



# भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन और राजमार्ग मंत्रालय, भारत सरकार)

## National Highways Authority of India

(Ministry of Road Transport & Highways, Government of India)

परियोजना क्रियान्वयन इकाई - मेरठ

Project Implementation Unit, Meerut

ए-1, वैष्णो धाम, निकट गायत्री हाईट्स, कंकरखेड़ा, एन.एच.-58, मेरठ-250001

A-1, Vaishno Dham, Near Gayatri Heights, Kankerkheda, NH-58, Meerut-250001

टेलीफोन/Telephone: 0121-2631228 ई-मेल/e-mail: meerut@nhai.org



NHAI/PIU-MRT/66014/2023/D- 27717

Dated: 16.06.2022

To  
The Divisional Forest Officer  
Muzaffarnagar  
Uttar Pradesh 251001

**Name of Project Road-Forest Land Diversion proposal for "Improvement and Up-gradation to 4-lane configuration of Meerut-Nazibabad section of NH-119 between Km 39+165 to Km 78+635 in the state of Uttar Pradesh".**

**Online Proposal No: - FP/UP/ROAD/43253/2019**

Ref: - EDS raised in 5<sup>th</sup> REC, MoEFCC, Lucknow meeting on 30/05/2023, and the minutes published, vide letter no:-8B/UP/06/265/2021/FC/175 on dated 09/06/2023 & letter no.4021/14-1 (FP/UP/Road/43253/2019-FCA) dated 09.06.2023.

Sir,

Please refer to the above captioned subject and aforementioned reference.

We, herewith submit the point wise reply of above referred letter. The detail of reply is annexed as Appendix-1.

**Encl. Submitted in 05 sets.**

(Santosh Kumar Bajpai)  
Project Director

Enclosure: - Appendix -1 (Point wise details of EDS)

Annexure- I (WII, Dehradun study report on mitigation and conservation plan)

Annexure- II (combined kml file showing project road, forest area, old PA boundary along with its notified ESZ and newly notified PA boundary file, in digital format))

Annexure-III (Avenue & Median Plantation scheme)

**Copy to:-**

1. RO-West, UP, Lucknow – for information & necessary action.
2. Nodal Officer, Lucknow - for information & necessary action.

# Appendix-I

Compliance of EDS raised in 5<sup>th</sup>REC, MoEFCC, Lucknow meeting, and the minutes published, vide letter no: - II/1092/REC/2014- UP (Part-2)/ 96; on dated 05/06/2023

Name of Project Road-Forest Land Diversion proposal for "Improvement and Up-gradation to 4-lane configuration of Meerut-Najibabad section of NH-119 between Km 39+165 to Km 78+635 in the state of Uttar Pradesh".

Online Proposal No: - FP/UP/ROAD/43253/2019

SL	EDS raised in REC, MoEFCC Lucknow dated 30/05/2023	Compliance by User Agency
1	Since the area proposed for diversion is part of WLS option of elevated stretches in WLS area may be explored.	<p>It is submitted that PCCF wildlife vide letter dated 08.09.2021 requested WII Dehradun for providing report on biodiversity impact assessment and wildlife study.</p> <p>Wildlife Institute of India; Dehradun conducted detailed study and submitted its detailed report in respect of "mitigation measures for improvement and upgradation to 4 lane configuration of Meerut – Najibabad, section of NH – 119 passing through Hastinapur wildlife century, Uttar Pradesh" vide letter dated 15.04.2022.</p> <p>After incorporating the recommendations of the WII, the realignment plan was submitted to the WII. WII vide letter dated 22.06.2022 confirmed that the modified alignment is as per suggestions/ recommendation of the WII.</p> <p>DFO Muzaffarnagar requested for submitting the rectified proposal by incorporating the recommendations of WII.</p> <p>All mitigation measures as recommended in the detailed report of the WII have already been incorporated in the subject proposal under consideration.</p> <p>In view of the above, the EDS may be considered as complied.</p>
2	The report of WII may be submitted for consideration of REC.	Report of WII has already been submitted along with the subject proposal (page no. 132 - 157). However, the report is being submitted again for ready reference (Annexure - I).
3	Kml file of area proposed for diversion may be revised as per final notification of WLS.	Complied. Enclosed as Annexure – II (digital format).
4	Details of ROW available for roadside plantation in non- forest areas shall be submitted along with the road side Plantation Scheme	<p>Complied. Enclosed as Annexure – III.</p> <p>It is submitted that as per road side plantation scheme total 37,000 nos. (i.e. 25500 nos. in median and 11500 in avenue plantation) of trees are proposed to be planted.</p>

16/6/23

**Santosh Kumar Bajpai**  
Project Director  
National Highways Authority of India  
PHI - Meerut





# भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन और राजमार्ग मंत्रालय, भारत सरकार)

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परियोजना क्रियान्वयन इकाई - मेरठ

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A-1, Vaishno Dham, Near Gayatri Heights, Kankerkheda, NH-58, Meerut-250001

टेलीफोन/Telephone: 0121-2631228 ई-मेल/e-mail: meerut@nhai.org



NHAI/PIU-MRT/2023/D- 277/16

Dated: 16.06.2022

To  
The Divisional Forest Officer  
District-Bijnor

**Name of Project Road-Forest Land Diversion proposal for "Improvement and Up-gradation to 4-lane configuration of Meerut-Nazibabad section of NH-119 between Km 39+165 to Km 78+635 in the state of Uttar Pradesh".**

**Online Proposal No: - FP/UP/ROAD/43253/2019**

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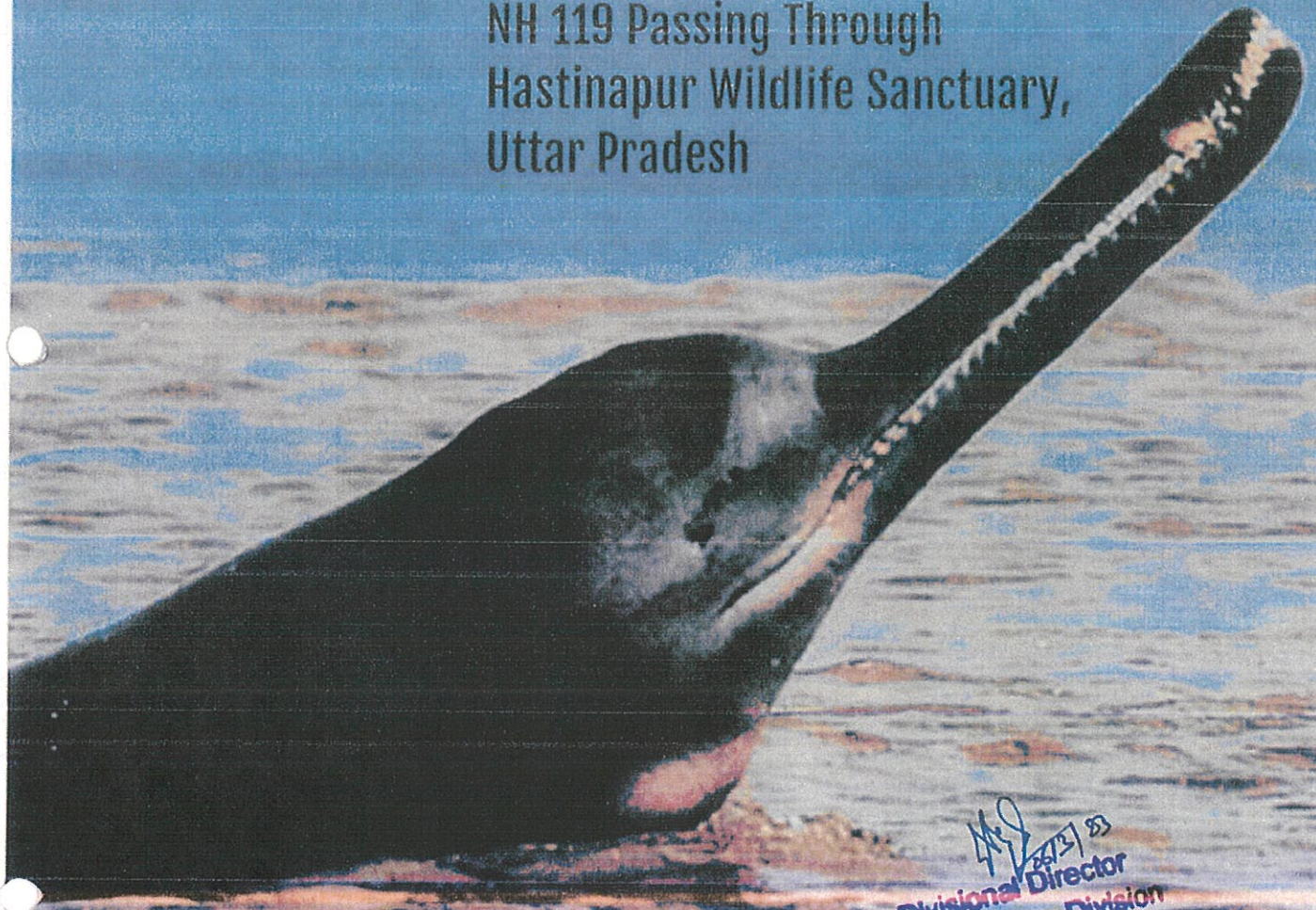
Annexure-III (Avenue & Median Plantation scheme)

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Mitigation Measures for the  
Improvement and Up-gradation  
to 4-lane Configuration of  
Meerut-Nazibabad Section of  
NH 119 Passing Through  
Hastinapur Wildlife Sanctuary,  
Uttar Pradesh



*[Signature]*  
Divisional Director  
Social Forestry Division  
BIJNOR

*16/01/23*  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

*10/01/22*  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

*06/01/23*  
उप प्रशासकीय अधिकारी  
सा. का. प्रभाग, बिजनौर

April - 2022



# Mitigation Measures for the Improvement and Up-gradation to 4-lane Configuration of Meerut-Nazibabad Section of NH 119 Passing Through Hastinapur Wildlife Sanctuary, Uttar Pradesh

*[Signature]* 06/12/22  
Divisional Director  
Social Forestry Division  
BIJNOR

*[Signature]* 16/6/23  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

*[Signature]* 10/10/22  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

## Advisors

Director, Wildlife Institute of India  
Dean, FWS, Wildlife Institute of India

## Faculty

Dr. Bilal Habib, Scientist – E

## Researchers

Akanksha Saxena  
Adil Khan  
Saumyata Srivastava



Wildlife Institute of India (WII)  
Post Box # 18, Chandrabani  
Dehradun – 248001, INDIA  
Tel : +91-135-640111 to 115  
Fax : +91-135-640117  
Website : <http://www.wii.gov.in>

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10/10/22  
Santosh Kumar Bajpal  
Project Director  
National Highways Authority of India  
PTU - Meerut

06/3/27  
सां.पां. मजारा, बिजनीय



## Acknowledgements

This report would not have been possible without the support of various persons who actively helped us during different stages of the project.

We are thankful to Uttar Pradesh Forest Department for all necessary permissions and support. We are thankful to NHAI for support and assistance during field visit.

We wish to express our profound gratitude to Director, WII. We are equally thankful to the Dean-Faculty of Wildlife Science, WII, Research Coordinator, and the Registrar, WII, for their continuous support in various ways.

16/6/23  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PTU - Meerut

16/6/23  
Divisional Director  
Social Forestry Division  
BIJNOR

13/11/22  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PTU - Meerut



# Contents

	Page No.
<b>Acknowledgments</b>	
1 Introduction	01
2 Project Background	01
3 Project Site	02
4 Projected impacts of the highway up-gradation	05
5 WII's Involvement	05
6 Objectives of the Study	05
7 Identification of critical wildlife areas across the stretch of highway segment to be up-graded	06
Mitigation measures considering animal movement and presence in the study area	09
8. General recommendations	13
9 References	16

16/6/23  
 Divisional Director  
 Social Forestry Division  
 BIJNOR

16/6/23  
 Santosh Kumar Bajpai  
 Project Director  
 National Highways Authority of India  
 PTU - Meerut

10/10/22  
 Santosh Kumar Bajpai  
 Project Director  
 National Highways Authority of India  
 PTU - Meerut

06/3/23  
 उप प्रमोक्षक वनाधिकारी  
 सा. शा. प्रमोक्ष, बिजनौर



## Introduction

India has the second-largest road network in the world, spanning over 5.8 million km (IBEF 2021) and costing more than INR 6.26 lakh crore. More than 64.5% of all goods in the country are transported through roads, while about 90% of the total passenger traffic uses this road network to commute (Ministry of Road Transport & Highways 2020). The Indian Government launched the Bharatmala Pariyojana, which aims to build 66,100 km of economic corridors, border and coastal roads, and expressways to boost the highway network<sup>1</sup>. It is envisaged that the programme will provide 4-lane connectivity to 550 districts, increase the vehicular speed by 20-25% and reduce the supply chain costs by 5-6%.

Earlier, when environmental protection was poorly regulated, protected areas (PAs) were managed as natural 'islands' that remained largely untouched by human influence (WII 2016). Today, it is understood and recognized that these 'islands' can no longer exist as individual identities and that they are part of larger, global matrix that need to interact for their survival – and the survival of biodiversity. Their survival is dependent on a wide variety of human and natural factors – some of which are disruption of contiguity as a result of construction and up-gradation of linear infrastructure. In India, forests cover a total of 21.34% of the country's land surface, out of which only 4.89% come under protection (WII 2016). Within many of these protected areas, roads, railway lines and transmission lines cut across the landscape, fragmenting (Taylor & Goldingay 2010) them and opening them to further exploitation and death. Wide-ranging species require contiguity of their habitat across landscapes. With the increase in extent of linear development in most landscapes, outside protected areas present a major challenge for wildlife management and conservation. The impact of roads and railway lines are similar, as they convert a strip of land into an area of fast-paced vehicles that can collide and maim/ kill both human and animal (Rendall et al. 2021). They also emit loud noises and lights that act as a deterrent and thus create a sense of physical barrier to the movement of animals (Rico et al. 2007; van der Ree et al. 2011; Shilling et al. 2020).

The need to harmonise linear development and biodiversity conservation is essential to both economic and ecological security. Wildlife crossing structures and mitigation strategies like underpasses (e.g., amphibian tunnel, badger pipe, ledges in culvert), overpasses (e.g., land bridge, rope bridge, glider pole), early – warning systems (Santosh et al. 2017; Ford et al. 2017) etc. can help regulate and ensure safe movement of wildlife across roads and highways (WII 2016; Development Bank 2019; United States Department of Agriculture 2021).

## Project Background

The National Highways Authority of India (NHAI) has proposed up-gradation and improvement of a 40 km section of the National Highway 119 between Meerut and

<sup>1</sup> Soni, Prerna. "Highway to growth". *Invest India: National Investment Promotion & Facilitation Agency*, दिजनीव



Nazibabad in Uttar Pradesh. The total length of the road is 40.165 km, out of which 8.085 km of road traverses the Eco-Sensitive Zone (ESZ) of the Hastinapur Wildlife Sanctuary (HWLS), 1.830 km is outside HWLS, and remaining 30.250 km passes through HWLS. NH-119 is to be developed as 4 lane road to provide alternative connectivity to Haridwar to relieve pressure on Delhi – Haridwar National Highway (NH 58) during the annual pilgrimage of Shiva devotees during the 'Shravan' months i.e. monsoon. Hundreds of thousands of devotees from surrounding states of Delhi, Uttar Pradesh, Haryana, Rajasthan, Punjab, Bihar, Jharkhand, Chhattisgarh and Madhya Pradesh reach these places to participate in Kanwar Mela. Heavy security measures are undertaken by the government and the traffic on the Delhi – Haridwar National Highway (NH 58) and is diverted to NH 119 (presently 2 lane) for the period. The project road provides connectivity from take-off point at NH-58 to NH-119 (near Meerut) and at terminal point on Nazibabad on NH-74 to ensure seamless movement of traffic on NH-58, NH-74 & NH-119.

### Project Site

The proposed up-gradation of NH-119 traverses the Hastinapur Wildlife Sanctuary (HWLS) for a total length of 40.165 km, of which 8.085 km of road traverses the Eco-Sensitive Zone (ESZ) of the HWLS, 1.830 km is outside HWLS, and remaining 30.250 km passes through HWLS. The sanctuary covers an area of 2037 sq. km. of which 239.41 sq. km. comprises of the ESZ.

HWLS is situated between 29.5799° and 28.7538° latitude, and 77.9009° and 78.1372° longitude in the state of Uttar Pradesh. It is spread across 5 districts in the state of Uttar Pradesh, namely – Meerut, Bijnor, Muzaffarnagar, Hapur and Amroha. The altitude of the area ranges between 130 and 150 m above mean sea level (Khanal et al. 2013). This sanctuary was notified to specifically provide protection to a niche specific mega-herbivore, the swamp deer (*Rucervus duvaucelii duvaucelii*) (Kumar et al. 2021). It is also home to other mammals like leopard (*Panthera pardus*), striped hyena (*Hyaena hyaena*), nilgai (*Boselaphus tragocamelus*), and spotted deer (*Axis axis*) among other animals (Ramsar 2021).

Haiderpur Wetland, a Ramsar site (Ramsar 2021) is located in Muzaffarnagar and Bijnor Districts of Uttar Pradesh in the northern part of India, has an area of 60.98 sq. km. Towards the east of the wetland is River Ganga, to the west is Nizampur and Haiderpur Reserve Forest and Bijnor Barrage on the south of the wetland. Haiderpur Wetland came into existence in 1984 after the construction of Madhya Ganga Barrage on River Ganga, about 10 km west of Bijnor city and is located within the boundaries of Hastinapur Wildlife Sanctuary. The entire wetland is thus protected under India's Wildlife (Protection) Act, 1972. This freshwater human-made wetland receives backwater flow from River Ganga during monsoons and retains water till the end of February. It comprises varied deep upstream reservoir, shallow flooded land and stretches of river (Ganga and Solani). In addition to the perennially inundated patches, the wetland boundary also takes into account the seasonal patches and ecologically sensitive areas between these patches. This mosaic is the key to the rich biodiversity

Divisional Director  
Social Forestry Division  
BIJNOR

Santosh Kumar Bajpal  
Project Director  
National Highways Authority of India  
PTU - Meerut



associated with the wetland and hence has been included in the wetland boundary. Haiderpur Wetland at least 32 species of plants, over 300 species of birds of which 102 species are water birds, more than 40 species of fishes and at least 10 species of mammals including Ganges River Dolphin (*Platanista gangetica*). The site also serves as a breeding ground for the near-threatened Indian Grassbird (*Graminicola bengalensis*) and nesting site for gharials (*Gavialis gangeticus*) ("Haiderpur Wetland" 2021).

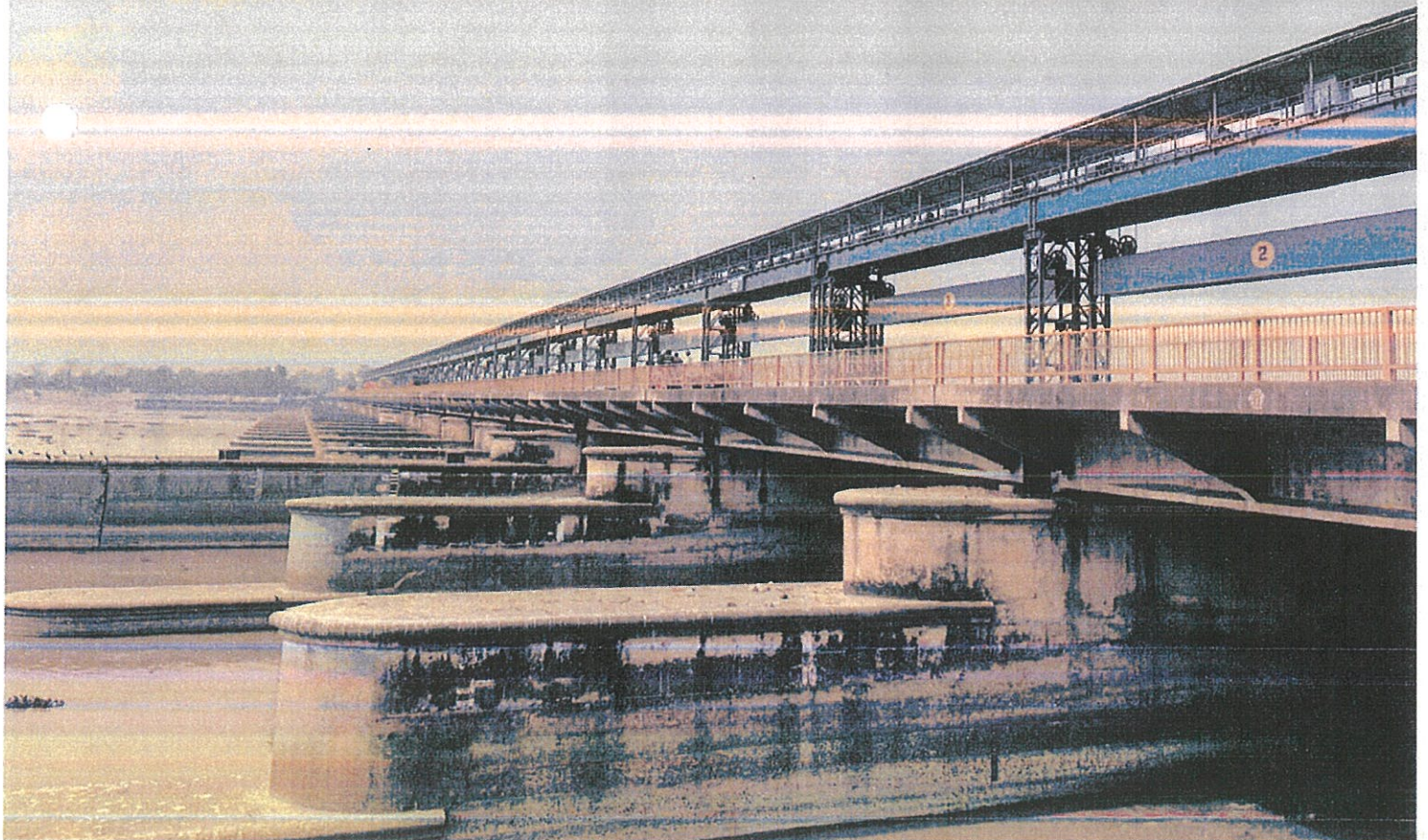
Divisional Director  
Social Forestry Division  
BIJNOR

Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

Bijnor Barrage on River Ganga on NH - 119

उप प्रभागीय वनाधिकारी  
म. व. प्रभाग, बिजनौर

Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut





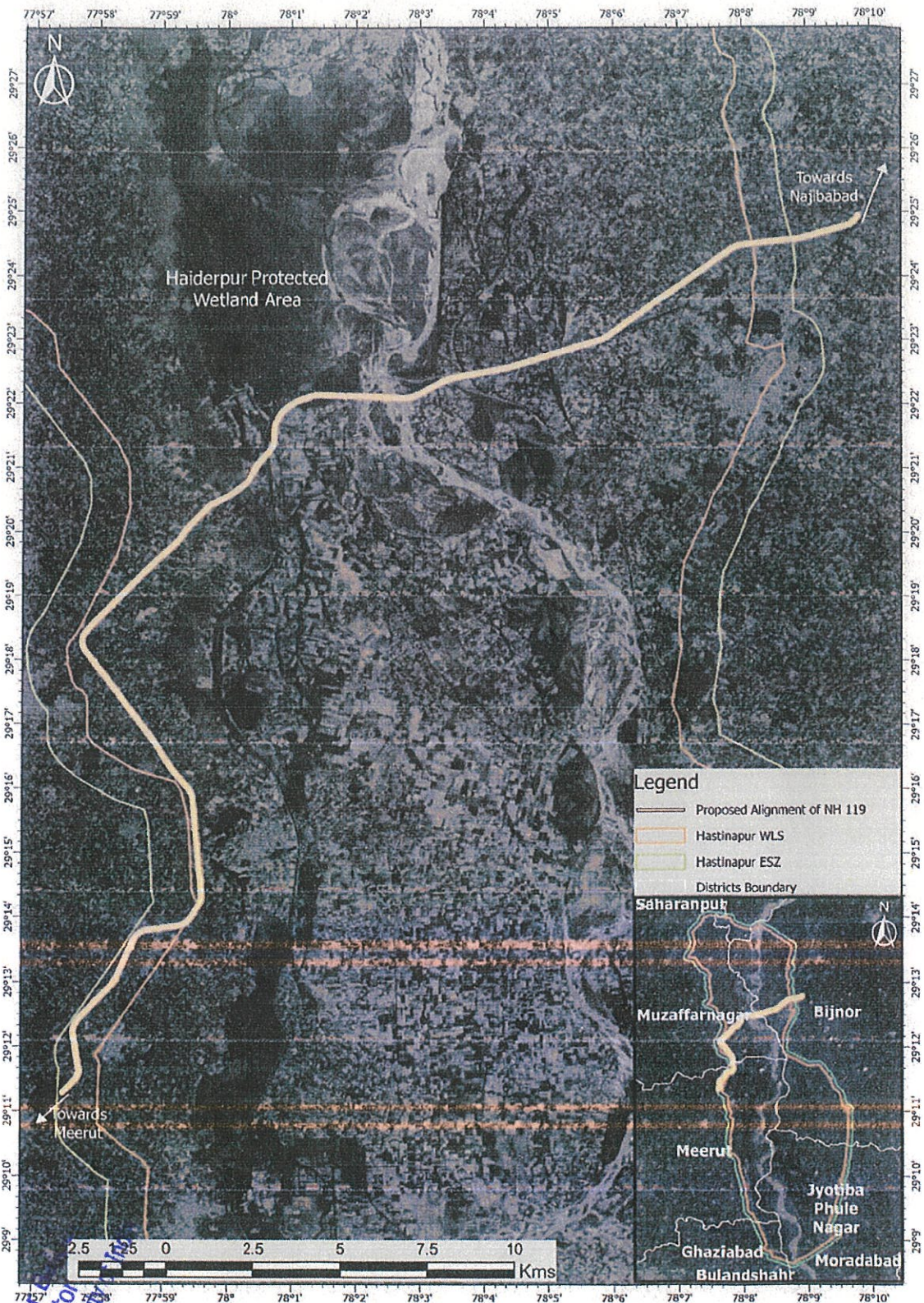


Figure 1: Proposed alignment of the National Highway 119 passing through Hastinapur Wildlife Sanctuary and ESZ.

11/6/22  
Santosh Kumar  
Project Director  
National Highways Authority of India  
PTU - Meerut

10/12/22  
Divisional Director  
Social Forestry Division  
BIJNOR

10/10/22  
Santosh Kumar Bajpal  
Project Director  
National Highways Authority of India  
PTU - Meerut

उप प्रशासिक अधिकारी  
सां. व. प्रशा. बिजौर



### Projected impacts of the highway up-gradation

The proposed up-gradation of NH-119 passes through the Hastinapur Wildlife Sanctuary covering a total length of the road is 40.165 km, out of which 8.085 km of road traverses the Eco-Sensitive Zone (ESZ) of the Hastinapur Wildlife Sanctuary (HWLS), 1.830 km is outside HWLS, and remaining 30.250 km passes through HWLS.

The impact of roads and railway lines are similar, as they convert a strip of land into an area of fast-paced vehicles that can collide and maim/ kill both human and animal (Rendall et al. 2021). Widening of the roads for up-gradation will amplify their negative impacts on wildlife. Not only will the animal be present on the road for a longer duration while crossing (Rendall et al. 2021) especially for larger slow moving species (Saxena et al. 2020), they will also be more prone to getting hit by vehicle due to higher speed limits on vehicles (Jackson 2000; Dennehy et al. 2021). They also emit loud noises and lights that act as a deterrent and are also known to influence bird nesting (Rao & Koli 2017) and alter small mammal populations (Roedenbeck et al. 2007). Increased traffic intensity, fast-paced traffic along with higher probability of wildlife-vehicle collisions therefore creates a sense of physical barrier to the movement of animals (Rico et al. 2007; van der Ree et al. 2011; Shilling et al. 2020) as well as poses a threat to human life (Taylor & Goldingay 2010; Diaz-Varela et al. 2011; Kučas & Balčiauskas 2021).

### WII's involvement

The National Highways authority of India (NHAI) has proposed up-gradation and improvement of a 40 km section of the National Highway 119 between Meerut and Nazibabad in Uttar Pradesh. The NHAI has requested WII to conduct a biodiversity impact assessment, wildlife study, and to prepare a mitigation and conservation plan for the project vide letter NHAI/PIU-MrT/66011/2021/D-22365 dated 30th July, 2021. Directives to conduct the study were also issued by the Principal Chief Conservator of Forests (HoFF), Lucknow, vide letter Desk-2870/26-11 NH-119 (43253/2019) dated 8th September 2021. A study plan was subsequently submitted by WII, and field work and desk studies were subsequently conducted.

### Objectives of the study

To avoid, minimize and remedy the adverse impacts of the proposed up-gradation to 4-lane configuration of Meerut-Nazibabad section of NH-119, Uttar Pradesh on biodiversity values of the protected area, reserve forests and maintain connectivity in the larger landscape through appropriate planning and mitigation measures. The objectives of the assessments are as follows:

1. To identify critical wildlife areas across the stretch of highway segment to be upgraded.

2. To suggest mitigation measures considering animal movement and presence locations in the study area.

Divisional Director  
Social Forestry Division  
BIJNOR

Santosh Kumar Bajpai<sup>5</sup>  
Project Director  
National Highways Authority of India  
PTU - Meerut

संयोजक, प्रशासनिक  
सा. वा. प्रशासन, बिजनौर



## 1. Identification of critical wildlife areas across the stretch of highway segment to be upgraded

### Methods

A team of WII biologists accompanied by local forest department personnel surveyed the entire stretch of the highway (38.335 km) to assess potentially important wildlife areas and crossing points based on animal signs, direct sightings (presence) and landscape features. During two intensive surveys, we considered direct sightings of animals, presence of carcasses, and other signs such as pug/ hoof marks and scat/ pellet/ dung as evidence of animal presence.

Locations of regular animal crossing locations as well as important bird sites (including Haiderpur Wetland) were also recorded based on information from beat guards. All the spatial information was recorded, including GPS locations of the signs, sightings and crossing locations.

We also conducted spatial characterization of area around proposed alignment to be upgraded to identify land-use land-cover types that are important in the context of wildlife and bird presence/movement.

We used high resolution optical satellite data i.e. Sentinel-2 imagery. Sentinel-2 Level-2 data with band composition of red (R), green (G), blue (B), near-infrared (NIR) and short-wave infrared (SWIR) for the year 2021. The data after monsoon season was stacked together to include the pixel value of the region for each season and then it was reduced to calculate mean for further processing. Only RGB, NIR and SWIR was used from the sentinel data as they have same spatial resolution i.e. 10 meters, and because normalized difference vegetation index (NDVI) and normalized difference water index (NDWI), can be computed using red and NIR band, and NIR and SWIR respectively. The analysis work has been done in Google Earth Engine (GEE).

An effective classification system and an adequate number of training samples are the basic requirements for a good classification. The land cover was divided into 5 major classes – Water Bodies, Forest, Built-up, Grassland and Agricultural land. Grassland and forest land have been classified using NDVI index, while water class is demarcated using NDWI index, and normalized difference built-up index (NDBI) helps in identification of built-up area. The classification method used for this is random forest classifier. Random forest, like its name implies, consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction. These large number of relatively uncorrelated models (also represented as trees in the classifier) operating as a group will outdo any of the individual constituent models.

Data received from the Forest Department and the information collected during the field surveys were collated for the presence of animals and/or movement near the

14/6/23  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
Divisional Director  
Social Forestry Division  
BIJNOR

10/11/22  
Santosh Kumar Bajpai<sup>6</sup>  
Project Director  
National Highways Authority of India  
PTU - Meerut



existing and proposed highway to identify important animal corridors and crossing points intersected by the highway.

Finally, all animal presence locations, records of endangered and rare birds and nesting sites were collated and overlaid with the spatial characterization layer in the GIS domain to identify critical areas for mitigation in the area.

### Results

We found that most of the new and existing alignment of the highway passes through agricultural land (Fig. 2). The forests lie near the Haiderpur Wetland, and some riverine grasslands near the barrage.

We found 2 potential areas of importance from the wildlife perspective (Fig. 2 (a) and (b)):

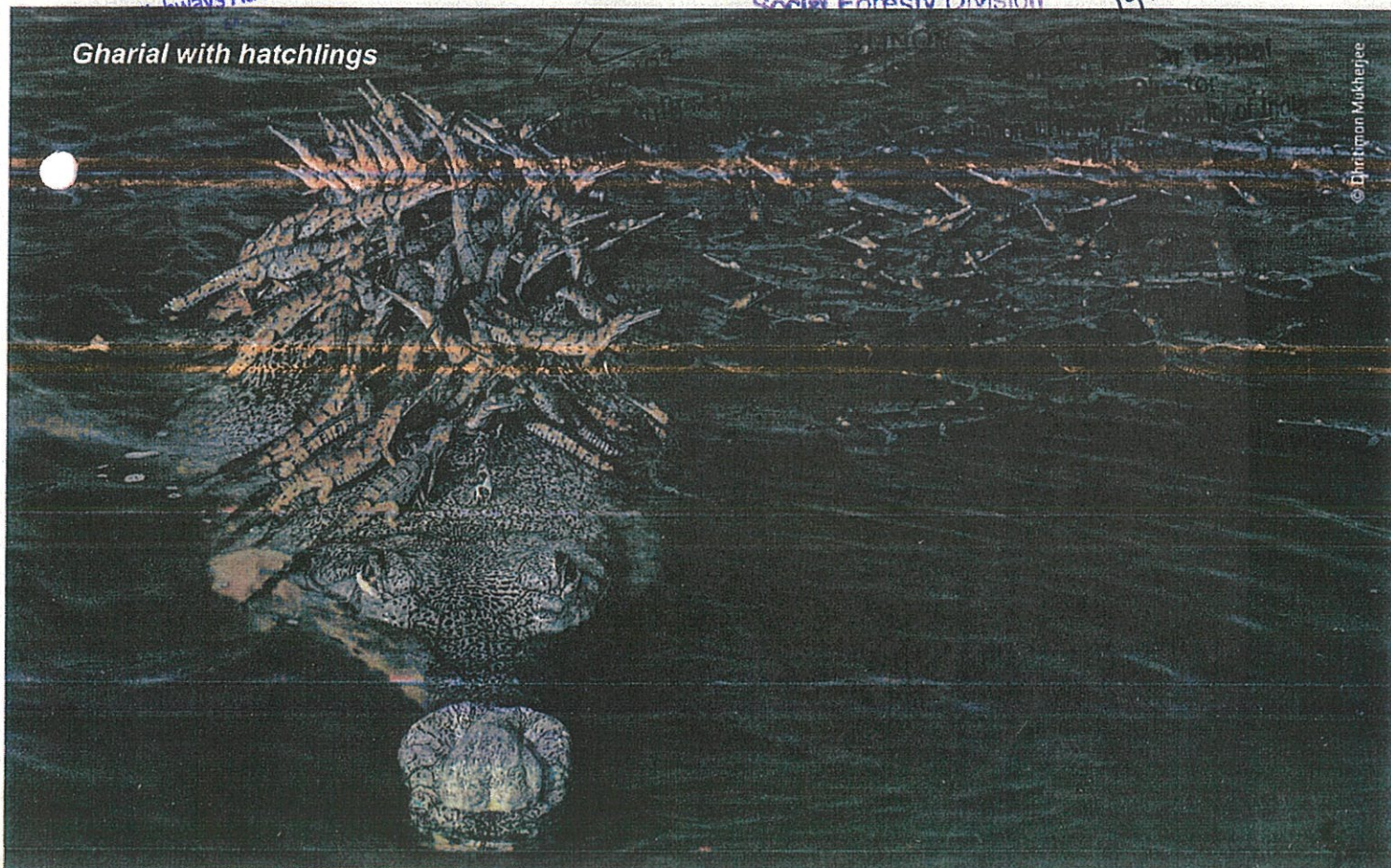
- a) The grassland patch near the barrage which is part of the Haiderpur Wetland has been reported to be the breeding site of vulnerable bristled Grassbird (*Schoenicola striatus*) and near-threatened Indian Grassbird (*Graminicola bengalensis*). The area is also known to host the critically endangered yellow-breasted bunting (*Emberiza aureola*) whose population has been rapidly declining (IANS 2021).
- b) An 800 m stretch of the road having forest cover on both the side. This stretch is being used by animals like spotted deer and nilgai (Meerut Bureau 2019) to cross. The segment lies between chainages 60/250 – 61/050.

16/6/23  
Santosh Kumar Baspal  
Project Director  
Highways Authority of India

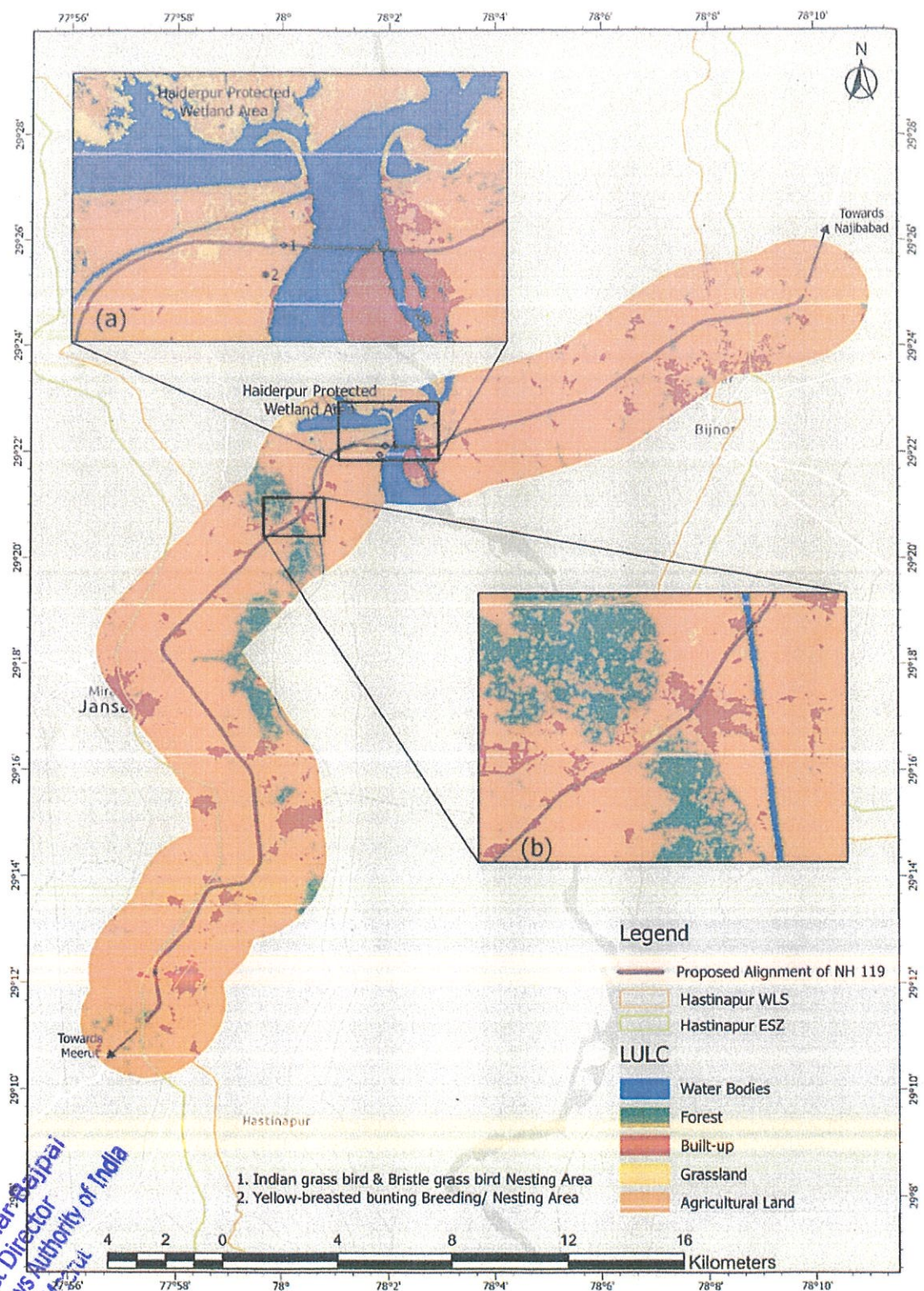
16/6/23  
Divis... Director  
Social Forestry Division

19/10/22

Gharial with hatchlings







**Figure 2:** Consolidated map of LULC classes on 2 km buffer on either side of the proposed alignment of National Highway 119, and ((a) and (b)) important sites identified for wildlife and birds).

संयोजक प्रशासकीय अधिकारी  
 एन. हा. प्रसाद, बिजनौर

Divisional Director  
 Social Forestry Division  
 BIJNOR

Santosh Kumar Bajpai  
 Project Director  
 National Highways Authority of India  
 PII - Meerut



## 2. Mitigation measures considering animal movement and presence in the study area

We evaluated existing structures on the highway and assessed the scope of additional measures on identifying priority animal crossings on the basis of these presence points, and assessed possible mitigation measures for the up-gradation of the highway.

### Results

With respect to the two priority sites, the following specific measures are recommended. These recommendations have also been summarized in Table 1.

- a. For the identified important bird breeding sites, which is also in close proximity to the Haiderpur Wetland, the alignment of the highway should be aligned along the forest edge in a way so as to avoid the grassland habitat lying to the south of the wetland and breeding sites. The bridge on the new alignment should start elevating at chainage 63/250 and the pillars are to be built on the edge of the forest patch with light and sound barriers. The alignment would then join the proposed alignment at chainage 65/250 (Fig. 3). Given the reported presence of Gangetic dolphin and gharial in the area, measures to reduce disturbance to aquatic fauna should be implemented at all stages of the construction of the highway. The height of the proposed bridge should be 9-11 m to reduce the impact on aquatic life. Disturbance to the river bank should be minimised as much as possible. Water and sand from the river should not be used for construction purposes.
- b. For the 800 m segment of the highway passing through forested area (chainage 60/250 – 61/050), two 50 m underpasses of 5 m height are recommended (Fig. 4).

**Table 1:** Summary of mitigation measures recommended on NH 119 proposed for up-gradation passing through the Hastinapur Wildlife Sanctuary and ESZ.

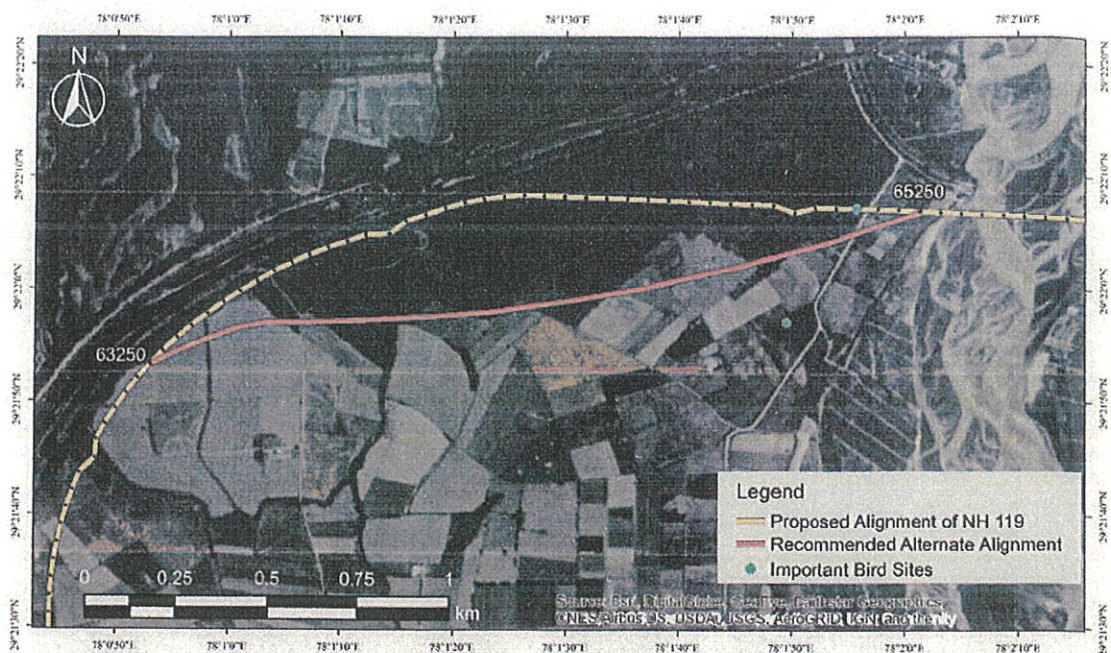
Segment	Mitigation measures recommended	Chainage
(a) Highway alignment south of the Haiderpur Wetland.	Elevated structure to be provided in the forest patch with minor – realignment along the edge of the forest patch.	63/250 – 65/250
(b) 800 m segment passing through forested patch	Two animal underpasses measuring 50 m each	60/350 – 60/400 and 60/750 – 60/800
	Fencing	60/250 – 61/050

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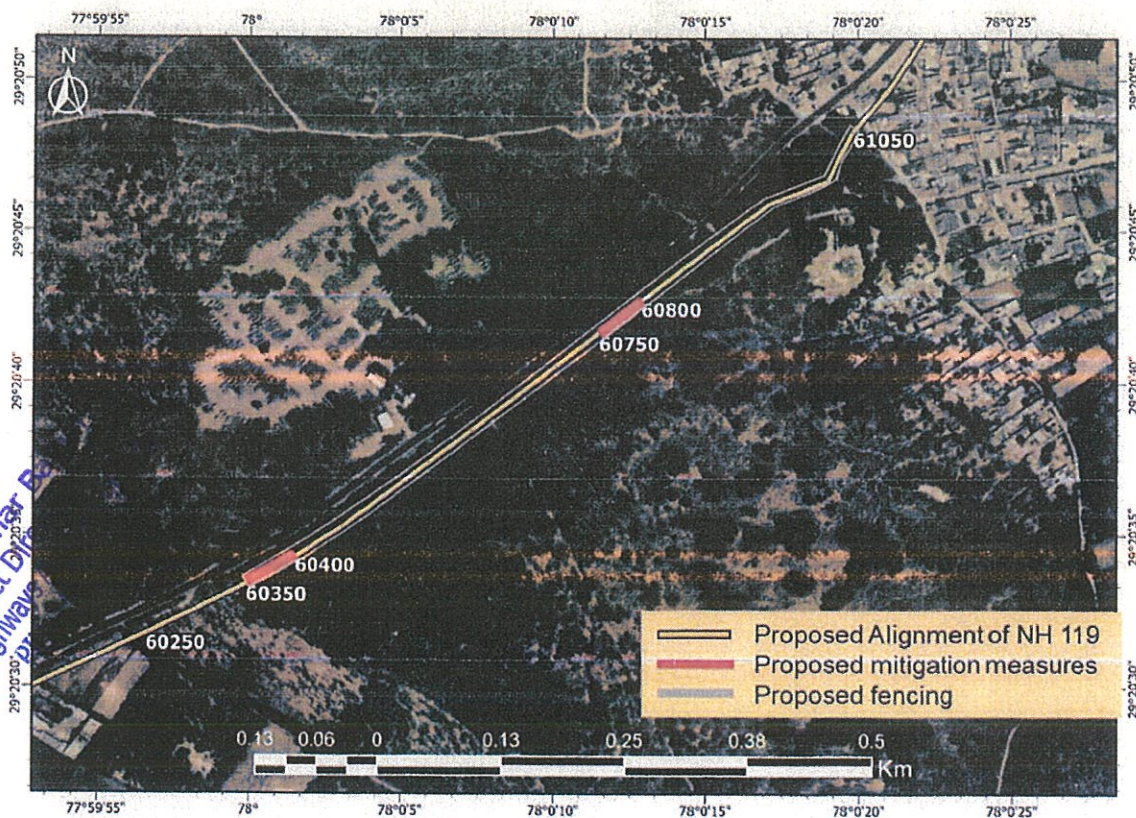
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National Highways Authority of India  
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**Figure 3:** Proposed alignment of NH 119 (red line) around important bird breeding sites on the grasslands south of the Haiderpur Wetland, between chainage 63/250 and 65/250  
(Red – line does not represent exact alignment – only for representation to show alignment along the forest edge).



**Figure 4:** Proposed mitigation measures on NH 119 between chainage 60/250 and 61/050. Red lines indicate locations of two proposed 50 m wildlife underpasses, grey line indicates stretch of the highway to be fenced.

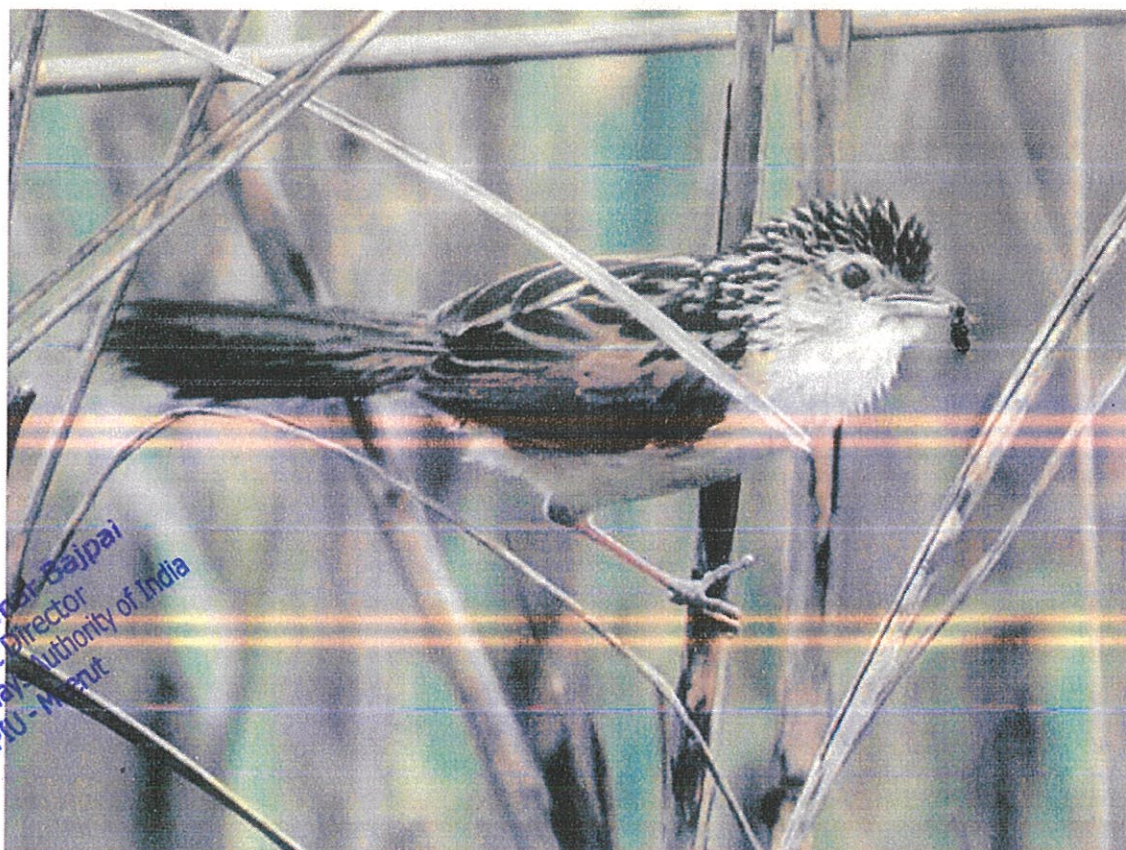
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Photograph showing grassland patch – the alignment should be at the edge of the patch, not through the middle of this patch.



Indian Grassbird reported from the grassland patch near the barrage.

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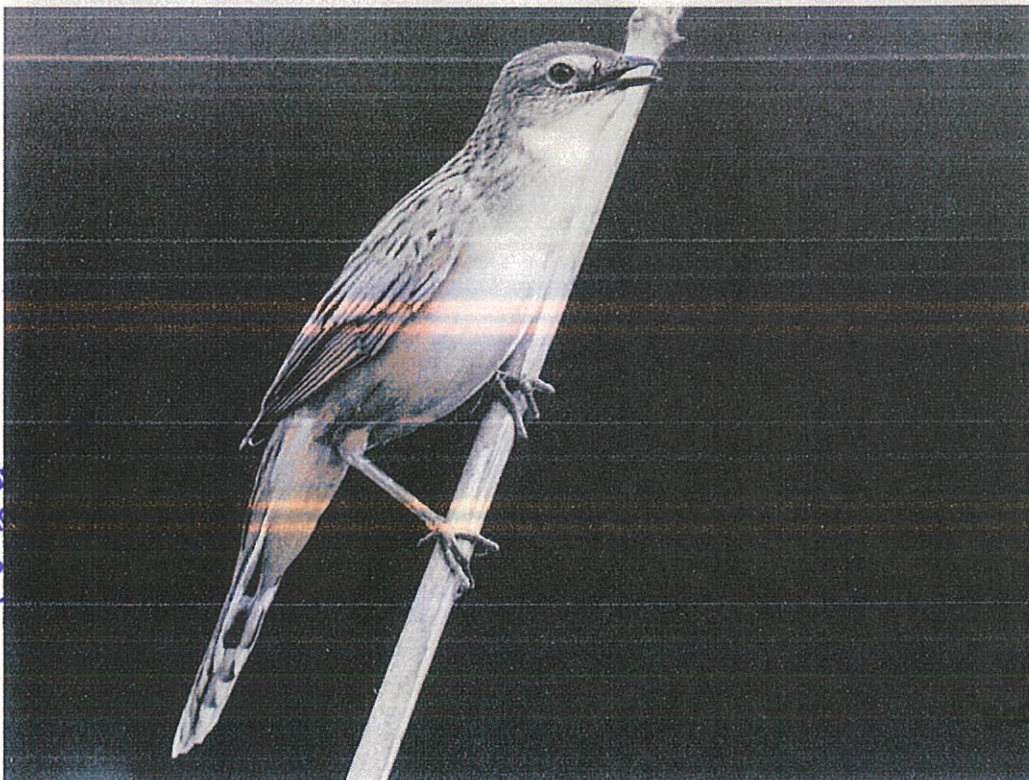
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Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
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Yellow-breasted bunting reported from the grassland patch near the barrage.



Bristled Grassbird reported from the grassland patch near the barrage.

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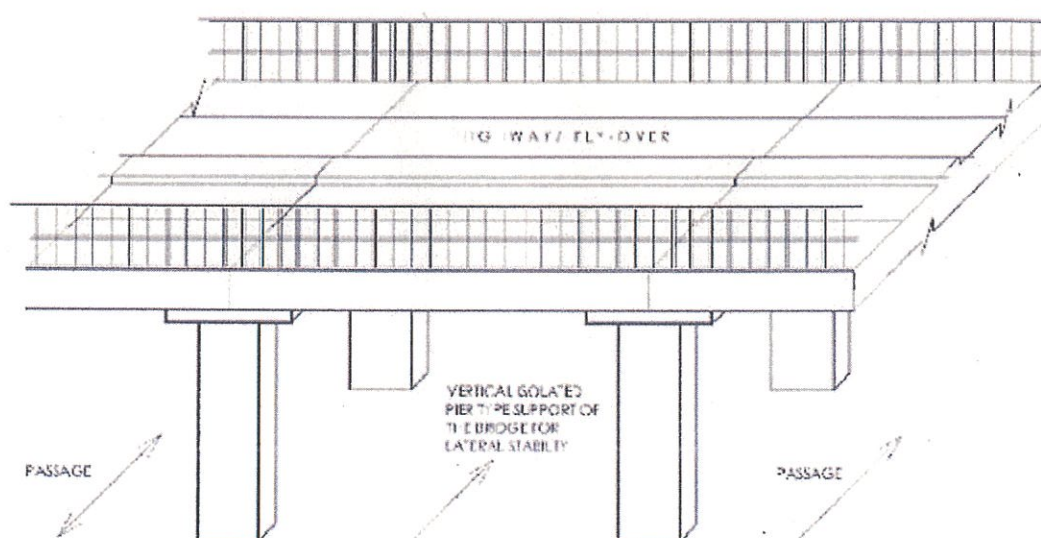
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National Highways  
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## General Recommendations

1. Construction near the barrage and important bird sites shall be avoided during winters i.e., time of visit of migratory birds to the wetland and barrage.
2. The height of all bridges, box culverts and other drainage structures (including those in agricultural areas) should not be less than 3 m. The minimum width of all box culverts should not be less than 5 m. The minimum height should not be achieved by ground excavation but by elevating the road.
3. Divisions between the crossing structures should be of pillar type, instead of wall-type (Fig. 5).



**Figure 5: Pillar-type division of bridge**

4. The underpasses must be kept free of all human-related activities and disturbances including foot-trails and roads, as these have a negative influence on the use of crossing structures by wildlife. The existing road under the proposed crossing structures between chainages 60/350 and 61/050 should be removed post-construction of the crossing structures. Only the access road from the north side of the highway towards the timber depot near the highway should be used.
5. Noise and sound barriers (2 m high) should be installed along the entire stretch of the highway passing through sensitive areas, which would also act as fencing to prevent animals from entering the road corridor. The top ends of the barrier should be turning outwards or be slightly tilted/angled outwards (Fig. 6), to reduce inward propagation of noise (and subsequently within the crossing structure via the gap in the median). Additionally a fibre glass covering should

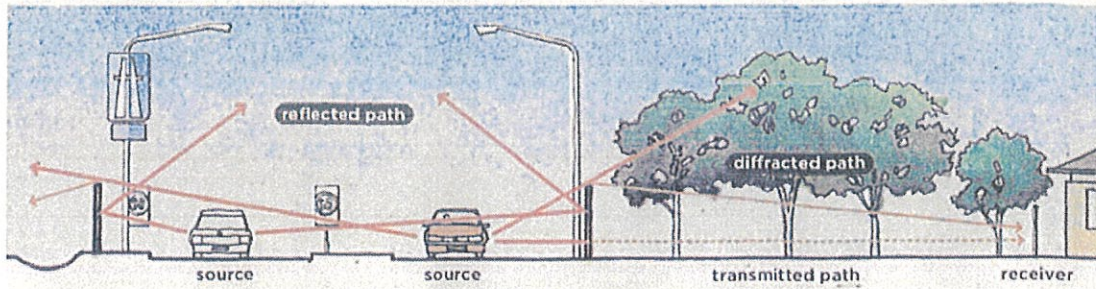
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Project Director  
National Highways Authority of India  
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be installed on top of the median opening to reduce ingress of noise into the crossing structures.



Reflective paths can add to noise and need to be considered.



Tilted noise barriers can direct noise away from the receiver.

**Figure 6:** Barriers for attenuating noise along the highway showing reflected noise (top); tilted noise barriers for minimising reflected noise (bottom).

(Source: Noise wall design guideline, Centre for Urban Design, NSW Government).

6. Cattle guards (2 m wide) must be installed at both ends of all structures to stop wild and domestic animals from getting trapped within the fences/barriers (Fig. 7).

16/6/23  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

06/3/23  
Divisional Director  
Social Forestry Division  
BIJNOR

06/3/23  
अव प्रसंगीय वनाधिकारी  
प्रा. वन प्रसाद, बिजनौर

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Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
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**Figure 7:** Cattle guards/grids to be installed at both ends of the crossing structure on NH 119 at Chainage 60/350 and 61/050.  
Source: (Clevenger & Huijser 2011)

7. Disturbance during construction in the sensitive areas is to be kept minimum by the following mechanisms:
  - Use of pre-fabricated materials for construction
  - Use of water from sources other than the river
  - Disposal of construction-related debris away from the sensitive sites
  - Prohibition on camping of construction personnel near these sites
8. Post-construction rehabilitation of uprooted grassland and riverine vegetation is to be done using native flora in collaboration with forest department. No avenue plantation or planting of fruit-bearing trees should be done along the sensitive stretches of the highway.
9. Site specific measures to avoid water pollution and siltation are to be employed including use of oil interceptors.
10. Warning and information boards for awareness should be erected along the highway regarding the ecological importance of the area.
11. Both sensitive stretches should be declared no honking and no stopping/parking zones.

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Santosh Kumar Bajpal  
Project Director  
National Highways Authority of India  
PTU - Meerut

Divisional Director  
Social Forestry Division  
BIJNOR

उप प्रमुख, प्रशासकीय  
सा. वा. प्रभाग, बिजनौर

10/01/22  
Santosh Kumar Bajpal  
Project Director  
National Highways Authority of India  
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Social Forestry Division  
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Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PTU - Meerut




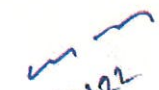
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Social Forestry Division  
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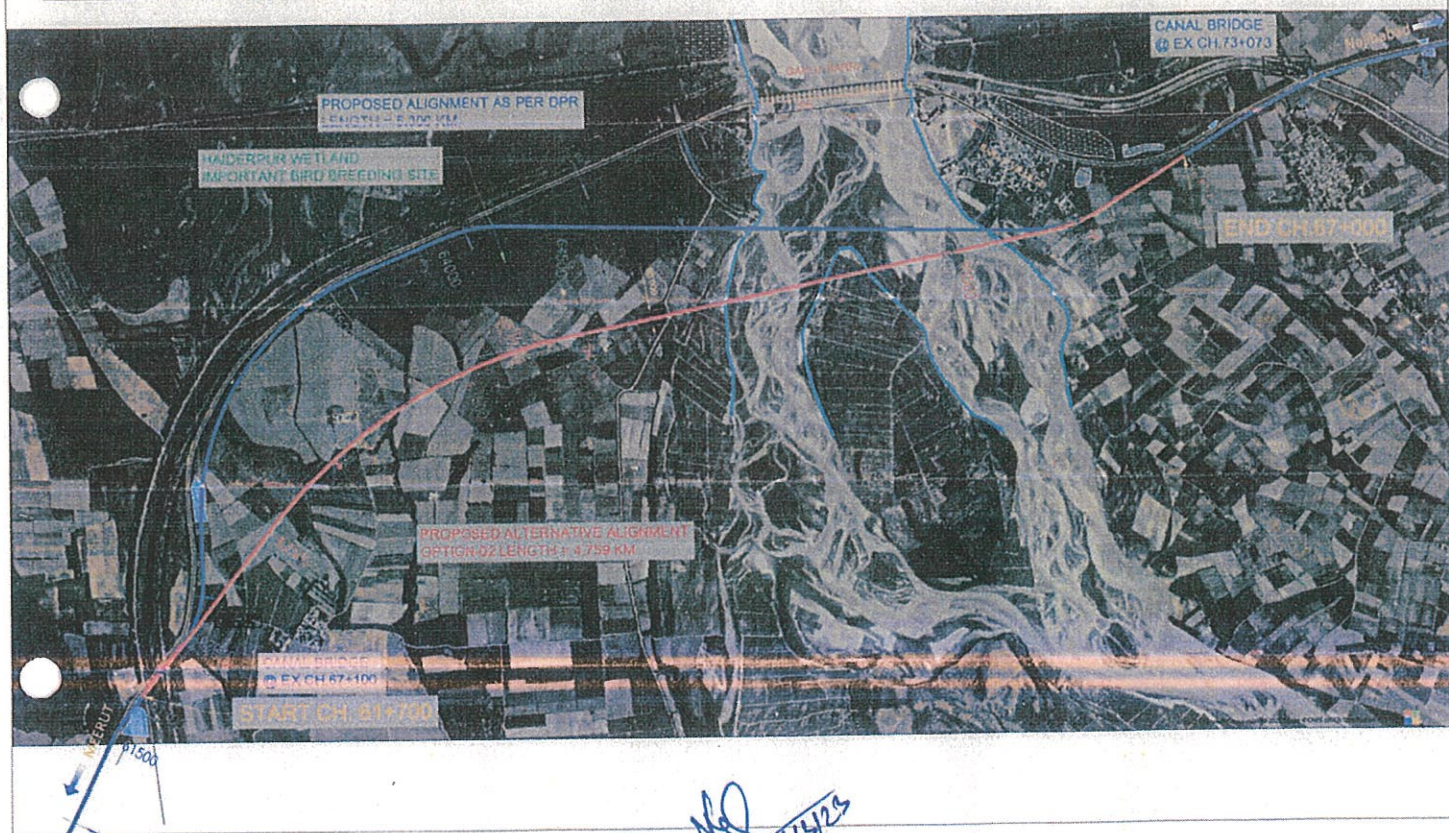
  
Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PIU - Meerut

  
सम प्रशासकीय सहायक  
राज्य सरकार, बिजनौर

  
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Project Director  
National Highways Authority of India  
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# Alternative Alignment Options at Ganga Barrage location for Meerut Najibabad NH-119 PKG - II



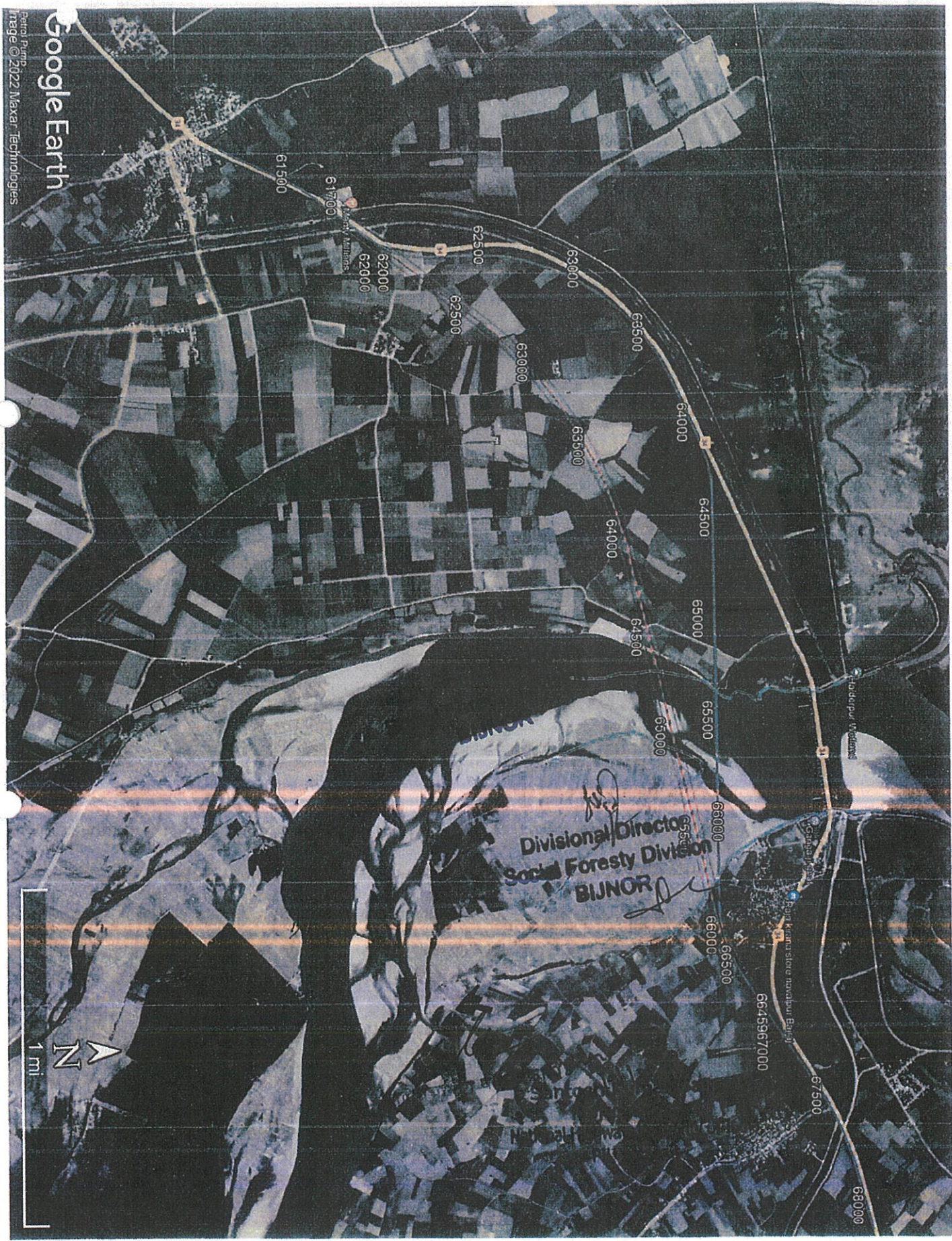
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उप प्रभागीय वनाधिकारी  
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Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
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सा. प्र. शा. गणपत, विजयवाड़ा

19/10/22

Director  
Wildlife Institute of India, Chandrabani  
Dehradun, India 248 001  
Tel: 00 91 135 2646101  
Fax: 00 91 135 2640117  
E-mail: [dwi@wii.gov.in](mailto:dwi@wii.gov.in)  
[www.wii.gov.in](http://www.wii.gov.in)



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## Annexure-III

# Avenue & Median Plantation Scheme


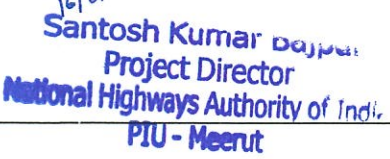
**Name of Project:** - Project Name: - Forest Land Diversion proposal for "Improvement and Up-gradation to 4-lane configuration of Meerut-Nazibabad section of NH-119 between Km 39.165 to Km 78.635 in the state of Uttar Pradesh".

**Online Proposal No;** - FP/UP/ROAD/43253/2019

**Area of Forest Land Diversion:** - 38.8514 Hectare

**Length of Project Road:** - 39.470 Km



<p>Santosh Kumar Bajpai Project Director Project Implementation Unit Meerut, Uttar Pradesh.</p> <p>Signature: - </p> <p>Seal: - </p>	
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## Table of contents

1. Introduction .....	2
2. Objectives of the Project: .....	2
3. Average width available for avenue plantation .....	2
4. Plantation strategy .....	2
5. Average width available for median plantation: .....	3
Table 1: Details of Median & Avenue Plantation .....	3
Table 2: Details of Avenue Plantation .....	3
6. Plantation Layout Plan and Pits digging .....	5
Figure 1: Plantation Layout Plan .....	5
7. Technical Specifications .....	5
Table 3: Technical Specifications of Ornamental/ Flowering Plants .....	6
8. Species Planned for median Plantation: .....	6
Table 4: Species Proposed for Median Plantation .....	6
9. Species Planned for 1 <sup>st</sup> Row of Avenue Plantation: .....	7
Table 5: Species Recommended for 1st Row of Avenue Plantations .....	7
10. Planting Material: .....	7
a. Insecticide/pesticide/fungicide: .....	7
b. Manure/compost/fertilizer: .....	8
c. Watering Plan: .....	8
d. Plantation Protection Plan: .....	8
e. Fire: .....	8
f. Insects and fungi: .....	9
g. Wild animals: .....	9
h. Domestic animals: .....	9
i. Barbed Wire fencing: .....	9
11. Benefit of tree plantation in terms of Greenhouse effect .....	9
12. Abstract of estimated project cost: .....	10
13. Source of fund for implementation scheme .....	10
Typical Cross sections of project road .....	11

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## Plantation Scheme

### 1. Introduction

This proposed plantation scheme is for the project namely "Improvement and Up-gradation to 4-lane configuration of Meerut-Nazibabad section of NH-119 between Km 39.165 to Km 78.635 in the state of Uttar Pradesh". The plantation scheme is prepared to compensate the ecological loss for felling of trees, development of aesthetic values and enhancement microclimatic conditions. Avenue and median plantation will be carried out as per IRC SP: 21 2009 and National Green Highways Policy 2015. The project road for which the Plantation scheme is prepared is located in District Meerut, Muzaffarnagar and Bijnor, Uttar Pradesh. The total length of the project road is 39.470 km, traverse predominantly through Agricultural and settlement area. Keeping in view of prevailing code for plantation and availability of land one row plantation can be accommodated and the same is provisioned. All together approx. 25500 nos. of shrubs in median and 11500 trees as avenue plantation will be planted within the PRow of project road.

### 2. Objectives of the Project:

The main objectives of planting along the project road are as follows: -

- For aesthetic enhancement of the project road by planting selective ornamental trees, median plantation with ornamental shrubs and turfing with grasses.
- To reduce the impacts of air pollution and dust as trees and shrubs are known to be natural sink for air pollutants.
- To provide much needed shade on glaring hot roads during summer.
- To reduce the impact of ever-increasing noise pollution caused due to increase in number of vehicles.
- To arrest soil erosion at the embankment slopes.
- Prevention of glare from the headlight of incoming vehicles.
- Moderating the effect of wind and incoming radiation

### 3. Average width available for avenue plantation

Project road is a section of existing highway (NH119) between Meerut and Bijnor. In general proposed right of way (PRow) is 60 meters, while the existing road width (Bituminous) is of 10 meter (2 lane). There is an elevated road section near Ganaga Barrage between km 62+000 to 66+500 accordingly roadside avenue plantation is not provisioned, However, median plantation will be carried out. Similarly, there is provision of service road (both side measuring km 18.83 km at different location and in this section plantation is not possible (either side) so in these section only Median Plantation in two row is proposed.

### 4. Plantation strategy

Keeping in view of availability of land, which is between 5 to 7.5 meter either side, single row plantation is proposed. The project road runs through urban and semi-urban areas accordingly a combination of ornamental, shade and screening trees have been proposed. Wildlife Institute of India (WII) Dehradun has also been engaged for the study pertain to wildlife conservation and mitigation and it is recommended that "No avenue plantation or planting of fruit-bearing trees should be done along the sensitive stretches of the highway". This is primarily to keep away the birds and other animals like Monkey from highway so the associated collision with vehicle can be avoided.



5. Average width available for median plantation:

Average width available for median plantation is 4.0 m.

The area/location of avenue and median has been presented in Table 1 & 2 below.

**Table 1: Details of Median & Avenue Plantation**

Details of Median Plantations									
SL	Type of Plantation	Length (Km)		Length (km)	Width kept for plantation (m)	Plant to Plant distance (m)	No. of row	Total no. of plant to be planted	Remarks
		From	To						
1	Median	39.165	78.635	39.470	4.00	3	2	25500.00	As the project is of 4 lane with paved shoulder 4.0 meter median is provision which can accommodate 26287.00 in 2 row at plant to plant distance 3 meter in staggered way. However, at site keeping in view of road user safety / and site clearance at curve / at median opening/ at junctions, the total number of median plants may likely to slightly reduce and for the purpose of calculation the figure kept is 25500.00
		Total median plantation						25500.00	

**Table 2: Details of Avenue Plantation**

SL	Type of Plantation	Chainage		Length (Km)	Width kept for plantation (m)	Plant to Plant distance (m)	No. of Row	Total no. of plant	Remarks
		From	To						
1	Avenue	42.000	44.000	2.000	5.0 -7.5	3	1+1	1332	New Construction of 4-Lane with Paved Shoulder, Behsuma Bypass 39.85-45.70
2		46.900	47.700	0.800	5.0 -7.5	3	1+1	532	New Construction of 4-Lane with Paved Shoulder, Ramraj Bypass 46.30-49.50
3		51.100	54.640	3.540	5.0 -7.5	3	1+1	2357	New Construction of 4-Lane with Paved Shoulder Mirapur Bypass 50.30-55.30
4		55.700	58.500	2.800	5.0 -7.5	3	1+1	1864	LHS Eccentric



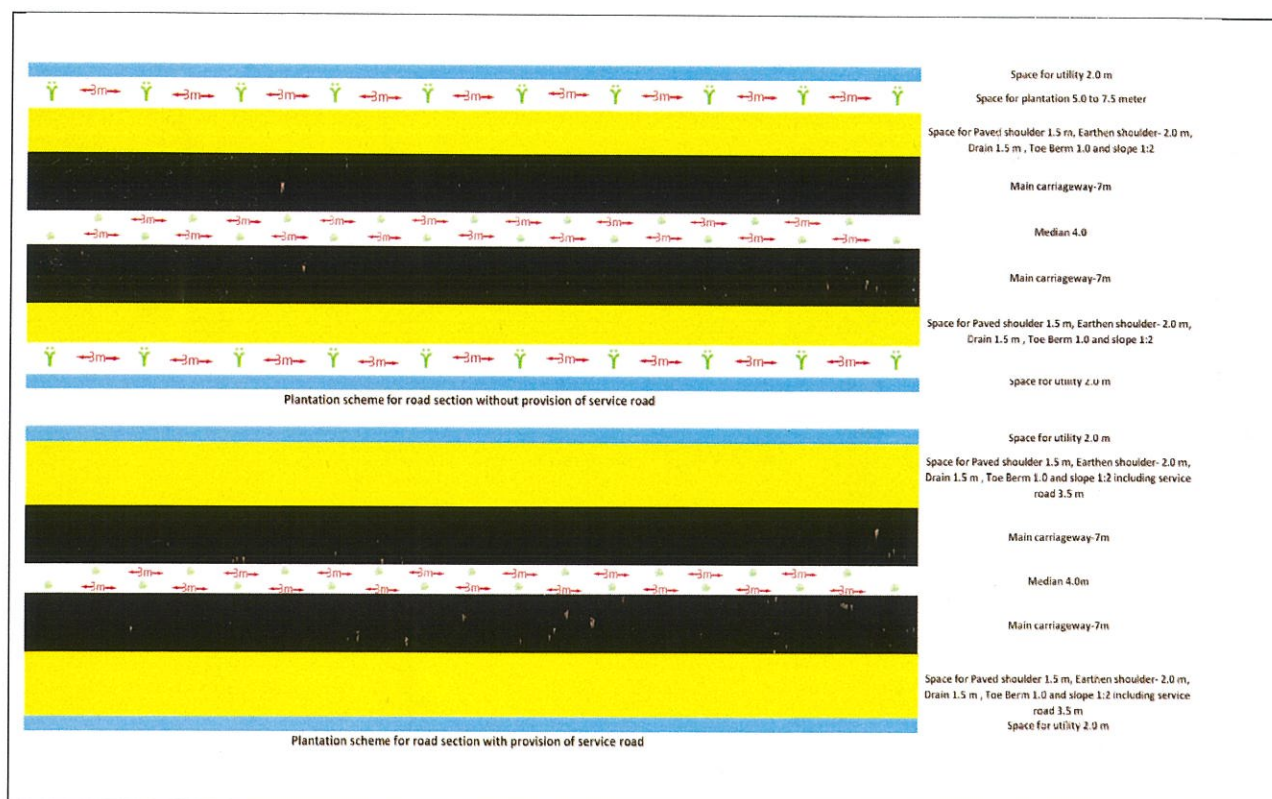
									Widening and Reconstruction to 4-Lane with Paved shoulder
5		58.500	59.300	0.800	5.0 -7.5	3	1+1	532	New Construction of 4-Lane with Paved Shoulder & Service Road in Built-Up Area , Kelapur Jasmor
6		61.400	62.000	0.600	5.0 -7.5	3	1+1	399	RHS Eccentric Widening and Reconstruction to 4-Lane with Paved shoulder
7		62.000	62.770	0.770	5.0 -7.5	3	1+1	513	New Construction of 4-Lane with Paved Shoulder (Realignment)
8		62.770	63.180	0.410	5.0 -7.5	3	1+1	273	New Construction of Ganga Bridge Approach without Service Road
9				0.000					New Construction of Ganga Bridge / Viaduct
10		65.970	66.400	0.430	5.0 -7.5	3	1+1	286	New Construction of Ganga Bridge Approach without Service Road
11		66.400	68.000	1.600	5.0 -7.5	3	1+1	1066	RHS Eccentric Widening and Reconstruction to 4-Lane with Paved shoulder
12		68.000	68.700	0.700	5.0 -7.5	3	1+1	466	Concentric Widening and Reconstruction to 4-Lane with Paved shoulder
13		68.700	70.680	1.980	5.0 -7.5	3	1+1	1319	LHS Eccentric Widening and Reconstruction to 4-Lane with Paved shoulder
14		76.200	77.700	1.500	5.0 -7.5	3	1+1	999	New Construction of 4-Lane with Paved Shoulder (Bypass)
15		78.700	78.810	0.110	5.0 -7.5	3	1+1	73	RHS Eccentric Widening and



									Reconstruction to 4-Lane with Paved shoulder
				18.04				12011	
Total Avenue Plantation calculated – 12011.00. Considering cross drainages and underpasses it is estimated that total number of plants can be planted, will be 11500.00.									

## 6. Plantation Layout Plan and Pits digging

Although multiple rows of plantation are advisable for better protection against soil erosion and water purification but due to constrain in space as well as significant part of road section is traverse through populated area, single row avenue plantation is proposed. However, median plantation is proposed in 2 row all through the project road length. Median plantation is to be done in staggered manner. The plantation layout plan has been shown in **Figure 1** below.



**Figure 1: Plantation Layout Plan**

## 7. Technical Specifications

The technical specifications specified here are proposed and during execution of project the concerned DFO may suggest for some modification as per site condition or condition stipulated in In-principal approval

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Santosh Kumar Bajpai  
Project Director  
National Highways Authority of India  
PTU - Meerut



of Forest Clearance. The site-specific project report shall prescribe plantation pattern based on actual site conditions. The technical specifications of ornamental/flowering plants have been presented in Table 3.

**Table 3: Technical Specifications of Ornamental/ Flowering Plants**

Distance from embankment	1m away from the toe of embankment
Spacing between plant to plant	1m in case of single row median plantation (at median opening considering road user safety) 3 meter spacing in 2 row staggered in 4.0 meter wide median. Avenue plantation is proposed in single row at spacing of 3 meter.
Canopy Shape & Size	Preferable Cylindrical/oblong with small CSA/ having vertical canopy growth.
Spacing between rows	Single row plantation
Size of the pits (normal soil)	60 X 60 X 60 cm
No of plants per Km for median	333 x 2 = 666
No. of plants per km for avenue	333 x 1+1 = 666
Height of the plant	1.5 m to 2 m

#### 8. Species Planned for median Plantation:

The shrubs to be planted in the median shall be of low or medium height for prevention of the headlight glare. Two rows of flowering shrubs have proposed as in general median width is 4.0 meter. However, in sections (at location of median opening, junction) where the median width is less than 1.5 m, only grasses turf has been proposed. Some herbaceous species may also be planted as ground cover, not only on the medians but on special landscapes and embankment slopes also.

In median width of less than 3 meters one row of shrub whereas in 3.5 to 4.0 m median width, plantation of two rows of flowering shrubs at a spacing of 1.5 m and atleast 0.75 to 1 m from the inner edge is proposed. The plants shall be at spacing of 3 X 3 m and size of the pits for planting shall be 0.6 m dia and deep.

The surface for the median plantation shall be well prepared. The masses of loose debris on the median and any convexities shall be removed and similarly any concavities are to be filled with good soil. The surface shall have sufficient layer of good quality soil so as to have a better growth and survival of grasses and shrubs. As the plantable length for median plantation is approx. 39.0 km and for avenue plant is 18.0 km limited variety of shrubs and avenue plants are proposed to maintain landscaping. Species proposed for median plantation has been presented in Table 4 below.

**Table 4: Species Proposed for Median Plantation**

S. No.	Botanical Name	Common Name
1.	<i>Bougainvillea spectabilis</i>	Great Bougainvillea
2.	<i>Tecoma stans</i>	Yellow elder



#### 9. Species Planned for 1<sup>st</sup> Row of Avenue Plantation:

Single row of plantation along the project road have been worked out based on the land availability which is between 5 to 7.5 meter within the PROW. Based on codal provision of plantation and land scaping in highway project (IRC: SP:21:2009 and Green highway policy 2015, the Agro-climatic zone and climatic conditions following tree species as presented in Table 5 proposed to be planted in 1<sup>st</sup> row.

**Table 5: Species Recommended for 1<sup>st</sup> Row of Avenue Plantations**

SL	Botanical Name	Local Name	Remarks
1.	<i>Bauhinia variegata</i>	Kachnar	In km/ chainages where available land with for avenue plantation is 5-6 meter
2.	<i>Cassia fistula</i>	Amaltas	In km/ chainages where available land with for avenue plantation is 5-6 meter
3.	<i>Delonix regia</i>	Gulmohar	In km/ chainages where available land with for avenue plantation is 5-6 meter
4.	<i>Terminalia arjuna</i>	Arjun	In km/ chainages where available land with for avenue plantation is 6-7.5 meter
5	<i>Pongamia pinnata</i>	Kanji	In km/ chainages where available land with for avenue plantation is 6-7.5meter

#### 10. Planting Material:

Plant quality determines success in plantation, particularly in relation to root development. Once the plantation contractor has selected which tree species to use it is then important to select seedlings that are best suited to the site conditions but also ensure that the seed stock is healthy (i.e., it comes without pests or diseases).

##### a. Insecticide/pesticide/fungicide:

When a plant cannot function normally, it is diseased. The primary causes of disease in trees are pathogens and environmental factors. Trees have many disease pathogens: viruses, bacteria, fungi, nematodes, mycoplasma-like organisms, and parasitic higher plants. Fungal pathogens are the most prevalent. They cause seed rots, seedling damping-off, root rots, foliage diseases, cankers, vascular wilts, diebacks, galls and tumors, trunk rots, and decays of aging trees. Unfavorable weather and environmental factors such as temperature and moisture extremes, high winds, or ice can damage trees directly and predispose the trees to pest attack.

All parts of a tree—roots, stems, foliage, shoots and terminal leaders—are vulnerable to attack by pests. Pest damage can range from slight damage that has no effect on the value of the harvested product to severe damage that stunts or kills the trees or reduces their market value. Tree pests include insects and mites, diseases, weeds, vertebrates, and nematodes. Managing tree pests effectively should be based on thorough consideration of ecological and economic factors.

Pesticides are a very important tool in Integrated pest management (IPM) when large pest populations threaten high-value trees. Knowledge of the pest's life cycle, selection of an appropriate pesticide, proper timing of the application, and use of the right application equipment will improve coverage and effectiveness. The ability to recognize beneficial bio control organisms, combined with cultural and mechanical controls, may allow to reduce, delay, or eliminate pesticide treatment of a minor pest problem. The method chosen to apply a pesticide will depend on the nature and habits of the target pest, the site, the pesticide, available application equipment, and the cost and efficiency of alternative methods. The choice is often predetermined by one or more of



these factors. Some common application methods proposed under this plantation are described below.

- Broadcast application is the uniform application of a pesticide to an entire area.
- A directed-spray application targets pests in a specific area in an effort to minimize pesticide contact with the crop or beneficial insects.
- Foliar application directs pesticide to the leafy portions of a plant. Spot treatment is application of a pesticide to small, discrete areas.
- Soil application places pesticide directly on or in the soil rather than on a growing plant.
- Soil incorporation is the use of tillage equipment to mix the pesticide with the soil.
- Soil injection is application of a pesticide beneath the soil surface.

**b. Manure/compost/fertilizer:**

Manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition. The art of collecting and using wastes from animal, human and vegetable sources for improving crop productivity is as old as agriculture. Manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Naturally occurring or synthetic chemicals containing plant nutrients are called fertilizers. Manures with low nutrient content per unit quantity have longer residual effect besides improving soil physical properties compared to fertilizer with high nutrient.

Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left-over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent  $P_2O_5$  and 0.5 per cent  $K_2O$ . Urine, which is wasted, contains one per cent nitrogen and 1.35 per cent potassium.

**c. Watering Plan:**

Watering in avenue as well as median plantations need at least periodic watering during the first growing season to obtain a satisfactory survival rate. Watering will begin after the cessation of rains, when the moisture content of the soil has fallen to near the wilting coefficient; then watering should be repeated at intervals until the onset of the next rainy season. Before each watering, the area around the tree will be cleared of weeds, and a shallow basin should be made around the stem of each tree or shrub to collect as much water as possible. In some instances, regular cultivation and weeding, especially during the first growing season, are sufficient measures to conserve soil moisture for satisfactory survival of the plants, eliminating the need for watering. Since, length of project road is only 10.135 km, watering for proposed plantation can be easily done through water tanker from available surface water sources such as canal located at km 63+180

**d. Plantation Protection Plan:**

Once are plants established; the work shall not be considered finished. It will be necessary to protect the plantation against weather, fire, insects, fungi, and animals. A variety of cultural treatments also may be required to meet the purpose of the plantation.

**e. Fire:**

Damage by fire imposes a serious threat to plantations. The fire risk is generally high in the dryer climatic regions; but, even in relatively moist or high rainfall areas, there may be warm and dry spells when the fire



risk is high. Fire risk has been considered a major consideration from the early stages of plantation development.

**f. Insects and fungi:**

Most insects and fungi are selective of the host species. In their natural environment, trees and shrubs normally attain a state of equilibrium with indigenous pests. However, when exotic trees and shrubs are planted, exotic pests can also be introduced. Quite often, these exotic pests readily adapt themselves to the conditions of their new habitat. In general, the risk of damage from pests is higher when the plants are physiologically weakened from planting on unsuitable sites, improper site preparation, inefficient planting, adverse climatic conditions, or neglect of weeding and other maintenance operations. The main precautions to be taken in guarding against possible future damage from insects and fungi are to plant tree or shrub species that are suitable to the climatic and soil conditions of the site.

Insects and fungi can often be checked by applications of appropriate chemical insecticides or fungicides. Usually, these chemicals are available as liquids (or wettable powder), dusts, or smokes. Spraying with hand-operated spray guns or portable mist-blowers is frequently used to control attacks in young plantations; with canopy closure, aerial spraying and dusting or smoking can be more effective and cheaper. Only previously tested and environmentally sound insecticides and fungicides should be prescribed for use.

**g. Wild animals:**

Damage to avenue plantations by wild animals mainly takes the form of tree browsing or de-barking. In general, there are three orders of wild animals responsible for damage: rodents (rats, mice, and moles and squirrels); lagomorphs (hares and rabbits); and artiodactyls (pigs and buffaloes). The principal method of controlling damage by wild animals involves the use of fences, hedges or ditches, trapping and removal, and poison baits. Since, a significant part of the project road is located in Wildlife area / close to wildlife so there is a chance of damaging plant by wild animal.

**h. Domestic animals:**

Grazing or browsing by sheep, goats and cattle can be a menace to young plantations. At times, hedges and fences are used to prevent intrusion by domestic animals. Where fencing costs are high, trespass by livestock can be controlled by guards.

The fencing of single row plantation is generally done by using iron/bricks/cement guards. Under this plantation scheme, locally available bamboo/ wooden and iron guards are proposed to ensure the protection of avenue plant. The description and specification for the iron guards as per IRC: SP: 21-2009 are given below:

**i. Barbed Wire fencing:**

The fencing of multiple rows plantations will be done preferably by barbed wire. Five strands barbed wire fencing, with cross strands, stretches on angle iron is recommended. Live fencing/ bamboo fencing/ thorn fencing may be used where protection can be ensured through them.

**As per site condition the barbed wire fencing is the most suitable and cost effective option recommended for protection of plantation.**

**11. Benefit of tree plantation in terms of Greenhouse effect**

Trees help by removing (sequestering) CO<sub>2</sub> from the atmosphere during photosynthesis to form carbohydrates



that are used in plant structure/function and return oxygen back into the atmosphere as a byproduct. Roughly half of the greenhouse effect is caused by CO<sub>2</sub>. Therefore, trees act as carbon sinks, alleviating the greenhouse effect. On average, one acre of new forest can sequester about 2.5 tons of carbon annually. Young trees absorb CO<sub>2</sub> at a rate of 5.9 kg per tree each year. Trees reach their most productive stage of carbon storage at about 10 years at which point they are estimated to absorb 21.8 kg of CO<sub>2</sub> per year.

Trees also reduce the greenhouse effect by shading houses and office buildings. This reduces the need for air conditioning by up to 30 percent which in turn reduces the amount of fossil fuels burned to produce electricity. The combination of CO<sub>2</sub> removal from the atmosphere, carbon storage in wood and the cooling effect makes trees extremely efficient tools in fighting the greenhouse effect. Planting trees remains one of the most cost-effective means of drawing excess CO<sub>2</sub> from the atmosphere.

#### 12. Abstract of estimated project cost:

The estimate is prepared based on market price and similar cost estimation for neighboring districts. The abstract of estimated cost of plantation including 5 years of maintenance is presented in Table 6 below:

**Table 6: Cost of Plantation**

SL	Type of Plantation	Unit cost of Plantation (Rs.)	Number of Plants	Cost (Rs.)
1.	Avenue Plantation	3000	11500.00	3,45,00,000.00
2.	Median Plantation	1200	25500.00	3,06,00,000.00
<b>Total</b>			<b>37000.00</b>	<b>6,51,00,000.00</b>
<b>In words; six crores fifty-one lakhs only.</b>				

#### 13. Source of fund for implementation scheme

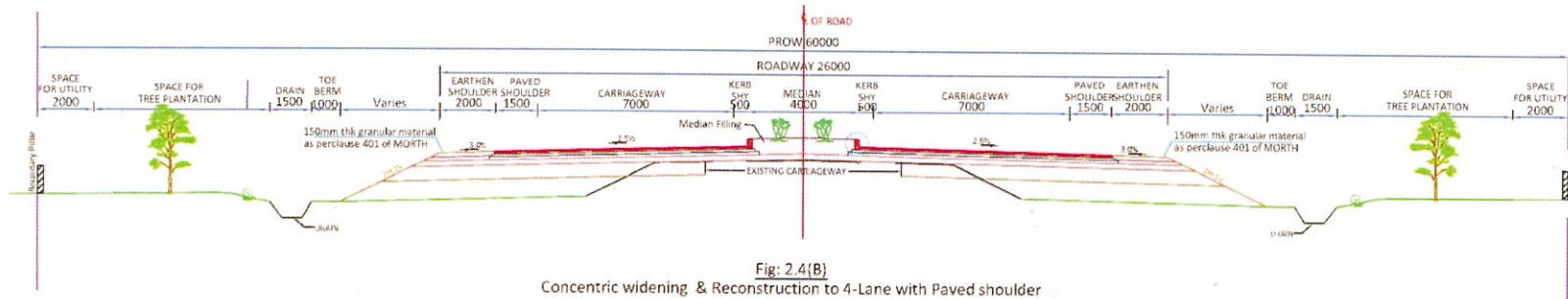
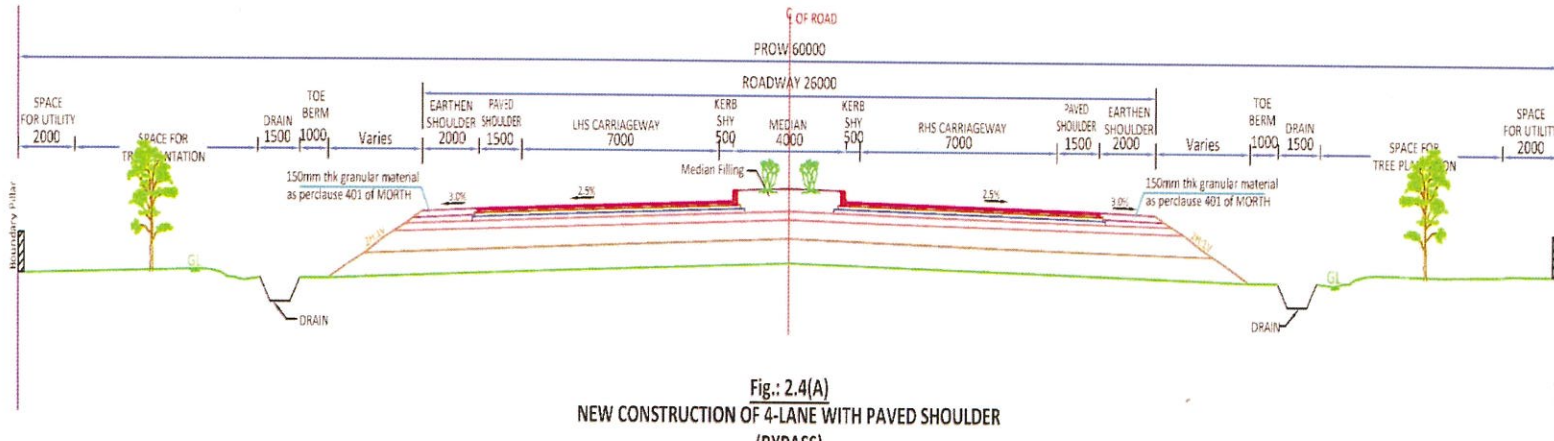
The concessionaire will be responsible for plantation and its maintenance; accordingly, the budget of this plantation scheme is included in project cost/

-----End-----

14/6/23  
**Santosh Kumar Bajpai**  
 Project Director  
 National Highways Authority of India  
 PIU - Meerut



## Typical Cross sections of project road



Santosh Kumar  
Project Director  
National Highways Authority of India  
PIU - Meerut



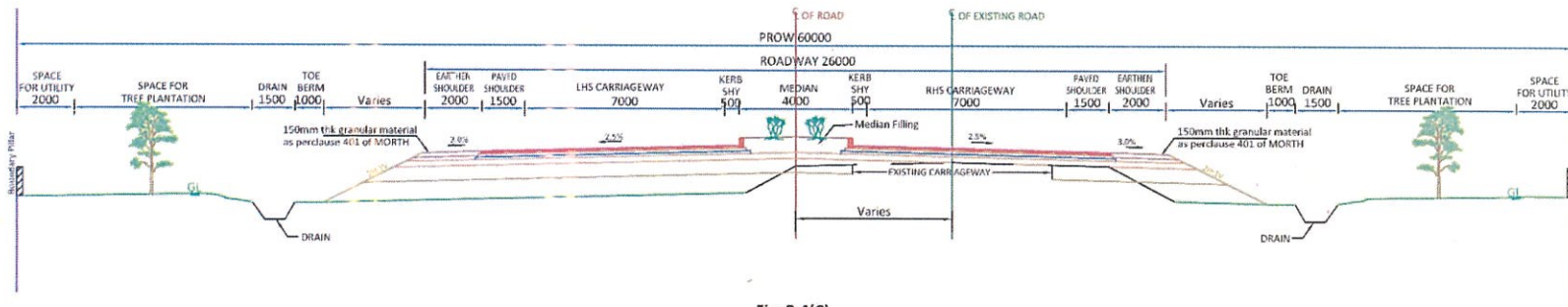


Fig: 2.4(C)  
LHS ECCENTRIC WIDENING AND RECONSTRUCTION  
TO 4-LANE WITH PAVED SHOULDER

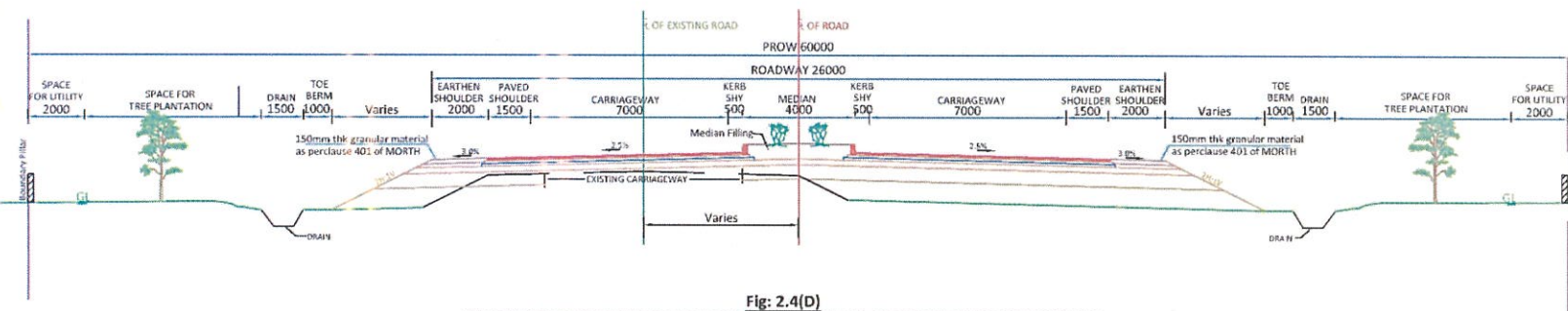


Fig: 2.4(D)  
RHS ECCENTRIC WIDENING AND RECONSTRUCTION TO 4-LANE WITH PAVED SHOULDER



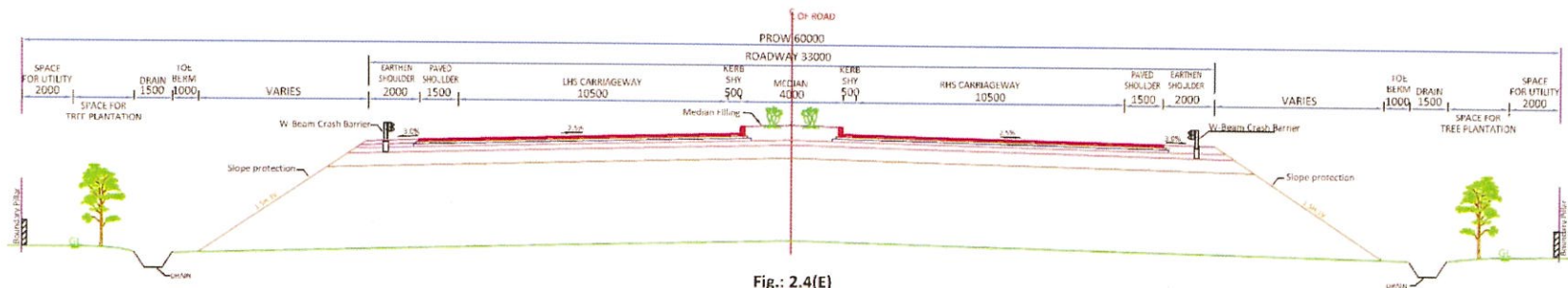


Fig.: 2.4(E)  
NEW CONSTRUCTION OF GANGA RIVER MAJOR BRIDGE APPROACH  
(ON REALIGNMENT)

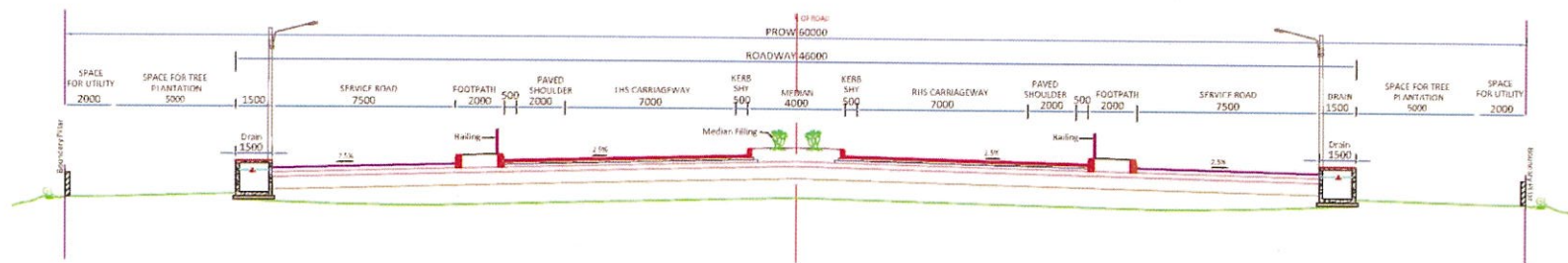


FIG. : 2.5(C)  
NEW CONSTRUCTION OF 4-LANE WITH PAVED SHOULDER  
& SERVICE ROAD IN BUILT-UP