qualified person to relocate the animal.
- ❖ Animal underpasses are proposed to be constructed for animals to cross the road. Different types of underpasses such as Box culverts, pipe culverts, and culverts with furniture will be constructed for passage of herpeto-fauna, amphibians etc.
- ❖ Fences shall be provided in combination with underpasses to direct animals away from the road.
- ❖ Vegetation or other habitat features (rocks, fallen timber) will be placed, planted or allowed to regrow so that animals are directed to preferred crossing locations.
- ❖ The plantation and lighting systems along the road should be made less attractive to birds to avoid collision of birds with vehicles.

5.3.3. IMPACT ON DISTURBANCE LEADING TO DISPLACEMENT OF ANIMAL GROUPS:

The major disturbance will be during road construction period. Certain standard guidelines are prepared for issuing to the contractor and full powers to forest authorities to take any action and modifications during construction phases with respect to wildlife protection and conservation.

Disturbances during post construction work or during traffic conditions:

The main disturbances are effect of animals on their feeding, breeding and behavioural aspects due to light, noise, vibrations, loss of vegetations, habitat, pollution etc. The native faunal species which are residents of the core project zone will get disturbed due to the above facts and displacement will occur in this region. They cannot adjust to the new habitat conditions as well as inter species competition for food and other functional aspects will occur.

5.3.4. IMPACT ON COLLISION RISK:

Collision risk study has been conducted by direct and indirect methods. Certain areas sensitive to wildlife crossings were observed during the study and suggest mitigation measures to overcome this problem. Many aspects are considered in this regard like slope, curvature, speed of the vehicles, animal escaping routes near the tracks, water bodies, underpasses, ramps etc. Langurs (Bonnet macaque (*Macaca radiate*), Rhesus macaque (*Macaca mulatta*) are very common throughout the region. They used to stay adjoining to the roads and sometimes causes problems to the vehicles. The passengers used to give some food, fruits etc which is also leading to accidents.

Collision impact on reptiles especially snakes, monitor lizards, civets, and other wild cats:

In the study area there are 17 species of reptiles found in this region. Certain nocturnal animals under Mammals are also observed during night time. The chances of road kills are more for civets and other wild cats along with amphibians and reptiles. During monsoon season, amphibians come out from hibernation for breeding. Collision risk is more for Amphibians than reptiles. Usually, killings of only large mammals are reported while the smaller wildlife goes unnoticed. In the last few years, leopard, Sloth bears, Porcupine, langurs, sambar, chital, civet cats, etc have died on national highways. Road kills of King cobra, monitor lizard, common krait, sand boa and frogs have been sighted on highways near forested habitats.

Factors that influence the occurrence of wildlife-traffic collisions

There are various factors that determine the risk of animal-vehicle collisions. The numbers of collisions generally increase with traffic intensity and animal activity and density. Temporal variations in traffic kills can be linked to biological factors which determine the species' activity e.g. the daily rhythm of foraging and resting, seasons for mating and breeding, dispersal of young, or seasonal migration between winter and summer habitats



Fig 5.4 Factors influencing the number of wildlife traffic accidents.

Mitigation measures for avoiding collision risk to wild animals:

- ❖ Speed limitations on roads can also offer a simple tool to change traffic flows in the road network and reduce disturbance and mortality in wildlife areas.
- ❖ Safety barriers/delineators hard shoulders on main roads
- ❖ Traffic signs and pavement markings.
- ❖ Underpasses and other grade separators at congested junctions
- ❖ Removal of junctions and direct access points on main roads.
- ❖ Improved median openings with stacking lanes.

- ❖ Separate provisions and direct access point.
- ❖ Service roads in towns and villages for segregating local and through traffic.



Fig. 5.5 Model speed breakers to be made during laying the road.

Road Signs (Danger boards/ Wildlife awareness boards/ Speed limits/ other hazardous indicators)

Awareness on wildlife crossings, information to vehicle drivers during particularly night-time precautionary measures shall be kept near both the sides of the road and forest check posts. The user agency shall take guidelines from the forest department while placing the boards and signs. All signs shall be placed on the left-hand side of the road. Where extra emphasis is warranted, they may be duplicated on the right-hand side as well. On non-kerbed, the extreme edge of the sign shall be 1.5m-2.0m from the edge of the carriageway. On kerbed portion, it shall not be less than 60cm from the edge of the kerb. Arrangement for proper surveillance by MoRTH personnel after the expiry of the maintenance period by the construction agency.

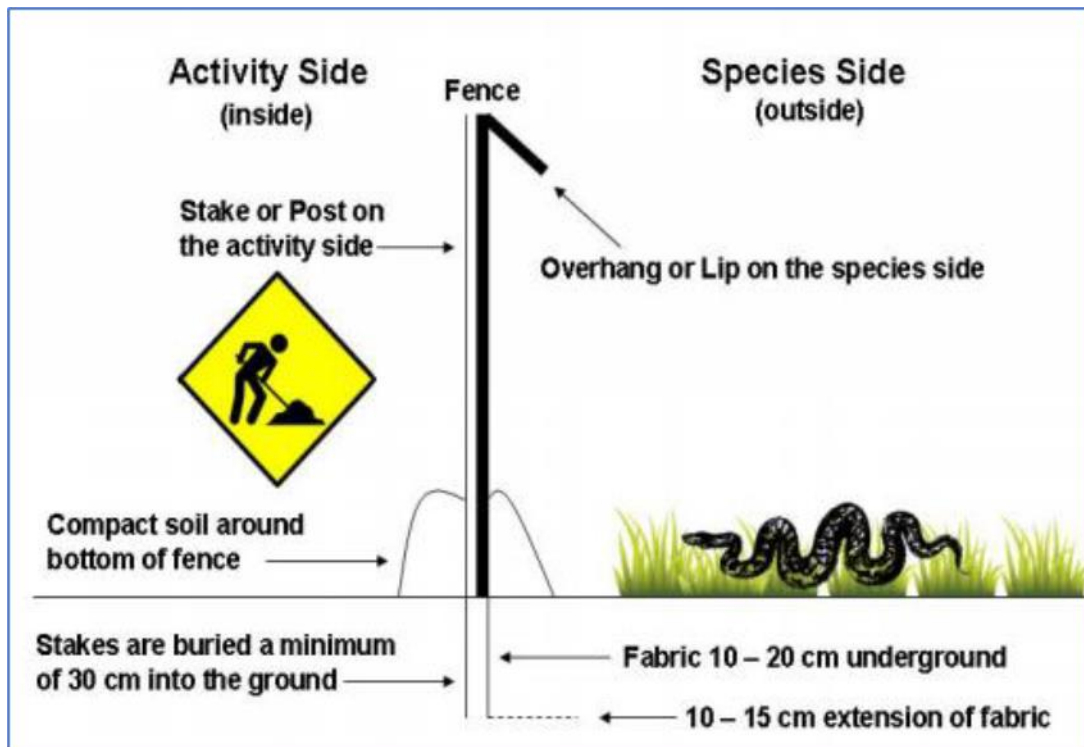


Fig: 5.6 Basic exclusion fencing (side view) used to prevent animals from traversing road surfaces. An overhang is used to prevent animals from climbing or jumping over the top of the fence.

5.4. IMPACTS VS MITIGATION MEASURES OF THE REGION

- ❖ Invariably the user agency is the responsible party to regulate the various activities and man-power relating to the highway widening project.
- ❖ Considering the importance of the Reserve Forests, all the Trees to be felled due to road widening shall be transplanted in the nearest possible and viable forest area for the betterment of the habitat.

Table 5.1: Impacts Vs Mitigation measures and responsible authority to monitor the activities.

Phase/ Aspect	Impacts identified	Mitigation measures suggested	Responsible authority
Construction phase : Removal of vegetation near the project core area	<ul style="list-style-type: none"> ✓ Loss of native species. ✓ Loss of habitat for wild animals. ✓ Habitat fragmentation ✓ Loss of food source for invertebrates. ✓ Loss of hiding place 	<ul style="list-style-type: none"> ❖ Vegetation removed from the construction zone before commencement of construction. All works carried out such that the damage or disruption to flora other than those identified for cutting is minimum. ❖ Only ground cover/shrubs that 	User Agency i.e., MoRTH and work contractor

	<p>for faunal species from predators.</p> <p>✓ Loss of bird nesting and breeding sites.</p>	<p>impinge directly on the permanent works or necessary temporary works are removed with prior approval from the Environmental Expert. The Developer, under any circumstances not cut or damage trees. Trees identified under the project and cut only after receiving permission from the Forest Department of Andhra Pradesh.</p> <p>❖ Tree transplantation shall be taken up to the nearby forest area or along the proposed highway.</p> <p>❖ Compensatory afforestation at 1:3</p>	
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		<p>shall be planted for trees which need to fell.</p> <p>❖ For tree felling, permission shall be taken from concern authorities of Andhra Pradesh Forest Department</p>	
Dust Pollution	<p>✓ Accumulation of dust on plant leaves.</p> <p>✓ Reduction of photosynthetic rate.</p> <p>✓ Stunted growth and reduction of yield.</p> <p>✓ Respiratory disorders to fauna and human habitations.</p>	<p>❖ The Developer take precautions viz. water sprinkling etc. to reduce the level of dust generated from the construction site. All the plants sited at least 1 km in the downwind direction from the nearest human settlement.</p> <p>❖ The Developer will provide necessary certificates to confirm that all crushers used in construction conform to relevant</p>	User Agency i.e., MoRTH and work contractor

		dust emission control legislation.	
Noise and vibration generated by heavy machinery.	Noise induced psychological and behavioural changes occur to wild animals. Disturbance caused to human habitations.	<ul style="list-style-type: none"> ❖ Dense vegetation along the road may be provided for attenuation of noise. ❖ Acoustic enclosure should be placed to cover the hammer and the exposed pile to reduce the air noise. The air noise levels can be reduced to about 60 dB with these measures ❖ Silence zone will be marked and provided with sign boards to alert drivers ❖ Noise buffers using diversity of tree species, with a range of foliage shapes and sizes, combination of shrubs and trees 	User Agency i.e., MoRTH and work contractor

		<p>and evergreen species will be provided.</p> <p>❖ Servicing of all construction vehicles and machinery done for exhaust silencers and will be checked and if found defective will be replaced.</p> <p>❖ All the construction sites within 150m of the nearest habitation, noisy construction work such as crushing; concrete mixing works to be done from 6.00 AM to 6.00 PM.</p> <p>❖ No noisy construction activities will be permitted around educational institutions / health centers (silence zones) up to a distance of 100 m</p>	
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		<p>from the sensitive receptors.</p> <p>❖ Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to IC.</p>	
Loss of top soil.	Loss of hibernating fauna.	<p>❖ Topsoil on stripping shall be removed and stockpiled on sides to be used on the side slopes, for top cover of borrow areas and for plantation in pits</p> <p>❖ Soil compaction for embankment work should be done immediately to avoid erosion.</p>	User Agency i.e., MoRTH and work contractor
Solid waste generation	Death to faunal species. Animal injuries.	❖ The Environmental Expert approved these disposal sites after conducting a joint inspection on the site with the	User Agency i.e., MoRTH and work contractor

		<p>Developer.</p> <p>❖ Non- bituminous wastes dumped in borrow pits (preferably located in barren lands) covered with a layer of the soil. No new disposal site created as part of the project, except with prior approval of the Environment Expert. All waste materials completely disposed of and the site fully cleaned and certified by Environmental Expert before handing over.</p>	
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Construction activity	Degradation of Habitat Quality	<ul style="list-style-type: none"> ❖ Precautions will be taken to avoid leakage of chemicals, any hazardous materials due to construction activities. ❖ Labour camps will be located far from habitat of any fauna ❖ Invasive alien species will be removed from time to time 	User Agency i.e., MoRTH and work contractor
Operation phase: Direct Collision	<p>Injury and mortality due to direct collision.</p> <p>There is a potential impact of direct animal hitting during animal crossing the roads.</p>	<ul style="list-style-type: none"> ❖ With the proposed mitigative measures such as construction of culverts, road alignment, speed breakers etc, ❖ Injured animals shall be immediately taken to forest department or veterinary hospitals 	User Agency i.e., MoRTH and work contractor
Impact of	Restricts	❖ Hedges along both	User Agency

headlight glare on wild animals.	animal movement nearer to road	sides of road will be provided to lower the intensity of lights	i.e., MoRTH and work contractor
Degradation of habitat quality.	Water, air, soil and biodiversity of the region will get deteriorated in long term.	<ul style="list-style-type: none"> ❖ Habitat improvement programmes shall be taken up on either side of the forest areas of the present road. ❖ Ecological monitoring by expert scientist must be done once in every 4 years to know the animal behaviour and migration status. 	Forest department with the funds deposited by User Agency i.e., MoRTH as a part of Wildlife Mitigation plan.
Langurs (Bonnet macaque (<i>Macaca radiate</i>), Rhesus macaque (<i>Macaca mulatta</i>)) create	Langurs are hundred in number and get killed during direct collisions.	Langurs must be rehabilitated from the existing range. Supply of sufficient food and water in forest premises shall be taken care.	Forest department with the funds deposited by User Agency i.e., MoRTH as a part of WL report.

problems to Vehicles.			
Impact on turtle	Indian Star Tortoise movement will be restricted.	<ul style="list-style-type: none"> ❖ Limit the construction activity within the designated areas. ❖ Check the site for turtle trapped in, or in danger from civil works and use a qualified person to relocate the animal. 	User Agency i.e., MoRTH and work contractor
Avoidance of Road by Animals	To avoid Injury and Mortality of animals	<ul style="list-style-type: none"> ❖ Animal underpasses are proposed to be constructed for animals to cross the road. ❖ Different types of underpasses like Box culverts, pipe culverts, and culverts with furniture will be constructed for passage of herpeto-fauna, amphibians etc. ❖ Fences will be provided in 	User Agency i.e., MoRTH and work contractor

		<p>combination with underpasses to direct animals away from the road.</p> <ul style="list-style-type: none"> ❖ Vegetation or other habitat features (rocks, fallen timber) will be placed, planted or allowed to regrow so that animals are directed to preferred crossing locations. ❖ The plantation and lighting systems along the road should be made less attractive to birds to avoid collision of birds with vehicles. 	
Reduce access	<ul style="list-style-type: none"> ❖ Wild animals frequently move for food, water and mating. Access to other side of 	<ul style="list-style-type: none"> ❖ Construct more number of under passes where animal crossings are more. ❖ Creation or improvement of 	User Agency i.e., MoRTH and work contractor

	the road reduce where underpasses are not present.	<p>water bodies will be done so that the animals have access to water.</p> <ul style="list-style-type: none"> ❖ Plantation along the water body will be done to attract the animals towards it. ❖ The saltlicks areas will be protected from reach of human beings. 	
Increased Human Pressure and Human-Wildlife Conflict	❖ Impact on wildlife with human activities.	<ul style="list-style-type: none"> ❖ Caution signs will be provided to alert drivers about wildlife ❖ Speed limit will be restricted in and around dense habitation area to avoid any collision of animal. ❖ Parking shall be restricted to avoid any encounter of humans with animals. ❖ Temporary warning signs may 	User Agency i.e., MoRTH and work contractor

		<p>be provided to warn drivers during specific time like breeding periods of animals or animal movement.</p> <ul style="list-style-type: none"> ❖ Animal Detection Systems may be provided for detection of any animal near road. ❖ Poachers will be warned through sign boards 	
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5.5. PROJECT CONTRACTORS CONDITIONS DURING CONSTRUCTION PHASE:

- ❖ Maintaining records on Awareness programmes, Animal sightings, Deaths, accidents etc and shall inform to forest department for further action.
- ❖ Necessary guidelines shall be taken from forest authorities throughout the construction phase.
- ❖ The contractors to establish environmental units and implement public awareness programs during construction regarding the impacts caused by the construction activity.
- ❖ All building material for workers should be bought and carried from outside the project area.
- ❖ Project staff and workers should not be allowed to have fire-arms and animal traps etc.
- ❖ Forest fires must be avoided by the worker activities.
- ❖ Employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary workers should also agree not to participate in such activities;
- ❖ If any of the hunting activity is observed then the worker will be removed from the employment with immediate effect and legal action will be taken by forest department.
- ❖ There should be speed limit for the material carrying trucks/dumpers while traversing through the forest areas if at all. It is always better not to travel in the forest areas that would disturb the animal behaviour.
- ❖ Honking should be strictly prohibited in the forest area by the trucks and dumper used for the construction activity.
- ❖ No disposal of construction waste in the forest premises
- ❖ No earthen material or water from the springs present in the forest area will be used for the construction activity.

- ❖ Comply with environmental standards and strictly control workers to behave responsibly with respect to environmental issues;
- ❖ Site-specific waste collection and disposal management plan should be in place to, include good site practices such as: Providing the appropriate spill kits (e.g., containing absorbent cloths and disposal containers) on-site during construction; Prohibition of dumping or burying wastes within Project site; Implementation of an on-going waste management program consisting of reduction, reuse, and recycling of materials.
- ❖ Work should be under ISO: 14001 accreditation for environmental management which also be imposed on all the subcontractors; and cover each spot where excavated material is stored when climate conditions require to effect dust control by usage of dust suppression substances.

5.6. UNDERPASSES FOR WILDLIFE MOVEMENT

Wildlife crossing structures are being designed and incorporated into road construction and expansion projects to help restore or maintain animal movements across roads. Engineered wildlife crossings are designed both to allow animals to cross roads and to reduce hazards to motorist and wildlife. Wildlife crossing structures are typically combined with high fencing, and together these measures have proved to reduce road related mortality.

Daily, weekly or seasonal movements across landscape is necessary for the most terrestrial species. It may not be a serious threat for the smaller mammal and other terrestrial species but the large mammals may get highly affected. To prevent the impacts of fragmentation due to the road viz., limiting the availability of habitat, prevent access to water & other resources on the other side of the road, sub division of wildlife populations into smaller and more vulnerable sub populations

and affects the regular movement of wildlife, it is necessary to construct wildlife crossings in order to facilitate the smooth movement of animals all through its natural habitat. Wildlife crossings are a practice in habitat conservation, allowing connections or reconnections between habitats, combating habitat fragmentation. Wildlife passage (or crossing) structures are typically the most visible and engineering intensive green infrastructure employed to address wildlife needs along roads and highways, and often are the cornerstone of successful strategies to reduce the effect of roads on wildlife.

In conjunction with wildlife fencing, these structures have dramatically reduced the incidence of wildlife-vehicle collisions as much as 98% (Clevenger et al. 2001, Dodd et al. 2007a, Olsson et al. 2008, Gagnon et al. 2015), thus enhancing motorist safety and reducing direct impact on wildlife populations.

The broad objectives of the Wildlife crossing structures

1. Facilitate connections between habitats and wildlife populations
2. Improve motorist safety and reduce wildlife vehicle collisions.

The animal crossing points i.e., under passes for proposed road are enclosed as Annexure-A

6. PROJECT SPECIFIC MITIGATION PLAN WITH FINANCIAL OUTLAY

Chapter 6

6.1. MITIGATION MEASURES

Mitigation measures for the proposed road network evolved through a multi-step simultaneous process. We first evaluated the existing and proposed drainage and crossing structures on field, assessed the possibility of making the structures more suitable for wildlife movement and finally overlapped potential multi-taxa crossing zones to finalise the location and dimensions of the crossing structures.

The principal mitigation measure in the construction phase is strict application of standard specifications for erosion and sediment control, including routine inspections. The tree cutting is kept at the minimum level by modifying alignments, eccentric and concentric widening. No construction vehicles are allowed to enter into the dense vegetation area. As per the study objectives, we studied impacts of the proposed project on direct habitat loss, barrier effect and disturbance leading to displacement of animal groups, collision risk in the study area by using appropriate standard methods.

The competent authority has the discretion to modify, add and delete any mitigation measure and financial plan during the time of issue of demand notice.

The details of the proposed mitigation measures are given below for proposed road network.

6.1.1. PLANTATION AND OTHER HABITAT IMPROVEMENT ACTIVITIES WITHIN THE FOREST AREAS.

a. **Avenue plantations/ Greenbelt plantations:**

It is proposed to carry out compensatory plantation along the proposed road in the available space within RoW and this will provide shelter for various birds, reptiles, lizards etc., Tree plantation will also provide shelter for fauna like squirrel and other wild animals which reside with human settlement. Trees are usually used for nesting, therefore large trees are to be preserved wherever necessary and planted in core zone. Yearly monitoring of birds and fauna population, breeding, feeding, nesting, movement and dispersal to be done scientifically by wildlife experts/ institution/organization preferably in winter season. Creating awareness among the construction workers at construction phase and traffic at the operation phase will be created for mammals, reptiles and birds conservation. Putting boards with slogans along road side and important sensitive places.

As the highway creates a lot of openness all along the road, there is requirement to cover the sides of the roads at appropriate places to take up avenue plantations with native fruit bearing/ flowering/ shade giving plants to support the needs of small animals/ primates/ birds. Avenue plantations are to be raised by planting native species like Tamarind, Hill Mango, Jack, Jamun, Ficus species and such other fruit bearing and shade giving plants. For quick establishment, tall plants of above 2-3 m shall be taken up.

The project is being developed under Green National Highway Corridor Project (GNHCP) with the loan assistance of World Bank. Under this scheme the tree plantation shall be taken up for every tree cut/uprooted in the process of development of the project. So the avenue plantation is also a part of scope of work and to be taken up by the EPC Contractor as per the agreement with MoRTH.

b. Compensatory afforestation in CA Land under supervision of Forest department

Revised

10 YEARS ACTION PLAN FOR COMPENSATORY AFFORESTATION (CA) SCHEME FOR NH 516 E (FOR DIVERSION OF FOREST LAND 60.06 ha OF KOYYURU - CHAPRATHIPALEM-LAMBASINGI-PADERU SECTION) THE IDENTIFIED LAND OF 120.12 ha DEGRADED FOREST LAND IN COMPARTMENT NOS. 10, 122, 123 OF ARAKU (T) RANGE AND COMPARTMENT NOS. 417, 407 AND 401 OF PEDABAYALU (T) RANGE PADERU DIVISION

Sl. no.	Item of work	2022-23		2023-24			2024-25			2025-26			2026-27			2027-28			2028-29			2029-30			2030-31			2031-32			2032-33			2033-34			Total	
		Phy in ha.	Rate in Rs.	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	Phy in ha.	Rate	Fin in lakhs	
1	Nursery (Nos.) Raising	1.60	11800	18.88	0.334	12980	4.33																														23.21	
	Nursery (Nos.) Maint.				1.6	4565	7.30	0.334	5021.5	1.68																											8.96	
2	Advance operation works	120.12	43600	52.37																																	52.37	
3	Raising of Plantation				120.12	49720	59.72																														59.72	
4	SMC (CCT in cmt)				18018	296	53.33																														53.33	
5	RFD/Stone bund (in cmt)				18000	529	95.22																														95.22	
6	1st year maintenance of plantations							120.12	49005	58.86																											58.86	
7	2nd year maintenance of plantations										120.12	40795	49.00																								49.00	
8	3rd year maintenance of plantations												120.12	42166	50.65																						50.65	
9	4th year maintenance of plantations															120.12	22547	27.08																			27.08	
10	5th year maintenance of plantations																	120.12	26751	32.13																	32.13	
11	6th year maintenance of plantations including SMC works																				120.12	27866	33.47														33.47	
12	7th year maintenance of plantations including silvicultural operations																					120.12	27652	33.22													33.22	
13	8th year maintenance of plantations																								120.12	30418	36.54										36.54	
14	9th year maintenance of plantations																										120.12	33459	40.19								40.19	
15	10th year maintenance of plantations																																120.12	27247	32.73			32.73
16	Boundary demarcation pillars (Cost of 4 ft stone, Transprotataion and fixing of Survey stones in CA land area)	500 nos	Actuals	3.00																																		3.00
	Total :			74.25		219.92			60.54		49.00		50.65		27.08		32.13		33.47		33.22		36.54		40.19		32.73		689.73									
17	Over Heads (Administrative cost such workshops, Audit fee, awarness camps, wages to DEO maintenance of Computers, printers stationery etc.,)			7.43		21.99			6.05		4.90		5.06		2.71		3.21		3.35		3.32		3.65		4.02		3.27		68.97									
	Total :			81.68		241.91			66.60		53.90		55.71		29.79		35.35		36.82		36.54		40.19		44.21		36.00		758.70									

o/c Divisional Forest Officer
Paderu

6.1.2. DEVELOPMENT OF INFRASTRUCTURE

- a. Underpasses shall be constructed at selected locations. The existing under passes must be maintained by MoRTH contractor as per forest department suggestions.
- b. Ramps/sloped pathway from the road level to natural forest in cutting portions shall be made suitably. As the work of Ramps and underpasses involve safety criteria due to running traffic, the construction of underpasses shall be taken up by MoRTH under Wildlife Mitigation plan.

6.1.3. HABITAT ENRICHMENT WORKS

- a. Water storage and retention structures and saucer pits shall be constructed to retain the rain water for summer season.
- b. Automatic Solar water motors with borewell and storage pits
- c. Tractors and tankers shall be purchased for filling water in saucer pits
- d. Percolation tanks are to be developed in and project area.
- e. Solar based automatic water filling system will be placed for drinking purpose of wildlife.

6.1.4. WILDLIFE RESEARCH AND MONITORING WORKS

- a. Equipment for wildlife monitoring and research must be purchased for long-term monitoring aspects.
- b. Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.
- c. Experts on ecological aspects shall be appointed for studying the detailed mitigation plan. This work can be given to any

reputed and experienced National, Regional level NGOs and Government organisations.

6.1.5. PROTECTION OF WILDLIFE

- a) Mobile team for forest and wildlife protection during and after the project construction phase
- b) Watch towers shall be constructed for wildlife monitoring with in the study area.
- c) Fencing on the either side of the road shall be developed during construction phase.
- d) Fire lines shall be created with 3m width within the reserve forest areas for 10 km length.

6.1.6. PUBLICITY AND AWARENESS

- a. Publicity and awareness camps shall be conducted at local level.
- b. Awareness among all the workers and contractors during project phase regularly.
- c. 10 nos of Signage and boards to be placed at frequent intervals.

6.1.7. SPECIES SPECIFIC GENERAL MITIGATION MEASURES

- a) Artificial saltlicks shall be arranged within the forest areas.
- b) Wildlife alerting Alarm / sound systems near tunnels, cuttings, turnings etc.
- c) Vehicle speed to be maintained and minimised as per norms.
- d) Approach roads shall be constructed only near the project area.
- e) For any work related for project, existing roads only to be utilised

- f) Eco-friendly engineering practices shall be employed.
- g) As and when required forest officials can conduct meetings with MoRTH officials, contractors, workers, etc., and can inspect any project site, machinery, premises, etc.,
- h) No waste of any kind / debris to be dumped in reserve forest area.
- i) From time to time any conditions stipulated by forest officials for interest of wild life to be incorporated by contractors / user agency during construction phase.

6.1.8. UNDER PASSES

In the project area, for the uninterrupted movement of wildlife, there is a need to enhance the permeability of crossing structures which are to be effective and acceptable. This project has many minor bridges, box and pipe culverts over different locations on the proposed alignment but majority of those are falling outside of forest area. Out of 133.974 long road proposed, 34.56 km in Chinthapalli Division area and a small stretch of 0.10 km long road in Paderu Division area fall in forest stretch. As the wide NH causes fragmentation of wildlife habitat, to ensure safe passage of wildlife, the User agency has to provide under passes in the following locations

The underpass will be in the sizes desirable for movement of animals. The user agency should also make provision of covering the area outside the underpasses with vegetation cover for camouflage purpose.

New animal passages are proposed following location:

S. No	Forest Patch	Length in "Km"	Area in "Ha"	Structure Proposed	Location	Proposed Center Line Coordinates		Size (Span x Opening x Height) in "m"
						Easting	Northing	
1	Patch - 1 (128+800 - 132+100)	3.300	6.58	Box culvert	131+494	639323.49	1951828.7	1 x 4 x 4 x 5
2				Box culvert	132+039	639638.85	1952278.7	1 x 2 x 1.5
3	Patch - 2 (150+900 - 162+700)	11.800	23.58	Box culvert	150+920	642162.24	1962689.8	1 x 2 x 1.5
4				Box culvert	150+980	642177.41	1962632.5	1 x 2 x 1.5
5				Box culvert	151+855	641902.09	1962837.4	1 x 2 x 2
6				Box culvert	152+460	641930.48	1962927.2	1 x 2 x 2
7				Box culvert	152+590	641936.3	1962950.1	1 x 2 x 1.5
8				Box culvert	153+660	641759.13	1962967.6	1 x 2 x 1.5
9				Box culvert	153+770	641724.74	1962975.3	1 x 2 x 1.5
10				Box culvert	154+045	641522.16	1962854.2	1 x 2 x 1.5
11				Box culvert	154+470	641702.45	1963010.2	1 x 2 x 3
12				Box culvert	154+550	641657.61	1963024.5	1 x 2 x 1.5
13				Box culvert	154+755	641466.48	1962942.9	1 x 2 x 3
14				Box culvert	154+900	641346.49	1962879.4	1 x 2 x 1.5
15				Box culvert	155+010	641322.74	1962901.4	1 x 2 x 1.5
16				Box culvert	155+180	641462.88	1962996	1 x 2 x 2
17				Box culvert	155+540	641298.48	1962925.5	1 x 2 x 3
18				Box culvert	155+650	641265.67	1962948.8	1 x 2 x 1.5
19				Box culvert	157+560	641068.59	1963344	1 x 2 x 2
20	Patch -3 (167+610 - 169+610)	2.000	4.02	Box culvert	168+660	634834.37	1965044.6	1 x 2 x 3 x 2

21	Patch - 4 (187+230 - 188+300)	1.070	1.51	Pipe culvert	188+135	644986.4	1975944	1 X 1.2m Dia
22	Patch - 5 (189+250 - 194+900)	5.650	6.30	Box culvert	192+240	648404.01	1974617.4	1 x 2 x 3 x 2
23				Box culvert	192+550	648661.34	1974779.1	1 x 2 x 3 x 3
24	Patch - 6 (196+330 - 197+900)	1.570	1.08	Box culvert	197+786	653198.43	1973662.9	1 x 2 x 2
25	Patch - 7 (217+400 - 220+300)	2.900	9.90	Box culvert	217+640	658476.87	1980570.3	1 x 2 x 3 x 5
26	Patch - 8 (221+900 - 224+200)	2.300	6.85	Box culvert	222+940	659258.64	1984598.4	1 x 3 x 4 x 4
27				Box culvert	223+460	659219.71	1985092.9	1 x 2 x 3 x 4
28				Minor bridge	224+065	659283.87	1985543.8	2 x 5, 16m (Deck Width)
	Patch - 9 (238+600 - 238+700)	0.1	0.24	-	-	-	-	-
		Total	60.060					

6.2. FINANCIAL PLAN

Sl.no.	Management intervention in the core area	Estimated cost(Rs.in lakh)
1	Raising Avenue plantations/ Greenbelt plantations along the road.	It is a part of scope of work and to be taken up by EPC Contractor of MoRTH.
2	Underpasses and Rumble strips on the road to be constructed by User Agency in Consultation with DFO.	
3	Hoardings and signage's (Animal crossing, Don't feed animals, No horn zone etc.) in every 400 m (at straight path) and in every 100 m (at the turns) on the road where it passes through forest.	
4	Wildlife Conservaiton plan for Schedule -I fauna observed in the Study area. (Habitat improvement)	200.00
5	Wildlife Mitigation works proposed within project area. (Protection and Mitigation)	86.00
	Total	286.00

Project Director,
Project Implement Unit
Visakhapatnam

District Forest Officer,
Chintapalli

Divisional Forest
Officer, Paderu

Chief Conservator of Forests,
Visakhapatnam

Prl. Chief Conservator of Forests (WL) &
Chief Wildlife Warden

Wildlife Conservation Plan for Schdule-I Fauna observed in the Study Area.

S.No	Particulars	Nos	Unit cost (Rs in Lakhs)	Total amount (Rs in Lakhs)
1	Conservation and Management of Langurs	LS	LS	10.00
2	Habitat improvement works in the forest areas	LS	LS	20.00
3	Solar based automatic water filling system with borewell and storage pit	10	5.00	50.00
4	Establishing Salt licks	LS	LS	4.00
5	Detailed study to understand the long-term impact on wildlife due to expansion of project	LS	LS	25.00
6	Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.	3 times	2.00	6.00
7	Soil and moisture conservation measures in RF areas in Zone of influence a) CCTs b) RFDs Small Check dams	LS	LS	50.00
8	Equipment for wildlife monitoring and research	LS	LS	10.00
9	Development of Waterholes/ small ponds in RF areas	30 No	0.50	15.00

10	Water storage and retention structure / Saucer pits	20	0.50	10.00
	Grand total			200.00

Note: Part of the above Conservation plan amount will be utilized at Indira Gandhi Zoological Park, Visakhapatnam which is nearest Zoo Park for conservation of Schedule -I fauna in consultation with the Chief Wildlife Warden, Andhra Pradesh.

Wildlife Mitigation works proposed within project area. (Protection and Mitigation)

S.No	Particulars	Total amount (Rs in Lakhs)
1	Cost of drones 2 no. for monitoring wild animal movement @ 3,00,000/ drone	6.00
2	For protection and anti-depredation activity in Chinthapalli Forest Division with 2 no of squads with 10 persons.	70.00
3	Corpus fund/ emergency fund	10.00
	Grand total	86.00

Note: The entire mitigation plan amount will be utilized on the impacted areas in and around the project area for mitigation of fauna.

Table: 6.2 YEAR WISE FINANCIAL PLAN* (Rs. In Lakhs)

Year	1	2	3	4	5	6
	2022-2023 (Rs in Lakhs)	2023-2024 (Rs in Lakhs)	2024-2025 (Rs in Lakhs)	2025-2026 (Rs in Lakhs)	2026-2027 (Rs in Lakhs)	Total (Rs in Lakhs)
Conservation and Management of Langurs	5.00	3.00	2.00	0.00	0.00	10.00
Habitat improvement works in thre	5.00	5.00	5.00	5.00	0.00	20.00
Solar based automatic water filling system with borewell and storage pit	20.00	20.00	10.00	0.00	0.00	50.00
Establishing Salt licks	1.00	1.00	1.00	1.00	0.00	4.00
Detailed study to understand the long-term impact on wildlife due to expansion project	5.00	5.00	5.00	5.00	5.00	25.00
Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.	2.00	1.00	1.00	1.00	1.00	6.00
Soil and moisture conservation measures in RF areas in Zone of influence c) CCTs d) RFDs Small Check dams	10.00	10.00	10.00	10.00	10.00	50.00

Equipment for wildlife monitoring and research	2.00	2.00	2.00	2.00	2.00	10.00
Development of Waterholes/ small ponds in RF areas	3.00	3.00	3.00	3.00	3.00	15.00
Water storage and retention structure / Saucer pits	2.00	2.00	2.00	2.00	2.00	10.00
Cost of drones 2 no. for monitoring wild animal movement @ 3,00,000/ drone	6.00	0.00	0.00	0.00	0.00	6.00
For protection and anti-depredation activity in Chinthapalli Forest Division with 2 no of squads with 10 persons.	14.00	14.00	14.00	14.00	14.00	70.00
Corpus fund/ emergency fund	10.00	0.00	0.00	0.00	0.00	10.00
Grand total	115	46	45	43	37	286.00

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8. ANNEXURES

Chapter 8

8.1. ANNEXURE A

Table 8.1 a. List of proposed animal passages with location details by package wise. .

S. No	Package	Forest Patch	Length in "Km"	Area in "Ha"	Structure Proposed	Location	Proposed Size (Span x Opening x Height) in "m"	Status of Structure	Remarks
1	I	Patch - 1 (128+800 - 132+100)	3.300	6.58	Box Culvert	129+426	1 x 2 x 2	Existing	Reconstructed with improved size
2					Box Culvert	129+537	1 x 2 x 3	Existing	Reconstructed with improved size
3					Box Culvert	129+721	1 x 2 x 3	Existing	Reconstructed with improved size
4					Box Culvert	130+120	1 x 2 x 3	Existing	Reconstructed with improved size
5					Box Culvert	130+538	1 x 2 x 3	Existing	Reconstructed with improved size
6					Box culvert	131+494	1 x 4 x 4 x 5	New	
7					Box culvert	132+039	1 x 2 x 1.5	New	

8					Box culvert	150+920	1 x 2 x 1.5	New	
9					Box culvert	150+980	1 x 2 x 1.5	New	
10					Box culvert	151+431	1 x 2 x 3	Existing	Reconstructed with improved size
11					Box culvert	151+855	1 x 2 x 2	New	
12					Box culvert	152+460	1 x 2 x 2	New	
13					Box culvert	152+590	1 x 2 x 1.5	New	
14		Patch - 2 (150+900 - 162+700)	11.800	23.58	Box culvert	152+983	1 x 2 x 3	Existing	Reconstructed with improved size
15					Box culvert	153+119	1 x 2 x 2	Existing	Reconstructed with improved size
16					Box culvert	153+357	1 x 2 x 1.5	Existing	Reconstructed with improved size
17					Box culvert	153+473	1 x 2 x 1.5	Existing	Reconstructed with improved size
18					Box culvert	153+660	1 x 2 x 1.5	New	
19					Box culvert	153+770	1 x 2 x 1.5	New	
20					Box culvert	153+942	1 x 2 x 2	Existing	Reconstructed with improved size
21					Box culvert	154+045	1 x 2 x 1.5	New	
22					Box culvert	154+248	1 x 2 x 1.5	Existing	Reconstructed with improved size

23					Box culvert	154+324	1 x 2 x 3	Existing	Reconstructed with improved size
24					Box culvert	154+470	1 x 2 x 3	New	
25					Box culvert	154+550	1 x 2 x 1.5	New	
26					Box culvert	154+755	1 x 2 x 3	New	
27					Box culvert	154+900	1 x 2 x 1.5	New	
28					Box culvert	155+010	1 x 2 x 1.5	New	
29					Box culvert	155+127	1 x 2 x 2	Existing	Reconstructed with improved size
30					Box culvert	155+180	1 x 2 x 2	New	
31					Box culvert	155+362	1 x 2 x 3	Existing	Reconstructed with improved size
32					Box culvert	155+417	1 x 2 x 2	Existing	Reconstructed with improved size
33					Box culvert	155+540	1 x 2 x 3	New	
34					Box culvert	155+650	1 x 2 x 1.5	New	
35					Box culvert	155+785	1 x 2 x 1.5	Existing	Reconstructed with improved size
36					Box culvert	155+862	1 x 2 x 3	Existing	Reconstructed with improved size
37					Box culvert	156+213	1 x 2 x 2	Existing	Reconstructed with improved size

38					Box culvert	156+463	1 x 2 x 1.5	Existing	Reconstructed with improved size
39					Box culvert	156+758	1 x 2 x 1.5	Existing	Reconstructed with improved size
40					Box culvert	156+910	1 x 2 x 2	Existing	Reconstructed with improved size
41					Box culvert	157+179	1 x 2 x 3 x 2	Existing	Reconstructed with improved size
42					Box culvert	157+560	1 x 2 x 2	New	
43					Box culvert	158+064	1 x 2 x 1.5	Existing	Reconstructed with improved size
44					Box culvert	158+277	1 x 2 x 1.5	Existing	Reconstructed with improved size
45					Box culvert	158+861	1 x 2 x 4	Existing	Reconstructed with improved size
46					Box culvert	159+123	1 x 2 x 1.5	Existing	Reconstructed with improved size
47					Box culvert	160+228	1 x 2 x 4	Existing	Reconstructed with improved size
48					Box culvert	161+024	1 x 2 x 2	Existing	Reconstructed with improved size
49					Box culvert	161+187	1 x 2 x 2	Existing	Reconstructed with improved size
50					Box culvert	161+688	1 x 2 x 3 x 3	Existing	Reconstructed with improved size
51					Box culvert	161+920	1 x 2 x 4	Existing	Reconstructed with improved size
52					Box culvert	162+460	1 x 2 x 3	Existing	Reconstructed with improved size

53	II	Patch - 3 (167+610 - 169+610)	2.000	4.02	Pipe culvert	167+661	2 x 1.2m Dia	Existing	Reconstructed with improved size
54					Pipe culvert	167+942	2 x 1.2m Dia	Existing	Reconstructed with improved size
55					Pipe culvert	168+092	2 x 1.2m Dia	Existing	Reconstructed with improved size
56					Pipe culvert	168+246	2 x 1.2m Dia	Existing	Reconstructed with improved size
57					Pipe culvert	168+382	2 x 1.2m Dia	Existing	Reconstructed with improved size
58					Pipe culvert	168+550	2 x 1.2m Dia	Existing	Reconstructed with improved size
59					Box culvert	168+660	1 x 2 x 3 x 2	New	
60					Pipe culvert	168+883	2 x 1.2m Dia	Existing	Reconstructed with improved size
61					Box culvert	169+209	1 x 3 x4 x3	Existing	Reconstructed with improved size
62					Pipe culvert	169+571	2 x 1.2m Dia	Existing	Reconstructed with improved size
63		Patch - 4 (187+230 - 188+300)	1.070	1.51	Box culvert	187+686	1 x 2 x 2	Existing	Reconstructed with improved size
64					Pipe culvert	187+840	2 x 1.2m Dia	Existing	Reconstructed with improved size
65					Pipe culvert	188+135	1 X 1.2m Dia	New	
66		Patch - 5 (189+250 - 194+900)	5.650	6.30	Box culvert	189+400	1 x 2 x 2	Existing	Reconstructed with improved size
67					Pipe culvert	190+166	2 x 1.2m Dia	Existing	Reconstructed with improved size

68					Box culvert	190+612	1 x 2 x 3	Existing	Reconstructed with improved size
69					Pipe culvert	191+074	2 x 1.2m Dia	Existing	Reconstructed with improved size
70					Pipe culvert	191+251	2 x 1.2m Dia	Existing	Reconstructed with improved size
71					Pipe culvert	191+839	2 x 1.2m Dia	Existing	Reconstructed with improved size
72					Box culvert	192+240	1 x 2 x 3 x 2	New	
73					Box culvert	192+550	1 x 2 x 3 x 3	New	
74					Minor bridge	192+817	1 X 20, 16m (Deck Width)	Existing	Reconstructed with improved size
75					Pipe culvert	193+652	2 x 1.2m Dia	Existing	Reconstructed with improved size
76					Box culvert	194+587	1 x 2 x 3	Existing	Reconstructed with improved size
77		Patch - 6 (196+330 - 197+900)	1.570	1.08	Box culvert	196+630	1 x 2 x 3	Existing	Reconstructed with improved size
78					Pipe culvert	197+002	2 x 1.2m Dia	Existing	Reconstructed with improved size
79					Box culvert	197+182	1 x 2 x 3	Existing	Reconstructed with improved size
80					Box culvert	197+344	1 x 2 x 2	Existing	Reconstructed with improved size
81					Box culvert	197+786	1 x 2 x 2	New	

82	III	Patch - 7 (217+400 - 220+300)	2.900	9.90	Box culvert	217+640	1 x 2 x 3 x 5	New	
83					Pipe culvert	218+758	2 x 1.2m Dia	Existing	Reconstructed with improved size
84					Pipe culvert	218+889	2 x 1.2m Dia	Existing	Reconstructed with improved size
85					Pipe culvert	219+326	2 x 1.2m Dia	Existing	Reconstructed with improved size
86					Pipe culvert	220+120	2 x 1.2m Dia	Existing	Reconstructed with improved size
87		Patch - 8 (221+900 - 224+200)	2.300	6.85	Pipe culvert	222+753	2 x 1.2m Dia	Existing	Reconstructed with improved size
88					Box culvert	222+940	1 x 3 x 4 x 4	New	
89					Box culvert	223+739	1 x 4 x 4 x 4	Existing	Reconstructed with improved size
90					Box culvert	223+460	1 x 2 x 3 x 4	New	
91					Minor bridge	224+065	2 x 5, 16m (Deck Width)	New	

		Patch - 9 (238+600 - 238+700)	0.100	0.24	-	-	-	-	-
			Total	60.060	91 no				1. Box Culverts - 68 no, 2. Pipe Culverts - 21 no, 3. Minor Bridges - 2 no. I. Existing Structures being improved - 63 no II. New Structures - 28 no.
Note:	1. In box culverts, the fourth dimension (wherever applicable) denotes earth cushion above the box.								

8.2. ANNEXURE -B: LIST OF FLORA

S.no	Botanical name	Common name	Family	Local status (Dominant/ common/ sparse)
I	Trees			
1	<i>Mangifera indica</i>	Mango	Anacardiaceae	Common
2	<i>Grevillea robusta</i>	Silver Oak	Proteaceae	Common
3	<i>Pinus sabiniana</i>	Gray pine	Pinaceae	Sparse
4	<i>Semecarpus anacardium</i>	Marking nut, Nalla Jeedi	Anacardiaceae	Common
5	<i>Dalbergia latifolia</i>	Rosewood, Jitregi	Fabaceae	Rare
6	<i>Xylocarpus</i>	Konda Tangedu	Fabaceae	Common
7	<i>Schleichera oleosa</i>	Busi, Kusum	Sapindaceae	Sparse
8	<i>Syzygium cumini</i>	Neredu	Myrtaceae	Common
9	<i>Eucalyptus tereticornis</i>	Jamaoil, Nilgiri	Myrtaceae	Sparse
10	<i>Artocarpus heterophyllum</i>	Jack fruit, Panasa	Moraceae	Sparse
11	<i>Pterocarpus marsupium</i>	Yegisa	Fabaceae	Common
12	<i>Ailanthus excelsa</i>	Peddamanu	Simaroubaceae	Common
13	<i>Bombax ceiba</i>	Malabar silk	Malvaceae	Sparse
14	<i>Kydia calycina</i>	Pothadi	Malvaceae	Common
15	<i>Ficus benghalensis</i>	Banyan, Marri	Moraceae	Sparse
16	<i>Pongamia pinnata</i>	Pongamia, Kanuga	Fabaceae	Sparse
17	<i>Terminalia arjuna</i>	Tella Maddi	Combretaceae	Common
18	<i>Terminalia chebula</i>	Karaka	Combretaceae	Sparse
19	<i>Tamarindus indica</i>	Chintha	Leguminosae	Common
20	<i>Garuga pinnata</i>	Garugu	Burseraceae	Common
21	<i>Butea monosperma</i>	Flame of the forest, Moduga	Fabaceae	Common

22	<i>Albizia odoratissima</i>	Chinduga, Ganara	Fabaceae	Sparse
23	<i>Mallotus philippensis</i>	Kunkum	Euphorbiaceae	Sparse
24	<i>Terminalia bellirica</i>	Tani	Combretaceae	Common
25	<i>Gmelina arborea</i>	Gummadi Teku	Lamiaceae	Common
26	<i>Acrocarpus fraxinifolius</i>	Acrocarpus		Common
27	<i>Phyllanthus emblica</i>	Goose berry, Usiri	Phyllanthaceae	Common
28	<i>Lagerstroemia parviflora</i>	Chennangi	Lythraceae	Common
29	<i>Manilkara hexandra</i>	Pala chettu	Sapotaceae	Sparse
30	<i>Acacia chundra</i>	Sundra	Mimosaceae	Sparse
31	<i>Cassia fistula</i>	Rela	Caesalpinaceae	Common
32	<i>Tectona grandis</i>	Teak	Verbenaceae	Sparse
33	<i>Anacardium occidentale</i>	Cashew nut, Jeedi	Anacardiaceae	Common
34	<i>Ficus religiosa</i>	Peepal, Ravi	Moraceae	Sparse
35	<i>Lannea coromandelica</i>	Gumpena	Anacardiaceae	Common
36	<i>Anogeissus latifolia</i>	Chirumanu	Combretaceae	Sparse
37	<i>Sapindus emarginatus</i>	Soap nut, Kunkudu	Sapindaceae	Sparse
38	<i>Grewia tiliaefolia</i>		Tiliaceae	Common
39	<i>Strychnos potatorum</i>	Chilla	Loganiaceae	Common
40	<i>Psidium guajava</i>	Jama	Myrtaceae	Common
41	<i>Chloroxylon swietenia</i>	Satin, Bhilludu	Rutaceae	Rare
II	Shrubs			
1	<i>Calotropis gigantea</i>	Julledu	Asclepiadaceae	Common

2	<i>Acacia pinnata</i>	Korintha	Mimosaceae	Common
3	<i>Adathoda vasica</i>	Addasaram	Acanthaceae	Common
4	<i>Capparis sepiara</i>	Nalla uppi	Capparidaceae	Sparse
5	<i>Carissa carandus</i>	Kalivi	Apocynaceae	Common
6	<i>Cassia auriculata</i>	Tangedu	Caesalpiniaceae	Common
7	<i>Cassia montana</i>	Konda Tangedu	Caesalpiniaceae	Common
8	<i>Erythroxylum monogynum</i>	Adavi Gorinta	Linaceae	Sparse
9	<i>Glycosmis pentaphylla</i>	Golugu	Rutaceae	Sparse
10	<i>Jatropha glandulifera</i>	Chinna Nepalam	Euphorbiaceae	Common
11	<i>Lantana indica</i>	Lantana	Verbinaceae	Common
12	<i>Lawsonia alba</i>	Gorinta	Lythraceae	Sparse
13	<i>Randia dumetorum</i>	Balusu	Rubiaceae	Common
14	<i>Toddalia aculeata</i>	Konda mirapa	Rutaceae	Common
15	<i>Woodfordia floribunda</i>	Tella Pala	Rubiaceae	Common
16	<i>Zizyphus mauritiana</i>	Regu	Rhamnaceae	Common
17	<i>Zizyphus oenoplea</i>	Parimi	Rhamnaceae	Common
III	Herbs			
1	<i>Achyranthus aspera</i>	Uttareni	Amaranthaceae	Common
2	<i>Tephrosia purpurea</i>	Vempali	Papilionaceae	Common
3	<i>Tribulus terrestris</i>	Palleru	Zygophyllaceae	Common
IV	Climbers/ Creepers			
1	<i>Abrus precatorius</i>	Gurivinda	Papilionaceae	Sparse
2	<i>Acacia concinna</i>	Shikai	Mimosaceae	Common
3	<i>Acacia intia</i>	Korintha	Mimosaceae	Common
4	<i>Asparagus racemosus</i>	Pilli theegalu	Liliaceae	Sparse
5	<i>Bauhinia vahlii</i>	Adda aku	Caesalpiniaceae	Common

			e	
6	<i>Butea superba</i>	Tiga moduga	Caesalpiaceae	Common
7	<i>Caesalpinia bonducella</i>	Gacha	Caesalpiaceae	Sparse
8	<i>Dioscorea esculenta</i>	Tippa theega	Dioscoreaceae	Common
9	<i>Hemidesmus indicus</i>	Sugandhapala	Asclepiadaceae	Common
10	<i>Mucuna pruriens</i>	Duradagondi	Papilionaceae	Sparse
11	<i>Piper longum</i>	Pippallu	Piperaceae	Common
V	Grasses:			
1	<i>Aristida setacea</i>	Paraka gaddi	Graminae	Common
2	<i>Cymbopogon coloratus</i>	Bodha gaddi	Graminae	Sparse
3	<i>Cymbopogon martini</i>	Kanchi	Graminae	Common
4	<i>Cynodon dactylon</i>	Gariki gaddi	Graminae	Common
5	<i>Ischaemum pilosum</i>	Kundara gaddi	Graminae	Sparse
6	<i>Imperata arundinacea</i>	Darbha gaddi	Graminae	Sparse
7	<i>Vetiveria zizanioides</i>	Vattiveru	Graminae	Sparse

8.3. ANNEXURE -C: LIST OF FAUNA

8.3.1. MAMMALS

S.no.	Common name	Scientific name	Family	IUCN status	WPA status
1	Panther	<i>Panthera pardus</i>	Felidae	NT	I
2	Wild dog	<i>Cuon alpinus</i>	Canidae	EN	II
3	Sloth Bear	<i>Melursus ursenus</i>	Ursidae	VU	I
4	Hyena	<i>Hyeana hyaena</i>	Hyaenidae	NT	III
5	Indian Jackal	<i>Canisaureus</i>	Canidae	LC	II
6	Hare	<i>Lepus nigricollis</i>	Leporidae	LC	IV
7	Indian gaur	<i>Bos gaurus</i>	Bovidae	VU	I
8	Wild boar	<i>Sus scrofa cristatus</i>	Suidae	LC	III
9	Black buck	<i>Ursus americanus</i>	Bovidae	LC	I
10	Wild fox	<i>Vulpes bengalensis</i>	Canidae	LC	II
11	Porcupine	<i>Hytrix indica</i>	Hystriidae	LC	IV
12	Pangolin	<i>Manis crassicaudata</i>	Manidae	CE	I
13	Four horned antelope	<i>Tetracerus quadricornis</i>	Bovidae	VU	I
14	Spotted deer	<i>Axis axis</i>	Cervidae	LC	III
15	Barking deer	<i>Muntiacus muntjac</i>	Cervidae	LC	III
16	Rhesus monkey	<i>Macaca mulatta</i>	Cercopithecidae	LC	II
17	Bonnet monkey	<i>Macaca radiata</i>	Cercopithecidae	LC	II
18	Sambhar	<i>Cervus unicolor</i>	Cervidae	VU	III

19	Mongoose	<i>Herpestes edwardsi</i>	Herpestidae	LC	II
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List of birds, reptiles, ichthyo fauna recorded in and around Project area

Sl.no.	Common name	Scientific name	Family	IUCN status
1	Pea fowl	Pavocristatus	LC	I
2	Black ibis	Pseudibis papillosa	Near threatened	IV
3	Golden oriole	Orioluskundoo	LC	IV
4	Black drongo	Dicrurusmacrocerus	LC	IV
5	Cattle Egret	Bubulcus ibis	LC	IV
6	Red Jungle fowl	Gallus gallus	LC	IV
7	Grey Jungle fowl	Gallus sonneratti	LC	-
8	Crow pheasant	Centropus sinensis	LC	IV
9	Red Vented bulbul	Pycnonotuscafer	LC	IV
10	Darter	Anhinga rufa	LC	IV
11	Grey Heron	Ardea cinerea	LC	IV
12	Grey partridge	Phasianidae	LC	IV

List of reptiles and amphibians in and around Project area:

S.no	Common name	Scientific name	Family	IUCN status	WPA status
1	Indian Python	<i>Python molurus</i>	Pythonidae	NT	I
2	King cobra	<i>Ophiophagus hannah</i>	Elapidae	VU	II
3	Cobra	<i>Naja naja</i>	Elapidae	LC	II
4	Krait	<i>Bungarus caeruleus</i>	Elapidae	LC	II
5	Russel's viper	<i>Vipera russelli</i>	Viperidae	LC	II

6	Saw scaled viper	<i>Echis carinatus</i>	Viperidae	LC	II
7	Rat snake	<i>Ptyas mucosus</i>	Colubridae	Not evaluated	II
8	Chameleon	<i>Chamaeieozeyla nicus</i>	Chamaeleonidae	LC	II
9	Monitor Lizard	<i>Varanus benghalensis</i>	Varanidae	LC	II

Aquatic animals & fish:

S.no.	Common name	Scientific name	Family	IUCN status
1	Fresh water turtle	<i>Trionyx species</i>		LC
2	Frog	-	-	LC
3	Fishes	-	-	LC

Abbreviation for IUCN Red list categorization:

LC - Least concern

NT - Near Threatened

VU - Vulnerable

EN - Endangered

