

*Technical Report No. 2015/006*

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**PROPOSED MITIGATION MEASURES FOR  
MAINTAINING HABITAT CONTIGUITY AND  
REDUCING WILD ANIMAL MORTALITY ON NH 6  
& 7 IN THE CENTRAL INDIAN LANDSCAPE**

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भारतीय वन्यजीव संस्थान  
Wildlife Institute of India



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May, 2015

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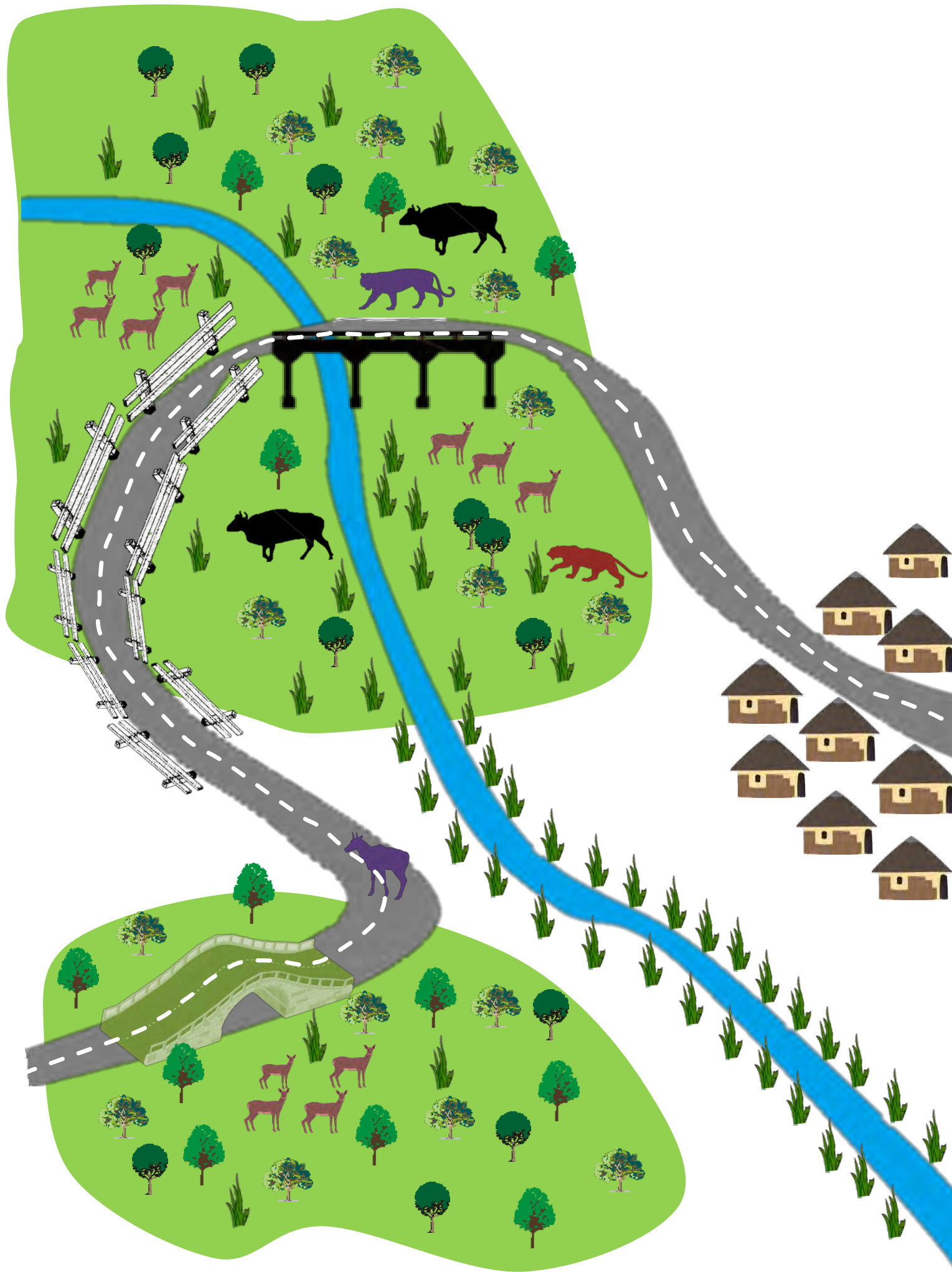
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**Citation:** Bilal Habib, Akanksha Saxena, Indranil Mondal, Asha Rajvanshi, V. B. Mathur and H.S. Negi (2015). Proposed Mitigation Measures for Maintaining Habitat Contiguity and Reducing Wild Animal Mortality on NH 6 & 7 in the Central Indian Landscape. Technical Report, Wildlife Institute of India, Dehradun and National Tiger Conservation Authority, Govt. of India, New Delhi, pp 100. **TR 2015/006.**



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*Beginning with the launch of the Project Tiger in 1973, and subsequently the National Tiger Conservation Authority in 2005, the Government of India has expended a lot of effort towards the long term conservation of tiger the national animal, its habitat and associated species. Other initiatives such as amendment of the Wildlife (Protection) Act (1972), delineation of inviolate critical core areas in existing tiger reserves, declaration of new tiger reserves, incentivized voluntary relocation programs and identification of critical corridor areas connecting major tiger landscapes for long term conservation planning have led to an increase in tiger population from 1708 in 2010 to 2226 in 2014. These efforts have not only saved the tiger from possible extinction, but have also insured the continuous provision of innumerable vital ecosystem services that core tiger habitats provide like carbon sequestration, maintenance of hydrological cycle, protection of genetic diversity of economically important plant and animal species etc. The monetary value of these services translates into Rs. 50,000 to Rs. 1,90,000 per hectare, as estimated by a recent study of 25 ecosystem services from select tiger reserves in India. Additionally tourism activities in these areas generate revenues for local and state governments that run into billions of rupees and also provide livelihood to many local people.*

*These initiatives and their implementation by respective State Governments have been critical in securing the survival of key tiger populations, and the biodiversity and the ecosystem services of the forests they inhabit. In order to conserve these ecosystem services and ensure their flow for our future generations, it is essential to integrate management of tiger reserves into the broader landscape and enhance/restore ecological connectivity among these tiger reserves and their wide environment. Any breakdown in the connectivity within these landscapes now will jeopardize the manual and monetary efforts that the Government has put into reviving the integrity of these habitats over the past 4 decades, and will endanger the source of ecosystem benefits that sustains life on earth as we know it.*

***Pathless wood: a fantasy of the past.....***

***There is pleasure in the pathless woods,  
There is rapture on the lonely shore,  
There is society, where none intrude.....***

***- Lord Byron***



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## ACKNOWLEDGEMENT

*This Technical Report has been prepared in response to the directives given in the meeting held under the Chairmanship of Hon'ble Chief Minister of Maharashtra and in the presence of Hon'ble Union Minister of Road, Transport, Highways and Shipping and Hon'ble Union Minister of State of Environment, Forest and Climate Change held on 13<sup>th</sup> February 2015, and reports the findings of the resurvey of National Highway 6 and 7, conducted jointly by the Wildlife Institute of India (WII) Dehradun and the National Tiger Conservation Authority (NTCA) New Delhi.*

*The team would like to acknowledge the guidance extended towards this task by Dr Rajesh Gopal, former Member Secretary, NTCA, Shri S. P. Yadav, former Joint Director, NTCA, Shri B. S. Bonal, Member Secretary, NTCA, Dr H. S. Negi, Inspector General of Forests, NTCA, Shri Vinod Ranjan, ADG (Wildlife) MoEFCC, and Dr D. Swain, Inspector General, NTCA Maharashtra. The team would also like to extend due thanks Dr S. K. Khanduri, Inspector General of Forests (Wildlife), MoEFCC for his guidance and support.*

*We would like to extend our sincere acknowledgments to Shri. Sarjan Bhagat, Chief Wildlife Warden, Maharashtra, and Sh. Meyipokym Aier, Additional Chief Conservator of Forest (Wildlife) East for their knowledgeable inputs.*

*Mr M. S. Reddy, Field Director, Pench Tiger Reserve, Maharashtra, Mr. Alok Kumar, Field Director, Pench Tiger Reserve, Madhya Pradesh, Dr Kiran Bisen, Deputy Director, Pench Tiger Reserve, Madhya Pradesh, Sh. S. G. Tembhurnikar, Chief Conservator of Forests (Territorial), Nagpur, are sincerely thanked for their facilitation of the resurvey.*

*We acknowledge the on-ground support of RFO Deolapar, RFO Chorbauli, RFO Sillari (Pench Tiger Reserve) for NH 7 Maharashtra section; RFO Rukhad for NH 7 MP section and DCF Bhandara Forest Division, RFO Sakoli, RFO North Deori, DFO for NH 6 Maharashtra. The field knowledge and assistance of round officers and forest guards during the survey is greatly appreciated.*

*The field work would not have been timely and effectively completed without the active interest and rigour of each team member. We sincerely acknowledge the contributions of Ankita Bhattacharya, Mirza Ghazanfarullah Ghazi and Rahul Talegaonkar for field data collection.*

*We would like to thank the staff in Hon'ble MEF office for providing necessary facilitation.*

**The Team**

## 1. BACKGROUND:

In the backdrop of the need for development in the transportation sector, the National Highway Authority of India (NHAI) and the Ministry of Road, Transport and Highways began upgradation work on the two arterial highways of India, National Highways 6 (2026 km) and 7 (2367 km), connecting the East with the West and North with the South respectively under the National Highways Development Plan (NHDP) Phase III. National Highway 6 runs through Gujarat, Maharashtra, Chhattisgarh, Odisha, Jharkhand and West Bengal states, and National Highway 7 is the major North-South National Highway in India that runs through Uttar Pradesh, Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu.

Wildlife corridors, that are the connecting links between critical tiger habitats, are however intersected by these highways at many places and could sever connectivity of many animal populations attempting to disperse within these zones and between the protected areas, which is vital for their long-term survival. A stretch of 23.85 km of National Highway 6, and 65 km of National Highway 7 planned for an upgradation to 4-lane highway traverse through forest areas adjoining important protected areas and bisect animal movement corridors between these and other protected areas in the Central India Landscape (Figure 1).



**Figure 1:** Wildlife corridors intersected by major highways in the Central Indian Landscape

The Central Indian landscape is home to some 688 tigers distributed across 19 tiger reserves and other protected areas (Jhala et al., 2015). Sections of NH-6 & 7 have already impacted at least 6 tiger corridors in the Vidarbha region of

Maharashtra. These are Nagzira-Navegaon, Kanha-Indravati, Bor-Melghat on NH-6 and Tadoba-Kawal, Tadoba-Bor, and Tadoba-Tipeshwar on NH-7.

Long term survival of Central Indian tiger population is only possible if these protected areas are connected with functional corridors which can aid movement of both predators and prey. In order to sustain a tiger population of 80-100 individuals, 20-25 females of breeding age require an area of 1000 sq. km to sustain this population over 100 years or more. Not a single tiger population in the Central Indian landscape is viable in the long run by itself. Therefore, immigration and emigration of adult tigers within the landscape is a prerequisite for long term tiger conservation in this landscape. The long term survival of tigers is highly dependent on the habitat connectivity of tigers and associated species through a network of corridors. These corridors act as connecting links between these vital habitats which are imperative for the long term survival of the national animal.

In 2009, the Central Empowered Committee (CEC) appointed by the Hon'ble Supreme Court, had made its recommendations to the Hon'ble Supreme Court on May 25, 2009, after consulting top wildlife experts who were of the opinion that "the ecological cost of the present project is immense and no mitigation measures are adequate to compensate the same". The CEC itself stated that this (stalled NH-7 work) is one of those exceptional cases where ecological security necessarily has to take precedence over developmental needs. The CEC recommended that instead of widening this critical stretch, the alternative route via Chhindwara may be used by traffic on NH-7.

Considering the CEC recommendations, the apex court had ordered that the issue be decided by the statutory authorities like the National Board of Wild Life (NBWL), the Wildlife Institute of India, National Tiger Conservation Authority and the State Government. A survey of NH-7 (Maharashtra and MP sections) and NH-6 (Maharashtra and Chhattisgarh sections) was thus carried out by the Wildlife Institute of India, and their recommendations were submitted in their reports 'Conservation Plan in Response to Diversion of Forest Area for Widening of National Highway 6: A Review' and 'Revised Proposal for 4-Laning of National Highway 7: A Review' to NTCA. (Link to the reports: [http://wiienvi.nic.in/Content/publications\\_8380.aspx#Other\\_Publications](http://wiienvi.nic.in/Content/publications_8380.aspx#Other_Publications))

The following major recommendations were made:

### **1.1. WII RECOMMENDATIONS FOR NH-7 MADHYA PRADESH SECTION:**

- i. Of the 39 structures (14 underpasses and 25 pipe/slab/box culverts) proposed by NHAI on the road section passing through Pench Tiger Reserve, Madhya Pradesh (chainage 627 to 634.5 km), WII recommended 11 underpasses with suggested change in height for all underpasses from 4 m to 7 m and 70 m to 200 m in width for the underpass at chainage 632.050 km. Of the 25 pipe/slab/box culverts, WII recommended 22 structures.

- ii. 5 additional underpass structures were recommended for inclusion in this section (chainage 627 to 634.5 km) with widths between 1200 and 60 m and 7m heights at locations that were identified by WII as established animal crossing zones for various animals such as tiger, dholes, jackals, Indian fox, and herbivores such as gaur, chital and wild pig, among other animals.
- iii. WII recommended all 37 structures proposed by NHAI on stretches within South Seoni Forest Division (chainages 624 to 627 km and 635.9 to 652 km) that included 7 minor bridges, 11 box/slab culverts, 12 pipe culverts and 7 underpasses, with the suggestion that the height of the underpasses should be 7 m. In addition to these structures, WII also recommended one animal underpass (600 m wide and 7 m high) of 300 m and 4 underpasses of 700 m, 800 m, 800 m and 1000 m width with 7 m height.

### **1.2. WII RECOMMENDATIONS FOR NH-7 MAHARASHTRA SECTION:**

- i. WII recommended all 38 animal crossings suggested by NHAI (6 underpasses, 15 bridges and 17 box/pipe/slab culverts). WII recommended that the height of the underpasses and bridges should not be less than 7 m. Most of these structures are existing bridges, drainage channels etc. which are required for maintaining road contouring.
- ii. WII recommended 10 additional underpasses based on a site inspection for forest patches 1, 2 and 3. These underpasses were recommended to be of widths 60, 100, 2000, 300, 200, 2000 and 500 m and 7 m high.

### **1.3. WII RECOMMENDATIONS FOR NH-6 MAHARASHTRA SECTION:**

For ensuring the connectivity between 7 vital tiger populations found in the Central Indian Landscape that would be affected by the NH-6 road stretch, WII reviewed the NHAI proposal and made the following recommendations.

- i. WII disapproved the reduction of ROW (right of way) on both sides of the highway from 60 m to 45 m as it would reduce the space and time for animals to get accustomed to the traffic on the road.
- ii. The two box culverts provided by NHAI on the upgraded road section lying between chainage 406.600 km and 412.900 km (forest patch 01) measuring 3.05 m in height and 6.10 m in width separated by 1.5 km were found to be small and inadequate for use by wild animals of the area by WII. Two additional underpasses measuring 1000 and 2000 m in width and 7 m in height were proposed by WII.
- iii. On the two-lane segment of NH-6 lying between chainage 419.650 km and 422.400 km (forest patch 6), three box culverts have been proposed by NHAI measuring 3.5 m in height and 6.10 m in width. WII found the three

structures to be unsuitable for the type of wildlife in this area and also with respect to location. WII thereby proposed an additional underpass measuring 2000 m in width and 7 m in height for the area.

- iv. Two box culverts had been proposed by NHAI at the two-lane segment of NH-6 lying between chainage 432.300 km and 433.400 km (forest patch 8) measuring 3.5 m height and 6.10 m height. These box culverts had been largely conceived as drainage channels and WII found these structures to be unsuitable for use by the type of wildlife in this area and also not best suited with respect to their location. WII proposed an additional underpass measuring 1500 m in width and 7 m in height.
- v. On the two-lane stretch of NH-6 lying between chainage 458.000 km and 461.200 km, NHAI proposed one box culvert measuring 3.05 m in height and 6.10 m in width. WII found this structure to be unsuitable for the type of wildlife in this area and proposed another underpass measuring 1500 m in width and 7 m in height.

#### **1.4. WII RECOMMENDATIONS FOR NH-6 CHHATTISGARH SECTION:**

- i. The 4-lane section of NH-6 starting from the Maharashtra-Chhattisgarh border bisects 70% of the forest patch on the Chhattisgarh side; this forest forms part of the North – South Wildlife Corridor that connects 8 protected areas within the Central Indian Tiger Landscape. In view of the importance of this section, WII recommended two flyovers of 1500 m height and 7 m height.

#### **1.5. WII's justification for recommending 5 m high underpasses for Central Indian landscape**

WII, in its Technical Report (TR 2012/005) submitted to PCCF (WL) Vide Letter No. WII-EIAA/2011-2012/018/NTCA/NH6-PROP-598; dated: 14<sup>th</sup> May 2012, recommended the height of 7 meters for animal underpasses on NH-6. This specification of height of 7 m was made to prevent the impacts of bifurcation of wilderness areas resulting from widening/upgrading of existing roads to facilitate the movement of increasing traffic on roads particularly on national highways.

The maximum height of 7 meter for underpasses was recommended by WII for ensuring the ultimate benefit of maximising permeability of a roadway that is likely to be compromised in the event of four laning of the roads. It is well understood from experience and published literature that height and openness ratio are the two most critical factors for designing wildlife underpasses that are highly effective for maintaining habitat connectivity, genetic interchange and dispersal of wild animals (Forman et al, 2003). Both these factors (height and openness) were considered in the assessment of the maximum height required for construction of wildlife underpasses on NH 6. Examples from around the globe were reviewed before recommending the 7 m height of underpasses on NH-6.

For example, 13.7 m high underpass with an openness ratio of 1.43 along the eastbound lane of I-64 5 mi west in Virginia has been very effective for Mule Deer (*Odocoileus hemionus*) (shoulder height 106 cm). The deer unhesitatingly used this passage in comparison to the use of 4 m high underpasses that were designed based on minimum requirement of passage height that was determined by the height of such species (Donaldson, 2006).

Approximately 8 meter high underpass for animals such as Malayan Tiger (*Panthera tigris jacksoni*), Asian Elephant (*Elephas maximus*), Asian Tapir (*Tapirus indicus*), Barking Deer (*Muntiacus muntjak*), Sambar Deer (*Rusa unicolor*) and Wild Pig (*Sus scrofa*) at SG Deka Malaysia being effectively used by these species (Silvanathan and Ali, 2012).

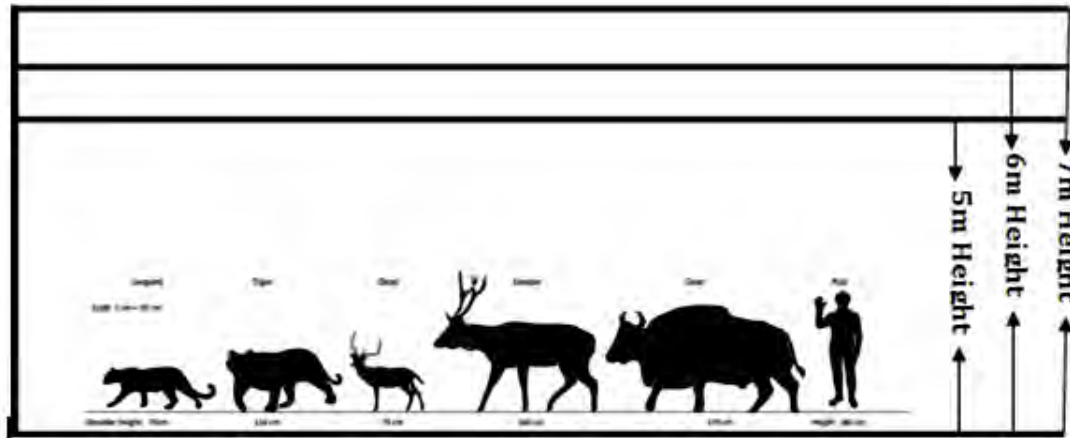
In view of the comments received from NHAI on WII's recommendation of planning 7 m high underpasses, the height considerations were reviewed to ensure maximum benefits of openness for animals that will use these as movement corridors. The criteria that were specifically considered in this review of the height of animal passages include 1): type of animals (big or small) 2): behaviour (solitary or group living), 3): openness ratio 4): terrain 5): time of crossing (diurnal or nocturnal). The reduction in height of the underpass to near minimum based on less than optimal openness ratio should not be a compelling factor. Instead, the efficacy of structures must be determined based on optimum benefits of facilitated animal movements across passages. The animal passage should in addition consider other site specific variables such as vegetation, topography, hydrology, disturbance and target species. Traffic noise, vibrations resulting from movement of vehicles may also discourage the utilization of the underpasses by wild animals.

For animals with shoulder height of 75 cm (Chital), openness index of 0.52 (metric) is a minimum requirement for the animal to use the underpass effectively. For Sambar (shoulder height 160 cm), openness index of 1.12 (metric) and for Gaur (shoulder height 175 cm), openness index of 1.22 (metric) is minimum requirement for animals to use the underpass effectively. These calculations are based on effectiveness of underpasses for Mule deer (Shoulder Height 106 cm) (Foster and Humphrey, 1995; Olbrich, 1984; Putnam, 1997; Reed et al., 1975; Reed et al., 1979; Reed, 1981; Reed and Ward, 1987; Ward, 1982). The use of underpasses is negatively correlated with crossing length and positively correlated with openness index (Clevenger and Waltho, 2000).

In an area where Sambar and Gaur are the largest herbivores present with shoulder height ranging between 100 cm and 175 cm, a minimum height of 5 m of the underpasses can be acceptable if the viaduct is 300 m long and span of the underpass is 28 – 30 m. For any other underpass with viaduct less than 300 m the minimum height should be 7 meters to provide an openness ration that would provide optimally suitable passage for movement of animals. Figure 2 shows the scaled height of various ungulates and predators with respect to underpass height.

While approaching the underpass, the animal should be able to view the horizon across the underpass from a distance. Although 5 m high and passage with a viaduct length of 300 m should be able to provide a good view necessary for the

animal to perceive the risks and opportunities on the other side, 7 m high passage would provide a more liberal view created by higher openness ration.



**Figure 2:** Scaled height of various animals with respect to underpass height

The design features of the wall and the pier types can also significantly improve the acceptability of passage structure by animals. The isolated piers can be made more effective with cross beam at the top and are relatively more suitable compared to wall type piers that reduce lateral visibility and increases tunneling effect especially for group living species, such as Chital.

#### **1.6. STANDING COMMITTEE MEETING OF NBWL ON 12 - 13 AUGUST 2014:**

The matter related to diversion of 4.493 ha of forest land from Pench Mowgli Wildlife Sanctuary for up-gradation of existing 2-lane to 4-lane on Seoni-Khawasa MP-Maharashtra border section of NH-7 (MP) was discussed in the 31<sup>st</sup> meeting of the Standing Committee of the National Board for Wildlife held on 12-13 August 2014 at Indira Paryavaran Bhavan, New Delhi (meeting minutes attached as Annexure I). After discussions, the Standing Committee recommended the proposal subject to the following mitigation measures as suggested by NTCA and WII:

- i.** The modifications on the design and location suggested by WII for construction of culverts shall be adhered to by NHAI.
- ii.** Specific dimensions (height, breadth) and locations for the underpasses shall be finalized only in consultation with the WII.
- iii.** The underpass located at 630.341 km and 631.014 km are not recommended as separate underpasses but recommended to be constructed as a single underpass of 1 km length and 7 m height.
- iv.** At chainages 628.100 to 629.100 km and 630.000 to 631.200 km, the proposed two flyovers should be replaced by underground tunnels while providing access to villagers.

### **1.7. NHAI'S RESPONSE ON MITIGATION MEASURES SUGGESTED BY WII ON NH-7 MAHARASHTRA SECTION:**

NHAI conveyed its non-acceptance of the mitigation measures suggested by WII on the NH-7 stretches between Mansar and the Maharashtra-MP border citing excessive cost involved. According to NHAI estimates, the cost involved in the implementation of these measures would amount to approximately Rs 750 crores.

### **1.8. INTERVENTION OF NAGPUR BENCH OF HON'BLE BOMBAY HIGH COURT:**

The Nagpur Bench of Hon'ble Bombay High Court, in its direction dated 07.01.2015 (attached as Annexure II) in response to a PIL No. 88/2013 sought the intervention of the Hon'ble Chief Minister of the State, Hon'ble Minister of Road, Transport and Highways and Shipping and Hon'ble Minister of State (Independent Charge) MoEF&CC, Government of India to work out amicable agreements on a mitigation plan for safe animal crossings on the said highway stretches proposed to be upgraded to 4-lane.

Following deliberations, it was decided to constitute a committee in light of directives from the Nagpur Bench of Hon'ble Bombay High Court, comprising of the APCCF (Wildlife) Nagpur, CCF and Field Director Pench Tiger Reserve, Nagpur, CCF (Territorial) Nagpur and representatives from NHAI, WII, NTCA and Public Works Department, Nagpur.

### **1.9. MODIFICATIONS SUGGESTED BY COMMITTEE IN REPORT SUBMITTED TO GOVT. OF MAHARASHTRA ON 31ST JANUARY 2015:**

A meeting of this committee reviewed the cost estimates of the mitigation measures proposed by WII. The committee carried out a field visit on 30<sup>th</sup> January 2015 to the affected sections of NH-7 and suggested the following changes in the structures along with revised costs. Considering the WII report, the committee considered to revise the height of all the underpasses to 4.5 m, as it was considered to be more pragmatic as well as more cost effective.

#### **FOREST PATCH I – NH-7 MAHARASHTRA:**

It was suggested by the committee that as two existing bridges located at the Maharashtra-MP border would take care of animal movement at chainage 651.180 km, the underpass suggested was not necessary.

- i.** The widths of three underpasses initially measuring 100 m were revised to 60, 50 and 80 m with provisions for approaches and guide walls.
- ii.** The width of one underpass measuring 2000 m was revised to 1000 m with provisions for approaches and guide walls.
- iii.** The width of one underpass initially measuring 300 m remained unchanged but provisions for approaches and guide walls were recommended.

The heights of all proposed structures that were initially 7 m were reduced to 4.5 - 5 m considering Gaur as the major species in the area.

**FOREST PATCH II – NH-7 MAHARASHTRA:**

- i. The width of one underpass initially measuring 200 m was reduced to 65 m, with a provision for guide walls.

**FOREST PATCH III – NH-7 MAHARASHTRA:**

- i. The width of one underpass initially measuring 200 m was revised to 100 m with provisions for approaches and guide walls and reduction in height (4.5 - 5 m).
- ii. The width of one underpass initially measuring 2000 m was revised to 1000 m with provisions for approaches and guide walls and reduction in height (4.5 - 5 m).
- iii. The width of one underpass initially measuring 500 m was revised to 50 m with provision for guide walls and reduction in height (5 m).

The NHAI also provided rough estimate for the revised mitigation measures which came to Rs. 344.84 crore. The additional burden on NHAI for implementing these measures would be only Rs. 244.84 crores as the highway upgradation would cost Rs. 100 crores without the mitigation.

It was also decided by the committee that in areas where underpasses are not provided and the road passes through forest areas, clearing of brushwood and bushes up-to a width of 15 m on both sides of the road would be maintained by NHAI for clear visibility of the wild animals crossing the road.

**1.10. DIRECTIVES FROM MEETING AT PUNE UNDER THE CHAIRMANSHIP OF HON'BLE CHIEF MINISTER OF MAHARASHTRA:**

Following the directives of the Hon'ble High Court and a GOM communication dated 08.01.2015, a meeting was held on 13<sup>th</sup> February 2015 at the Divisional Commissioner Office, Pune under the Chairmanship of the Hon'ble Chief Minister of Maharashtra and was attended by Hon'ble Union Minister of Road, Transport, Highways and Shipping and Hon'ble Union Minister of State (Independent Charge) of MoEF&CC, and representatives of NHAI, State Forest Department, WII and NTCA. Here NHAI expressed its non-acceptance of the suggested flyovers of 1000 m width and underpass of 300 m width, and instead of these structures, proposed to build three underpasses measuring 50 m in width with adequate guide walls. These underpasses would cost Rs.122 crores according to NHAI.

After hearing all concerns and taking international practices into account, it was decided to request WII and NTCA to conduct a resurvey of the NH-7 to identify locations for providing three to four 50 m long underpasses for safe wildlife crossings and to suggest fencing of the remaining portion of the road stretch to

funnel animals towards the underpasses. The stretches of NH-7 in Madhya Pradesh and NH-6 on the forest section of the Chhattisgarh-Maharashtra border to Bhandara in Maharashtra were also to be similarly surveyed for proposing mitigation measures. The minutes of the meeting are placed as Annexure III. After this meeting, the CWLW, Govt. of Maharashtra requested WII and NTCA to resurvey NH 6 and 7 (Annexure IV) and NTCA also nominated their representative for the re-survey (Annexure V).

Subsequent to this, a team of WII researchers re-surveyed the aforementioned stretches of roads between 10<sup>th</sup> and 31<sup>st</sup> March 2015.

## **2. THE CENTRAL INDIAN LANDSCAPE:**

Central India is considered to be the heart of India's wildlife. It is home to some of India's largest forest tracts, rich wildlife as well as indigenous people. It is also recognized by the National Tiger Conservation Authority, Government of India as a region with one of the best potentials for long-term tiger conservation. It harbours about 688 numbers of tigers in 19 tiger reserves (Jhala et al., 2015). Other than the tiger (*Panthera tigris*), the faunal diversity includes some of the most charismatic and endangered species such as the leopard (*Panthera pardus*), sloth bear (*Melursus ursinus*), gaur (*Bos gaurus*) and the hard ground swamp deer (*Cervus duvacelli*).

The tiger reserves and protected areas are connected by wildlife corridors falling outside the Protected Area network. These corridors can provide crucial connectivity and allow the free movement of tigers and other wildlife from one forest area to another, thereby connecting 'source' populations and ensuring demographic and genetic viability. This connectivity is also important to maintain the habitat quality of these contiguous forests for the other faunal species of the landscape. Any infra-structure development in this landscape should therefore consider the importance of the need to maintain connectivity between these animal populations.

A large number of species present in the landscape will get affected if connectivity is lost between these areas. The species present in the landscape along with their behaviour (group living/ solitary) and their status under the Wildlife (Protection) Act, 1972, that may be affected by threats to habitat connectivity are given in Table 1.

## **3. OBJECTIVES OF FIELD WORK:**

- i.** To identify specific animal crossing zones on NH-7 (Maharashtra and MP) and NH-6 (Maharashtra) passing through vital wildlife corridors and to suggest feasible locations for making underpasses and their dimensions, and in the light of these findings, review the earlier proposed mitigation measures.

- ii. To evaluate the barrier effect on different animal species due to factors such as road type (2 and 4-lane), traffic heterogeneity, traffic volume, vehicle speed and species characteristics at current traffic volume .

#### **4. AREAS SURVEYED:**

##### **4.1. NATIONAL HIGHWAY 7:**

During the recent survey, four stretches in Madhya Pradesh and three in Maharashtra on NH-7 were re-surveyed. The details of these stretches are given below along with a map of the area.

- In Madhya Pradesh, three stretches through South Seoni Forest Division (Chainage 624 to 627 km and chainage 635.9 to 653.2 km), and the 8.9 km section through Pench Tiger Reserve MP (Chainage 627 to 635.9 km) were resurveyed.
- In Maharashtra, three forest patches within the 37 km stretch adjoining Pench Tiger Reserve Maharashtra between chainage 652 to 689 km

The details of the stretches of National Highway 7 and adjoining forest areas studied during the course of the survey are given in Table 2 and Figure 3.

**Table 1:** Animal species of the Central Indian Landscape, their social behaviour and WPA (Wildlife Protection (Act)) Status

Species	Scientific Name	Social Behaviour	WPA Status
Tiger	<i>Panthera tigris</i>	Solitary	Schedule I
Common Leopard	<i>Panthera pardus</i>	Solitary	Schedule I
Jungle cat	<i>Felis chaus</i>	Solitary and pair	Schedule II
Leopard Cat	<i>Prionailurus bengalensis</i>	Solitary	Schedule I
Fishing Cat	<i>Prionailurus viverrinus</i>	Solitary	Schedule I
Rusty-spotted Cat	<i>Prionailurus rubiginosus</i>	Solitary	Schedule I
Common Palm civet	<i>Paradoxurus hermaphrodites</i>	Solitary	Schedule II
Small Indian Civet	<i>Viverricula indica</i>	Solitary	Schedule II
Grey Mongoose	<i>Herpestes edwardsii</i>	Solitary, pair or female with young	Schedule II
Ruddy Mongoose	<i>Herpestes smithii</i>	Solitary, occasionally in pair, and very rarely in small numbers (4-5)	Schedule IV
Striped hyena	<i>Hyaena hyaena</i>	Solitary, pair and colonies of 5-15	Schedule III
Wolf	<i>Canis lupus pallipes</i>	Packs, usually of 5-12 individuals	Schedule I
Golden Jackal	<i>Canis aureus</i>	Solitary, pair or small packs (3-5 individuals)	Schedule II
Wild Dog (Dhole)	<i>Cuon alpinus</i>	Pack-living	Schedule II
Indian Fox	<i>Vulpes bengalensis</i>	Solitary or pair	Schedule II
Sloth Bear	<i>Melursus ursinus</i>	Solitary	Schedule I
Ratel/Honey-Badger	<i>Mellivora capensis</i>	Solitary/ female with young	Schedule I
Indian Chevrotain or Mouse Deer	<i>Moschiola indica</i>	Solitary, except females with 1-2 offspring	Schedule I
Indian/Red Muntjac or Barking deer	<i>Muntiacus muntjak</i>	Solitary, in pair during breeding season	Schedule III
Sambar	<i>Rucervus unicolor</i>	Solitary/ Groups (2 – 5)	Schedule III
Chital/Spotted Deer	<i>Axis axis</i>	Group Living	Schedule III
Gaur	<i>Bos gaurus</i>	Group Living	Schedule I
Nilgai/Blue Bull	<i>Boselaphus tragocamelus</i>	Group Living	Schedule III
Four-horned Antelope or Chousingha	<i>Tetracerus quadricornis</i>	Solitary or in pair	Schedule I
Chinkara/ Indian Gazelle	<i>Gazella bennettii</i>	Group Living	Schedule I
Black buck	<i>Antelope cervicapra</i>	Group Living	Schedule I
Indian Wild Pig	<i>Sus scrofa</i>	Group Living	Schedule III
Rhesus Macaque	<i>Macaca mulatta</i>	Group Living	Schedule II
Hanuman Langur	<i>Semnopithecus entellus</i>	Group Living	Schedule II
Black-naped Hare	<i>Lepus nigricollis nigricollis</i>	Solitary or in pair	Schedule IV

**Table 2:** Details of road stretches surveyed during the present study on NH-7 (March, 2015)

Highway and State	Patch Identity (Figure 2)	Section/Chainage km	Location	Length (km)	Remarks
Madhya Pradesh (NH-7)	Patch 1 MP	624.000-627.000	SSFD, MP	3	Resurveyed
	Patch 2 MP	627.000-632.000	Pench Tiger Reserve, MP	5	Resurveyed
		632.000-635.9	Pench Tiger Reserve, MP	3.9	Not Resurveyed**
	Patch 3 MP	643.000-645.000	SSFD, MP	2	Resurveyed
	Patch 4 MP	650.000-652.000	SSFD, MP	2	Resurveyed
Maharashtra (NH-7)	Patch 1 MH	FP 1	Mansinghdeo Sanctuary, MH	8	Resurveyed
	Patch 2 MH	FP 2	Pench Tiger Reserve, MH	2.5	Resurveyed
	Patch 3 MH	FP 3	Pench Tiger Reserve, MH	5.6	Resurveyed

\*\* Mitigation measures as proposed in earlier reports remain unchanged in these sections considering hilly terrain in patch 2 and less forest cover in forest patch 3. Therefore these two patches were not re-surveyed during the present exercise.









**Figure 3:** Location of re-surveyed areas on NH-7 in Madhya Pradesh and Maharashtra during March, 2015

## 4.2. NATIONAL HIGHWAY 6:

Of the 23.85 km stretch falling within forest patches, 13.45 km of the stretch has already been upgraded to 4-lane. The remaining three forest patches of 10.4 km length (non-continuous) were surveyed in this study. These patches form part of the Navegaon-Nagzira and Kanha-Tadoba-Indravati wildlife corridors.

It is important to mention that out of 10 forest patches on NH-6, four laning has already been completed on 7 patches, only three patches are left. The details are indicated in Table 3 and the reference maps are shown in Figures 4 and 5.

**Table 3:** Status of 4 laning on NH-6 within forest area

Patch No	Location	Chainage KM	Distance (km)	Status of 4 Laning
1	Sirpur to Navatola	406.60 to 412.90	6.300	Completed
2	Deori to Dhobisarad	414.40 to 414.80	0.400	Completed
3	Dhobisarad	415.00 to 415.35	0.350	Completed
4	Dhobisarad to Murdoli	413.65 to 416.60	0.950	Completed
5	Murdoli to Maramjob	417.60 to 418.70	1.100	Completed
6	Maramjob to Banbitola	419.65 to 423.85	4.150	Not Done
7	Banbitola to Dongargaon	425.50 to 426.35	0.850	Completed
8	Bamhani to Duggipar	430.80 to 433.85	3.050	Not Done
9	Soundad to Sendurwafa	444.00 to 447.50	3.500	Completed
10	Sakoli to Mundipar	458.00 to 461.20	3.200	Not Done

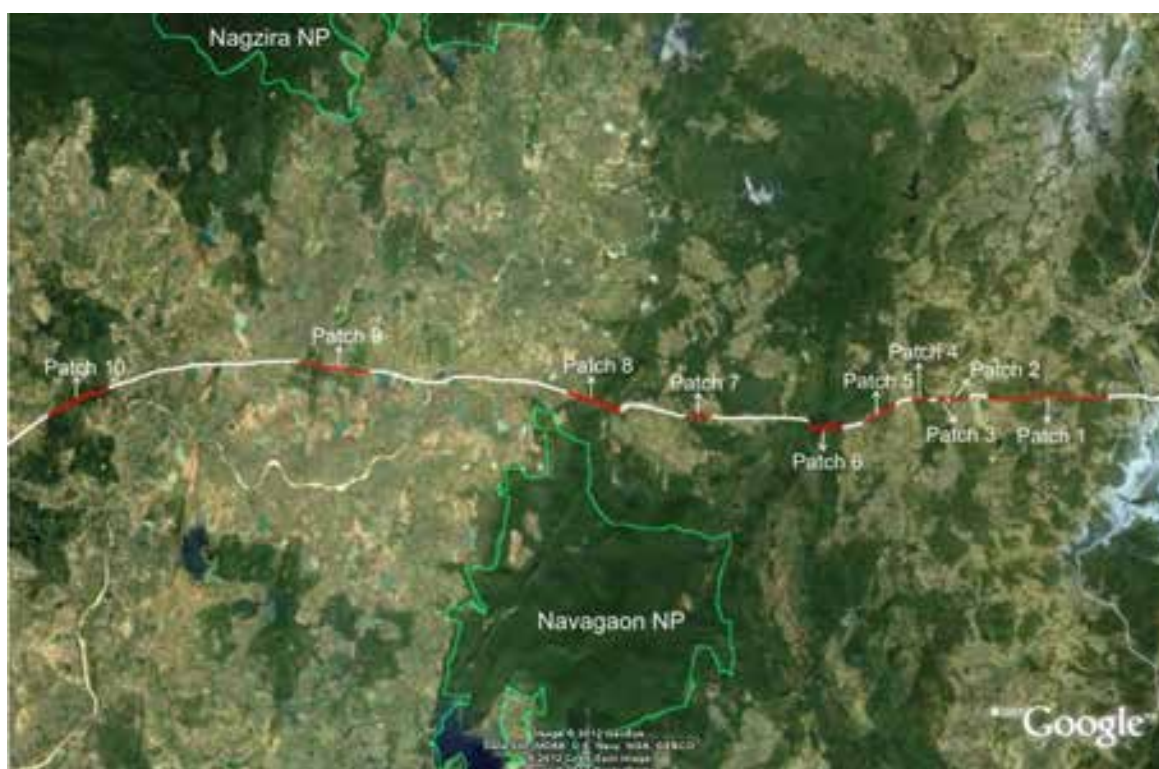
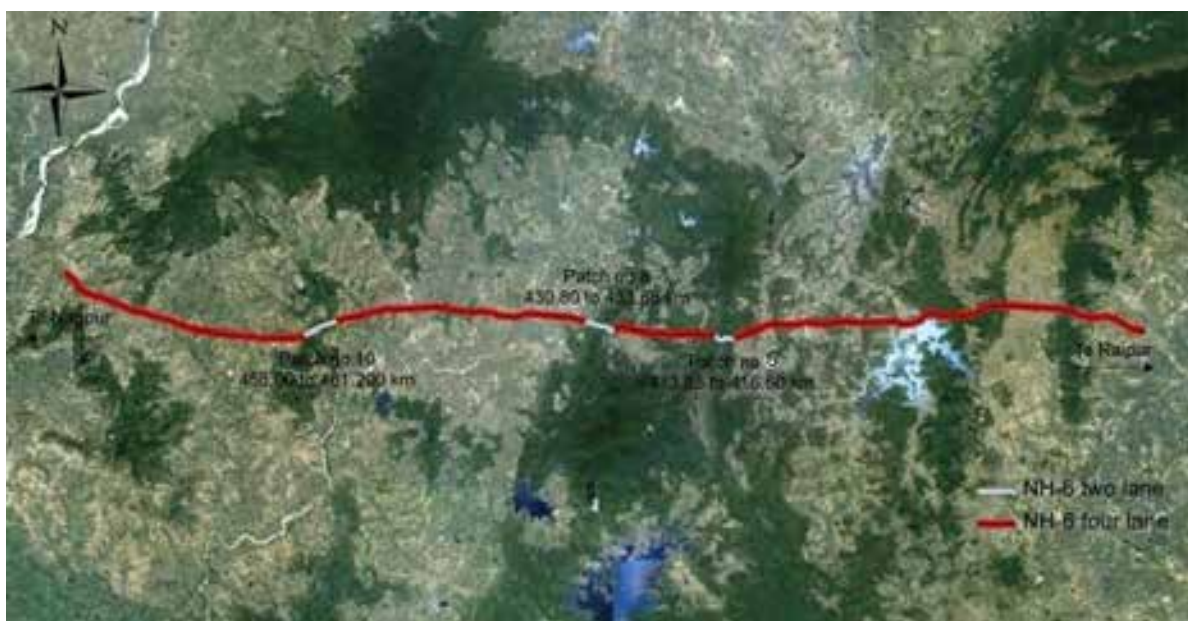


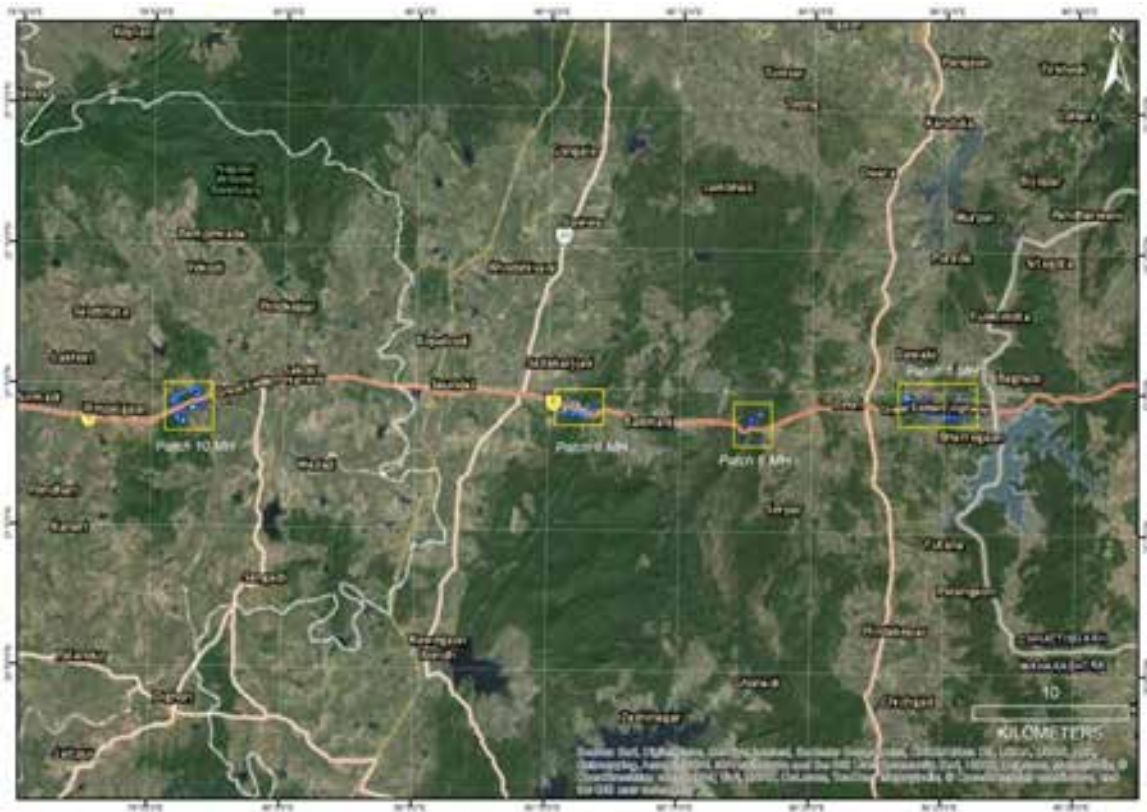
Figure 4: Location of forest patches in Gondiya and Bhandara Forest Division along NH-6 in Maharashtra



**Figure 5:** NH-6 showing four lane and two lane sections on Google Imagery  
The details of the stretches of National Highways 6 adjoining forest areas studied during the course of the survey are given in Table 4 and Figure 6

**Table 4:** Details of road stretches surveyed during the present study on NH-6

Highway and State	Patch Identity (Figure 5)	Section/Chainage km	Location	Length (km)	Remarks
Maharashtra (NH-6)	Patch 1	406.600 - 412.900	Sirpur to Navatola	6.300	Resurveyed
	Patch 6	419.650 - 423.800	Maramjob to Banbitola	4.150	Resurveyed
	Patch 8	430.800 - 433.850	Bamhani to Duggipar	3.050	Resurveyed
	Patch 10	458.000 - 461.200	Sakoli to Mundipar	3.200	Resurveyed



**Figure 6:** Location of surveyed areas on NH-6 in Maharashtra

## 5. SURVEY AND ANALYTICAL METHODS:

The following methods were used during the re-survey carried out in March, 2015:

- i. Sign survey to identify Animal Crossing Zones.
- ii. Vehicle transects to identify hotspots of animal death.
- iii. Study of traffic heterogeneity, traffic volume, vehicle speed and species characteristics at current traffic volume to evaluate the barrier effect on different animal species due to factors such as road type (2- and 4-lane) and traffic volume.

### 5.1. To identify specific animal crossing zones and to suggest feasible locations for making underpasses and their dimensions:

**Sign surveys** along the affected road stretches were conducted during morning and evening hours to assess animal use of these habitats. For this, we walked parallel to the road stretch at perpendicular distances 30 (roadside), 250, 500 and 750 m from the road on both sides. Signs recorded included pellets, scats, pug/hof marks, other animal signs and direct animal sightings. At each sign/sighting, topography and forest type was also

recorded. Data regarding topography and vegetation cover was recorded along the entire stretch at every 250 m along the sign survey routes. The number and type of water bodies found on both sides of the road was also recorded. The exercise involved a total effort of  $(45.8 \times 8) = 366.4$  km during which 1200 animal signs were recorded.

**Identifying specific animal crossing zones:** Locations of animal signs collected in field were plotted in GIS domain and sign occurrence density per unit area was calculated using Home Range Tools extension for ArcGIS (Rodgers et al., 2007). We used Kernel analysis which is a non-parametric statistical method for estimating probability densities from a set of points. The method begins by centering a bivariate probability density function with unit volume (i.e., the “kernel”) over each recorded point. A bivariate kernel probability density estimator (i.e., a “utilization distribution”) is then calculated using the probability density estimates at each sign. The resulting kernel probability density estimator will have relatively large values in areas with many observations and low values in areas with few. Intensity use area estimates were indicated by using colour shading, with light colour showing low sign densities and darker shades indicating higher sign densities. This colour variation define intensity use areas at different probability levels, based on which we identified multi-species animal crossing zones along the respective road stretches.

**Vehicle transects to identify hotspots of animal death:** Morning, afternoon, evening and night time vehicle transects of the 12 road stretches were carried out twice in order to – 1) count incidents of road kills on road stretches and assess level of road verge habitat usage by animals at different times of the day; and 2) evaluate road visibility and animal detection ability of the driver at different times of the day. For the vehicle transects, an observer seated on the co-driver seat of a vehicle moving at 20 kmph made recordings of road-kills and activities of wild animals along the road verge. Measurements of road visibility (in meters) were taken every 250 m. This exercise involved a total effort of 366.4 km. Previous road-kill data was obtained from the state forest department which was used to validate hotspots of animal’s deaths on the road stretch.

**To identify designs of wildlife crossings suitable for animal species found in the landscape:** While planning and designing wildlife crossings, it is important to remember that every mitigation plan will be different and it is not always possible to extrapolate results across landscapes. Determining the specific placement or siting of a crossing is generally done after a thorough field survey. Considerations of the placement of the crossings begin also by determining the wildlife species or groups of concern. Once the focal species or group is identified, many factors such as road-kill data, radio and satellite telemetry, capture-mark-recapture, road surveys, track beds, genetic sampling, GIS-based movement model, rapid assessments and capability of adjacent land-use can be used to identify the best locations for wildlife crossing structures. *It is critical to make a field visit and be on the ground at the potential location for any wildlife crossing regardless of the tools or techniques used.* (Clevenger and Huijser, 2011). Existing underpasses and

bridges on the road stretches were surveyed for their suitability as animal crossings in terms of vehicle noise perceived under the structure compared to that on the road, as well as in terms of dimensions of the structure to determine the openness ratio.

**5.2. To evaluate the barrier effect on different animal species due to factors such as road type (2- and 4-lane), traffic heterogeneity, traffic volume, vehicle speed and species characteristics at current traffic volume:**

The barrier effect is the reduction in the number of animal movements across the roads, and results from a combination of factors such as avoidance due to noise, vehicle movement, pollution and human activity, and presence of physical hindrances such as the road itself, fences, ditches (Jaarsma et al., 2006). The character of the road verge may also act as a barrier for many species that may find it too open or too closed for passage. The barrier effect could have adverse implications for populations, interactions among species and entire ecosystems. Thus the barrier effect is a function of traffic volume and heterogeneity, vehicle speed and type, road type (2- or 4-laned, verge type) and animal characteristics (behaviour and morphometry). Thus it is important to study the interactions among these factors to quantify how the barrier effect will manifest itself for animal species in the landscape.

**Data on traffic heterogeneity and volume** were obtained from the toll plazas for information on traffic heterogeneity or types of vehicles traversing the national highways and average daily and weekly traffic volumes and peak traffic days and hours.

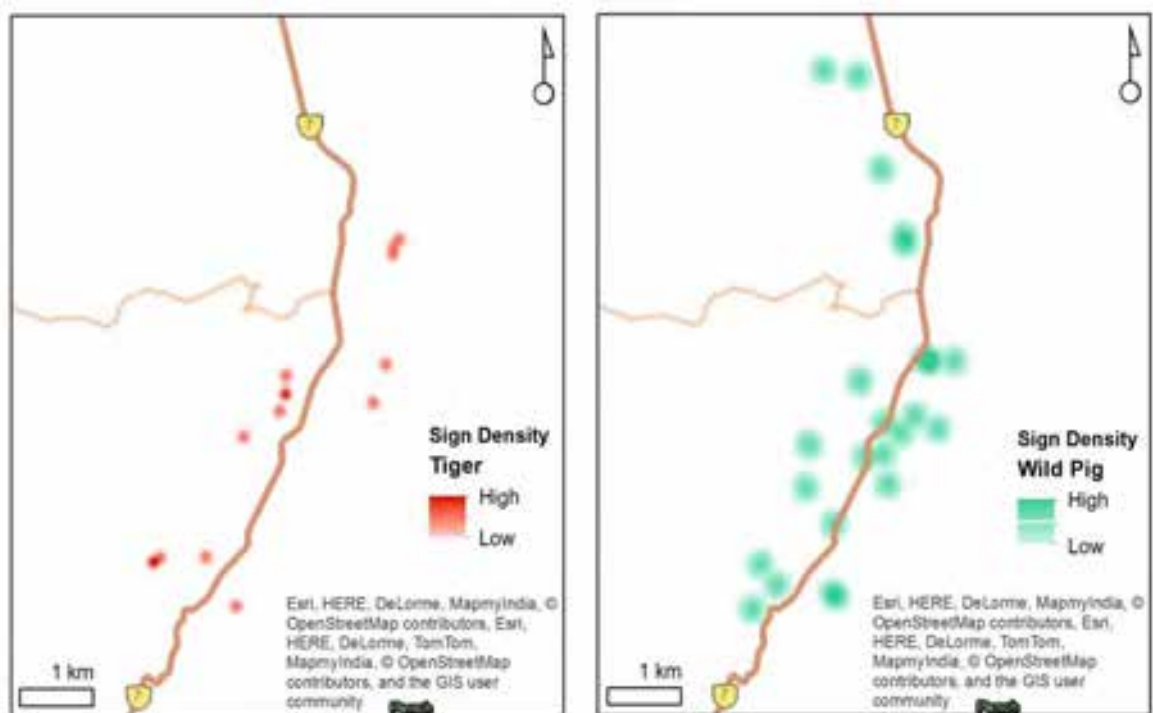
**Vehicle speed estimation in 2- and 4-laned sections of roads:** After determining peak traffic hours for NH-6 and NH-7 from the traffic data obtained from local toll plazas, we determined the speeds of different types of vehicles on the 2- and 4-laned sections of both highways separately at the peak traffic hour. This was done by photographing vehicles at two points (say at 0 km and 1 km) for incoming and outgoing traffic. The time stamps on the photographs were then used to determine the time taken by the vehicle to traverse 1 km and thus the speed was calculated.

**Species characteristics** of animals found in the landscape such as species behaviour (solitary/group living) were considered for evaluating the barrier effect.

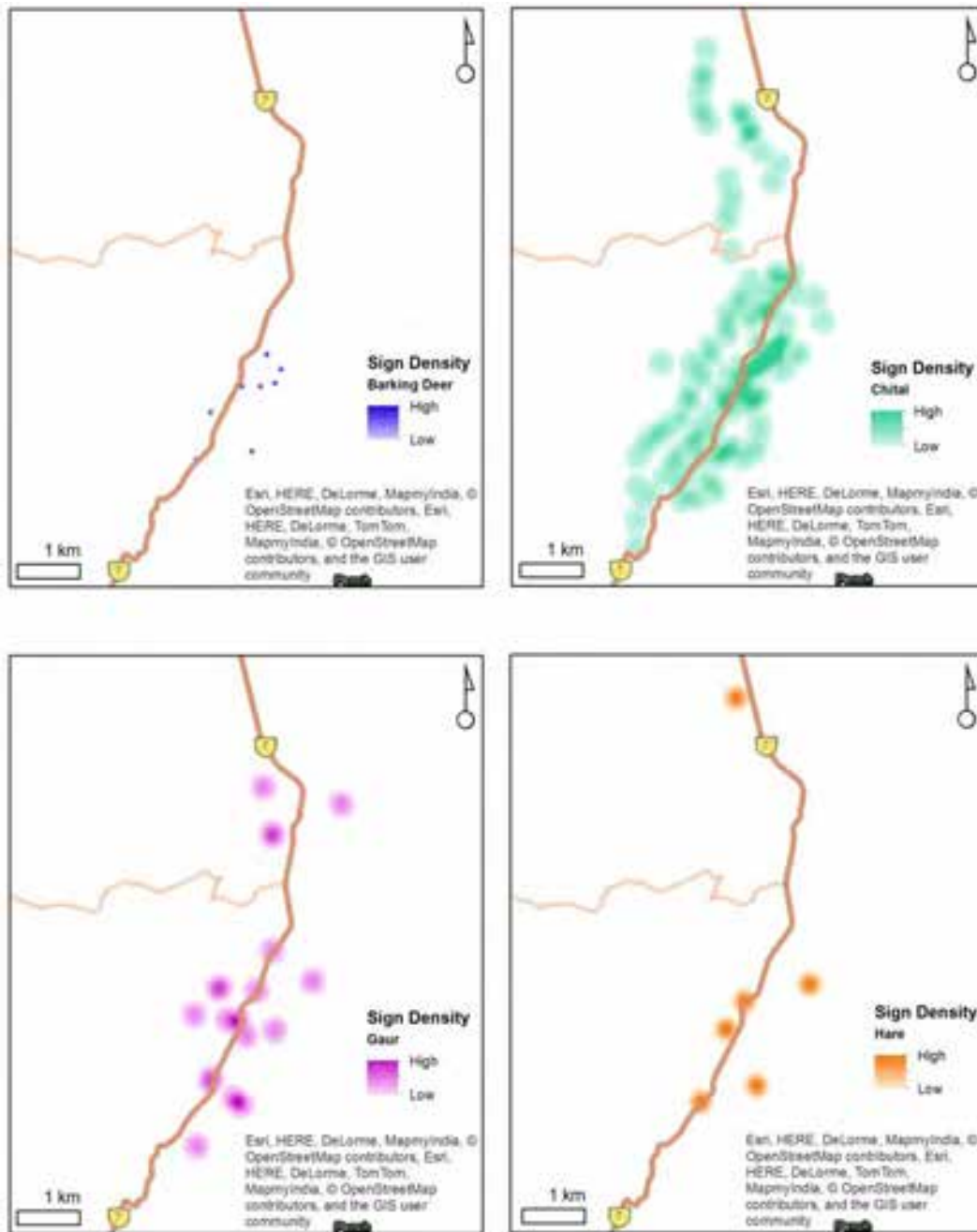
## 6. IDENTIFICATION OF SPECIFIC ANIMAL CROSSING ZONES ON NH-7 MADHYA PRADESH:

### 6.1. Patch 1 (Chainage 624.000 – 632.000 km) NH-7 MP:

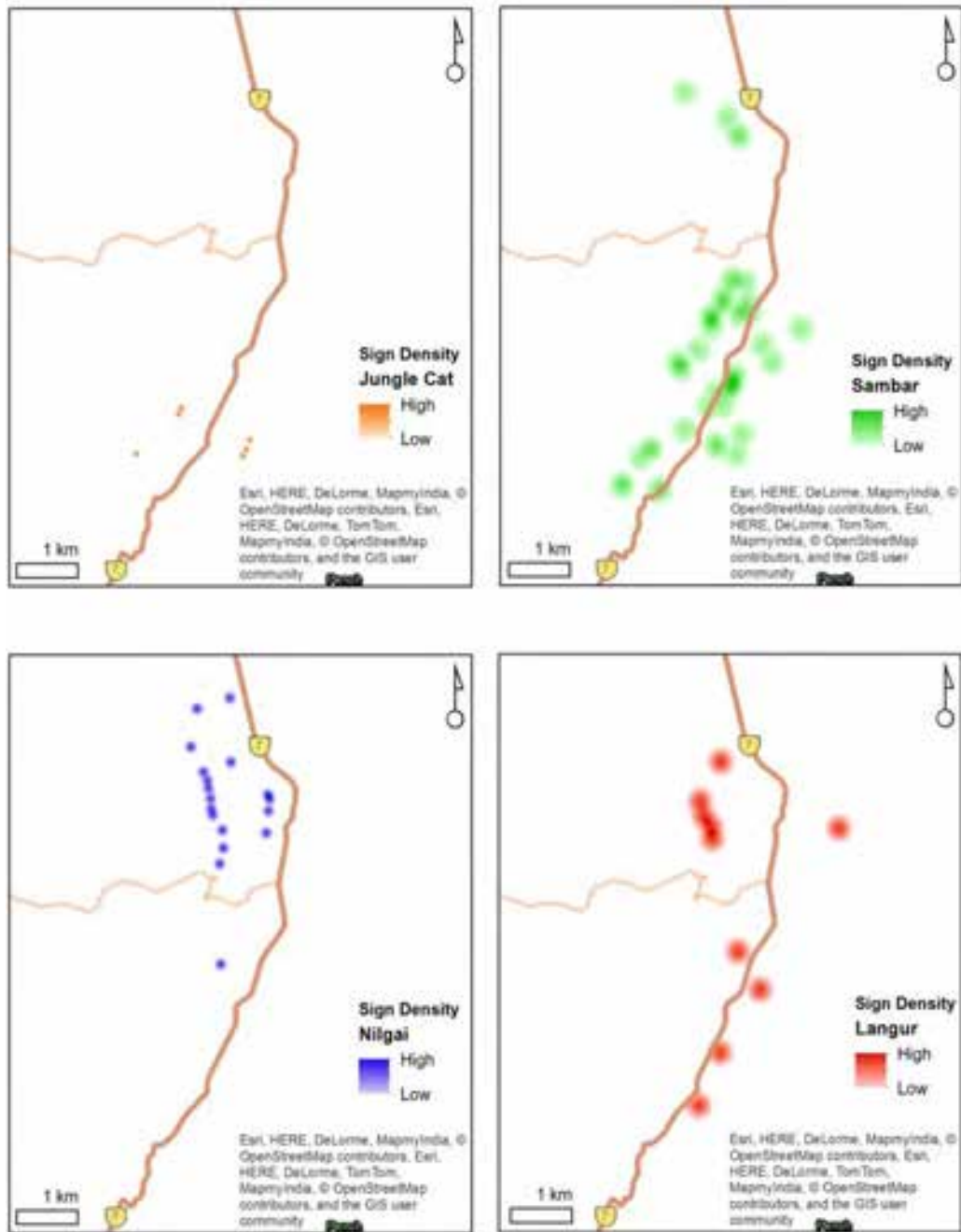
This patch includes 3 km of road stretch in South Seoni Forest Division before the Pench Tiger Reserve MP and 5 km of Forest Stretch from the Pench Tiger Reserve. During the resurvey, evidences of 10 species of mammals were found to use this section of highway. The species include Tiger, Jungle Cat, Barking Deer, Chital, Gaur, Sambar, Hare, Nilgai, Langur and Wild Pig. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 7 (a, b and c). Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 8 and details provided in Table 5.



**Figure 7 (a):** Sign intensity for Tiger and Wild Pig as indicated by kernel analysis on NH-7 MP Patch 1



**Figure 7 (b):** Sign intensity for Barking Deer, Chital, Gaur and Hare as indicated by kernel analysis on NH-7 MP Patch 1



**Figure 7 (c):** Sign intensity for Jungle Cat, Sambar, Nilgai and Langur as indicated by kernel analysis on NH-7 MP Patch 1



**Figure 8:** Location of multi-species crossing zones and mitigation measures on NH-7 Patch 1 identified by kernel and overlay analysis based on intensity of signs across the road stretch

**Table 5:** Details of crossing zones on NH-7 Patch 1 MP as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MP Patch 1	1	1000	7	Tiger (I) Gaur (I) Jungle cat (II) Hanuman Langur (II) Chital (III) Wild pig (III) Barking deer (III)
	2	1500	7	Tiger (I) Gaur (I) Hanuman Langur (II) Chital (III) Wild pig (III) Nilgai (III) Barking deer (III)
	3	1000	6	Tiger (I) Gaur (I) Hanuman Langur (II) Chital (III) Wild pig (III) Nilgai (III)

\*WPA status of animals are given in parentheses

### Recommendations for Patch 1 NH-7 Madhya Pradesh:

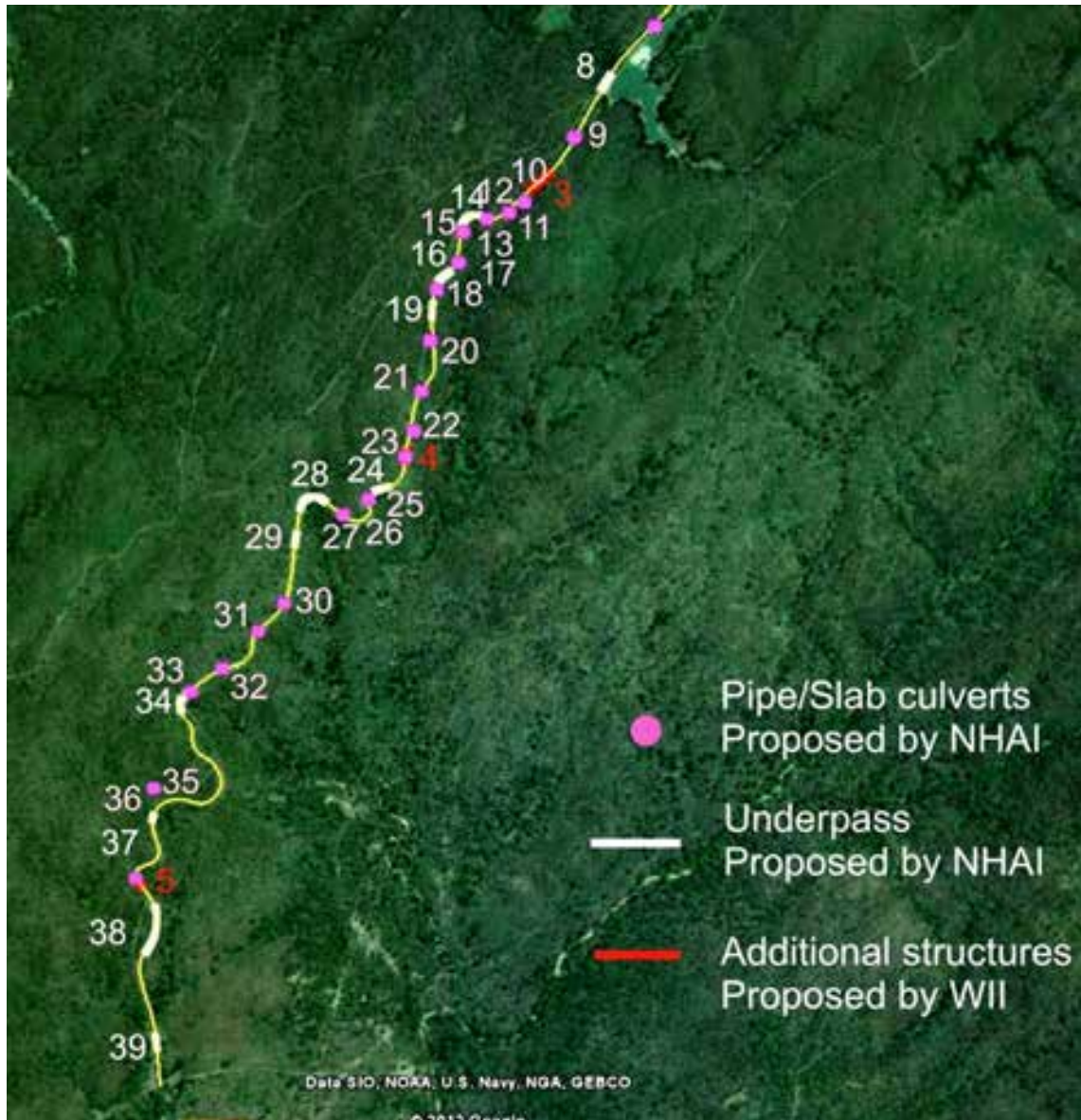
Based on the locations of crossing zones, villages and other ancillary development along this stretch of the road as validated during the ground survey, WII and NTCA recommend two crossing structures of 500 m length and 5 m height of viaduct (50 m + 300 m on either side as approach) and 800 m length and 5 m height of viaduct (100 m + 300 m on either side as approach road). The locations of proposed mitigation measures are indicated in Figure 8 and details provided in Table 6.

**Table 6:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 1, NH-7, Madhya Pradesh

S. No.	GPS Location Mid-Point	Structure Type	Dimension (m)		
				Width (viaduct)	Height
1.	21 53 40.38 79 31 57.84	Underpass for Animals	RCC structure	500	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	50 + 50	2
2.	21 51 40.38 79 31 19.62	Underpass for Animals	RCC structure	800	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	100 + 100	2

## 6.2. Patch 2 (Chainage 632.000 – 635.900 km) NH-7 MP:

This patch includes 3.9 km of road stretch in the Pench Tiger Reserve MP and is hilly in nature. The stretch was not surveyed during the present re-survey. However, based on earlier recommendations, WII, NTCA and NHAI are in agreement on the mitigation measures proposed in earlier WII report. The map and details are provided in Figure 9 and Table 7.



**Figure 9:** Locations of 11 underpasses, 21 pipe/slab/box culverts proposed by NHAI and 03 additional underpasses proposed by WII on Google Earth Imagery from chainage 632.000 – 635.900 (3.9 kms) hilly area of NH-7 passing through PTR

**Table 7 :** Summary of 32 structure in 3.9 km section of NH-7 passing through Pench Tiger Reserve (Hilly Area)

S. No. (as in Figure 8)	Chainage wise location of structur e	Type of structure					
		Pipe Culverts		Slab Culverts		Underpass	
		No	Diameter (m)	No.	Diameter (m)	Width (m)	Height (m)
08	632.050	-	-	-	-	70	5
09	632.191	-	-	1	2	-	-
10	632.361	-	-	1	2	-	-
11	632.443	1	1	-	-	-	-
12	632.498	1	1	-	-	-	-
13	632.542	-	-	1	2	-	-
14	632.626	-	-	-	-	90	5
15	632.652	1	1	-	-	-	-
16	632.729	-	-	-	-	60	5
17	632.775	1	1	-	-	-	-
18	632.886	-	-	1	2	-	-
19	632.950	-	-	-	-	60	5
20	633.020	-	-	1	2	-	-
21	633.117	1	1	-	-	-	-
22	633.222	-	-	1	2	-	-
23	633.363	-	-	1	2	-	-
24	633.400	-	-	-	-	60	5
25	633.550	1	1	-	-	-	-
26	633.559	1	1	-	-	-	-
27	633.875	-	-	1	6	-	-
28	633.920	-	-	-	-	120	5
29	634.143	-	-	1	2	-	-
30	634.193	-	-	1	2	-	-
31	634.400	-	-	-	-	60	5
32	634.416	-	-	1	2	-	-
33	634.569	1	1	-	-	-	-
34	634.730	-	-	-	-	70	5
35	635.093	-	-	1	2	-	-
36	635.368	-	-	1	3	-	-
37	635.700	-	-	-	-	30	5
38	635.885	-	-	-	-	180	5
39	636.141	-	-	-	-	60	5

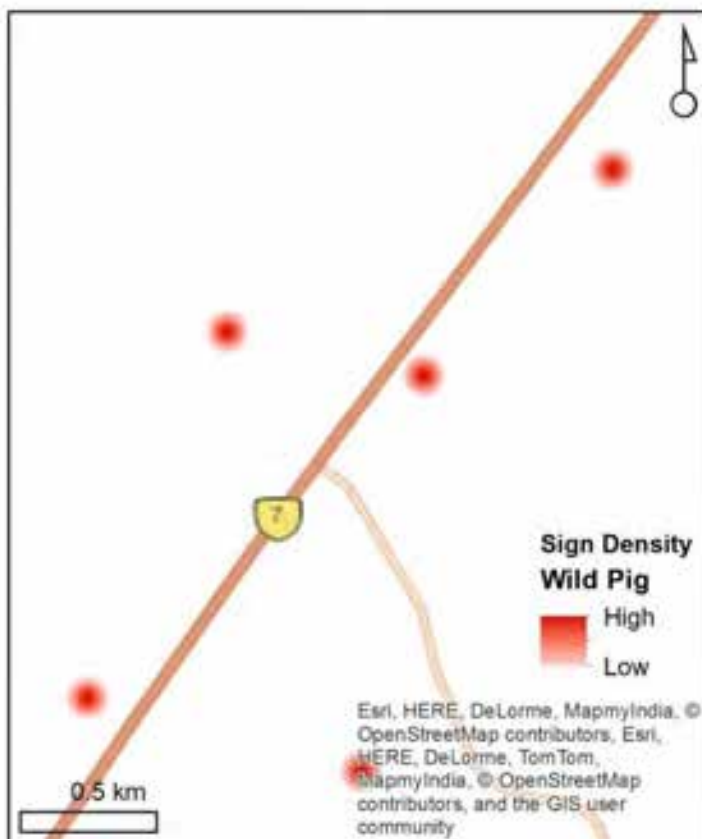
On this section of road, other than the measures proposed by NHAI, WII and NTCA have recommended three additional structures. These structures are marked in red in Figure 8 and the details are indicated in Table 8.

**Table 8:** Details of additional mitigation measures proposed by WII and NTCA on Forest Patch 2, NH-7, Madhya Pradesh

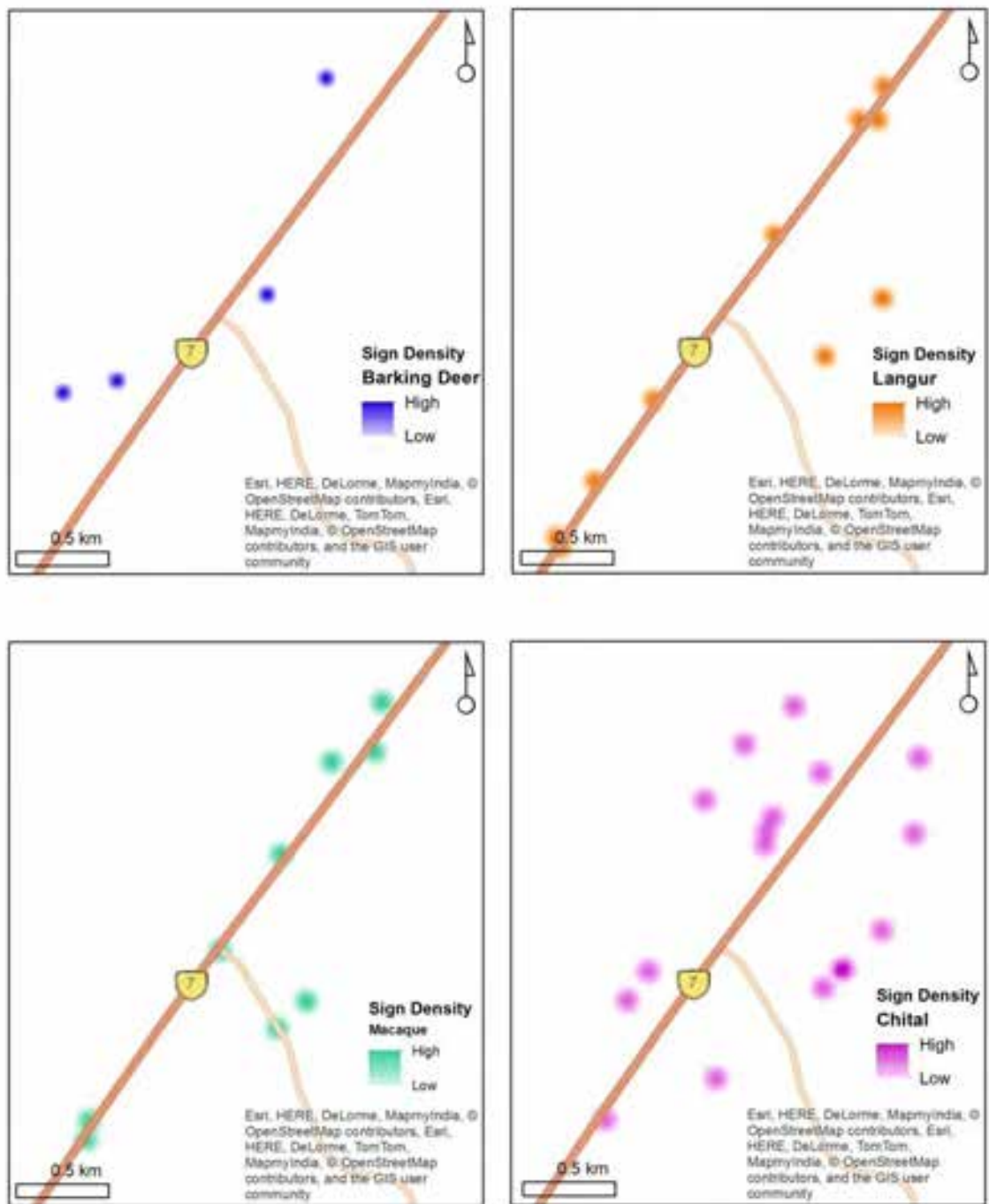
S. No. (as in Figure 8)	Chainage km (Mid-Point)	Structure Type	Dimension (m)	
			Width	Height
3.	632.350	Underpass for Animals	90	5
4.	633.550	Underpass for Animals	60	5
5.	635.050	Underpass for Animals	60	5

**6.3. Patch 3 (Chainage 643.000 – 646.000 km) NH-7 MP:**

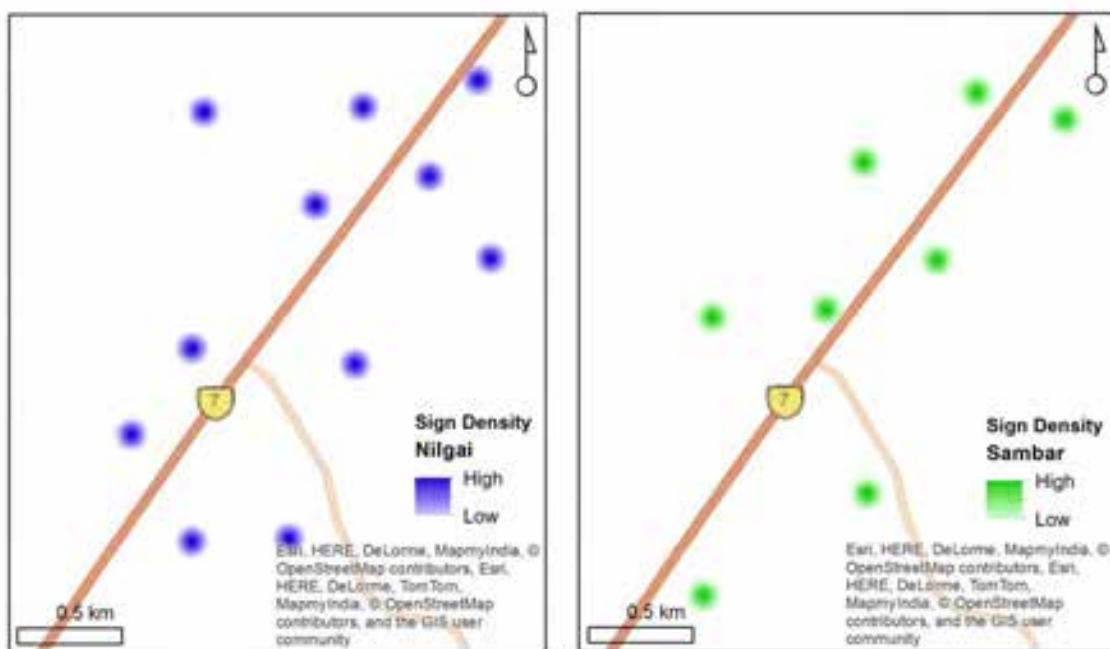
This patch includes a three km road stretch in South Seoni Forest Division after the hilly portion of Pench Tiger Reserve MP towards Maharashtra. During the resurvey evidences of 7 species of mammals using this section of highway were found. The species include Barking Deer, Chital, Sambar, Nilgai, Langur, Macaque and Wild Pig. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 10 (a, b and c). Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 11 and details provided in Table 9.



**Figure 10(a):** Sign intensity for wild pig as indicated by kernel analysis on NH-7 MP Patch 3



**Figure 10 (b):** Sign intensity for Barking Deer, Langur, Macaque and Chital as indicated by kernel analysis on NH-7 MP Patch 3

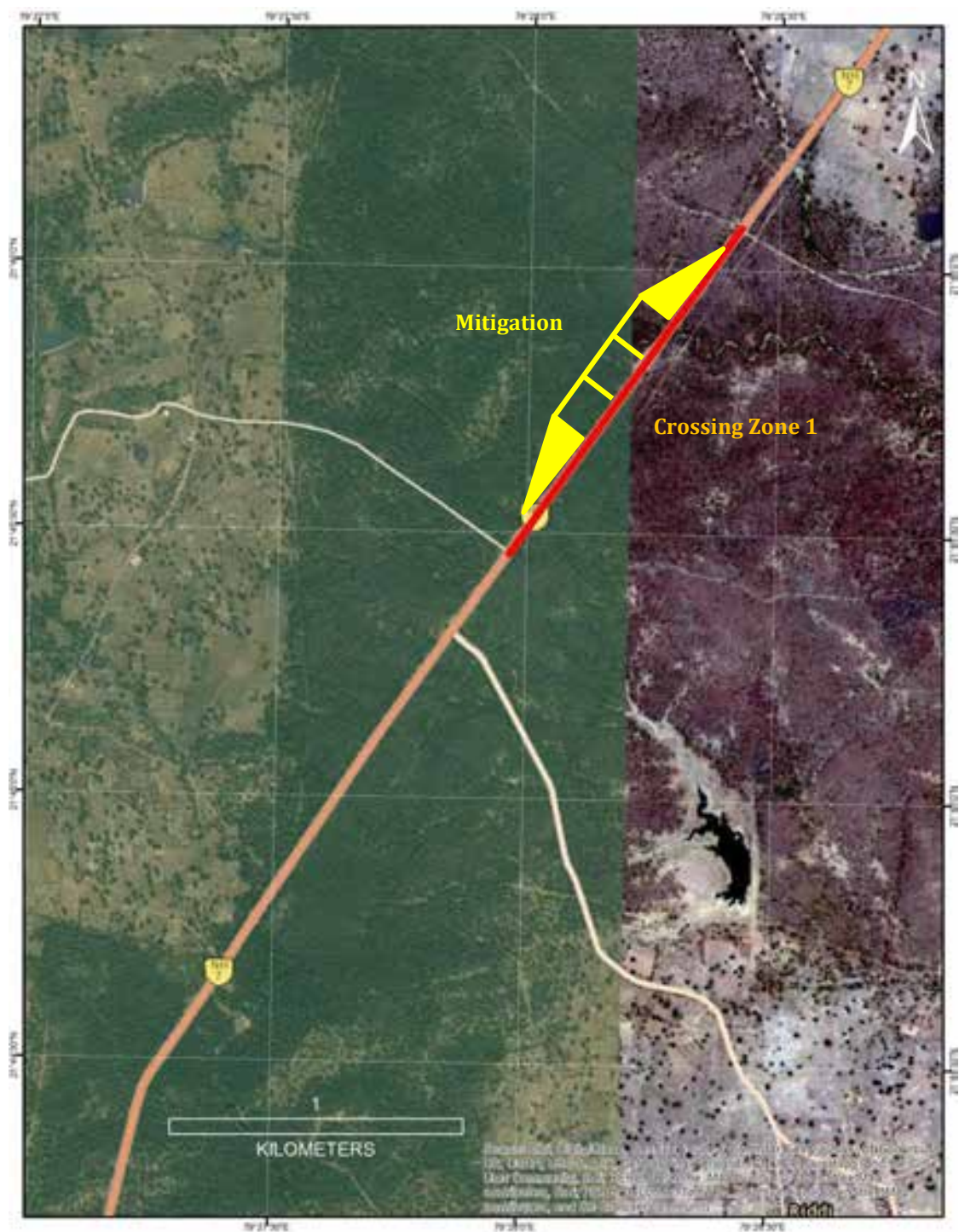


**Figure 10 (c):** Sign intensity for Nilgai and Sambar as indicated by kernel analysis on NH-7 MP Patch 3

**Table 9:** Details of crossing zones on NH-7 Patch 3 as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MP Patch 3	1	1300	7	Hanuman Langur (II) Rhesus macaque (II) Chital (III) Nilgai (III) Sambar (III) Wild pig (III) Barking Deer (III)

\*WPA status of animals are given in parentheses



**Figure 11:** Location of multi-species crossing zone and mitigation measure on NH-7 Patch 3 identified by kernel and overlay analysis based on intensity of signs across the road stretch

### Recommendations for Patch 3 NH-7 Madhya Pradesh:

Based on the locations of crossing zones, villages and other ancillary development along this stretch of the road as validated during the ground survey, WII and NTCA recommend one crossing structure of 500 m length and 5 m height of viaduct (500 m + 300 m on either side as approach). The locations of the proposed mitigation measures are indicated in Figure 11 and details provided in Table 10.

**Table 10:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 3, NH-7, Madhya Pradesh

S. No.	GPS Location Mid-Point	Structure Type	Dimension (m)		
			Width (viaduct)	Height	
1.	21 45 50.23	Underpass for Animals	RCC structure	500	5
	79 28 14.38		Approach (both sides)	300 + 300	
			Guide walls (both sides)	100 + 100	2

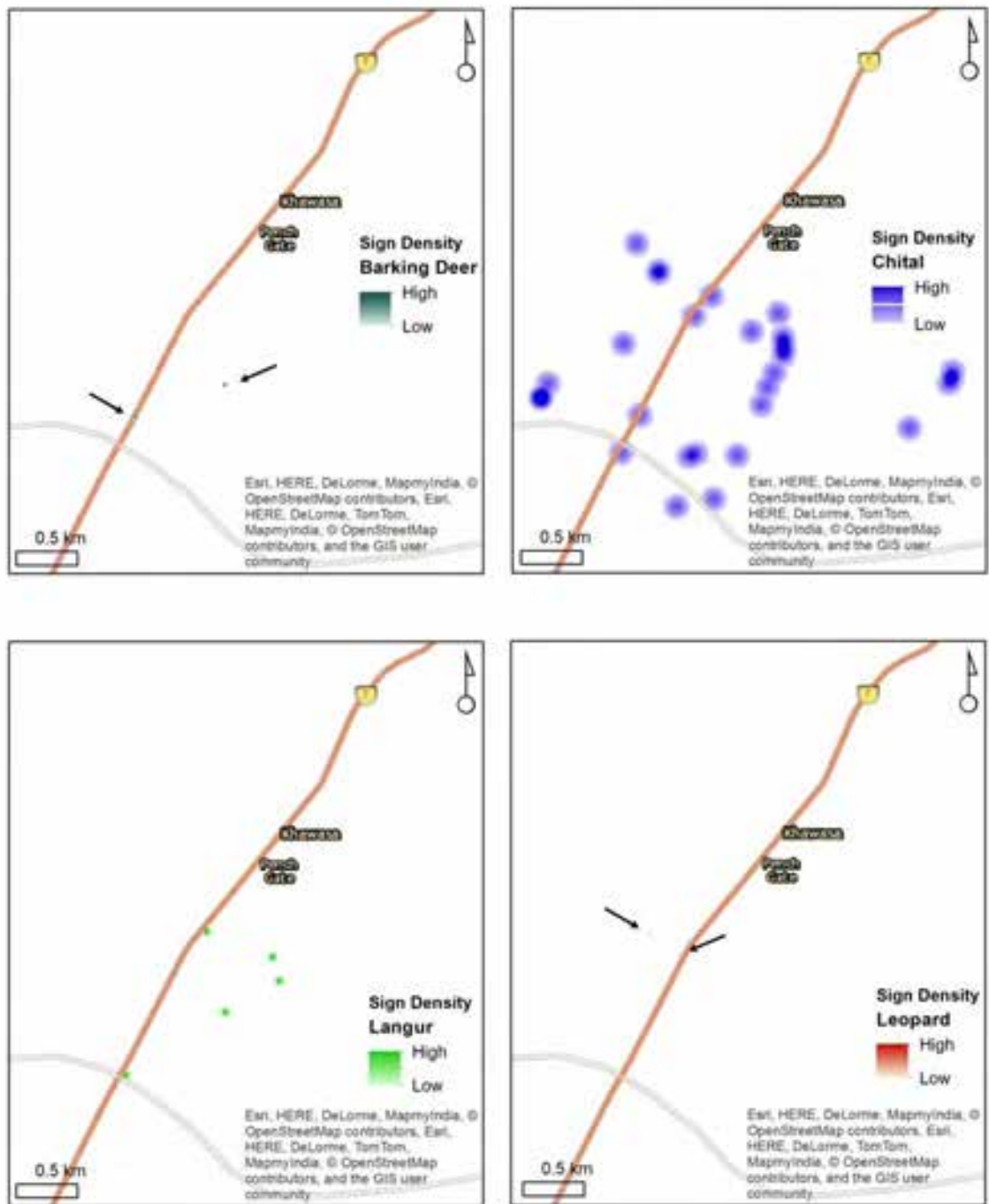
### 6.4. Patch 4 (Chainage 650.000 – 652.000 km) NH-7 MP:

This patch includes two km of road stretch in South Seoni Forest Division from Khawasa to Maharashtra border. During the resurvey evidences of 8 species of mammals were found to use this section of highway. The species include Wolf, Leopard, Barking Deer, Chital, Sambar, Nilgai, Langur and Wild Pig. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 12 (a and b). Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 13 and details provided in Table 11.

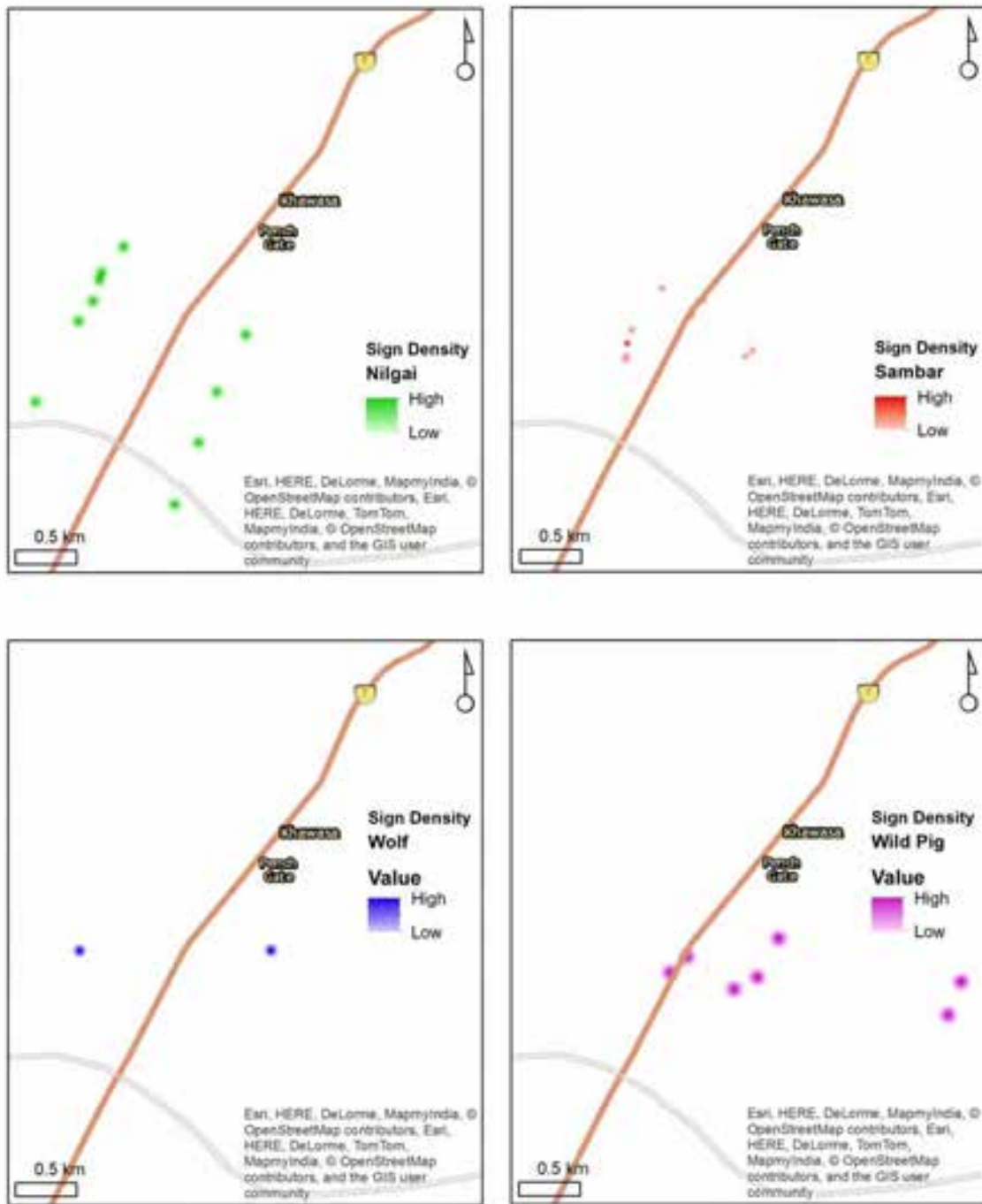
**Table 11:** Details of crossing zones on NH-7 Patch 4 as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MP Patch 4	1	700	4	Hanuman Langur (II) Barking Deer (III) Chital (III) Nilgai (III) Leopard (I) Indian grey wolf (I) Sambar (III) Wild pig (III)

\*WPA status of the animals are given in parentheses



**Figure 12 (a):** Sign intensity for Barking Deer, Chital, Langur and Leopard as indicated by kernel analysis on NH-7 MP Patch 4



**Figure 12 (b):** Sign intensity for Nilgai, Sambar, Wolf and Wild Pig as indicated by kernel analysis on NH-7 MP Patch 4



**Figure 13:** Location of multi-species crossing zone and mitigation measure on NH-7 Patch 4 identified by kernel and overlay analysis based on intensity of signs across the road stretch

### Recommendations for Patch 4 NH-7 Madhya Pradesh:

Based on the locations of crossing zones, villages and other ancillary development along this stretch of the road as validated during the ground survey, WII and NTCA recommend one crossing structure of 300 m length and 5 m height of viaduct (300 m + 300 m on either side as approach). The location of proposed mitigation measure is indicated in Figure 13 and details provided in Table 12.

**Table 12:** Details of mitigation measure proposed by WII and NTCA on Forest Patch 4, NH-7, Madhya Pradesh

S. No.	GPS Location Mid-Point	Structure Type	Dimension (m)		
			Width (viaduct)	Height	
1.	21 41 47.85 79 25 44.46	Underpass for Animals	RCC structure	300	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	50 + 50	2

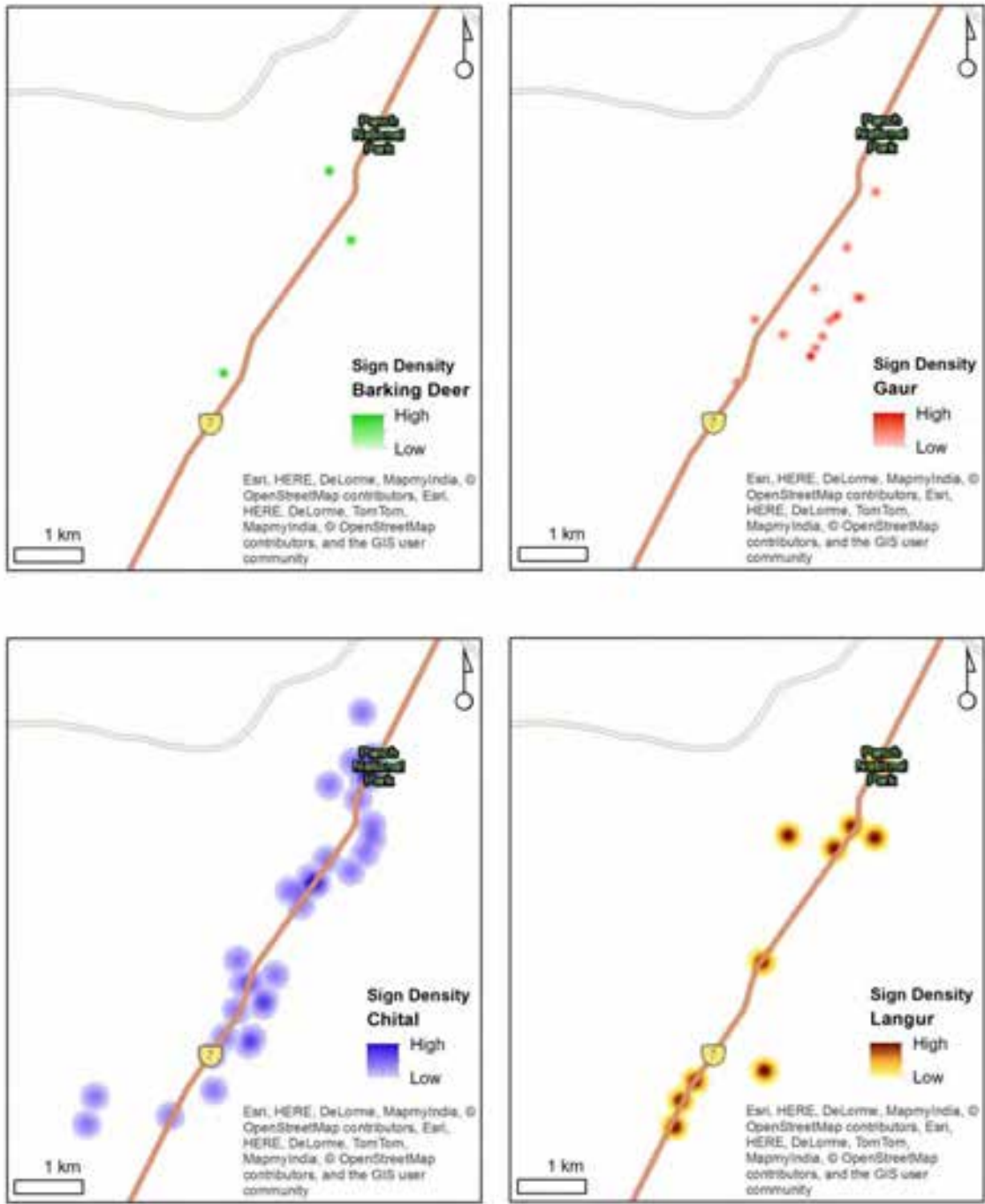
## 7. IDENTIFICATION OF SPECIFIC ANIMAL CROSSING ZONES ON NH-7 MAHARASHTRA:

### 7.1. Patch 1 (From MP Border (Manegaon tek) to Wadamba) NH-7 MH:

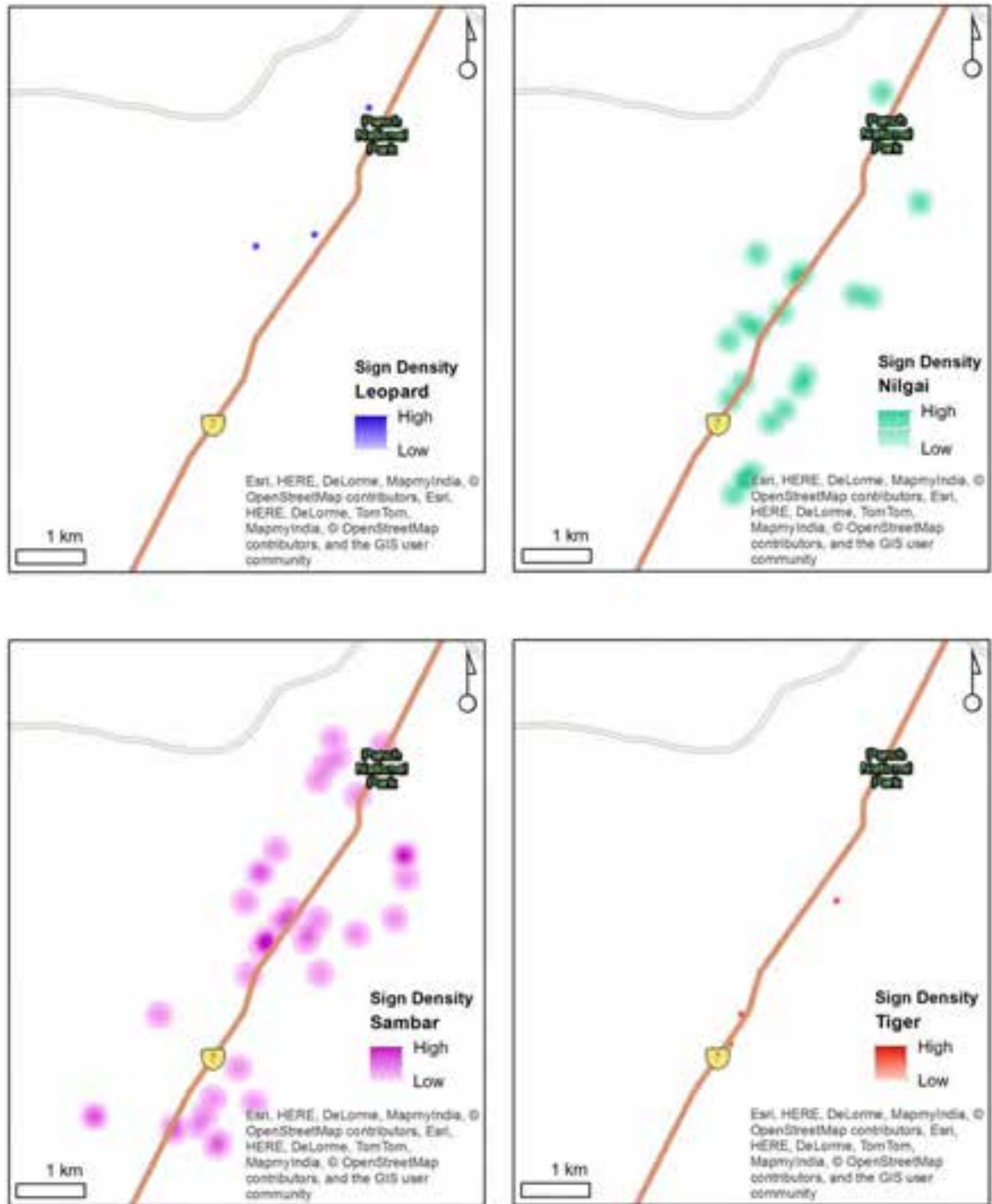
This patch of 8 km length is adjoining to Mansinghdeo Wildlife Sanctuary, Maharashtra. During the resurvey, evidences of 9 species of mammals were found to use this section of highway. The species include Tiger, Leopard, Barking Deer, Chital, Gaur, Sambar, Nilgai, Langur and Wild Pig. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 14 (a, b and c). Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 15 and details provided in Table 13.



**Figure 14 (a):** Sign intensity for Wild Pig as indicated by kernel analysis on NH-7 Forest Patch 1



**Figure 14 (b):** Sign intensity for Barking Deer, Gaur, Chital and Langur as indicated by kernel analysis on NH-7 Forest Patch 1



**Figure 14 (c):** Sign intensity for Leopard, Nilgai, Sambar and Tiger as indicated by kernel analysis on NH-7 Forest Patch 1



**Figure 15:** Location of multi-species crossing zones and mitigation measures on NH-7 Patch 1 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch

**Table 13:** Details of crossing zones on NH-7 Patch 1 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MH Patch 1	1	500	4	Hanuman Langur (II) Chital (III) Sambar (III) Wild pig (III),
	2	650	6	Tiger (I) Gaur (I) Chital (III) Wild pig (III) Nilgai (III) Barking deer (III)
	3	750	5	Gaur (I) Hanuman Langur (II) Sambar (III) Wild pig (III) Nilgai (III)
	4	700	7	Tiger (I) Leopard (I) Gaur (I) Chital (III) Wild pig (III) Nilgai (III) Barking deer (III)
	5	450	3	Gaur (I) Hanuman Langur (II) Barking deer (III)
	6	600	6	Leopard (I) Hanuman Langur (II) Chital (III) Sambar (III) Wild pig (III) Nilgai (III),

\*WPA status of animals are given in parentheses

## Recommendations for Patch 1 NH-7 Maharashtra:

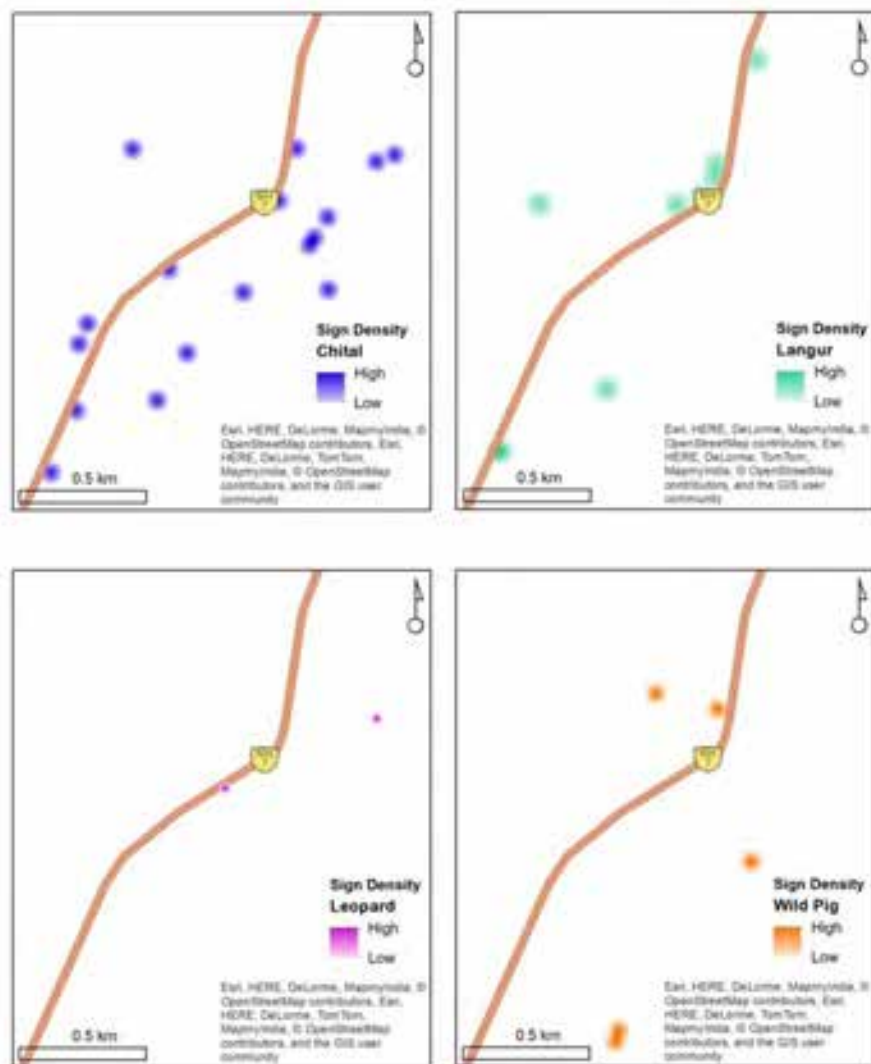
Based on the locations of crossing zones, villages, intensity of use by animals and existing river channels along this stretch of the road as validated during the ground survey, WII and NTCA recommend five crossing structures on this stretch of the road. The details of mitigation measures as proposed by WII and NTCA are provided in Table 14. The revised committee report submitted to Govt. of Maharashtra on 31<sup>st</sup> January 2015 was also considered while suggesting revised mitigation measures.

**Table 14:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 1, NH-7, Maharashtra

Crossing Zone Number	GPS Location (Mid-point)	Chainage (km) (Centre)	Type	Provision	Dimensions	
					Width (m)	Height (m)
01	21 40 16.87 79 24 56.98	653.770	Minor Bridge	Structure Extension	60	5
				Guide Walls	50 + 50	2
02	21 39 58.35 79 24 47.42	654.360	Under pass	RCC Structure	50	5
				Approaches	300 + 300	
03 and 04	21 39 07.3 79 24 19.19	656.200	Under pass at 655+800	Guide Walls	50 + 50	2
				RCC Structure	750	5
				Approaches	300 + 300	
05	21 38 15.48 79 23 51.01	657.950	Minor Bridge	Structure Extension	80	5
				Guide Walls	50 + 50	2
06	21 37 24.04 79 23 18.56	659.520	Under pass	RCC Structure	300	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2

## 7.2. Patch 2 (Between Bothiya - Deolapar) NH-7 MH:

This patch of 2.5 km length is adjoins Pench Tiger Reserve, Maharashtra. During the resurvey, evidences of 4 species of mammals were found to use this section of highway. The species include Leopard, Chital, Langur and Wild Pig. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 16. Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 17 and details provided in Table 15.



**Figure 16:** Sign intensity for Chital, Langur, Leopard and Wild Pig as indicated by kernel analysis on NH-7 Forest Patch 2

**Table 15:** Details of crossing zones on NH-7 Patch 2 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MH Patch 2	1	700	4	Hanuman Langur (II) Chital (III) Wild pig (III) Leopard (I)

\*WPA status of animals are given in parentheses

### Recommendations for Patch 2 NH-7 Maharashtra:

Based on the locations of crossing zones, villages, intensity of use by animals and existing river channels along this stretch of the road as validated during the ground survey, WII and NTCA recommend one crossing structures on this stretch of the road. This is widening of existing bridge to make it conducive for animal use. The details of the mitigation measure as proposed by WII and NTCA are provided in Table 16. The revised committee report submitted to Govt. of Maharashtra on 31<sup>st</sup> January 2015 was also considered while suggesting revised mitigation measure.

**Table 16:** Details of the mitigation measure proposed by WII and NTCA on Forest Patch 2, NH-7, Maharashtra

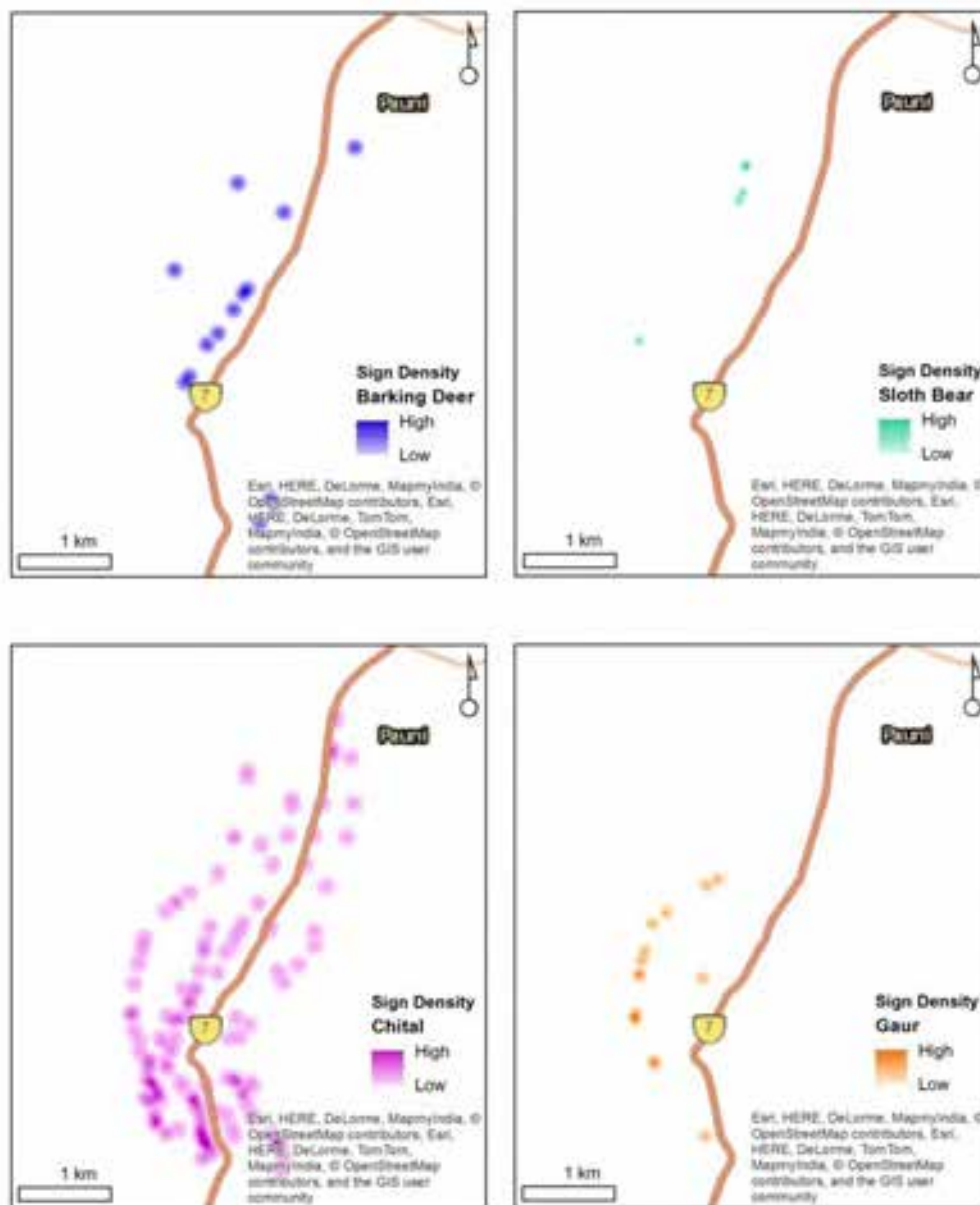
Crossing Zone Number	GPS Location (Mid - Point)	Chainage (km) (Centre)	Type	Provision	Dimensions	
					Width (m)	Height (m)
01	21 40 16.87 79 24 56.98	667.900	Minor Bridge	Structure Extension	65	5
				Guide Walls	100 + 100	2



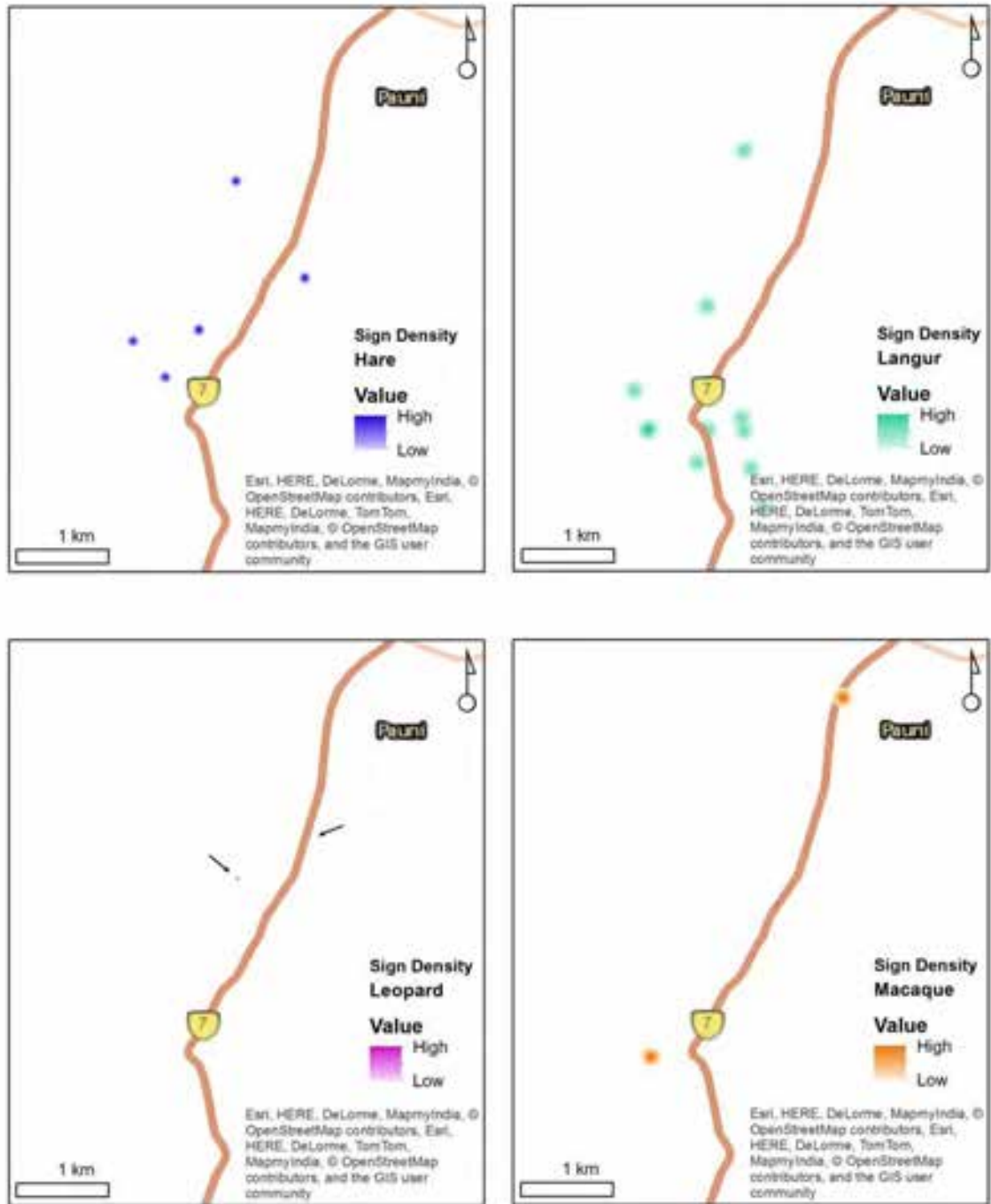
**Figure 17:** Location of multi-species crossing zone on NH-7 Patch 2 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch and location of proposed bridge

### 7.3. Patch 3 (From Chorbahuli to Pauni) NH-7 MH:

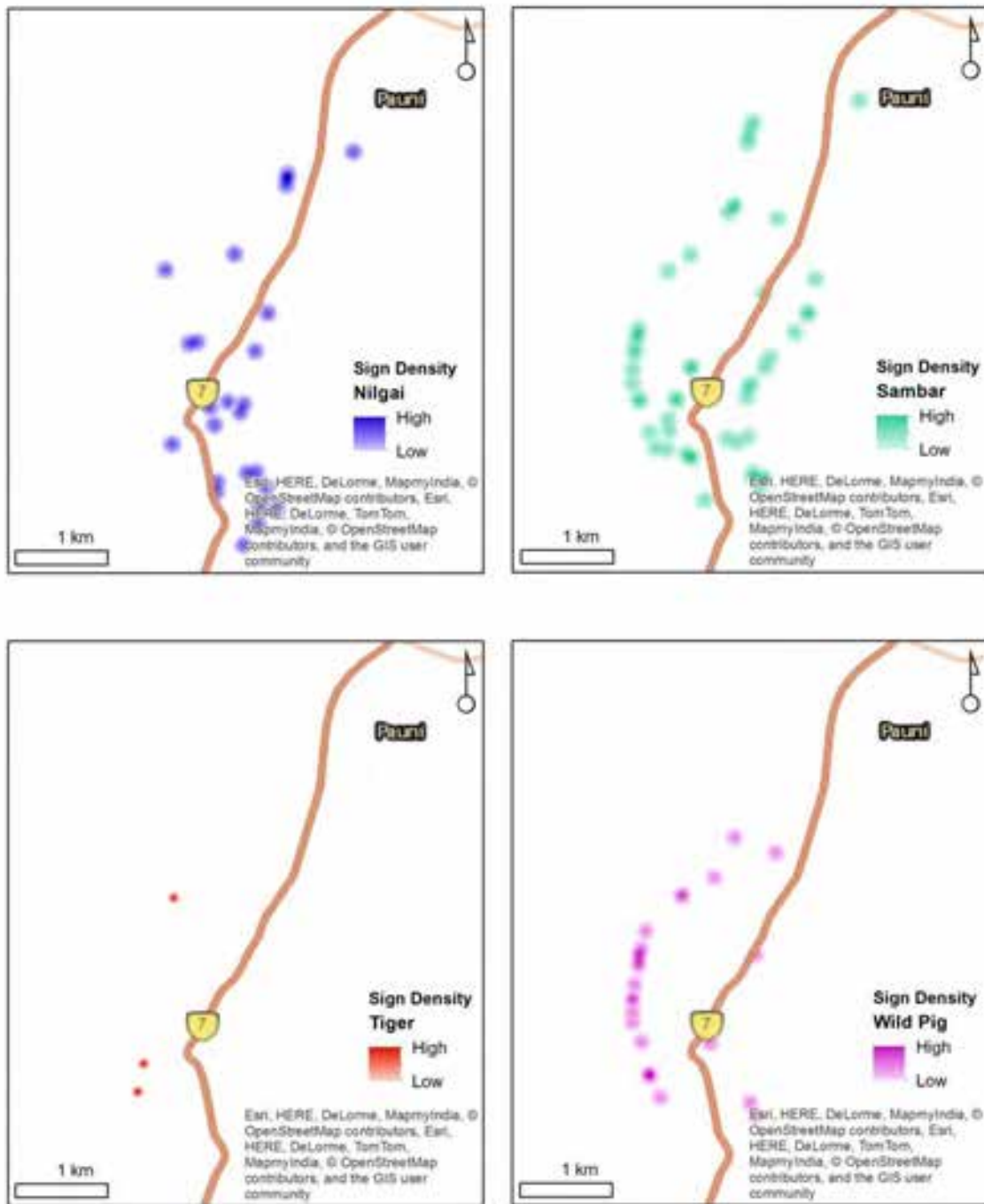
This patch of 5.6 km length is adjoining to Pench Tiger Reserve, Maharashtra. During resurvey evidences of 12 species of mammals were found to use this section of highway. The species include Barking Deer, Sloth Bear, Chital, Gaur, Hare, Langur, Macaque, Leopard, Nilgai, Sambar, Wild Pig and Tiger. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 18 (a, b and c). Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 19 and details provided in Table 17.



**Figure 18 (a):** Sign intensity for Barking Deer, Sloth Bear, Chital and Gaur as indicated by kernel analysis on NH-7 (MH) Forest Patch 3



**Figure 18 (b):** Sign intensity for Hare, Langur, Leopard and Macaque as indicated by kernel analysis on NH-7 (MH) Forest Patch 3



**Figure 18 (c):** Sign intensity for Nilgai, Sambar, Tiger and Wild Pig as indicated by kernel analysis on NH-7 (MH) Forest Patch 3



**Table 17:** Details of crossing zones on NH-7 Patch 3 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-7 MH Patch 3	1	1000	9	Tiger (I) Gaur (I) Hanuman Langur (II) Rhesus macaque (II) Chital (III) Nilgai (III) Barking deer (III) Sambar (III) Wild pig (III)
	2	2500	12	Gaur (I) Leopard (I) Tiger (I) Sloth bear (I) Hanuman Langur (II) Rhesus macaque (II) Chital (III) Barking deer (III) Nilgai (III) Sambar (III) Wild pig (III) Hare (IV)

\*WPA status of animals are given in parentheses

### Recommendations for Patch 3 NH-7 Maharashtra:

Based on the locations of crossing zones, villages, intensity of use by animals and existing river channels along this stretch of the road as validated during the ground survey, WII and NTCA recommend one crossing structures on this stretch of the road. This is widening of existing bridge to make it conducive for animal use. The mitigation measure as proposed by WII and NTCA are shown in Figure 19 and details are provided in Table 18. The revised committee report submitted to Govt. of Maharashtra on 31<sup>st</sup> January 2015 was also considered while suggesting revised mitigation measure.

**Table 18:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 3, NH-7, Maharashtra

Mitigation Measure	GPS Location (Mid - Point)	Chainage (km) (Centre)	Type	Provision	Dimensions	
					Width (m)	Height (m)
01	21 31 12.28 79 20 03.43	673.700	Under pass	RCC Structure	100	5
				Approach	300 + 300	
02	21 29 47.54 79 19 35.52	675.500	Under pass	RCC Structure	750	5
				Approach	300 + 300	
03	21 28 45.08 79 19 23.09	677.300	Minor Bridge	Structure	50	5
				Extension		
				Guide Walls	250 + 250	

## 8. IDENTIFICATION OF SPECIFIC ANIMAL CROSSING ZONES ON NH-6 MAHARASHTRA:

### 8.1. Forest Patch 01: (from Chhattisgarh Border) (Chainage 406.600 to 412.900 km; Sirpur to Nawatola; Length 6.300 km)

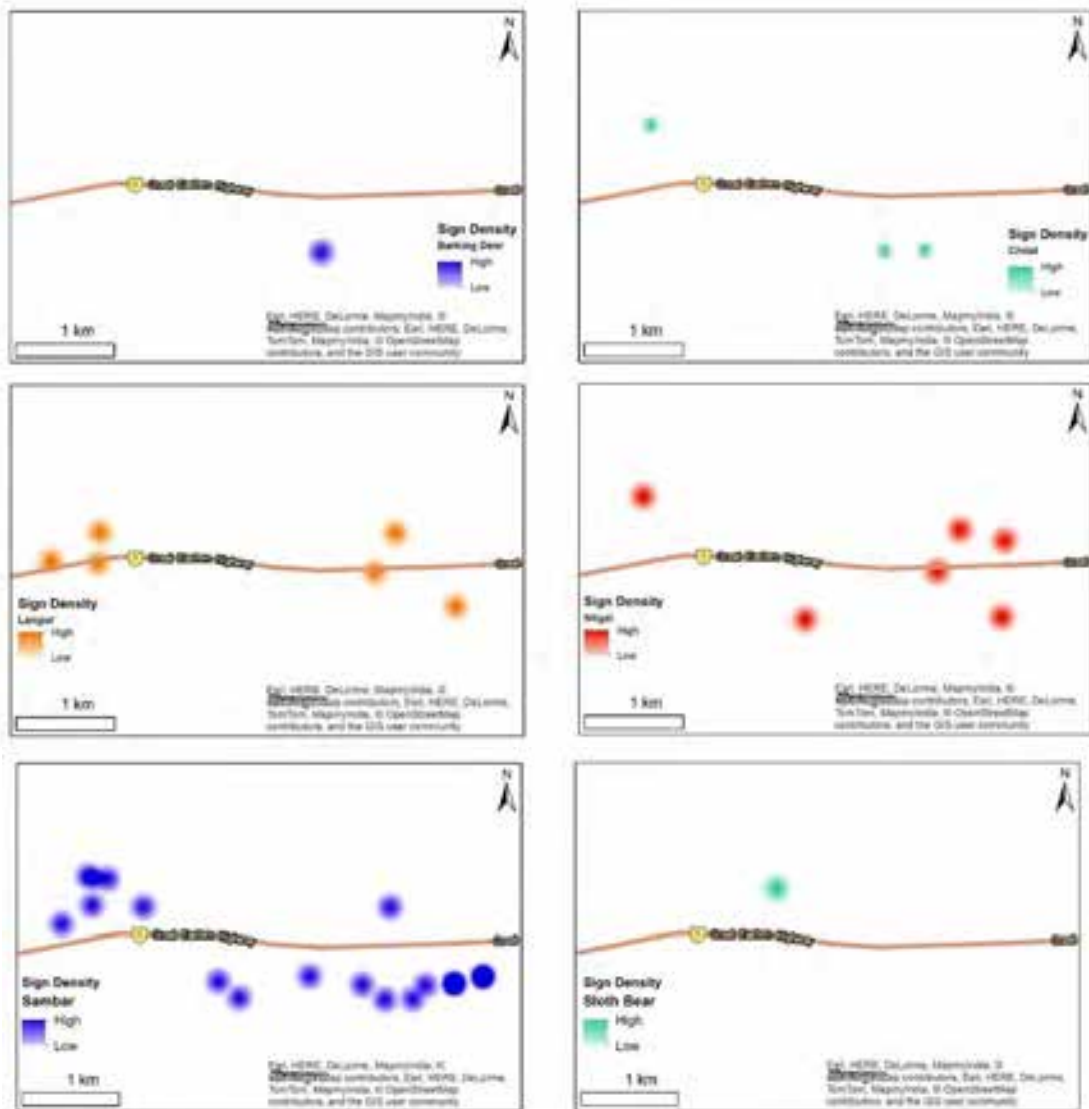
This is an almost leveled stretch. The four laning work has been completed and has already led to the bifurcation of the corridor between North to South (Kanha and Pench Tiger Reserves in North to Nagzira Wildlife Sanctuary, Navegaon and Tadoba Tiger Reserves in south and further down). Two box culverts at chainage 409.300 km and 410.800 km of size 3.05 m (height) and 6.10 m (width) have been provided by NHAI. Considering the length of the forest stretch, (6.3 km) two box culverts of 6.10 m width separated by the distance 1.5 km are too small for usage by the animals for crossing. The two underpasses are more of drainage structures in area and too small for use by wild animals of the area.

During resurvey evidences of 6 species of mammals were found to use this section of highway. The species include Barking Deer, Chital, Langur, Nilgai, Sambar and Sloth Bear. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 20. Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 21 and details provided in Table 19.

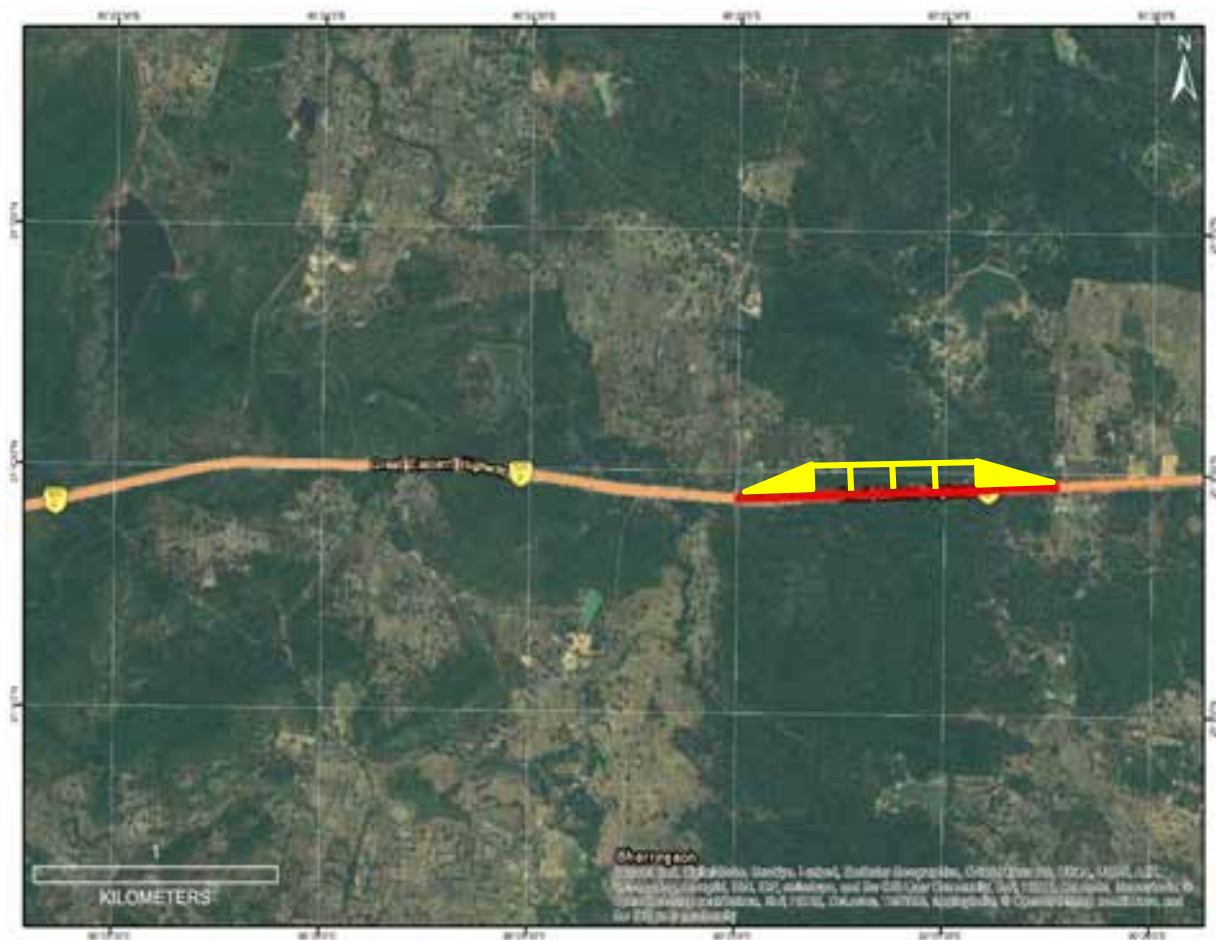
**Table 19:** Details of crossing zones on NH-6 Patch 1 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-6 MH Patch 1	1	1300	5	Hanuman Langur (II) Chital (III) Nilgai (III) Barking deer (III) Sambar (III)

*\*WPA status of animals are given in parentheses*



**Figure 20:** Sign intensity for Barking Deer, Chital, Langur, Nilgai, Sambar and Sloth Bear as indicated by kernel analysis on NH-6 (MH) Forest Patch 01



**Figure 21:** Location of multi-species crossing zone on NH-6 Patch 01 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch and location of proposed mitigation measures

**Recommendations for Patch 01 NH-6 Maharashtra:**

Based on the locations of crossing zones, villages, intensity of use by animals and as validated during the ground survey, WII and NTCA recommend one crossing structures on this stretch of the road. The mitigation measure as proposed by WII and NTCA is shown in Figure 21 and details are provided in Table 20. Since the four laning in this section has already been completed, the traffic is moving with very high speed in this section. NHAI should be asked to implement the mitigation measures in this section of the road as soon as possible. Delay in implementing the mitigation measures would affect the long term functionality of this crucial wildlife north – south corridor connecting 09 protected areas in Central Indian Tiger landscape complex.

**Table 20:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 01, NH-6, Maharashtra

S. No.	Chainage-wise location of structure	Structure Type	Dimension (m)		
				Width (viaduct)	Height
1.	Start: 406.750 End: 407.450	Underpass for Animals	RCC structure	700	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	100 + 100	2

## 8.2. Forest Patch 06

**(Chainage 419.650 to 423.800 km; Maramjob to Dongargaon; Length 4.150 km)**

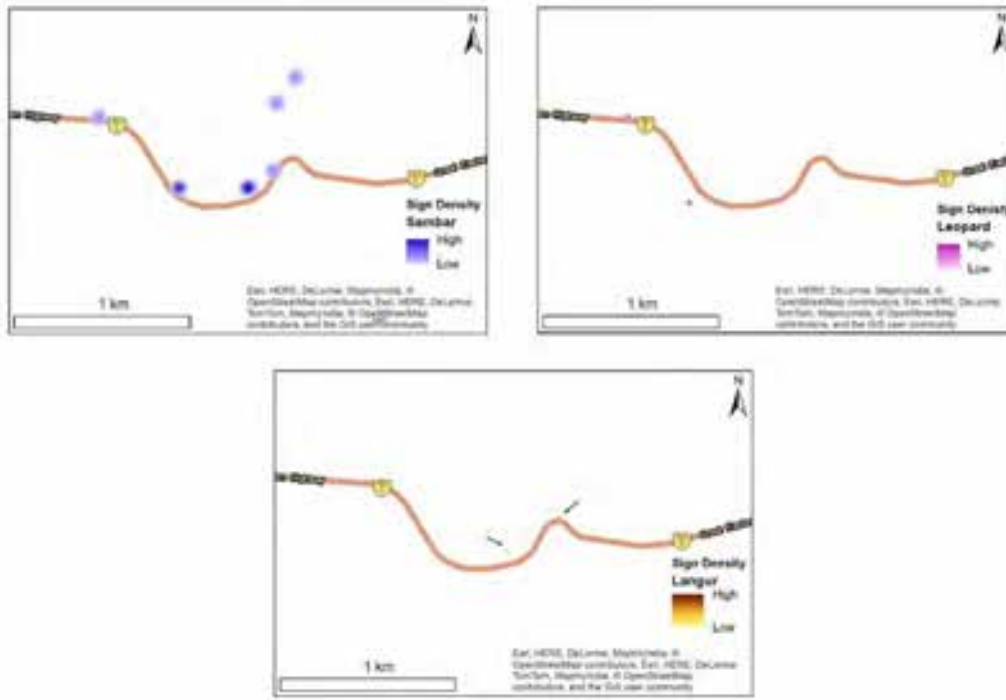
This patch has good forest cover and extends on both sides of NH-6. This portion can be divided into two parts flat and hilly. NH-6 in the flat section (chainage 422.400 km to 423.800 km) has already been upgraded to four lanes. The hilly section (chainage 419.650 km to 422.400 km) is still to be upgraded. Since this part of the highway is hilly, diversion of road is requested by NHAI authorities. Three box culverts at chainage 422.500 km, 421.500 km and 420.700 km of size 3.05 m (height) and 6.10 m (width) have been proposed by NHAI. All the three structures are unsuitable for the type of the wildlife in this area and also with respect to location. The box culverts have been located to serve as drainage structures.

During the resurvey, evidences of 3 species of mammals were found using this section of highway. The species include Sambar, Leopard and Langur. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 22. Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 23 and details provided in Table 21.

**Table 21:** Details of crossing zones on NH-6 Patch 06 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-6 MH Patch 6	1	1200	3	Leopard (I) Hanuman Langur (II) Sambar (III)

\*WPA status of animals are given in parentheses



**Figure 22:** Sign intensity for Sambar, Leopard and Langur as indicated by kernel analysis on NH-6 (MH) Forest Patch 06



**Figure 23:** Location of multi-species crossing zone on NH-6 Patch 6 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch and location of proposed mitigation measures

## Recommendations for Patch 06 NH-6 Maharashtra:

Based on the locations of crossing zones, villages, intensity of use by animals and other ancillary development along this stretch of the road as validated during the ground survey, WII and NTCA recommend one crossing structure on this stretch of the road. The mitigation measure as proposed by WII and NTCA are shown in Figure 23 and details are provided in Table 22.

**Table 22:** Details of the mitigation measure proposed by WII and NTCA on Forest Patch 06, NH-6, Maharashtra

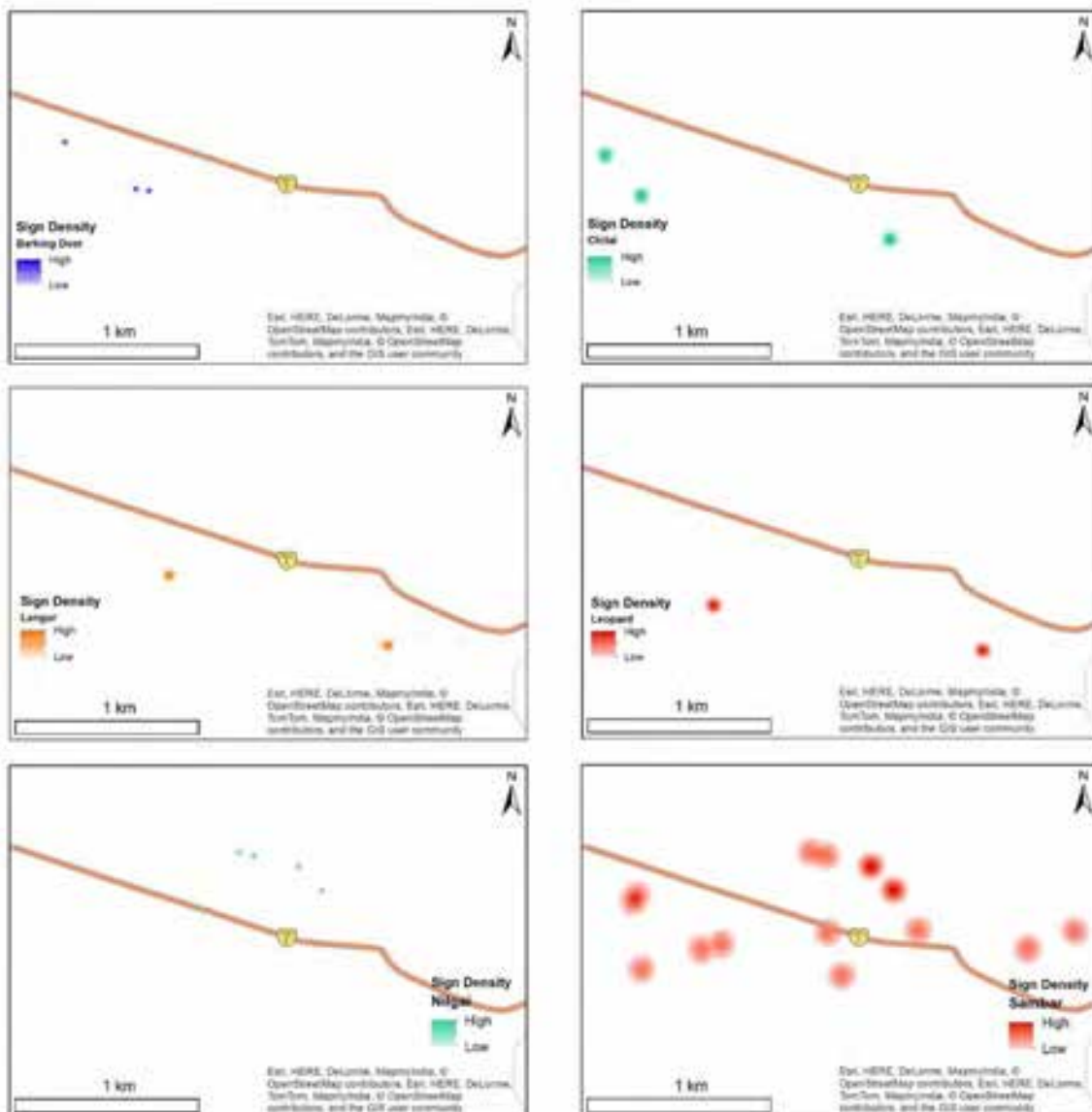
S. No.	Chainage-wise location of structure	Structure Type	Dimension (m)		
			Width (viaduct)		Height
1.	Start : 420.750 End : 421.550	Underpass for Animals	RCC structure	750	5
			Approach (both sides)	300 +	
			Guide walls (both sides)	300	2
				100 +	
			100		

### 8.3. Forest Patch 08

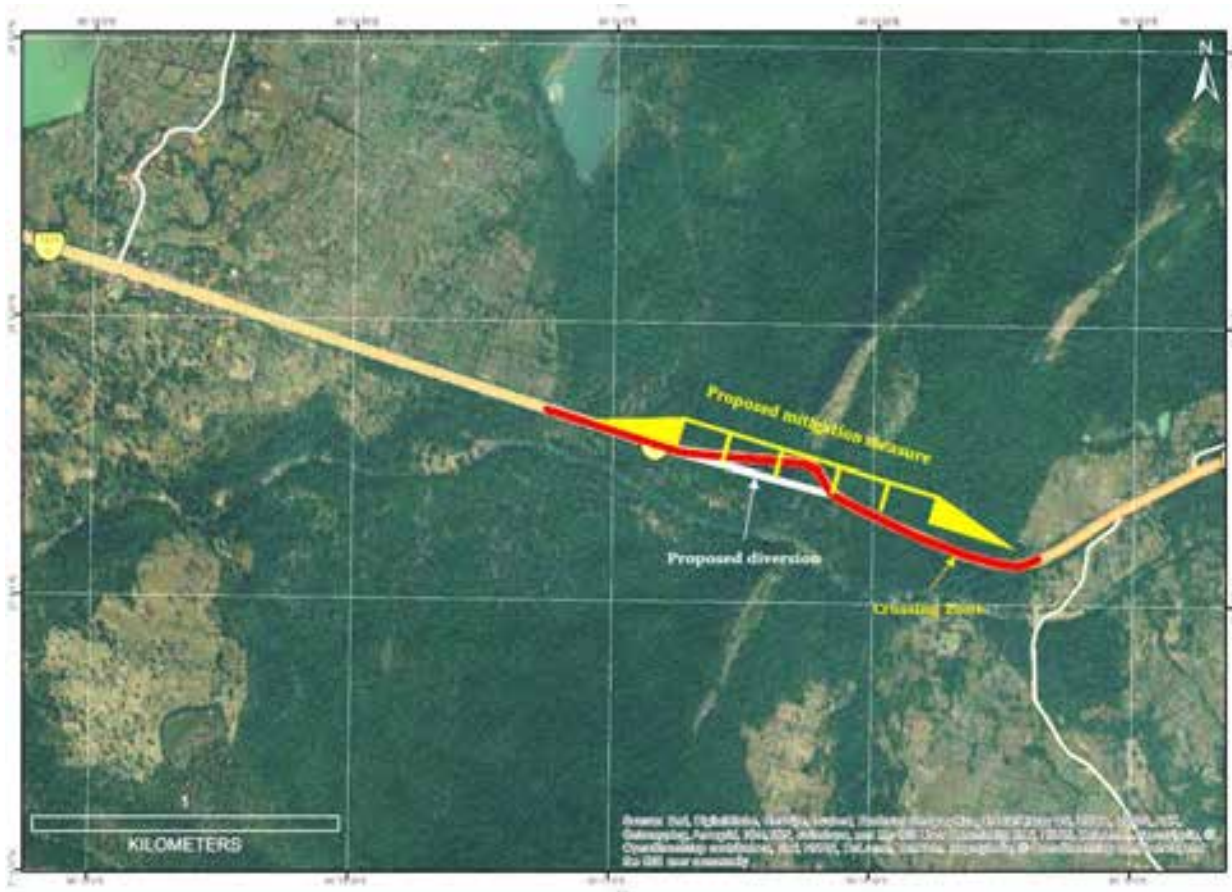
**(Chainage 430.800 – 433.850 km; Bamhani to Duggipar; Length 3.050 km)**

This is an undulating stretch near Navegaon National Park which is important in terms of providing connectivity with Nagzira Wildlife Sanctuary. NH-6 is approximately 1 km from the boundary of the National Park. Four laning work has been completed in the flatter area, diversion as well as realignment is requested by NHAI within this section. Two box culverts at chainage 432.300 km and 433.400 km of size 3.05 m (height) and 6.10 m (width) have been proposed by NHAI. Both these structure are unsuitable for the type of the wildlife in this area and also with respect to location. The box culverts have been again largely conceived as drainage channels.

During the resurvey, evidences of 6 species of mammals were found using this section of highway. The species include Barking Deer, Chital, Langur, Leopard, Nilgai and Sambar. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 24. Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 25 and details provided in Table 23.



**Figure 24:** Sign intensity for Barking Deer, Chital, Langur, Leopard, Nilgai and Sambar as indicated by kernel analysis on NH-6 (MH) Forest Patch 8



**Figure 25:** Location of multi-species crossing zone on NH-6 Patch 8 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch and location of proposed mitigation measures

**Table 23:** Details of crossing zones on NH-6 Patch 8 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-6 MH Patch 8	1	1600	3	Leopard (I) Hanuman Langur (II) Sambar (III) Barking Deer (III) Chital (III) Nilgai (III)

\*WPA status of animals are given in parentheses

### Recommendations for Patch 8 NH-6 Maharashtra:

Based on the location of crossing zones and intensity of use by animals and as validated during the ground survey, WII and NTCA recommend one crossing structure on this stretch of the road. The mitigation measures as proposed by WII and NTCA are shown in Figure 25 and details are provided in Table 24.

**Table 24:** Details of mitigation measures proposed by WII and NTCA on Forest Patch 08, NH-6, Maharashtra

S. No.	Chainage-wise location of structure	Structure Type	Dimension (m)		
			Width (viaduct)	Height	
1.	Start : 431.150 End : 431.950	Underpass for Animals	RCC structure	750	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	100 + 100	2

**8.4. Forest Patch 10  
(Chainage 458.000 – 461.200 km; Sakoli to Mundipar; Length 3.200km)**

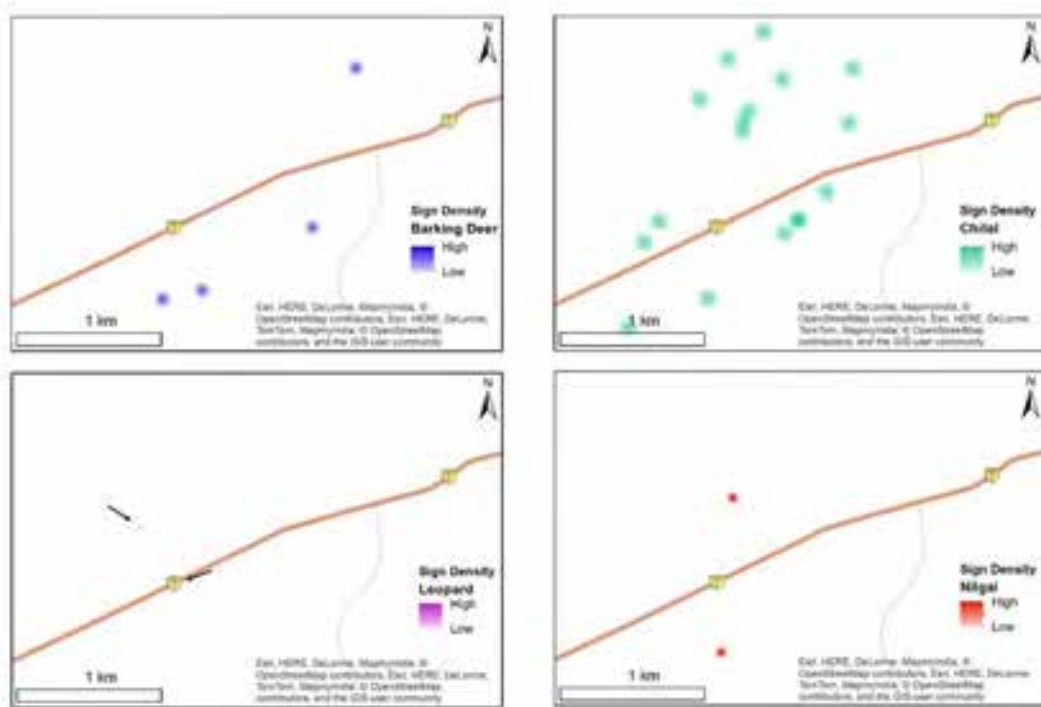
This is almost a flat area with slight undulation. One box culvert at chainage 458.480 km of size 3.05 m (height) and 6.10 m (width) has been proposed by NHAI. This structure will be unsuitable for the type of the wildlife in this area and also with respect to location. The box culverts have been located with respect to drainage network of the area. This box culvert will serve well as drainage channels.

During the resurvey, evidences of 4 species of mammals were found using this section of highway. The species include Barking Deer, Chital, Leopard and Nilgai. The species specific sign intensity zones as identified by Kernel Analysis are shown in Figure 26. Based on the sign intensities of different species, we identified potential multi-species crossing zones across the road stretch by overlay analysis in ArcGIS. The locations of these crossing zones are indicated in Figure 27 and details provided in Table 25.

**Table 25:** Details of crossing zones on NH-6 Patch 10 Maharashtra as identified by kernel and overlay analysis based on intensity of signs across the road stretch

Highway & patch	Crossing zone number	Width of crossing zone (in m)	Number of species whose signs were found	Name of species whose signs were found*
NH-6 MH Patch 10	1	3000	4	Leopard (I) Barking Deer (III) Chital (III) Nilgai (III)

*\*WPA status of animals are given parentheses*



**Figure 26:** Sign intensity for Barking Deer, Chital, Leopard and Nilgai as indicated by kernel analysis on NH-6 (MH) Forest Patch 10



**Figure 27:** Location of species specific crossing zone on NH-6 Patch 10 (MH) identified by kernel and overlay analysis based on intensity of signs across the road stretch and location of proposed mitigation measures

## Recommendations for Patch 10 NH-6 Maharashtra:

Based on the location of crossing zones and intensity of use by animals and as validated during the ground survey, WII and NTCA recommend one crossing structure on this stretch of the road. The mitigation measure as proposed by WII and NTCA is shown in Figure 27 and details are provided in Table 26.

**Table 26:** Details of mitigation measure proposed by WII and NTCA on Forest Patch 10, NH-6, Maharashtra

S. No.	Chainage-wise location of structure	Structure Type	Dimension (m)		
			Width (viaduct)	Height	
1.	Start : 458.950 End : 460.000	Underpass for Animals	RCC structure	750	5
			Approach (both sides)	300 + 300	
			Guide walls (both sides)	100 + 100	2

## 9. North – South Wildlife Corridor and NH-6 Chhattisgarh Section:

As is evident from Figure 1, North – South Wildlife Corridor which connects 6 Tiger Reserves, 1 National Park and 1 Wildlife Sanctuary within Central Indian Tiger landscape complex falls on the Maharashtra – Chhattisgarh border. The extent of forest from Maharashtra/Chhattisgarh border towards Chhattisgarh is more than 15 km and is a continuous forest patch. Four laning has been completed in this entire section which has bifurcated more than 70 % of this vital wildlife corridor. During our visit to NH- 6 we also explored the plausible mitigation measures on Chhattisgarh side. WII and NTCA strongly recommend two flyovers in first 15 km section of the road to revive the functionality of this vital wildlife corridor. NHAI as a National Agency should take responsibility to make sure that the mitigation measures on Chhattisgarh side should be in place. NTCA should convey to the Chhattisgarh Forest Department the importance of this vital wildlife corridor and persuade them to take appropriate measures as suggested. The details of the proposed mitigation measures are provided in detail in Table 27. The details of mitigation measures proposed by WII are based upon a short visit and can be further improved upon.

**Table 27:** Details of structures proposed by WII in on Chhattisgarh side of NH-6

S. No.	GPS location of structure	Structure Type	Dimensions (m)	
			Width	Height
1	Start : 21° 04' 49.75" / 80° 30' 28.65" End : 21° 04' 51.13" / 80° 29' 38.04"	Underpass for Animals	750 Viaduct + 600 approach	05
2	Start : 21° 05' 2.55" / 80° 32' 33.58" End : 21° 05' 18.75" / 80° 31' 39.63"	Underpass for Animals	750 Viaduct + 600 approach	05

## **10. Alternative route via Chindwara:**

During its task oriented specific field visit, WII team also visited the entire alternative route via Chindwara. The road from Nagpur to Chindwara has forest at three places. The GPS locations of these forest patches are 21° 30' 31.25" and 78° 54' 59.93" for patch one, 21° 40' 34.1" and 78° 49' 01.7" for patch two and Ghat Section from GPS location 21° 46' 59.4" and 78° 49' 48.1" to 21° 48' 57.2" and 78° 50' 02.9" covering distance of 8 – 10 km.

The alternate route via Chindwara has already been upgraded to a two lane National Highway.

The three forest patches that have been identified by WII in this alternative route offer excellent connectivity between Satpura, Melghat and Pench Tiger reserves. These forest patches are vital links for connecting habitats outside and between 06 tiger reserves of Central Indian Tiger landscape complex. These forest corridors are critical for overall tiger conservation in India and especially in central Indian landscape complex. As upgradation work on Chindwara road has already been carried out, WII recommends that proper mitigation measures should be implemented in three patches of forest for retaining the landscape connectivity.

## **11. Evaluation of the barrier effect on different animal species due to factors such as road type (2- and 4-lane), traffic heterogeneity, traffic volume, vehicle speed and species characteristics at current traffic volume:**

The barrier effect of roads/ highways results from a combination of factors (such as traffic noise, vehicle movements, pollution, and human activities) and physical hindrances (such as infrastructure surface, ditches, and fences). The distance from the road to dense vegetation and the open verge character may also act as a barrier to many species, especially small ones (Oxley et al., 1974). Depending on the species, some animals may not experience any physical or behavioral barrier at all, whereas others may not even approach the road. Most infrastructure barriers do not completely block animal movements, but they do significantly reduce the number of crossings (Mader, 1984; Merriam et al., 1989). "The fundamental question therefore is: How many successful crossings are needed to maintain habitat connectivity" (Seiler, 2002). To answer this question, information is needed on the movements of specific species in a fragmented landscape and on the probability of a successful road crossing for those species that actually cross roads.

To evaluate barrier effect under existing road conditions, traffic volume and traffic heterogeneity on both NH 6 and 7, we collected required information to model the probability of successful crossing.

### **Traffic Characteristics:**

The data on road and traffic characteristics was collected from NHA Project Implementation Unit (PIU) Nagpur and data on speed on 2 and 4 lane stretches

was estimated by actually calculating time taken by different types of vehicles under heterogeneous traffic conditions during March, 2015. The details are given in Table 28. Traffic heterogeneity and hourly volume on NH-6 and NH-7 is given in Figure 28.

### Species Characteristics:

Data such as body length and behavior on six major species from the central Indian landscape was taken from the book 'Indian Mammals: A field Guide' (Menon, 2014). The details are given in table 29.

### Time taken by animal to cross road:

Time taken by any animal to cross the road (2 lane or 4 lane) and probability of being hit by a moving vehicle is a function of body length, average group size and speed of the animal to cross the road. Considering body length and average group size, the average time taken by species to cross 2 lane or 4 lane road may vary accordingly. We used expert knowledge to estimate the time taken by species to cross the road to model traversability. The data used for modeling is provided in Table 30 with the assumption that the median on 4 lane road is just a line or very small structure which is not going to affect the movement of the animal.

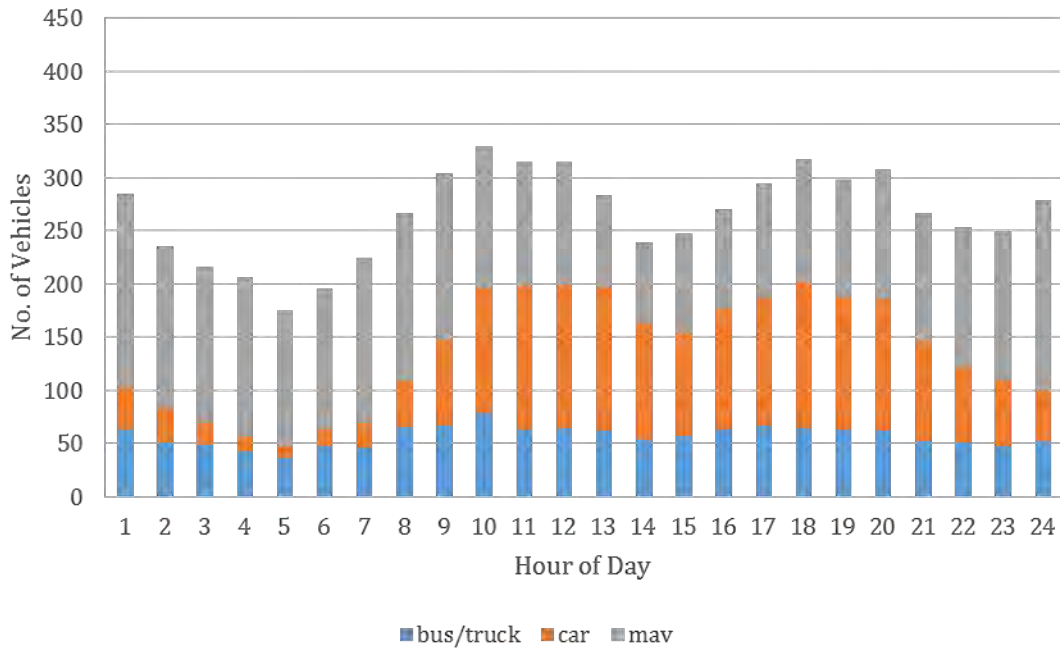
**Table 28:** Traffic and Speed Characteristics on NH-6 and NH-7 as on March 2015

Parameter	NH-7	NH-6	Data Source
Traffic Volume/Day (Average for 5 days)	6151	6377	NHAI - PIU Nagpur March 2015
Traffic Volume/Hour (Maximum at peak hr)	452	330	NHAI - PIU Nagpur March 2015
Traffic Heterogeneity			NHAI PIU Nagpur March 2015
Bus & Truck	90	79	
Cars	279	117	
MAV	83	134	
Time taken by vehicle to cover 1 km distance on 2 lane road	67.615 secs	94.3 secs	Data collected during road survey by WII team
Time taken by vehicle to cover 1 km distance on 4 lane road	62.5 secs	80.33 secs	
Speed 2 lane road m/sec and km/hr	14.79m/sec 53.24km/hr	10.58m/sec 38km/hr	
Speed 4 lane road m/sec and km/hr	16m/sec 57.6km.hr	12.45m/sec 44.81km/hr	
Average vehicle length (Based on traffic heterogeneity)	5.73 m	7.5 m	

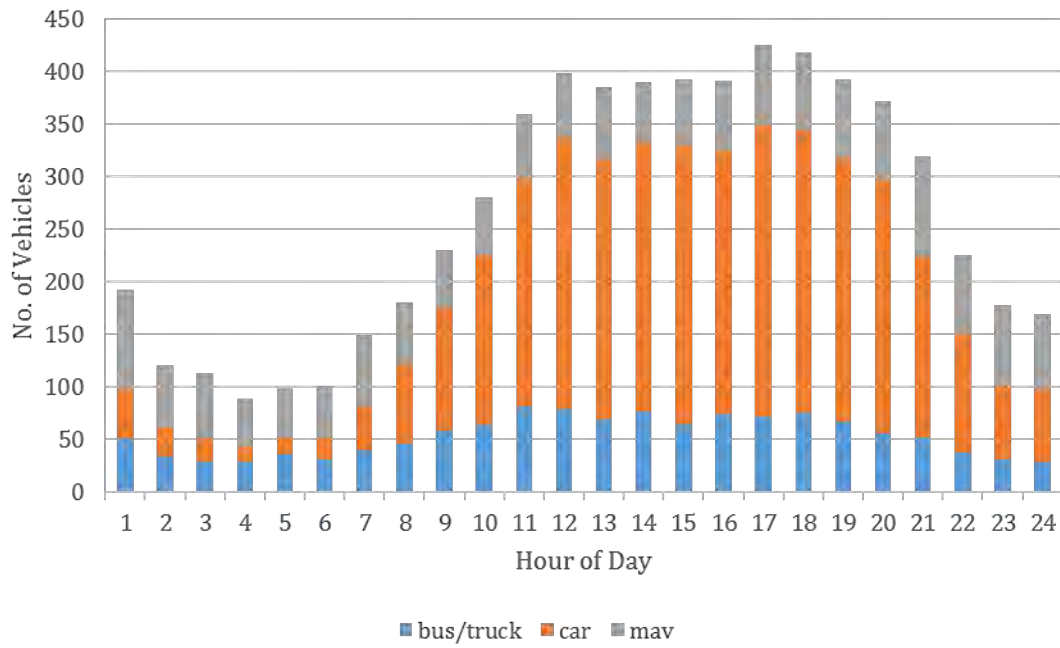
**Table 29:** Species characteristics body length and behavior (Menon, 2014)

<b>Species</b>	<b>Body Length (Max)</b>	<b>Behavioural Attribute</b>
Gaur	330 cm	Group Living
Chital	155 cm	Group Living
Sambar	210 cm	One or Two
Wild Pig	200 cm	Group Living
Tiger	310 cm	Solitary
Leopard	243 cm	Solitary

### Hourly Vehicle Volume – NH 6



### Hourly Vehicle Volume – NH 7



**Figure 28:** Traffic heterogeneity and volume on NH-6 and NH-7 (March 2015)

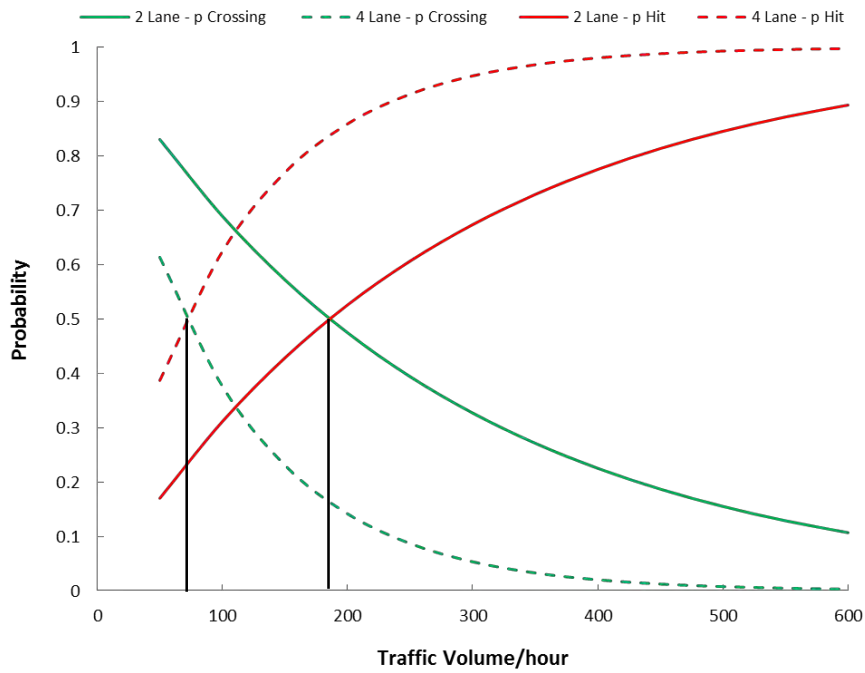
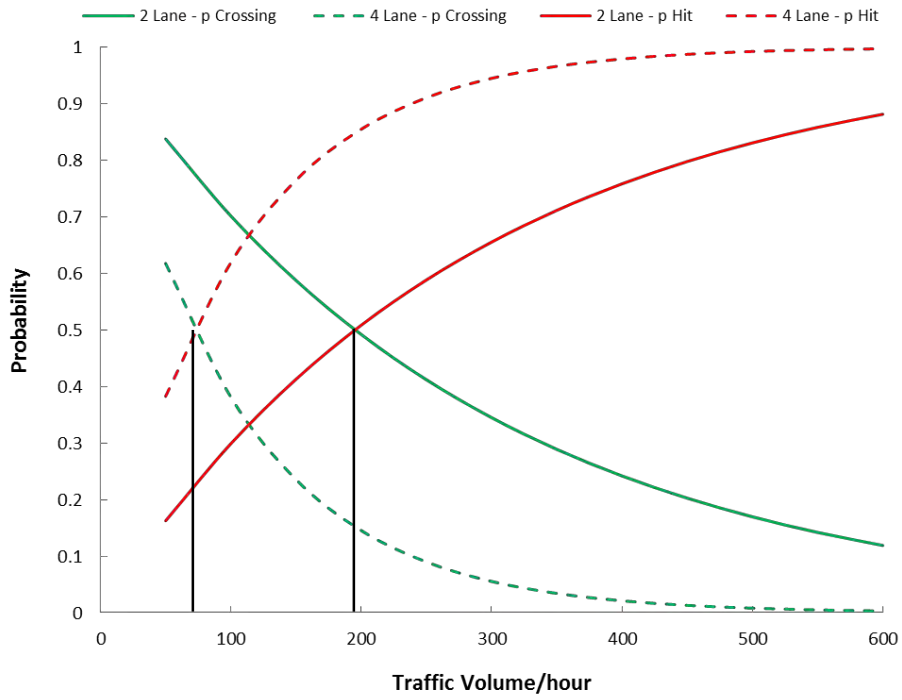
**Table 30:** Time taken by animal species to cross the road (based on expert knowledge)

Species	Time taken to cross 2 lane road (10 m) in sec	Time taken to cross 2 lane road (25 m) in sec
Gaur	12	34
Chital	15	30
Sambar	7	14
Wild Pig	8	16
Tiger	6	12
Leopard	5	10

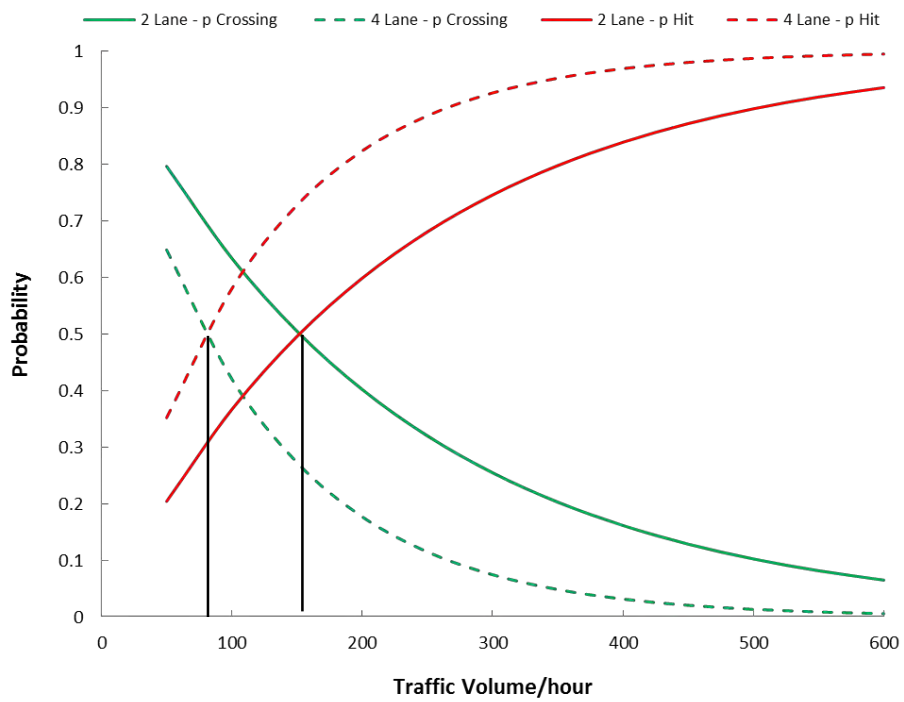
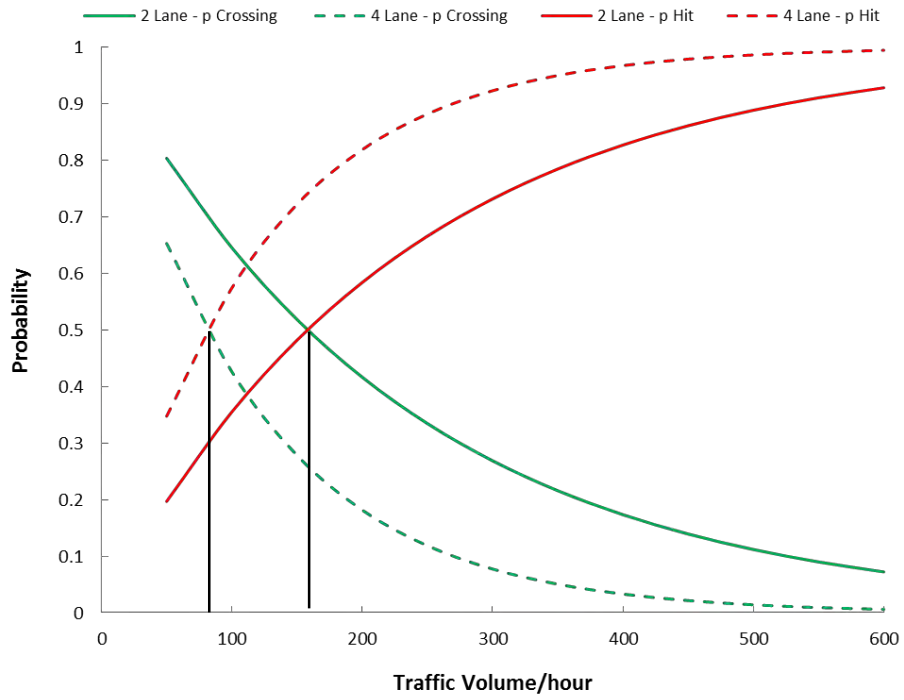
Considering the parameters as mentioned in table above, we modeled the probability of the animal being hit while crossing. We used Poisson Probability model to estimate the probability of hit of an animal by a vehicle in a given road condition with specific traffic volume and speed (Jaarsma et al., 2006).

In traffic engineering, the calculation of headway distributions, i.e. the frequency of the length of gaps between successive vehicles in a traffic flow at a given cross-section is commonly based on the assumption of a Poisson distributed process (Haight, 1963; Daganzo, 1997). The Poisson distribution is a discrete distribution that describes the number of events during a given time period. Here, the event is a vehicle arriving at a given location. In the Poisson distribution, the numbers of events in sequential time periods of an equal length are independent stochastic drawings. For a given traffic volume, the probability of a certain number of arrivals within a fixed time period depends only on the length of this period and is thus constant for periods of equal length. When the number of arriving vehicles in a sequence of fixed time periods is Poisson distributed, their headways are (negatively) exponentially distributed and independent of each other. To be Poisson distributed, the vehicles must approach a certain location in a so-called undisturbed flow (Jaarsma et al., 2006).

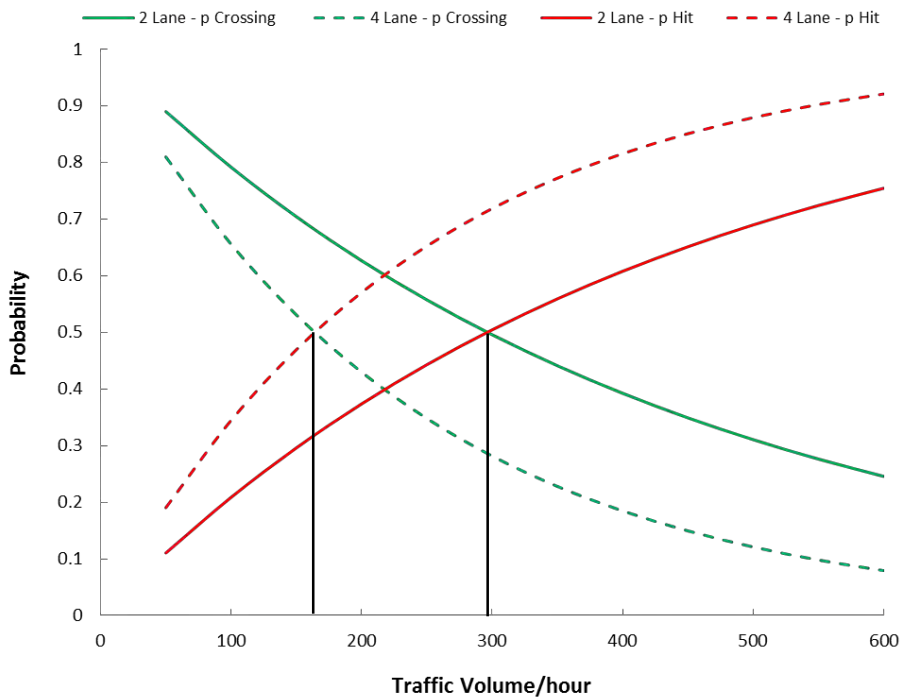
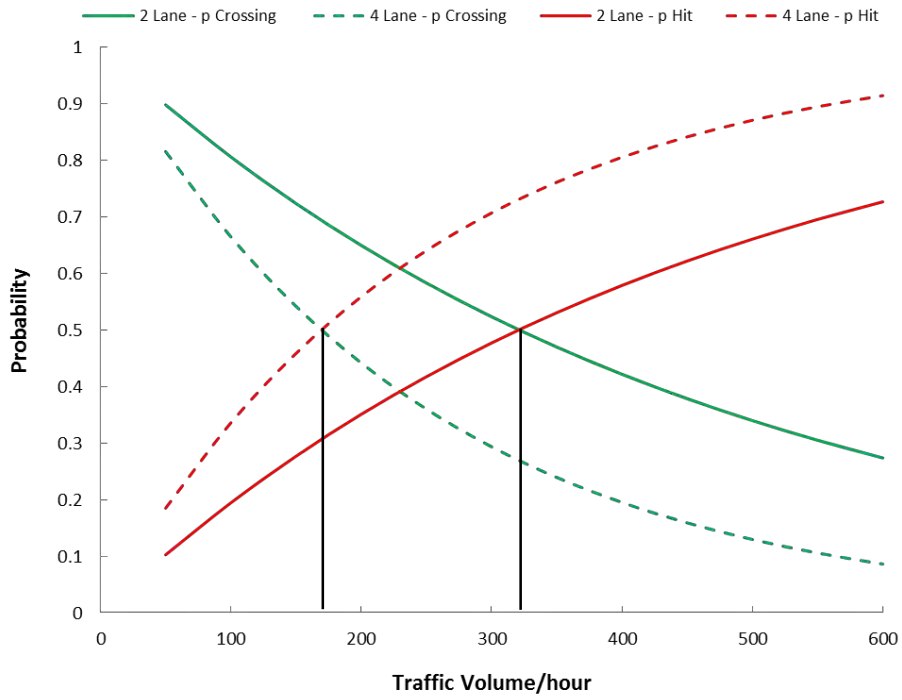
During the field visit we estimated traffic volume, average speed in heterogeneous traffic conditions on different stretches of the road to validate Traversability Model. We considered 2 lane and 4 lane road on both NH-6 and NH-7 to model possibility of animal to be hit by the vehicle at specific traffic volume and speed. The models for different species on NH-7 and 6 are depicted graphically below (Figure 29 – 34):



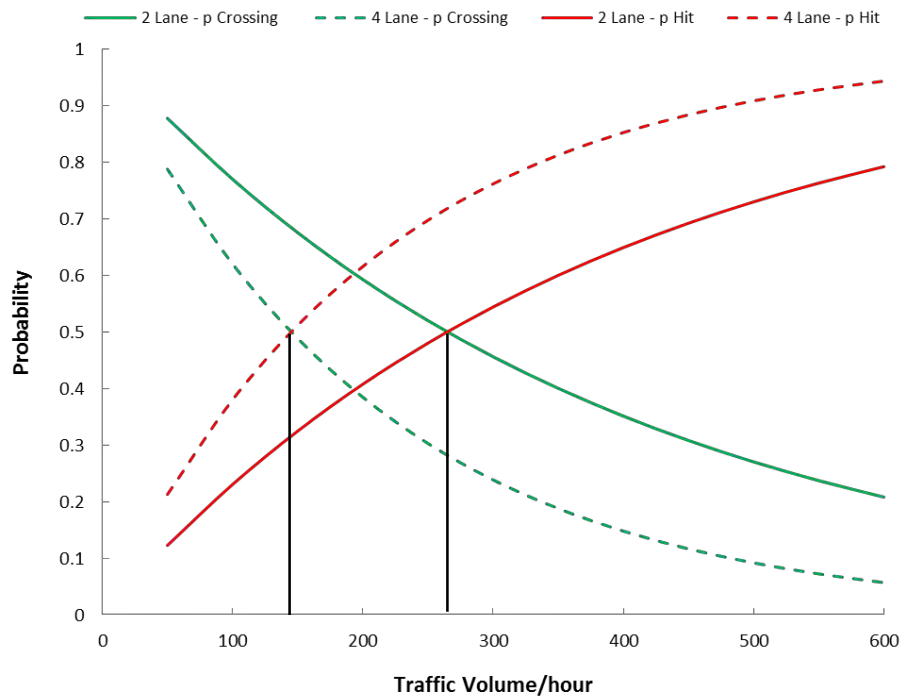
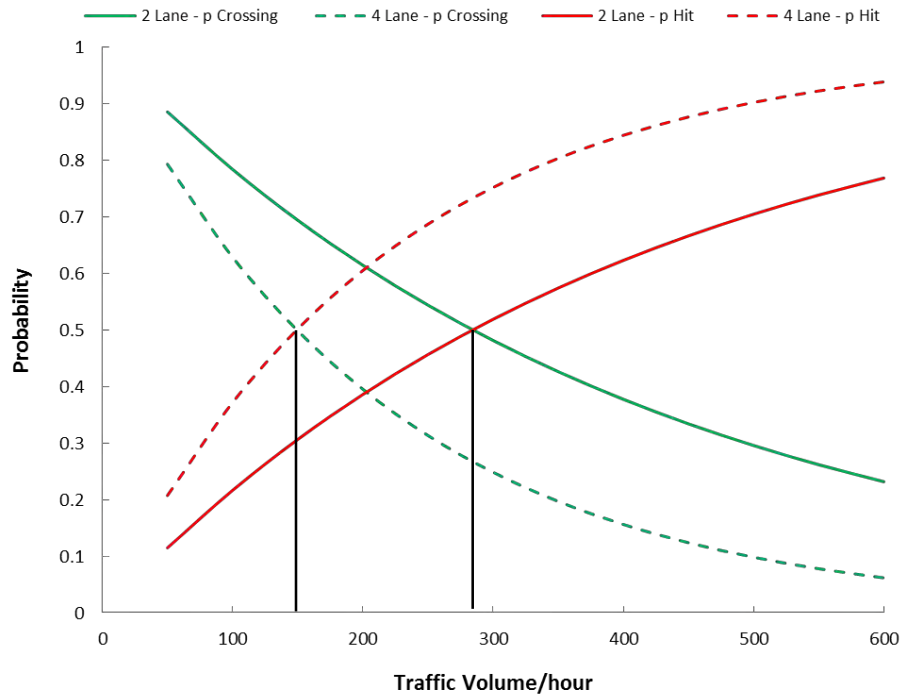
**Figure 29:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Gaur on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015



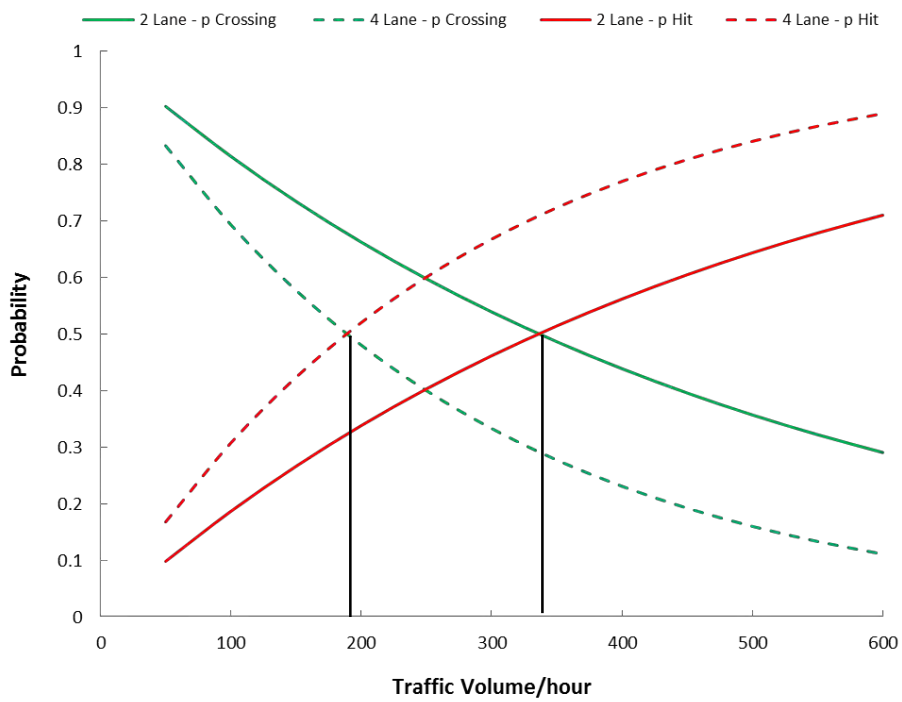
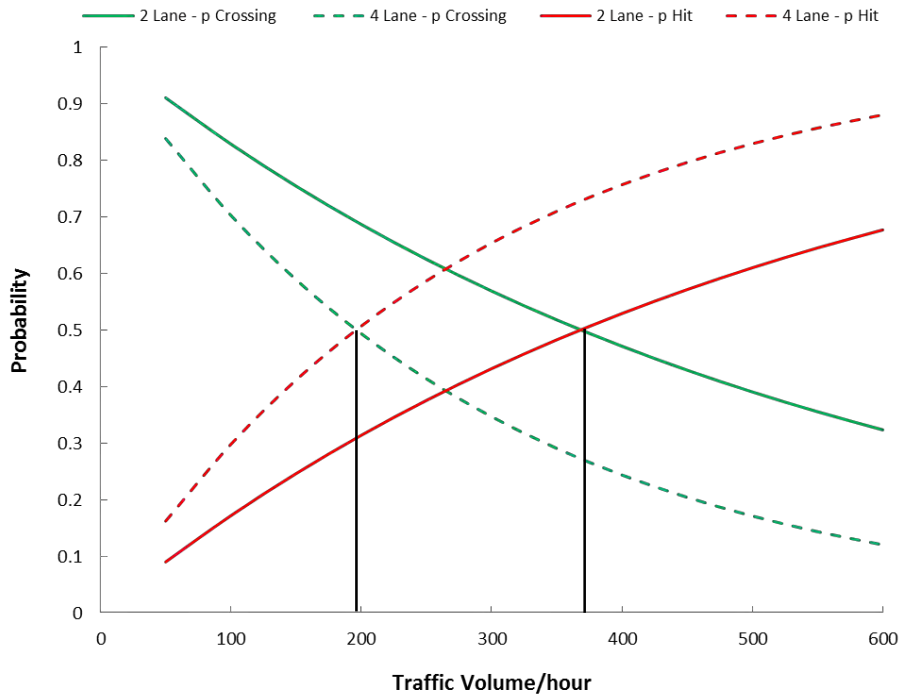
**Figure 30:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Chital on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015



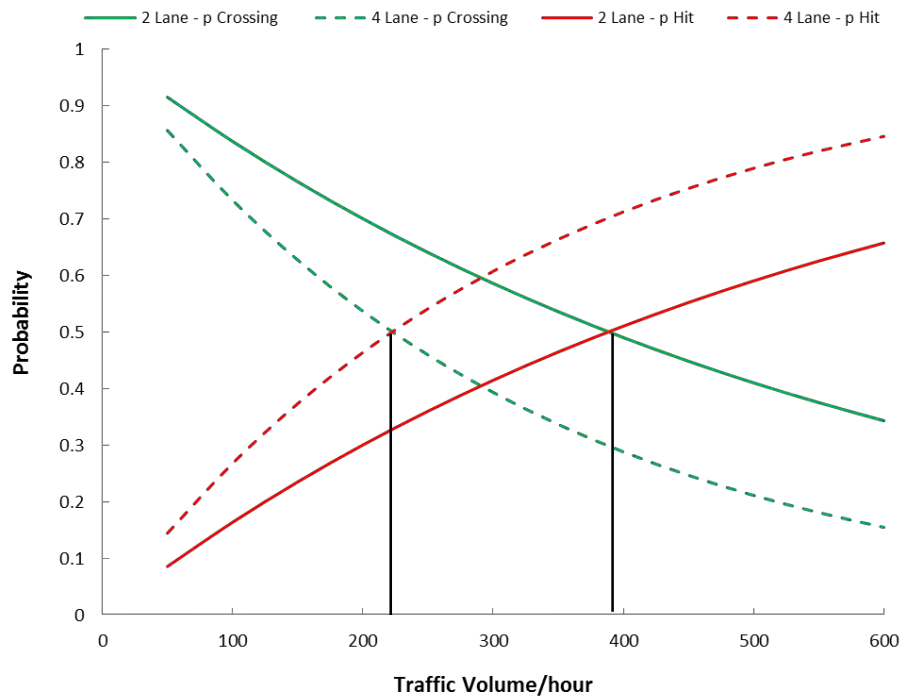
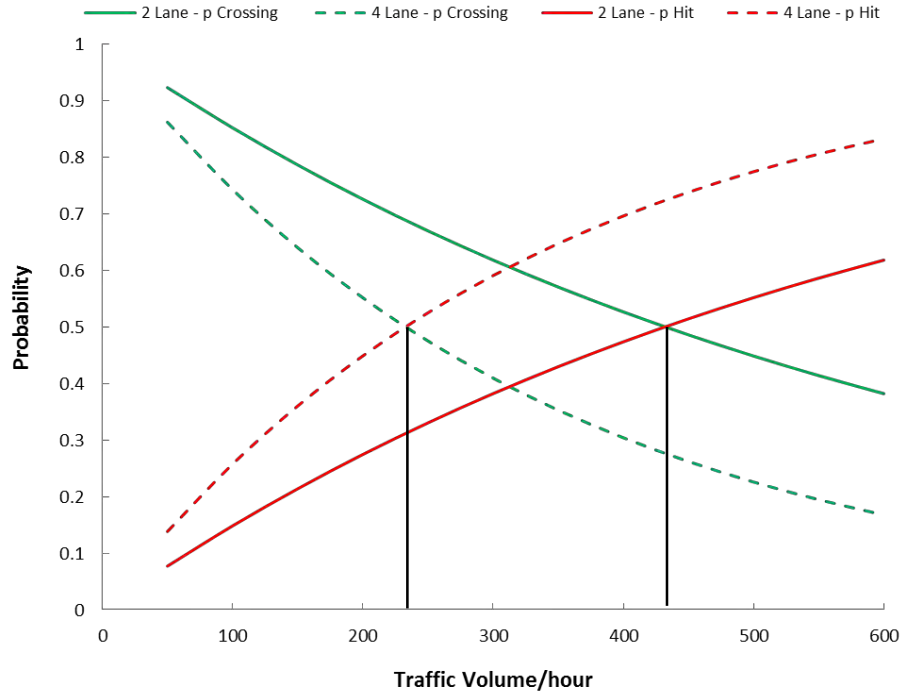
**Figure 31:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Sambar on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015



**Figure 32:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Wild Pig on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015



**Figure 33:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Tiger on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015



**Figure 34:** Traversability model showing probability of Hit (Red Lines) or Successful crossing (Green Lines) of Leopard on NH-7 (top) and 6 (bottom) w.r.t available traffic volume as on March 2015

To interpret the Traversability Model for each species on different stretches of road (2 lane/4 lane) and on different highways (NH-6/7) we have divided the probability spectrum into 3 classes: **Pass Zone** (0 – 0.5) – where 100% to 50% of the individuals of the species under current traffic and road conditions are able to cross the road, **Death Zone** (0.5 – 0.75) – where only a maximum of 25% of the individuals of the species are able to cross the road and **Deterrent Zone** (0.75 – 1) – where less than 25% of the individuals of the species are able to cross the road successfully. These models are distinguishable from each other with respect to the lower and upper limit of these zones depicted by the traffic volume values.

The corresponding traffic volume with respect to the species, road type (2/4 lane) and highway (NH-6/7) is indicated in table 31.

**Table 31:** No. of Vehicle/hr with respect to different zones of animal crossing on NH-7 and 6

Species	Road Type	Pass Zone (0 – 0.5)		Death Zone (0.5 – 0.75)		Deterrent Zone (0.75 – 1)	
		NH-7	NH-6	NH-7	NH-6	NH-7	NH-6
Gaur	2 Lane	0-190	0-180	190-380	180-380	>380	>380
	4 Lane	0-80	0-70	80-145	70-150	>145	>150
Chital	2 Lane	0-160	0-160	160-320	160-300	>320	>300
	4 Lane	0-80	0-80	80-160	80-160	>160	>160
Sambar	2 Lane	0-320	0-300	320-600	300-600	>600	>600
	4 Lane	0-180	0-175	180-340	175-320	>340	>320
Wild Pig	2 Lane	0-280	0-260	280-560	260-520	>560	>520
	4 Lane	0-160	0-150	160-300	150-280	>300	>280
Tiger	2 Lane	0-375	0-340	375-600	340-600	>600	>600
	4 Lane	0-195	0-190	195-390	190-380	>390	>380
Leopard	2 Lane	0-430	0-380	430-600	380-600	>600	>600
	4 Lane	0-230	0-230	230-450	230-450	>450	>450

## 12. Road kills and 'Barrier Effect'

Roads act as barriers for movement of animals in several ways, for example by causing discontinuity in habitat (Mader 1984; Baur and Baur, 1990) and causing road avoidance because of the associated disturbances (Singer, 1978; Mader, 1984; Leblond et al., 2013). Animals may also avoid roads as a consequence of road-related mortality. This gradually leads to the creation of a 'barrier' to animal movement (Mader, 1984; Riley et al., 2006; Rico et al., 2007). This 'barrier effect' is reflected in the reduced number of animal movements across the roads and results from a combination of factors such as avoidance due to disturbance caused by roads, presence of physical hindrances such as the road itself (Jaarsma et al., 2006) and the traffic density (Richardson et al., 1997). The character of the road verge may also determine the barrier influence for many species that may or may not find the openness of the verge conducive for movement (Barnett et al., 1978; Baur and Baur, 1990).

The barrier effect can have adverse implications for populations, and implications for interactions amongst species and the entire ecosystems. In a landscape such as the Central Indian Landscape that is intersected by a network of roads, it can lead to the isolation of animal populations. This may affect the overall connectivity of the landscape, compromising the conservation of wide ranging animal species such as the tiger (Yumnam et al., 2014). The barrier influence in sections of NH-6 and 7 can also be seen as a threat to isolation of populations of tiger and gaur.

The barrier effect of roads on wildlife populations can often pose more problems for a wide variety of species than the impacts of road-kill or habitat avoidance and has the potential to cause the most severe ecological impacts (Forman and Alexander, 1998).

While conducting vehicle surveys, road kill data (Table 32) was collected for wild animals in both 2 and 4 lane stretches of NH-6 (Maharashtra section) and NH-7 (Maharashtra and Madhya Pradesh sections). Road kill data was also obtained from the State Forest Department of Maharashtra for NH-6 (Table 33). This data was incorporated in the kernel density analysis for recognition of animal crossing zones.

**Table 32:** Details of road kills observed on NH-6 and NH-7 (MP and Maharashtra sections) during March 2015 by WII team

S. No	Date	Species	Forest Patch/ Chainage	Road type
<b>NH 7, Maharashtra section</b>				
<b>Traffic volume: 425 vehicles/hour</b>				
1.	11.03.2015	Langur	Forest patch 3	2-lane
2.	14.03.2015	Macaque	Forest patch 3	2-lane
3.	14.03.2015	Langur	Forest patch 3	2-lane
4.	15.03.2015	Shikra	Forest patch 2	2-lane
5.	15.03.2015	Wild pig	Forest patch 3	2-lane
6.	15.03.2015	Turtle dove	Forest patch 3	2-lane
7.	16.03.2015	Langur	Forest patch 3	2-lane
8.	21.03.2015	Wild pig	Forest patch 1	2-lane
<b>NH 7, Madhya Pradesh section</b>				
<b>Traffic volume: 425 vehicles/hour</b>				
1.	21.03.2015	Feral pig	Ch. 627-632	2-lane
<b>NH 6, Maharashtra section</b>				
<b>Traffic volume: 330 vehicles/hour</b>				
1.	29.03.2015	Jungle cat	Forest patch 1	4-lane
2.	29.03.2015	Garden lizard	Forest patch 1	4-lane
3.	30.03.2015	Langur	Forest patch 1	4-lane

We also obtained road kill data for the period 2005-2014 from the Office of the Deputy Conservator of Forests, Bhandara Division, Maharashtra, for NH-6. The details are given in Table 33.

**Table 33:** Road kill data for the years 2005-2014 obtained from the Maharashtra Forest Department, Bhandara Division, Maharashtra

S.no.	Forest area	Date	Species
<b>2005</b>			
	--	--	--
<b>2006</b>			
1.	Bhandara	7.04.2006	Wild pig
<b>2007</b>			
	--	--	--
<b>2008</b>			
	--	--	--
<b>2009</b>			
	--	--	--
<b>2010</b>			
	--	--	--
<b>2011</b>			
	--	--	--
<b>2012</b>			
	--	--	--
<b>2013</b>			
1.	Lakhani	07.02.2013	Blackbuck
2.	Lakhani	05.03.2013	Leopard
3.	Lakhani	21.06.2013	Chital
4.	Sakoli	12.07.2013	Wild pig
5.	Bhandara	12.07.2013	Chinkara
<b>2014</b>			
1.	Sakoli	01.02.2014	Wild pig

Twelve kills were recorded during the course of the resurvey (March 2015) by the WII team. These road kills were of different species such as langur, macaque, wild pig, jungle cat, birds and lizards. Although we did not record mortalities of larger species such as chital, sambar, gaur, tiger or leopard, their use of the habitat within close proximity was established based on recordings of indirect signs and direct sightings of chital, jungle cat and Indian grey wolf during vehicle transects. These records depended upon the level of disturbance along the road sections and suitable habitat available for shy species such as tiger and chital.

According to road kill data collected during the survey, and data obtained from the Forest Department, the current traffic trends on the roads surveyed is at the threshold of deterrence levels for most species (refer Section 11, Table 28). This probably explains the low number of road kills for some species (leopard, chital, jungle cat) and no road kills recorded for species such as gaur, tiger and sloth bear. We thus assume that sections of these roads (NH-6 and 7) aligned through PAs under present traffic and road conditions have already become 'barriers' for the movement of these animals, and the few animals that attempt to cross these sections are killed.

Some animals like macaque, langur and wild pig that were observed to frequently use the roads have greater adaptability to road induced disturbance or the thresholds of current traffic volume were still low to make the roads impermeable for these species.



**Figure 35:** Road kills of different animal species observed during the resurvey on National Highways 6 & 7

**13. Observation on the NHAI suggestion based on a US-based publication entitled “Safe Passages: A user’s guide to developing effective highway crossings for carnivores and other wildlife” that wildlife underpass structures 50 m wide are sufficient for the passage of large carnivores like tiger:**

During the meeting held at Pune on 13<sup>th</sup> February 2015, NHAI quoted the aforementioned guidance book to support its argument that 50 m wide underpass structures would be adequate for use by tigers. We have carefully examined this publication. The suggestions in the publication have been made considering several factors such as traffic heterogeneity, daily and annual traffic volumes, and types of animals found in the United States, which are very different from Indian conditions. The traffic characteristics of United States also vary considerably as compared to a developing country like India. Moreover, these dimensions are viable if we consider them species-specific crossing structures, but our present requirement is to recommend crossing structures suitable for use by multiple species. This includes solitary animals such as tiger, leopard and sloth bear, and herd-living animals such as chital and wild pig, small animals such as jungle cat and the largest animal in the landscape- *Gaur*. All species differ in their acceptance of wildlife crossings and thereby a crossing structure with the adequate openness for the largest animal species and that for the largest herd of animals is needed. Spending money for under passes of 50 m or smaller will not be a wise investment as the probability of ensuring across movement of both target species (Tiger and Gaur) and other generic species (Chital, Sambar, Wild Pig etc.) would be low/ inadequate and hence is not recommended in this report.

The small mitigation structure of 50 m width will only help to reduce mortality at a specific place for a specific species under given population and traffic conditions. It will not ensure long-term connectivity for the suite of species, which is why large mitigation structures are required in the Indian context.

The NHAI is already constructing three flyovers of 400, 500 and 736 m long on NH – 72 in order to main functional connectivity for elephants in Rajaji landscape at the cost of 42.2, 52.8 and 77.7 crore respective. Figure 36 shows one of the mitigation measures under construction.



**Figure 36:** Under construction elephant crossing (736 m long) on NH – 72 (Rajaji National Park)

## 14. Summary of Recommendations:

Based on location and length of crossing zones on various road sections across NH-7 (MP and MH) and NH-6, the species assemblages and traffic volume, heterogeneity and road characteristics, the specific recommendations for various sections of road are summarised below. The comparison with mitigation measures proposed earlier is given in Annexure VI.

### 14.1. Recommendations for NH-7 Madhya Pradesh:

In additions to the structures proposed by NHAI, WII and NTCA recommend 7 additional structures across four forest patches on NH-7 Madhya Pradesh Section. The details of these structures are given in Table 34 (Refer to Section 6 for details).

**Table 34:** Details of mitigation measures proposed by WII and NTCA on NH-7, Madhya Pradesh

S. No.	Forest Patch	GPS Location Mid-Point/Chainage	Structure Type	Dimension (m)		
					Width (viaduct)	Height
1.	01	21 53 40.38 79 31 57.84	Underpass for Animals	RCC structure	500	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	50 + 50	2
2.	01	21 51 40.38 79 31 19.62	Underpass for Animals	RCC structure	800	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2
3.	02	632.350	Underpass for Animals	90		5
4.	02	633.550	Underpass for Animals	60		5
5.	02	635.050	Underpass for Animals	60		5
6.	03	21 45 50.23 79 28 14.38	Underpass for Animals	RCC structure	500	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2
7.	04	21 41 47.85 79 25 44.46	Underpass for Animals	RCC structure	300	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	50 + 50	2

## 14.2. Recommendations for NH-7 Maharashtra:

WII and NTCA recommend 9 structures across three forest patches on NH-7 Maharashtra Section. The details of these structures are given in Table 35 (Refer Section 7 for details).

**Table 35:** Details of mitigation measures proposed by WII and NTCA on NH-7, Maharashtra

S. No.	Forest Patch	GPS Location (Mid - Point)/ Chainage	Type	Provision	Dimensions	
					Width (m)	Height (m)
01	01	21 40 16.87 79 24 56.98 653.770	Minor Bridge	Structure	60	5
				Extension		
				Guide Walls	50 + 50	2
02	01	21 39 58.35 79 24 47.42 654.360	Underpass	RCC Structure	50	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2
03	01	21 39 07.3 79 24 19.19 656.200	Underpass	RCC Structure	750	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2
04	01	21 38 15.48 79 23 51.01 657.950	Minor Bridge	Structure	80	5
				Extension		
				Guide Walls	50 + 50	2
05	01	21 37 24.04 79 23 18.56 659.520	Underpass	RCC Structure	300	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2
06	02	21 40 16.87 79 24 56.98 667.900	Minor Bridge	Structure	65	5
				Extension		
				Guide Walls	100 + 100	2
07	03	21 40 16.87 79 24 56.98 673.700	Underpass	RCC Structure	100	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2
08	03	675.500	Underpass	RCC Structure	750	5
				Approaches	300 + 300	
				Guide Walls	50 + 50	2
09	03	677.300	Minor Bridge	Structure	50	5
				Extension		
				Guide Walls	250 + 250	2

### 14.3. Recommendations for NH-6 Maharashtra:

WII and NTCA recommend 4 structures across four forest patches on NH-6 Maharashtra Section. The details of these structures are given in Table 36 (Refer Sections 8 for details).

**Table 36:** Details of mitigation measures proposed by WII and NTCA on NH-6, Maharashtra

S. No.	Forest Patch	Chainage-wise location of structure	Structure Type	Dimensions (m)		
				Viaduct	Height	
1	01	Start : 406.750 End : 407.450	Underpass for Animals	RCC structure	700	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2
2	06	Start : 420.750 End : 421.550	Underpass for Animals	RCC structure	750	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2
3	08	Start : 431.150 End : 431.950	Underpass for Animals	RCC structure	750	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2
4	10	Start : 431.150 End : 431.950	Underpass for Animals	RCC structure	750	5
				Approach (both sides)	300 + 300	
				Guide walls (both sides)	100 + 100	2

### 14.4. Recommendations for NH-6 Chhattisgarh Section:

The extent of forest from Maharashtra/Chhattisgarh border towards Chhattisgarh is more than 15 km and this is a continuous forest patch. Four laning has been completed in this entire section which has bifurcated more than 70 % of this vital wildlife corridor and no mitigation measures are in place. Considering the importance of this corridor, WII and NTCA recommend two flyovers in first 15 km section of the road to revive the functionality of this vital wildlife corridor. The details of the proposed mitigation measures are provided in detail in Table 37. The details of mitigation measures proposed by WII are based upon short visit and can be further improved upon.

**Table 37:** Details of structures proposed by WII and NTCA in on Chhattisgarh side of NH- 6

S. No	GPS location of structure	Structure Type	Dimensions (m)		
			Provision	Width	Height
1	Start : 21° 04' 49.75" / 80° 30' 28.65" End : 21° 04' 51.13" / 80° 29' 38.04"	Underpass for Animals	Viaduct	750	05
			Approach	300 + 300	
2	Start : 21° 05' 2.55" / 80° 32' 33.58" End : 21° 05' 18.75" / 80° 31' 39.63"	Underpass for Animals	Viaduct	750	05
			Approach	300 + 300	

### 14.5. Mitigation measures on alternate route via Chindwara

As upgradation work on Chindwara road has already been carried out, WII recommends that the proper mitigations measures should be implemented in three patches of forest for retaining the landscape connectivity.

## 15. REFERENCES:

- Barnett J. L., R. A. How and W. F. Humphreys. 1978. The use of habitat components by small mammals in eastern Australia. *Australian Journal of Ecology*. 3, 277-285.
- Barnum, S.A. 2003. Identifying the best locations along highways to provide safe crossing opportunities for wildlife. Colorado Department of Transportation. Research Branch.
- Baur A. and B. Baur. 1990. Are roads barriers to dispersal in the land snail *Arianta arbustorum*? *Canadian Journal of Zoology*. 68, 613-617.
- Clevenger, A. P. and M. P. Huijser. 2011. Wildlife Crossing Structure Handbook: Design and Evaluation in North America.
- Clevenger, A. P. and N. Waltho. 2000. Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. *Conservation Biology*. 14 (1), pp. 47 to 56.
- Daganzo, C.F. 1997. Fundamentals of Transportation and Traffic Operations. *Elsevier*.
- Donaldson, B. M. 2006. Use of highway underpasses by large mammals and other wildlife in Virginia and factors influencing their effectiveness. IN: Proceedings of the 2005 International Conference on Ecology and Transportation, Eds. Irwin CL, Garrett P, McDermott KP. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: pp. 433-441.
- Forman, R. T. T. and L. E. Alexander. 1998. Roads and their major ecological effects, *Annual Review of Ecology and Systematics*. 29, 207-231.
- Forman, R. T. T., D. Sperling, J. Bissonette, A. Clevenger, C. Cutshall, V. Dale, L. Fahrig, R. France, C. Goldman, K. Heanue, J. Jones, F. Swanson, T. Turrentine and T. C. Winter. 2003. *Road Ecology: Science and Solutions*. Island Press, Washington, DC.
- Foster, M. L. and Humphrey, S. R. 1995. Use of Highway Underpasses by Florida Panthers and Other Wildlife. *Wildlife Society Bulletin*. 23 (1), pp. 95-100.
- Haight, F.A. 1963. Mathematical Theories of Traffic Flow. Academic Press, London.
- Jaarsma, C. F., F. van Langevelde and H. Botma. 2006. Flattened fauna and mitigation: Traffic victims related to road, traffic, vehicle and species characteristics. *Transportation Research Part D*. Pg 264-276.
- Jaarsma, C.F., F. van Langevelde, and H. Botma. 2006. Flattened fauna and mitigation: Traffic victims related to road, traffic, vehicle, and species characteristics. *Transportation Research*. Part D 11 (2006) 264-276). Elsevier.
- Jhala, Y. V., Q. Qureshi and R. Gopal. 2015. The status of tigers in India 2014. National Tiger Conservation Authority and Wildlife Institute of India, Dehradun.

- Leblond M., C. Dussault, and J. P. Ouellet. 2013. Avoidance of roads by large herbivores and its relation to disturbance intensity. *Journal of Zoology*. 289(1), 32-40.
- Mader, H. J. 1984. Animal habitat isolation by roads and agricultural fields. *Biological Conservation*. 29, 81-96.
- Menon, V. 2014. Indian Mammals: A field guide. Hachette India.
- Merriam, G., M. Kozakiewiez, E. Tsuchiya and K. Hawley. 1989. Barriers as boundaries for metapopulation and demes of *Peromyscus leucopus* in farm landscapes. *Landscape Ecology*. 2, 227-235.
- Olbrich, P. Untersuchung der Wirksamkeit von Wildwarnreflektoren und der Eignung von Wilddurchlässen (In German) (1984): In *Zeitschrift für Jagdwissenschaft*. 30, pp. 87 to 91.
- Oxley, D. J., M. B. Fenton and G. R. Carmody. 1974. The effects of roads on populations of small mammals. *Journal of Applied Ecology*. 11, 51-59.
- Putnam, R. J. 1997. Deer and Road Traffic Accidents: Options for Management. *Journal of Environmental Management*. 51, pp. 43 to 57.
- Reed, D. F. 1981. Effectiveness of Highway Lighting in Reducing Deer-Vehicle Collisions. *Journal of Wildlife Management*. 45, pp. 721 to 726.
- Reed, D. F. and A. L. Ward. 1987. Efficacy of Methods Advocated to Reduce Deer- Vehicle Accidents: Research and Rationale in the USA. In the *Highway and Wildlife Relationships Conference Proceedings*. Held in Strasbourg, France, June 5 to 7, 1985. Service d'Etudes Techniques de Routes et Autoroutes, Bagneaux, France, pp. 285 to 293.
- Reed, D. F., T. N. Woodard, and T. D. I. Beck. 1979. *Regional Deer- Vehicle Accident Research*. Report Number FHWA-CO-RD-79-11, Colorado Division of Wildlife, Denver, Colorado, November 1979.
- Reed, D. F., T. N. Woodward and T. M. Pojar. 1975. Behavioral Response of Mule Deer to a Highway Underpass. *Journal of Wildlife Management*. 39, pp. 361-167.
- Richardson J. H., R. F. Shore and J. R. Treweek. 1997. Are major roads a barrier to small mammals? *Journal of Zoology* (London). 243, 840-846.
- Rico, A., P. Kindlmann, and F. Sedlacek. 2007. Barrier effects of roads on movements of small mammals. *Folia Zoology*. 56, 1-12.
- Riley, S. P., J. P. Pollinger, R. M. Sauvajot, E. C. York, C. Bromley, T. K. Fuller, and R. K. Wayne. 2006. A southern California freeway is a physical and social barrier to gene flow in carnivores. *Molecular Ecology*. 15, 1733-1741.
- Rodgers, Arthur R., et al. "HRT: home range tools for ArcGIS." (2007).
- Seiler, A. 2002. Effects of infrastructure on nature. In: Anonymous, 2003, COST 341. Habitat fragmentation due to transportation infrastructure. *The European review*. European Commission, Directorate-General for Research, Brussel.

- Silvananthan, T. E., and A. Ali. 2012. Challenges in Designing Smart Green Infrastructure for Wildlife Corridors: Cross sectoral executive leadership forum on mainstreaming priority Tiger habitats 20 – 22 Feb. 2012, Kula Lumpur, Malaysia.
- Singer F. 1978. Behavior of mountain goats in relation to US Highway 2, Glacier National Park, Montana. *Journal of Wildlife Management*. 42, 591-597.
- Ward, A .L. 1982. Mule Deer Behavior in Relation to Fencing and Underpasses on Interstate 80 in Wyoming. In the *Transportation Research Record 859*, Transportation Research Board, National Research Council, Washington, D.C., pp. 8 to 13.
- WII. 2012. Conservation plan in response to diversion of forest area for widening of National Highway 6: A review. Technical Report 2012/005. Wildlife Institute of India, Dehradun, India.
- WII. 2012. Revised proposal for 4 laning of National Highway 7: A review. Technical Report 2012/006. Wildlife Institute of India, Dehradun, India.
- Yumnam, B., Y. V. Jhala, Q. Qureshi, J. E. Maldonado, R. Gopal, S. Saini, Y. Srinivas and R. C. Fleischer. 2014. Prioritizing Tiger Conservation through Landscape Genetics and Habitat Linkages. *PlosOne*. 9(11): 1-28.

Minutes of the Standing Committee meeting of NBWL held on 12-13 August 2014

*Minutes of 31<sup>st</sup> meeting of SC NBWL dated 12th & 13th Aug 2014*

**Ministry of Environment and Forests  
Wildlife Division**

**Minutes of the 31<sup>st</sup> Meeting of the Standing Committee of National Board for Wildlife held on 12-13 August 2014 at Indira Paryavaran Bhawan, Jor Bag Road, New Delhi.**

The 31<sup>st</sup> Meeting of the Standing Committee of National Board for Wildlife (NBWL) was held on 12-13 August 2014 in the Ministry of Environment and Forests (MoEF), New Delhi. The meeting was convened under the chairmanship of Hon'ble Minister of State (Independent Charge) for Environment, Forests and Climate Change. The list of participants is at **Annexure-1**.

At the outset, Hon'ble Chairman while welcoming all participants to the 31<sup>st</sup> Meeting of Standing Committee of NBWL mentioned that this meeting was being held after a long gap, due to the process of re-constitution of the National Board for Wildlife and its Standing Committee. He urged the participants that there was a need to take conservation alongside developmental activities and therefore, all the proposals that have been included in the agenda need to be looked into very carefully and judiciously. He also clarified that in case the Committee prescribes any conditions while recommending projects, care should be taken that the conditions are feasible for implementation and at the same time compliance of the conditions should also be closely monitored. The Chairman also pointed out that each case be discussed as per its merits. He then requested the Member Secretary to initiate the discussions on the agenda items.

The agenda items were then opened for discussion.

**Agenda No. 1:**

**Confirmation of the minutes of the 30<sup>th</sup> Meeting of Standing Committee of National Board for Wildlife held on 4<sup>th</sup> September 2014.**

The Member Secretary informed the Committee that the final minutes of the 30<sup>th</sup> Meeting of the Standing Committee of NBWL held on 4<sup>th</sup> September 2013 were circulated to all members of the Standing Committee on 7<sup>th</sup> November 2013. No comments have since been received on the final minutes.

The Standing Committee accordingly confirmed the minutes of the 30<sup>th</sup> Meeting held on 4<sup>th</sup> September 2013, subject to discussion on the points in the matters coming subsequently in the agenda.

**Agenda No. 2: Action Taken Report**

Action Taken on the decisions of the Standing Committee of NBWL in its 28<sup>th</sup> Meeting held on 20<sup>th</sup> March 2013.

with the 13 Gram Sabha representatives, who had declined the offer of the relocation package and to relocate out of the Sanctuary. He added that all other conditions, as laid down by the IBWL had been complied with and since the Gram Sabha had again declined the offer of the relocation package, the Standing Committee may consider waiving of the condition.

After discussions, the Standing Committee decided to waive of the condition regarding relocation of villages outside Kaimur Sanctuary.

**4.2 (25) Diversion of 0.97 ha of forest land in Pasuvemula Reserve Forest of WLM Nagarjuna Sagar Division for Anupu & Koppunuru Lift Irrigation Scheme(LIS) on the Foreshore of Nagarjunasagar Dam in Macherla, Andhra Pradesh.**

The Member Secretary briefed the Committee regarding the proposal. He also added that the site inspection report was circulated to all the members. After discussions, the Standing Committee considered the small area involved and the location specific nature of the proposal, and decided to recommend the proposal subject to the conditions specified by the State Board for Wildlife and the State Chief Wildlife Warden.

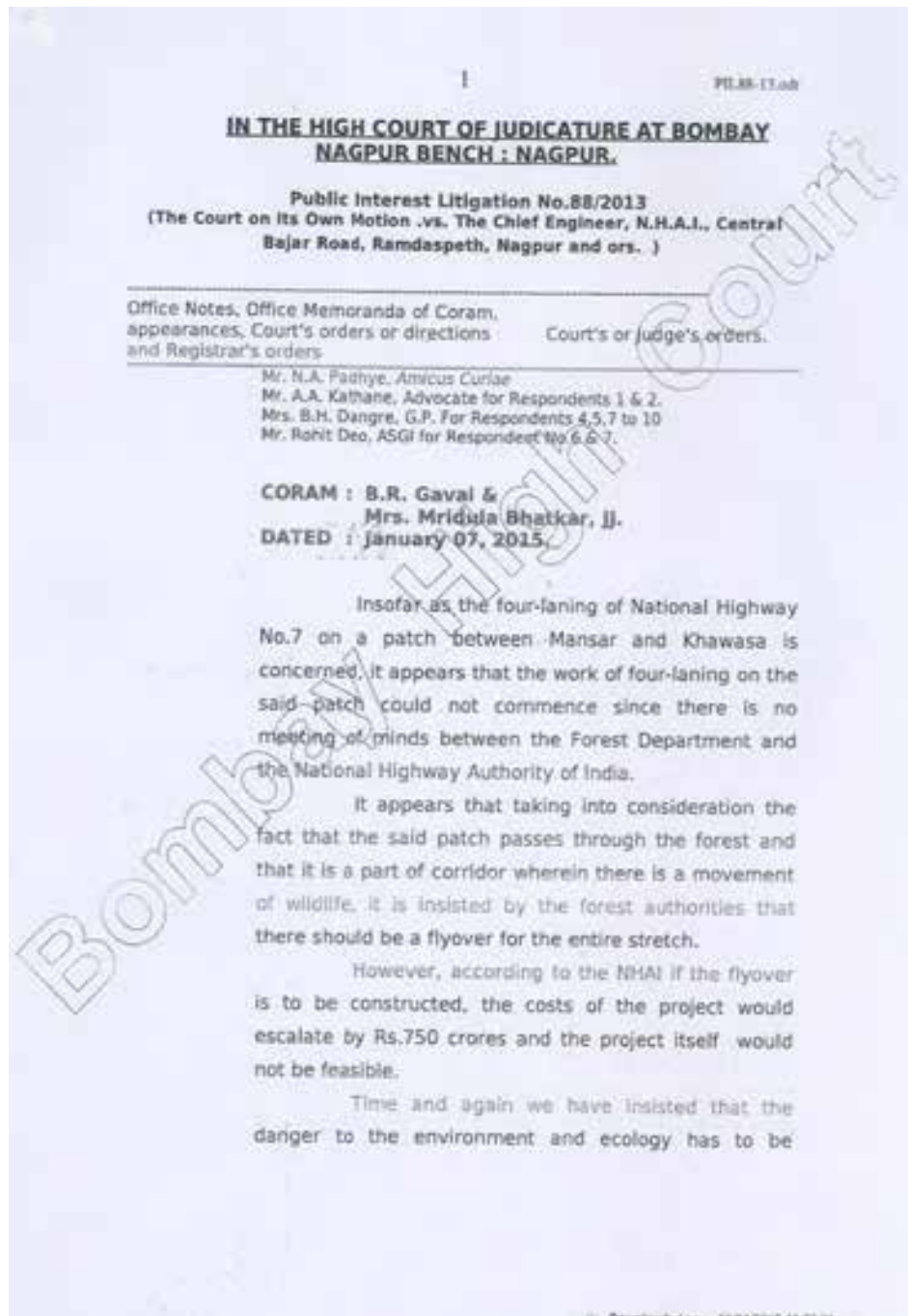
**4.2 (26) Diversion of 4.493 ha of forest land from Pench Mowgli Wildlife Sanctuary for rehabilitation/upgradation of existing 2 lane to 4 lane on Seoni-Khawasa (MP) MH Border Section of NH-7, Madhya Pradesh.**

The Member Secretary briefed the Committee regarding the proposal. He added that the report of NTCA on this was circulated to the members. Member Secretary NTCA informed that considering the location specificity of the project, the design for the stretch within the PA was worked on in such manner that impact can be minimized and movement routes of wildlife have been protected. The Director, Wildlife Institute of India informed that the WII had carried out studies on the ecological aspects of the project along the National Highway passing through the Pench Mowgli Tiger Reserve. He added that this was of the first of its kind model in ecological consideration in roads passing through Protected Area.

After discussion, the Standing Committee recommended the proposal subject to the following mitigation measures as suggested by NTCA and WII:

- i. The modifications on the design and location suggested by WII for construction of culverts shall be adhered to by NHAI*
- ii. Specific dimensions (height breadth) and locations for the underpasses shall be constructed only in consultation with the WII.*
- iii. The underpasses located at 630.341 km and 631.014 km are not recommended as separate underpasses by recommended to be constructed as a single underpass of 1 km length and 7 m height.*
- iv. At chainages 628.100 to 629.100 and 630.00 to 631.200, the proposed two flyovers should be replaced by underground tunnel while providing access to villagers.*

Direction of Hon'ble Bombay High Court dated 7<sup>th</sup> January 2015



minimized. However, at the same time the developmental work cannot be hampered with. For economic development of the country, the National Highways' work as important lifelines.

The judicial notice may be taken of the fact that on a patch on National Highway No.6 between Bhandara and Deori, on one side of the road there is a Nagzira Wildlife Sanctuary and on the other side there is Navegaon Wildlife Sanctuary. Undisputedly the said areas have also corridors for movement of wildlife. It is noticed that on the said Highway while four-laning underpasses have been provided at frequent distances so as to facilitate the free movement of the wildlife from one area to the other area. We find that if such an arrangement is made on a patch between Mansar and Khawasa, it would take care of the concern of the Forest Department and allow free movement of wildlife from one side of the road to other side.

It is to be noted that if the provision of 6 underpasses as proposed by NHAI is accepted, the costs would escalate by approximately about Rs.20 to 25 Crores whereas if flyover is to be constructed, it would escalate by Rs.750 crores. We do not want to go into the issue as to whether 6 number of underpasses would be sufficient or not. Even if it is accepted that it will be necessary to have more number of underpasses, still if we compare the costs if flyover is to be constructed and more number of underpasses are provided, the difference would be manifold.

Since the matter is pending for a considerable time, we find that it would be appropriate that the

Hon'ble Chief Minister of the State of Maharashtra; Hon'ble Minister of Road, Transport and Highways and Shipping and Hon'ble Minister of State (Independent Charge) of Environment, Forest and Climate Change of the Union of India intervene in the matter and impress upon the authorities concerned to arrive at an amicable arrangement.

In that view of the matter, we request the learned ASGI and the learned Government Pleader to convey our request to the Hon'ble Chief Minister, State of Maharashtra; Hon'ble Minister of Road, Transport and Highways and Shipping and Hon'ble Minister of State (Independent Charge) of Environment, Forest and Climate Change to intervene in the matter and impress upon all the concerned authorities to arrive at an amicable arrangement.

Stand over to 21<sup>st</sup> January, 2015.

JUDGE

JUDGE

7/1/15

### Annexure III:

Minutes of meeting held on 13<sup>th</sup> February 2015, about diversion of forest land for widening of National Highway- 7 from Mansar to Border of Maharashtra/Madhya Pradesh (between km 652 and 689) and National Highway- 6 from Maharashtra/Chhattisgarh border to Wainganga Bridge near Bhandara (between km 405 and 485) of National Highway Authority of India (NHAI)

**Government of Maharashtra**

No. S-2015/CR-16/F-10,  
Room No. 456/461 Annex,  
Revenue & Forest Department,  
Hazratma Rajgura Chowk,  
Madam Cama Marg, Mantralaya,  
Mumbai 400032.  
Dated:-24/02/2015

To,

1. Principal Chief Conservator of Forests (HoFF), Maharashtra State, Nagpur
2. Principal Chief Conservator of Forests (Wildlife), Maharashtra State, Nagpur
3. Additional Principal Chief Conservator of Forests and Nodal Officer, Maharashtra State, Nagpur
4. Additional Principal Chief Conservator of Forests (Wildlife), East, Nagpur
5. Chief General Manager (Tech), National Highways Authority of India, Mumbai.

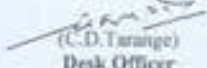
**Sub: Meeting for discussion on proposal of diversion of 49.246 Ha. Forest land Under FCA, 1980 for widening of NH-7 from Mansar to border of Maharashtra / MP**

**Ref: 1) Government of Maharashtra's even no. letter dated 07.02.2015  
2) Government of Maharashtra's even no. letter dated 18.02.2015**

Sir,

A meeting was held under the chairmanship of Hon'ble Chief Minister of the Maharashtra State and in presence of Hon'ble Minister of Road, Transport and Highways and Shipping and Hon'ble Minister of State (Independent Charge) of Environment, Forest and Climate Change of Government of India on 13/02/2015 at 5.00 PM at Divisional Commissioner Office, Pune.

The minutes of meetings issued, vide above referred letter No.2 are withdrawn & revised minutes of the above meeting are enclosed herewith for necessary action.

Yours faithfully,  
  
(C.D. Tarange)  
Desk Officer

**Enclosure:-As above**

**Copy to:-**

1. The Principal Secretary of the Hon'ble Chief Minister of Maharashtra, Mantralaya, Mumbai.
2. The Private Secretary of the Minister of Road, Transport and Highways and Shipping, Government of India, New Delhi.
3. The Private Secretary of the Minister of State (Independent Charge) of Environment, Forest and Climate Change, New Delhi.
4. The Private Secretary of the Minister of Forests, Government of Maharashtra, Mantralaya, Mumbai.
5. Director, Wildlife Institute of India, Deharadun.
6. Member Secretary, National Tiger Conservation Authority, New Delhi.
7. Chief Conservator of Forests (T.), Nagpur.

Minutes of Meeting held on 13<sup>th</sup> February 2015, about diversion of forest land for widening of National Highway- 7 from Mansar to Border of Maharashtra/Madhya Pradesh (between km 652 and 689) and National highway- 6 from Maharashtra/ Chhattisgarh border to Wainganga bridge near Bhandara (between km 405 and 485) of National Highway Authority of India (NHAI)

In compliance to the Orders by Hon'ble High Court of Bombay, Nagpur Bench dated 04.02.2015 in the matter of Public Interest Litigation (PIL) No.88/2013, meeting was held on 13.02.2015 which was chaired by Hon'ble Chief Minister of Maharashtra, Shri. Devendra Fadnis in presence of Hon'ble Minister of Road Transport, Highways & Shipping, Shri. Nitin Gadkari and Hon'ble Minister of State (Independent Charge) of Environment, Forest and Climate Change, Shri. Prakash Jawadekar at Divisional Commissioner's office, Pune.

2. The list of officials from National Highways Authority of India (NHAI), Maharashtra State Forest Department, Wildlife Institute of India (WII), National Tiger Conservation Authority (NTCA) who attended the meeting is at Annexure-A.

3. The Chairman welcomed all to the meeting and requested Member (PPP) of NHAI to present their concerns on the recommendations suggested by the Committee constituted by the Govt. of Maharashtra to advise on the mitigation measures on Mansar-Kawasa section of NH-7 in the State of Maharashtra.

4. The Member (PPP) of NHAI has informed that the Committee has suggested to provide 9 nos. of different structures on the road being widened to 4-lane configuration costing Rs.334.84 Crores which included 2 nos. of flyovers of 1 Km. each and one underpass of 300m which are the issues of concern as the other 6 structures advised by the Committee are acceptable to NHAI and same will be provided.

In respect of 3 structures of concern on Hon'ble High Court has also made their observations that these structures do not appear to be practicable and also they do not appear to be necessary. The Hon'ble High Court has also observed that the Project concern is only 4-laning of existing road and the road is in existence for a period of more than a century and not much casualties have been reported on account of any accident on the said patch between speedy vehicle and an animal. The concerns of Forest Department may be understood, if a new road project is constructed. The Hon'ble High Court has also asked to arrive at reasonable proposal.

NHAI suggested that crossings of 50m underpass with adequate guide walls has proposed at Km.654.360 of the recommendation by the Committee can be provided on these three locations also which will be in addition to the six structures already agreed. This will cost about Rs.122 Crores i.e. about 35% of the cost of the Project on this section. This can be borne by the NHAI for the sake of safe wildlife crossings on this section of road. The entire length of road where crossings (6 structures + 3 underpasses of 50 meters each) should be fenced so as to channelize wildlife to safe crossing.

To substantiate that the crossing of 50m is adequate, "A user guide to developing effective Highway crossings for Carnivores and other wildlife" which has been accepted by Federal Highway Administration, National Parks Services, US Fish & Wildlife Services, USDA Forest Services and various State Wildlife Agencies of United States was quoted which suggests that an opening of 50 feet i.e. 17m is enough for crossing of large carnivores, if placed after properly identifying the pattern of animal movement. The guidelines also suggested that small increase in structure size what may seem like subtle change in design, may have a huge effect on cost, all other things being equal, biologist should recommend the most cost effective design that will work for the target species.

5. The Hon'ble Minister, Shri Prakash Jawadekar asked the officials from State Forest Department to briefly respond the suggestion of NHAI and consider a more practical solution that will be cost effective while serving the purpose of allowing wildlife to cross the highway safely after the four laning of the highway NH7.

6. The Secretary (Forests), Forest & Revenue Department, Govt. of Maharashtra has informed that the Committee was formed because there was a recommendation by WII to provide for various crossing arrangements for wildlife on this section which was costing around Rs.750 Crores, thereby rendering the proposal as impractical and un-executable. Since, the report was prepared by representatives of WII, it was felt necessary to include them into the Committee and after review, the Committee has reduced the height of the structures from 7m to 4.5m as there was no justification for providing height of 7m. Regarding length of the structures, earlier proposals of 2 Km. long structures were pruned down to 1 Km., thereby reducing the estimated cost from Rs. 750 Crores to Rs.334.84 Crores which is still not acceptable to NHAI and the Hon'ble High Court has also advised to further review the proposals made by the Review Committee. The decision is required to be taken by Govt. of Maharashtra in accordance with the plan prepared by the Chief Wildlife Warden of the State, as per the conditions stipulated in Stage 1 forest clearance accorded by MOEF.

The Chief Wildlife Warden has informed that since there is already a Report of WII, he does not feel the necessity of a separate plan by Chief Wildlife Warden and the same should be provided, but, this has been rendered unreasonable & impractical.

The APCCF & Nodal Officer, Forest Department, Govt. of Maharashtra has informed that working permission to cut the tree and commence the work has already been accorded subject to finalization of mitigation measures which are to be decided now. The Hon'ble High Court has advised that the Hon'ble Chief Minister of Maharashtra, Hon'ble Minister of RTH&S and Hon'ble Minister of EF&CC to intervene and impress upon Authorities to arrive at a conclusive proposal for providing the mitigation measures.

7. After hearing all concerns and taking the international practices into account, the Hon'ble Ministers have decided that it will be prudent to provide for the mitigation measures as advised by the Review Committee with modifications. The Wildlife Institute of India and National Tiger Conservation Authority should be asked to resurvey the area and provide exact locations that would most likely be used by wildlife, especially tigers, as crossing points across the upgraded highway and also suggest location for three to four number of 50 mtr. long underpasses, so that the mitigation measures are cost effective. To avoid wildlife crossing the highway at undesired locations that could potentially cause accidents and mortality of wildlife as well as endanger vehicle passengers, the remaining part of the forest edge should be fenced off.

It was also decided that similar mitigation measures should be worked out and accepted by State Forest Department for –

The stretch of NH-7 in the State of Madhya Pradesh as the present proposal of mitigation measures for more than Rs.1000 Crores needs to be made more cost effective and reconsidered after a fresh site specific survey within a period of 4-6 weeks.

The stretch of NH-6 on forest section of Chhattisgarh / Maharashtra Border to Bhandara in the State of Maharashtra as the present proposal of mitigation measures in the forest stretch of 8 Km. of road costing Rs.80 Crores is about Rs.500 Crores.

All concerned officials were directed to prepare the mitigation plan for both the projects for immediate processing of forest clearance on the lines suggested above. A good monitoring plan for timely implementation of mitigation measures will be prepared and jointly operated by the Wildlife and NHAI authorities.

The meeting ended with vote of thanks.

## LIST OF OFFICERS PRESENT IN THE MEETING

### 1. NATIONAL HIGHWAYS AUTHORITY OF INDIA:

- (i) Sh. Sudhir Kumar, IAS, Member (PPP)
- (ii) Sh. V.K.Sharma, C.G.M. (Environment)
- (iii) Sh. M. Chandrashekhar, Regional Officer, Nagpur & Chhattisgarh
- (iv) Sh. Ashish Asati, G.M. (Technical)
- (v) Sh. Shri Ram Mishra, Project Director, PIU-Nagpur

### 2. FOREST DEPARTMENT, GOVT. OF MAHARASHTRA:

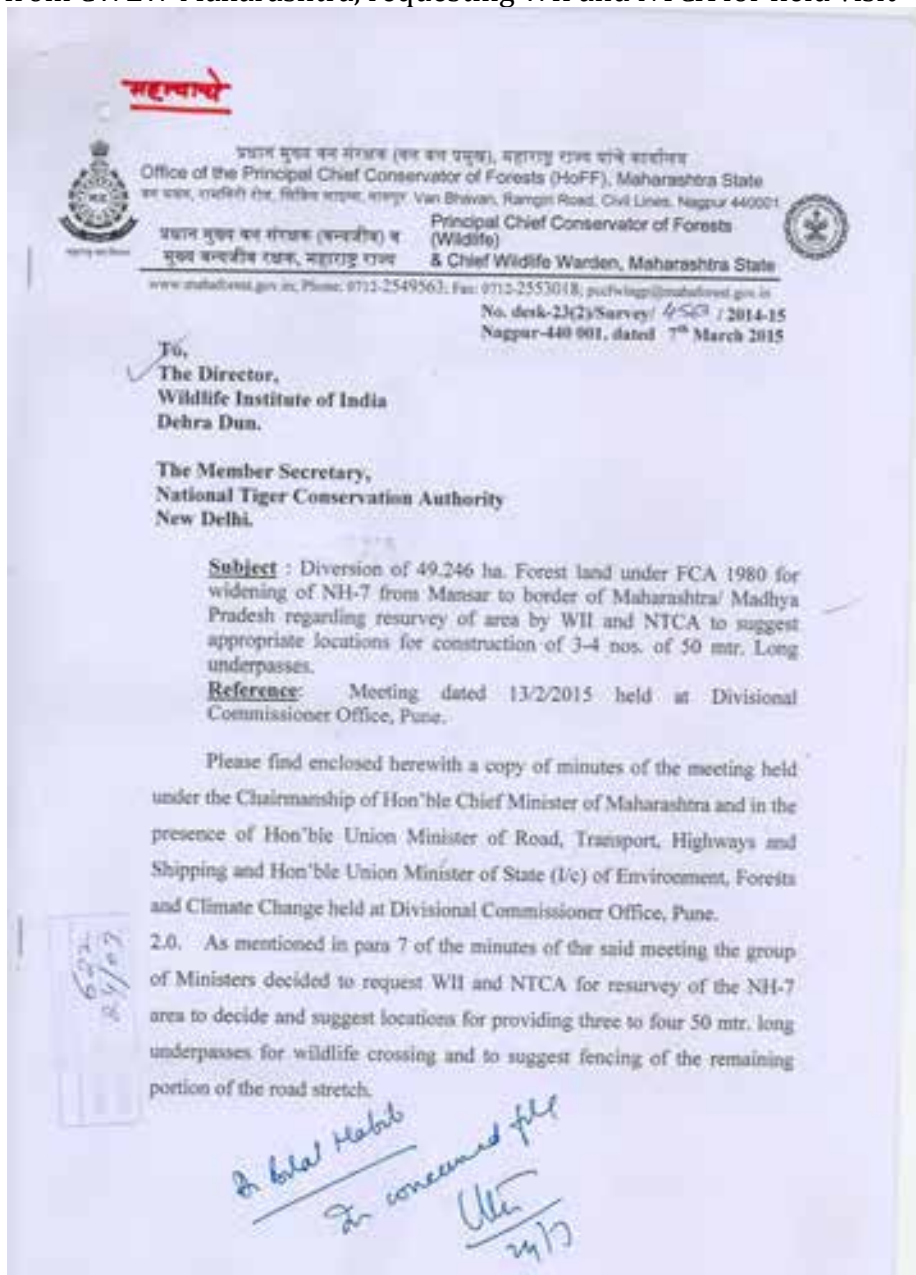
- (i) Sh. Vikas Kharge, Secretary (Forest)
- (ii) Sh. SwjanBhagat, PCCF (Wildlife)
- (iii) Dr. Suresh Gairola, APCCF & Nodal Officer
- (iv) Sh. Maipokim Ayer, APCCF (Wildlife East), Nagpur
- (v) Sh. Shailesh Tembumikar, CCF (Territorial), Nagpur

### 3. OFFICIALS FROM ADVISORY BODIES OF MOEF:

- (i) Dr. V.B. Mathur, Director, W.I.I., Dehradun.
- (ii) Dr. Bilal Habib, Scientist, W.I.I.
- (iii) Dr. H.S. Negi, I.G., N.T.C.A.

**Annexure IV:**

Letter from CWLW Maharashtra, requesting WII and NTCA for field visit



3.0. In the said meeting, directives were also issued to adopt similar mitigation measures for wildlife crossing in 8 Km.stretch of NH-6 road section of Chattisgarh/Maharashtra border to Bhandara. The NHAI has disagreed to the mitigation measures proposed by WII, Dehra Dun for the same reasons as in case of NH-7.

4.0. In the light of directives given in the said meeting as stated above under para 2 and 3, it is requested to depute your representative to make a field visit for early compliance within a month.

**Encl: As above.**

  
(Sarjan Bhagat) 7/3  
Principal Chief Conservator of Forests (Wildlife)  
Maharashtra State, Nagpur

Copy for information to :

1. Secretary (Forests) Revenue and Forest Department, Mantralaya, Mumbai
2. Director General of Forests, MoEF &CC Government of India New Delhi
3. Addl. PCCF and Nodal Officer, M.S. Nagpur.
4. APCCF (WL) East, Nagpur for facilitating the field visit of WII and NTCA representatives.
5. CCF(T) Nagpur for coordinating the field visit of WII and NTCA representatives.

**Annexure V:**

**Nomination of IGF, NTCA regional office to be part of resurvey**

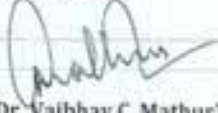
**F.N. 12-1/2009-NTCA (VoLI)**  
**Government of India**  
**Ministry of Environment, Forest and Climate Change**  
**National Tiger Conservation Authority**  
\*\*\*\*\*

1<sup>st</sup> Floor, NBCC Place, Pragati Vihar,  
Bhishma Pitamah Marg, New Delhi-110 003  
Email: aig3-ntca@nic.in  
Tele: 011-2436 2445  
**Dated: 12.03.2015**

**OFFICE MEMORANDUM**

**Sub: Diversion of 49.246 ha. Forest land under FCA 1980 for widening of NH-7 from Mansar to border of Maharashtra/ Madhya Pradesh regarding resurvey of area by WII and NTCA to suggest appropriate locations for construction of 3-4 nos. of 50 mtr. long underpasses -reg.**


In inviting to reference to PCCF (WL), Maharashtra letter No. desk-23(2)/Survey/4563/2014-15 on the subject cited above. In this context, I am directed to say that the IGF, NTCA, Regional Office, Nagpur is nominated for the said resurvey.

  
**(Dr. Vaibhav C. Mathur)**  
**Assistant Inspector General (NTCA)**

The Inspector General of Forests,  
National Tiger Conservation Authority,  
Regional Office, Nagpur

**Copy To:**

1. Secretary (Forests) Revenue and Forest Department, Mantralaya, Mumbai.
2. Director General of Forests, MoEF&CC, Govt. of India, New Delhi.
3. Addl. PCCF and Nodal Officer, M.S. Nagpur.
4. APCCF (WL), East, Nagpur for facilitating the field visit of WII and NTCA representatives.
- ✓ 5. The Director, Wildlife Institute of India, Dehradun

*B A Babal Habib*  
  
2/2

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DWT OFFICE  
File No: 580  
20/3/15

**Annexure VI:**

**Comparison of Mitigation Measures  
(Earlier Proposed and Revised)**

S. No.	Highway	Forest Patch	Structure Type	Earlier Mitigation Measures		Revised Mitigation Measures		
				Dimensions (m)		Dimensions (m)		
				Width (viaduct)	Height	Width (viaduct)	Height	
1	NH-7 MP	01	Under pass	600	7	Not Recommended		
2	NH-7 MP	01	Under pass	1000	7	RCC structure Approach (both sides)	500	5
						Guide walls (both sides)	300 + 300	2
3	NH-7 MP	01	Under pass	1200	7	RCC structure Approach (both sides)	800	5
						Guide walls (both sides)	300 + 300	2
4	NH-7 MP	Between 2 & 3	Under pass	800	7	Not Recommended		
5	NH-7 MP	02	Under pass	90	7	90		5
6	NH-7 MP	02	Under pass	60	7	60		5
7	NH-7 MP	02	Under pass	60	7	60		5
8	NH-7 MP	03	Under pass	1000	7	RCC structure Approach (both sides)	500	5
						Guide walls (both sides)	300 + 300	2
9	NH-7 MP	Between 3 & 4	Under pass	700	7	Not Recommended		
10	NH-7 MP	04	Under pass	800	7	RCC structure Approach (both sides)	300	5
						Guide walls (both sides)	300 + 300	2
11	NH-7 MH	01	Under pass	60	7	Not Recommended		
12	NH-7 MH	01	Minor Bridge	Structure Ext. 60	5	Structure Extension	60	5
				Guide Walls 2 X 2 X 50	2	Guide walls (both sides)	50 + 50	2
13	NH-7 MH	01	Under pass	RCC Structure 50	5	RCC structure Approach (both sides)	50	5
				Approaches 600	2	Guide walls (both sides)	300 + 300	2
				Guide Walls 2 X 2 X 50			50 + 50	
14	NH-7 MH	01	Under pass	RCC Structure 1000	5	RCC structure Approach (both sides)	750	5
				Approaches 600	2	Guide walls (both sides)	300 + 300	2
				Guide walls 2 X 2 X 50			50 + 50	
15	NH-7 MH	01	Minor Bridge	Structure Ext. 80	5	Structure Extension	80	5
				Guide Walls 2 X 2 X 50	2	Guide walls (both sides)	50 + 50	2
16	NH-7 MH	01	Under pass	RCC Structure 300	5	RCC structure Approach (both sides)	300	5
				Approaches 600	2	Guide walls (both sides)	300 + 300	2
				Guide Walls 2 X 2 X 50			50 + 50	
17	NH-7 MH	02	Minor Bridge	Structure Ext. 65	5	Structure Extension	65	5
				Guide Walls 2 X 2 X 100	2	Guide walls (both sides)	100 + 100	2
18	NH-7 MH	03	Under pass	RCC Structure 100	5	RCC structure Approach (both sides)	100	5
				Approaches 600	2	Guide walls (both sides)	300 + 300	2
				Guide walls 2 X 2 X 50			50 + 50	
19	NH-7 MH	03	Under pass	RCC Structure 1000	5	RCC structure Approach (both sides)	750	5
				Approaches 600	2	Guide walls (both sides)	300 + 300	2
							50 + 50	

				Guide walls 2 X 2 X 50		sides)		
20	NH-7 MH	03	Under pass	Structure Ext. 50 Guide Walls 2 X 2 X 250	5 2	Structure Extension Guide walls (both sides)	50 250 + 250	5 2
21	NH-6 MH	01	Under pass	1000	7	RCC structure Approach (both sides) Guide walls (both sides)	700 300 + 300 100 + 100	5 2
22	NH-6 MH	01	Under pass	2000	7	Not Recommended		
23	NH-6 MH	06	Under pass	2000	7	RCC structure Approach (both sides) Guide walls (both sides)	750 300 + 300 100 + 100	5 2
24	NH-6 MH	08	Under pass	1500	7	RCC structure Approach (both sides) Guide walls (both sides)	750 300 + 300 100 + 100	5 2
25	NH-6 MH	10	Under pass	1500	7	RCC structure Approach (both sides) Guide walls (both sides)	750 300 + 300 100 + 100	5 2
26	NH-6 Chhattisgarh	-	Under pass	1500	7	RCC structure Approach (both sides)	750 300 + 300	5
27	NH-6 Chhattisgarh	-	Under pass	1500	7	RCC structure Approach (both sides)	750 300 + 300	5



भारतीय वन्यजीव संस्थान  
Wildlife Institute of India



**Technical Report:** *Proposed Mitigation Measures for Maintaining Habitat Contiguity and Reducing Wild Animal Mortality on NH 6 & 7 in the Central Indian Landscape*

**TR No. 2015/006**

[www.wii.gov.in](http://www.wii.gov.in)

