सत्यमेव जयते

F.No.6-161/2020 WL
Government of India
Ministry of Environment, Forest and Climate Change
(Wildlife Division)

2nd Floor, Jal Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi – 110003.

Dated: 22nd January,2021

To
All Members
Standing Committee of NBWL.

Sub: Minutes of 60th Meeting of the Standing Committee of National Board for Wild Life- reg.

Sir / Madam,

Kindly find enclosed copy of the Minutes of 60th Meeting of the Standing Committee of National Board for Wild Life held on 5th January, 2021 under the chairmanship of Hon'ble Minister of Environment, Forest and Climate Change, Government of India.

Yours faithfully,

(Surender Gugloth)
Scientist 'D'
Email: ddwlmef@gmail.com

Encl: As above

Distribution:

1. Secretary, MoEF&CC
2. DGF&SS, MoEF&CC
3. ADGF(WL), MoEF&CC
4. ADGF(FC), MoEF&CC
5. ADGF (PT) and Member Secretary, NTCA
6. Director/IGF, PE Division, MoEF&CC
7. Director, WII, Dehradun
8. Director, GEER Foundation, Gandhinagar, Gujarat
9. Prof. R. Sukumar, Member, NBWL
10. Dr. H.S. Singh, Member, NBWL
11. Secretary, Environment, Forest, Science and Technology Department, Govt. of Andhra Pradesh.

Copy to:

1. PS to Hon'ble MoEF&CC
2. PS to Hon'ble MoSEF&CC
3. PPS to DGF&SS, MoEF&CC
4. PSO to Addl.DGF(WL), Sr.PPS to IGF(WL)
5. Additional Chief Secretary / Principal Secretary / Secretary, Forest Department, Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Rajasthan, Telangana, Uttarakhand, Uttar Pradesh;
6. PCCF & HoFF, Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Rajasthan, Telangana, Uttarakhand, Uttar Pradesh;
7. Chief Wild Life Warden, Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Rajasthan, Telangana, Uttarakhand, Uttar Pradesh.

MINUTES OF 60th MEETING OF THE STANDING COMMITTEE OF NATIONAL BOARD FOR WILD LIFE HELD ON 05 JANUARY, 2021

The 60th Meeting of the Standing Committee of National Board for Wild Life was held on 05 January, 2021 through Video Conference and chaired by the Hon'ble Minister for Environment, Forest & Climate Change. List of participants is placed at **ANNEXURE-I**.

The Hon'ble Chairman welcomed all the participants to the 60th Meeting of the Standing Committee of National Board for Wild Life and asked the Member Secretary to initiate the discussions on the Agenda Items.

AGENDA ITEM No.1

60.1.1 Confirmation of the minutes of the 59th Meeting of the Standing Committee of National Board for Wild Life held on 5th October, 2020.

The Member Secretary stated that the minutes of the 59th meeting of the Standing Committee of National Board for Wild Life held on 5th October, 2020 were circulated on 19th October, 2020 amongst all the Members of the Standing Committee.

He stated that the comments / suggestions have been received from Dr. H. S. Singh, Member through e-mail dated 5th January, 2021 requesting for reconsideration of his proposal regarding the exemption of NPV in cases of relocation of villagers from buffer areas and wildlife corridors to other forest areas.

Secretary, MoEFCC informed that the framing of rules for Forest (Conservation) Act, 1980 is under active consideration of the Ministry and this issue will be taken care while finalization of these Rules. The same was welcomed and accepted by Dr. H.S. Singh.

Decision Taken: Based on the discussions held, the Standing Committee decided to confirm the minutes of the 59th meeting.

AGENDA ITEM No.2

(Action Taken Report)

60.2.1 Proposal for use of 98.59 ha of reserve forestland from Saleki proposed reserve forest which is a part of Dehing Patkai Elephant Reserve for

Tikok OCP coal mining project by North-Eastern Coal Field, Coal India Limited, Assam State (Original Agenda – 54.4.3)

The Member Secretary stated that the Standing Committee in its 59th meeting decided to send a two members enquiry team comprising of an official each from the Ministry and the Assam Forest Department and submit a factual report within a month. Ministry has constituted a committee and it is already on job. The DDG, Shillong has requested for extension up to 31.01.2021 for submission of report.

Decision Taken: After discussions, the Standing committee decided to give extension of time up to 31.01.2021 for the enquiry team to submit its report.

60.2.2 Proposal for construction of residential cum commercial Project jointly developed by M/s Puravankara Ltd., M/s Melmont Construction Pvt. Ltd. and M/s Purva Realties Pvt. Ltd. at Edappally South and Vazhakkala Villages, Kanyannur Taluk, Ernakulam District, Kerala, Kerala State (Original Agenda – 57.3.12)

The Member Secretary briefed the Standing Committee that the proposal is for construction of residential cum commercial complex over an area of 7.3256 ha located 5.0 KM away from the Mangalavanam Bird Sanctuary. In the 57th meeting, the Standing Committee requested the Chief Wild Life Warden to furnish the report regarding the availability of vacant plots around the protected area. As the report was not received, the standing committee in the 59th meeting had decided to delist the proposal only to be placed before it after receipt of requisite information from the State Government.

The Member Secretary stated that the report regarding availability of vacant plots in 5km area from the boundary of Mangalavanam Bird Sanctuary has been submitted by the Chief Wild Life Warden.

Decision Taken: After discussions, the Standing Committee decided to recommend the proposal since it is located at 5 km from the Sanctuary and also outside the proposed Eco-sensitive Zone subject to the following:

A. **Condition imposed by the Chief Wild Life Warden:**

1. The user agency shall plant trees three times the trees felled.
2. The green area of the project site should be planted with native tree species

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life

Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.2.3 Proposal for expansion of production of silica sand from 1.0 lakh TPA to 3.0 lakh TPA by open cast mechanized method in the private land of 59.51 ha situated at Barodia, Tehsil Hindoli, District Bundi, Rajasthan State (Original Agenda – 53.3.22)

The Member Secretary stated that the proposal was considered by the Standing Committee in its 59th meeting held on 5th October, 2020 wherein it was decided to defer the matter till the finalization of ESZ. The Member Secretary stated that the proposal for declaration of ESZ around the Ramgarh Vishdhari Sanctuary was received in the Ministry which was examined by the Wildlife Division and Wildlife Institute of India. After examination, the proposal was sent to ESZ Division for publication of draft notification which has been published dated 30.12.2020. The proposed extent of the ESZ is from 25 m to 400 m from the boundary of the sanctuary.

Prof. Sukumar stated that the extent of ESZ from 25 m to 400m needs reconsideration. The Member Secretary stated that once the draft notification is published, the objections and comments are looked into by the Expert Committee constituted for the purpose of finalisation of ESZ around national park and sanctuaries. The Chairman requested that the extent of the ESZ may be looked into by the Expert Committee whether it is based on the natural features before finalisation.

Decision Taken: After detailed discussions, the Standing Committee decided to recommend the proposal since it is 3.6 km away from the boundary of the Sanctuary and also outside the proposed ESZ subject to the following:

A. **Condition imposed by the Chief Wild Life Warden:**

1. 2% of the proportional project cost of the project falling within ESZ of PA should be deposited in RPACS by the user agency for management and protection of wildlife in the state as corpus.
2. No work shall be done before sunrise and after sunset in the project area.
3. No material of any kind should be extracted from PA and its ESZ.
4. There will be no felling of trees and burning of fuel wood inside the PA and ESZ.
5. The waste material generated should be disposed outside the PA and its ESZ.
6. There will be no labour camp within 1 km from the boundary of PA during the work.

7. No blasting will be carried out within 1 km from the boundary of PA during the work.
8. Green belt should be created by the user agency on the periphery of the project area.
9. Water harvesting structure for recharging of water should be mandatory in the project area.
10. There shall be no high mast / beam /search lights & high sounds within 1 km from PA boundary.
11. Signages regarding information about the wild animals in the area, control of the traffic volumes, speed, etc., should be erected near PA.
12. The user agency and project personnel will comply with the provisions of the Wild Life (Protection), Act, 1972.
13. Maintenance activity of any nature should be carried out only after seeking formal approval from competent authority of tiger reserve / PA.
14. Six feet high wall is to be constructed on the periphery of applied project area.
15. Any permission / clearance required under FCA-1980 or other Acts may be taken as per rules.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.2.4 Proposal for collection of river bed materials from an area 10.0 ha located at Sajjanpur Village, Haridwar at distance of 9.0 km away from the boundary of Rajaji National Park, Uttarakhand State (Original Agenda – 54.4.27)

60.2.5 Proposal for collection of river bed materials from an area 55.51 ha located at Satiwal, Kudkawala, Teliwala and Kheri, at distance of 1.5 km away from the boundary of Rajaji National Park, Uttarakhand State (Original Agenda – 55.4.21)

The Member Secretary stated that the Standing Committee in the 59th Meeting held on 5th October, 2020 requested the State Government of Uttarakhand to submit the compliance certificate with respect to the Enforcement and Monitoring Guidelines for Sand Mining, 2020 for further consideration and seek opinion of NMCG on these proposals. The information from the State Government and NMCG is yet to be received.

Decision taken: After discussions, the Standing Committee decided to defer the proposals till the receipt of comments from NMCG and compliance

certificate with respect to the Enforcement and Monitoring Guidelines for Sand Mining, 2020.

60.2.6 Sixteen Writ Petitions of Quarry Owners - Judgments of the Hon'ble High Court of Kerala received with copies of Environmental Clearance along with all other necessary papers, Kerala State (Original Agenda – 58.3.2)

60.2.7 Judgement of the Kerala High Court dated 13.03.2020 in W.P(C) 7571/2020 and Judgment dated 23.03.2020 in W.P(C) 9061/2020, the two proposals viz. M/s Bestonne Granite Metals Pvt Ltd and Shri U.T. Raveendran (M/s Nobel Granites) reg. NOC for the petitioners mining projects located within 10 kms of Idduki Wildlife sanctuary and Malabar Wildlife Sanctuary (Original Agenda – 59.3.4)

60.2.8 Judgement of the Kerala High Court dated 14.07.2020 in W.P.(C) 13717/2020 request for considering the proposals of M/s Mancombu Granites Ltd. located within 10 kms of national parks and wildlife sanctuaries in Idukki Districts of Kerala (Original Agenda – 59.3.5)

The Member Secretary stated that above proposals were placed in 59th meeting held on 5th October, 2020 and the Standing Committee decided to request the State Government to resubmit the proposals as per the established guidelines and procedures. He further informed the Standing Committee that online applications for two cases were received in the Ministry. However, since, the proposals had shortcomings essential details have been sought from the State Government on these proposals. The reply from the State Government is yet to be received.

The Member Secretary brought to the notice of the Standing Committee the fact that the order of Hon'ble High Court of Kerala is that the State Government should send the proposals with all relevant papers. However, the State Government of Kerala has been forwarding the proposals without proper documents and without following the due procedure.

Decision Taken: The Standing Committee therefore decided to return the proposals and requested the State Government to forward the proposals with complete documents, as per the prescribed guidelines and procedures and in future similar proposals sent as per the directions of Court should be accompanied with all relevant papers.

60.2.9 Proposal for Tinaighat- Castlerock-Caranzol Railway doubling of South Western Railways, Karnataka (Original Agenda – 58.5.1)

The Member Secretary briefed the Standing committee that the proposal was considered by the Standing Committee in the 59th Meeting held on 5th October, 2020 wherein the standing committee requested the Wildlife Institute of India to conduct study and suggest mitigation measures within a period of two months. The Director, WII has submitted report to this ministry in consultation with Railways and Karnataka Forest Department and suggested mitigation measures.

Dr. R. Sukumar Member stated that he had conducted studies on Biodiversity assessment in the Tinaighat area and wanted to recuse himself from the decision on the proposals. The Standing Committee agreed to recuse Dr. Sukumar from this proposal.

Decision Taken: After discussions, the Standing Committee decided to recommend the proposal with the mitigation measures suggested by Wildlife Institute of India enclosed as **ANNEXURE II** and the following conditions:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. No work shall be done before sunrise and after sunset in the project area.
2. The user agency and project personnel will comply with the provisions of the Wild Life (Protection) Act,1972
3. The speed limit of the trains shall be followed strictly upto 35 kmph during night and 40 kmph during day time.
4. The muck generated during the tunnel excavation shall be disposed out of the sanctuary area without endangering the flora and fauna.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.2.10 Proposal for use of 6.704 ha of reserve forestland from Pilibhit Tiger Reserve for Mailani- Pilibhit Gauge Conversion chainage 212.520-213.070 KM and 242.310-250.140 KM (8.38 KM) between Kuriya-Dudhiyakhurd and Sandai Mala,Uttar Pradesh State (Original Agenda – 59.6.2)

The Member Secretary stated that the Standing Committee in 59th Meeting had decided that the animal passage plan forwarded by the Chief Wild Life Warden shall be vetted by Wildlife Institute of India. The report received from the Director, WII suggests that animal passage plan forwarded by the Chief Wild Life Warden was not as per the guidelines and needs a relook based on ecological, economical and hydrological aspects.

Decision Taken: After discussions, the standing committee decided that a joint committee comprising of the officials from Uttar Pradesh Forest Department, Rail Vikas Nigam Limited and WII shall study the site and suggest mitigation measures within a period of two months to the Ministry. The Standing Committee therefore, decided to defer the proposal.

AGENDA ITEM No.3

(Policy Matters, Court Orders/Rationalization of Boundaries of Protected Areas)

60.3.1 Inclusion of Caracal species under Recovery Programme for Critically Endangered Species of CSS-DWH [File No. 6-133/2020WL]

The Member Secretary briefed the Standing Committee and stated that the Ministry has been implementing the Centrally Sponsored Scheme – 'Development of Wildlife Habitats' (CSS-DWH) with a view to provide for conservation interventions with three components:

a. Support to Protected Areas (National Parks, Wildlife Sanctuaries, Conservation Reserves and Community Reserves)
b. Protection of Wildlife outside the Protected Areas
c. Recovery Programmes for Critically Endangered Species

Further, the Member Secretary stated that there is a provision in the scheme that the Director, Wildlife Preservation, Government of India with the approval of the Standing Committee of NBWL can initiate other recovery programmes or wind up an ongoing programme. In view of this, the Wildlife Division, MoEF&CC proposes inclusion of Caracal (*Caracal caracal*) in the Species Recovery Programme under CSS-DWH for taking up recovery programme as suggested by the Chief Wild Life Warden.

Dr. H.S. Singh, Member stated that there are many other species found in arid and semi-arid regions like desert fox which require attention for inclusion in the Species Recovery Programme for Critically Endangered Species. The Chair suggested that the proposal may be forwarded by State Government and after study, the same shall be considered by the Standing Committee.

Decision Taken: The Standing Committee after deliberations decided to recommend inclusion of Caracal species as suggested by the Chief Wild Life Warden, Rajasthan in the Species Recovery Programme for Critically Endangered Species under Centrally Sponsored Scheme – Development of Wildlife Habitats.

60.3.2 WP (C) No. 13056/2020 (F) - Manikandan T. Vs. MoEF & CC & Ors. And W.P. (C) No. 4280/2020 (H) – Betty Biju Vs. MoEF & CC & Ors.- High Court of Kerala at Ernakulam [File No. 6-160/2020WL]

60.3.3 WP (C) No. 7211/2020 (B) - Denson K.S. Vs. UOI & Ors- High Court of Kerala at Ernakulam [File No. 6-159/2020WL]

The Member Secretary informed the Standing Committee that the Principal Secretary, Environment Department, Government of Kerala has requested to place the matters before the Standing Committee of the National Board within a period of one week as directed by the Kerala High Court for consideration vide letters dated 21.10.2020. As per the normal procedure for consideration by the Standing Committee, the proposals should be received through proper channel with the recommendations of the State Chief Wild Life Warden, State Board for Wild Life and State Government.

Decision Taken: Based on the discussions held and documents submitted, the Standing Committee decided to return the proposals and requested the State Government of Kerala to submit the proposals as per the established guidelines and procedures.

60.3.4 De-notification of Megapode Sanctuary, Andaman and Nicobar Islands [File No. 6-132/2020WL]

The Member Secretary briefed the Standing Committee and stated that the proposal for de-notification of Megapode Sanctuary has been submitted by Office of Principal Chief Conservator of Forests (Wild Life), Andaman and Nicobar Islands. During the mega earthquake and Tsunami which occurred in December, 2004, the Megapode Island has been submerged in the sea and there is no existence of the island post Tsunami. He further stated that Nicobar Megapode is a terrestrial bird which nests on ground.

The Member Secretary informed the Standing Committee that views of Wildlife Institute of India were taken and they have suggested that the submergence of island now does not serve any purpose for the conservation of Nicobar Megapode.

Decision Taken: After discussions, the Committee decided to recommend the proposal and suggested that conservation measures shall be taken for the Nicobar Megapode in other islands with the help of Wildlife Institute of India.

60.3.5 Denotification of Galathea Sanctuary (Only intention to declare as sanctuary notified), Andaman and Nicobar Islands [File No. 6-

135/2020WL]

The Member Secretary briefed the Standing Committee and stated that Andaman and Nicobar Islands administration had notified intention to declare Galathea Bay as sanctuary for an area of 11.44 sq. km. vide notification dated 15.09.1997 under section 18 (1) of the Wild Life (Protection) Act, 1972. Proclamation notification for initiating acquisition proceedings was issued by the Collector on 14.10.1997. The acquisition proceedings have not been completed and final notification for the sanctuary has not yet been issued. Now, the Andaman and Nicobar Islands has submitted de-notification proposal for the Galathea Bay Sanctuary for which intention to declare as sanctuary alone was notified.

The proposal has been recommended by Chief Wild Life Warden and Andaman and Nicobar Islands Administration. The State Board for Wild Life, Andaman and Nicobar Islands have also recommended the proposal.

Secretary, MoEFCC stated that Andaman and Nicobar Islands Administration had sought clarification from the Ld. ASG who opined that de-notification of Galathea Sanctuary is not needed as the notification regarding intention to declare Galathea Bay as sanctuary isand void because rights were not settled within 2 years. Ministry had also sought clarification from the Ld. Solicitor General regarding the validity of the notification for intention to declare Galathea Bay as Sanctuary. However, the Ministry is of the opinion that the notification for intention to declare Galathea Bay as Sanctuary does not lapse even though the rights have not been settled. Therefore, the Ministry has decided to place the proposal before the Standing Committee to take a decision on this de-notification proposal of Andaman and Nicobar Administration.

Comments from the Wildlife Institute of India (WII) were sought and the Director, WII has opined that the concerned authorities develop and implement a mitigation plan to facilitate leather back and other turtles to continuously nest for which the connectivity between the Galathea River and the Bay should be ensured. The mitigation plan needs to be developed through a detailed study so that marine turtles continue to nest on the beaches near the Galathea Bay during both construction as well as operational phases of the International Shipment Project.

The provisions of CRZ should be enforced in the area. The concerned authorities should secure and conserve all other important turtles nesting areas of Andaman and Nicobar Islands with enhanced protection/conservation measures through appropriate legal/administrative means and through a Management Plan.

Dr. Sukumar, Member opined that there should be a management plan for conservation and nesting of Leatherback Turtles.

Decision Taken: After discussions, the Standing Committee decided to recommend the proposal with the recommendations of WII, CWLW and directed that a comprehensive management plan may be prepared and followed by the Andaman and Nicobar Administration for conservation and protection of Leatherback Turtles in Great Nicobar Islands along with the Wildlife Institute of India and the project proponents. The Andaman and Nicobar Islands Administration shall bring more areas under conservation of leatherback turtle.

AGENDA No. 4

60.4.1 Amendments in minutes of meeting of Standing Committee [File No. 6-182/2017 WL(pt)]

The Member Secretary briefed the Standing Committee and stated that the proposal for diversion of 13.27 ha forestland from Valmiki Tiger Reserve for construction of NH-28B was recommended by the Standing Committee in its 46th meeting held on 8th December, 2017 subject to the conditions and mitigation measures imposed by the State Chief Wild Life Warden and the NTCA. One of the conditions imposed by Chief Wild Life Warden while recommending the proposal was that the traffic- worthy maintenance of the earlier used access road segment (approximately 5 km) inside the sanctuary shall be limited to the extent of 2 years from the grant of permission. However, work could not be carried out in the given period as informed by the Chief Wild Life Warden and requested amendment in this condition for permission to use the existing road for 2 more years.

The State Board for Wild Life recommended the proposal in its meeting held on 13.08.2020 to extend the period for two years.

Decision taken: After discussion, the standing committee decided to recommend the proposal to extend the period for two years with a condition that no further request for extension shall be entertained.

AGENDA No.5

(Fresh Proposals Falling Inside / Outside the Protected Area)

60.5.1 Proposal for diversion of 6.82 ha. of forestland in Kadapa Range in Kadapa Division for laying of 16" dia VDPL pipeline route from Vijayawada in Andhra Pradesh and Dharmapuri in Tamil Nadu passing

through Andhra Pradesh in favour of HPCL. [File No. 6-63/2020WL; Proposal No. FP/AP/Others/4730/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 6.82 ha. forestland in Kadapa Range in Kadapa Division for laying of 16" dia VDPL pipeline route from Vijayawada in Andhra Pradesh and Dharmapuri in Tamil Nadu passing through Andhra Pradesh in favour of HPCL. The proposed project area falls within tiger corridor.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. Precautions should be taken while taking up construction works and it should be completed in the least possible time period under the supervision of Forest Department.
2. Sign boards on publicity and awareness for Wildlife Conservation shall be erected along the diverted area in consultation with DFO, Kadapa division.
3. The diversion area shall be monitored by the Forest Department by engaging wildlife watchers at the cost of User Agency to be decided by the DFO, Kadapa.
4. For wildlife conservation, habitat improvement and monitoring for five (5) years in and around the diversion area of 6.82 ha, an amount of Rs.42.135 lakhs is proposed to be deposited in Wildlife Conservation projects account of Andhra Pradesh.

B. **Conditions imposed by the NTCA:**

1. It is suggested that sufficient depth should be kept below the soil surface for laying down the VDPL pipeline.
2. The user agency should complete the work of laying of pipeline in minimum possible time so as to cause minimum disturbance in corridor area.
3. A proper surveillance/patrolling system shall be put in place for monitoring of wildlife movement/mortality during laying of pipeline.

C. Proper measures shall be taken for detection and prevention of leakages from the proposed pipeline by the project proponent along with monitoring by the State Forest Department.

D. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.2 Development of 8 lanes (Greenfield Highway) from Itawa village (Ch.284.000) to after Chambal River near Banda Hera (Ch. 392.800) Section of NH-148 N (Total length 108.800 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan. [File No. 6-80/2020WL; Proposal No. FP/RJ/ROAD/4716/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for Development of 8 lanes (Greenfield Highway) from Itawa village (Ch.284.000) to after Chambal River near Banda Hera (Ch. 392.800) Section of NH-148 N (Total length 108.800 Km), under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan in the National Gharial Sanctuary and its ESZ.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

General Conditions:

1. 5% of the proportional project cost falling within the Protected Area should be deposited in RPACS by the user agency for management and protection of wildlife in the state.
2. 2% of the proportional project cost of the project falling within the ESZ of Protected Area should be deposited in RPACS by the user agency for management and protection of wildlife in the State.
3. No work shall be done before sunrise and after sunset in the project area falling in the Protected Area.
4. No material of any kind should be extracted from the Protected Area and Eco-Sensitive Zone.
5. There will be no felling of trees and burning of fuel wood inside the Protected Area and Eco-Sensitive Zone.
6. The waste material generated should be disposed outside the Protected Area and Eco-Sensitive Zone.
7. There will be no labour camp within 1 km from the boundary of Protected Area.
8. No blasting will be carried out within 1 km from the boundary of Protected Area during the work.
9. To restrict movement of wild animals towards the road/railway track in the Protected Area, adequate mitigative measure such as wall/ chain link fencing will be constructed by the User agency to stop accidents.

10. There shall be no high mast/ beam/ search Lights & high sounds within 1 km from the Protected Area boundary.
11. Signages regarding information about the wild animals in the area, control of traffic volumes, speed etc. should be erected in the project area.
12. The user agency and project personnel will comply with the provisions of Wild Life (Protection) Act, 1972.
13. Maintenance activity of any nature should be carried out only after seeking formal approval from competent authority of tiger reserve/PA.
14. The user agency and project personnel will comply with the provision of Standard SOP/Guidelines issued by WII, Dehradun for linear projects.
15. Any permission / clearance required under FCA-1980 or other acts may be taken as per rules.

Site Specific Conditions:

1. Conditions and design as laid down in the report of site visit undertaken on 27.04.2019 by the committee constituted for the purpose of examining the project are to be strictly adhered to.
2. Additionally, the conditions imposed in minutes dated 27.06.2019 of meeting held in Chief Wild Life Warden office are to be complied with as per minutes of meeting enclosed as **ANNEXURE III**.

B. The animal passage plan submitted by the project proponent shall be implemented in toto.

C. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.3 Diversion of 8.405 ha of forest land from National Chambal Gharial Sanctuary for construction of Important Steel Girder Bridge for Mathura-Jhansi 3rd Railway Line Project on Chambal River in Revenue Village-Gher, District-Dholpur, Rajasthan. [File No. 6-165/2020WL; Proposal No. FP/RJ/RAIL/4184/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 8.405 ha of land from National Gharial Sanctuary for construction of Steel Girder Bridge, earthwork, approach road, workshop, site office and store for Mathura-Jhansi 3rd Railway Line Project in Revenue Village-Gher, District-Dholpur, Rajasthan. He stated that a case was registered against the user agency and a penalty of Rs. 5 Lakhs rupees has been deposited by the project proponent. User agency has filed S.B. Civil Writ Petition No.9889 of 2019 and Hon'ble High Court, Jaipur has issued interim directions on 31st May 2019 and the case is under process.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After detailed discussions, the Standing Committee decided to recommend the proposal notwithstanding the court case and subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. 5% of the proportional project cost falling within the Protected Area should be deposited in RPACS by the user agency for management and protection of wildlife in the state.
2. No work shall be done before sunrise and after sunset in the project area.
3. No material of any kind should be extracted from the Protected Area and Eco-Sensitive Zone.
4. There will be no felling of trees and burning of fuel wood inside the Protected Area and Eco-Sensitive Zone.
5. The waste material generated should be disposed outside the Protected Area and Eco-Sensitive Zone.
6. There will be no labour camp within 1 km from the boundary of Protected Area.
7. No blasting will be carried out within 1 km from the boundary of Protected Area during the work.
8. To restrict movement of wild animals towards the road/railway track in the Protected Area, adequate mitigative measures such as wall chain link fencing will be constructed by the User Agency to stop accidents.
9. There shall be no high mast/beam/search lights & high sounds within 1 km from the Protected Area boundary.
10. The user agency and project personnel will comply with the provisions of Wild Life (Protection) Act, 1972.
11. Maintenance activity of any nature should be carried out only after seeking formal approval from competent authority of tiger reserve / PA.
12. The user agency and project personnel will comply with the provisions of Standard SOP/Guidelines issued by WII, Dehradun for linear projects.
13. Any permission/clearance required under FCA-1980 or other acts may be taken as per rules.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.4 Diversion of forest land for Development of 8 lanes (Greenfield Highway) from Itawa (Ch. Km 284.000) to after Chambal River near

Durjanpura village at (Ch. Km 349.000) Section of NH-148 N (Total length 65.0 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan. [File No. 6-79/2020WL; Proposal No. FP/RJ/ROAD/36605/2018]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use land for development of 8 lanes (Greenfield Highway) from Itawa (Ch. Km 284.000) to after Chambal River near Durjanpura village at (Ch. Km 349.000) Section of NH-148 N (Total length 65.0 Km), under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan. The project area falls within the ESZ of Ranthambore Tiger Reserve.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to the following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. 2% of the proportional project cost of the project falling within the ESZ of Protected Area within the ESZ of Protected Area should be deposited in RPACS by the user agency for management and protection of wildlife in the State.
2. No work shall be done before sunrise and after sunset in the project area.
3. No material of any kind should be extracted from the Protected Area and Eco-Sensitive Zone.
4. There will be no felling of trees and burning of fuel wood inside the protected area and eco-sensitive zone.
5. The waste material generated should be disposed outside the Protected Area and Eco-Sensitive Zone.
6. There will be no labour camp within 1 km from the boundary of Protected Area.
7. No blasting will be carried out within 1 km from the boundary of Protected Area during the work.
8. To restrict movement of wild animals towards the road/railway track in the Protected Area, adequate mitigative measures such as wall/chain link fencing will be constructed by the User Agency to stop accidents.
9. There shall be no high mast / beam/search lights & high sounds within 1 km from the Protected Area boundary.
10. Signages regarding information about the wild animals in the area, control of traffic volumes, speed etc should be erected in the project area.
11. The user agency and project personnel will comply with the provisions

of the Wild Life (Protection) Act, 1972.

12. Maintenance activity of any nature should be carried out only after seeking formal approval from competent authority of tiger reserve / PA.
13. The user agency and project personnel will comply with the provisions of Standard SOP/Guidelines issued by WII, Dehradun for linear projects.
14. Any permission/clearance required under FCA-1980 or other acts may be taken as per rules.

Site Specific conditions

1. Conditions & design as laid down in 27.04.2019 site visit report of committee for the purpose of examining the project are to be strictly adhered to. In this context, specific mention is made of construction of underpasses, earthen bunds, elevated roads, underground structures etc as listed in the above mentioned report.
2. Additionally, the conditions imposed in minutes dated 27.06.2019 of meeting held in Chief Wild Life Warden office are to be complied with as per minutes of meeting enclosed as **ANNEXURE III**.

B. **Conditions imposed by the NTCA:**

1. The user agency shall undertake site specific mitigation measures as suggested by the Chief Wild Life Warden, Rajasthan in consultation with Wildlife Institute of India, Dehradun while considering mitigation measures recommended by State Board for Wild Life.
2. A proper surveillance/patrolling system shall be put into place for monitoring of wildlife movement/mortality during construction of highway.

C. The animal passage plan submitted by the User Agency shall be implemented in toto.

D. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.5 Construction of causeway across Jampannavagu at 0/550 kms on PWD R&B Road to Muthapur of Govindaraopet (M) in Mulugu District - 0.5 Ha. [File No. 6-166/2020WL; Proposal No. FP/TG/ROAD/40352/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 0.0429 ha forest land in Eturnagaram Sanctuary land for construction of causeway across Jampannavagu at 0/550 kms on PWD R&B Road to Muthapur of Govindaraopet(M) in Mulugu District. The project shall improve transportation facility to the tribal villagers for accessing the basic needs like medical and other facilities.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. The user agency will provide Rs.9.00 lakh for the following activities as part of wildlife mitigation measures:

(Rs. In lakh)

Component	**Finance target**
Construction of one base camp cum watch tower for protection staff @ Rs.6 lakh	6.00
Installation of caution and sign boards 2 nos. on either side of the causeway @Rs.1.00 lakh each	2.00
Administrative cost	1.00
Total	**9.00**

The above amount shall be deposited by the User Agency in the BIOSOT account of Chief Wild Life Warden, Telangana.

2. The works shall be carried out without disturbing or damaging flora, fauna or habitat of the area.
3. Work shall be carried out from 6.00 am to 6.00 pm only.
4. The material for carrying out the proposed works shall be kept outside the sanctuary area. As and when required, they should be carried to the site during execution of work.
5. No labour camp should be established inside the Tiger Reserve during the execution of the work.
6. The debris formed due to the execution of the works shall be taken away from the Wildlife Sanctuary on day-to-day basis.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.6 Proposal for use of 0.1339 ha of forestland from Mulugu and Eturnagaram Divisions for construction of causeway across Jampannavagu at 0/140 krn on R/F R&B Road to Motlagudem of Govindaraopet (M), Mulugu District, Telangana State. [File No. 6-167/2020WL; Proposal No. FP/TG/ROAD/40351/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 0.0511 ha of forestland from Eturnagaram Sanctuary for construction of causeway across Jarnpannavaagu at 0/140 krn on R/F R&B Road to Motlagudem of Govindaraopet (M), Mulugu District, Telangana State. The project shall improve transportation facility to the tribal villagers for accessing the basic needs like medical and other facilities. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. The user agency will provide Rs.20.00 lakh for the following activities as part of wildlife mitigation measures:

(Rs. in lakh)

S.No.	Component	Physical target	Unit cost	Financial target
i.	Construction of one fire watch tower for fire control.	1 No.	Rs. 10 lakh each	10.00
Ii	Construction of structure for drying and storage of grass seed collected locally	1 no.	Rs. 5.00 each	5.00
iii.	Installation of educative and caution sign boards on either side of the proposed causeway.	2 Nos	Rs.1.00 lakh each	2.00
iv.	Administrative cost and publicity material	LS	LS	3.00
			Total	**20.00**

The above amount shall be deposited by the User Agency in the BIOSOT account of Chief Wild Life Warden, Telangana.

2. The works shall be carried out without disturbing or damaging flora, fauna or habitat of the area.
3. Work shall be carried out from 6.00 am to 6.00 pm only.
4. The material for carrying out the proposed works shall be kept outside the sanctuary area. As and when required, they should be carried to the site during execution of work.
5. No labour camp should be established inside the Tiger Reserve during the execution of the work.

6. The debris formed due to the execution of the works shall be taken away from the Wildlife Sanctuary on day-to-day basis.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.7 Improvement, upgradation and construction of Ganeshpur- Dehradun road (NH72A) in the State of Uttarakhand (km 16.115 to 19.746) to 4 lane configuration. [File No. 6-129/2020WL; Proposal No. FP/UK/ROAD/45283/2020]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 9.6224 ha forest land for improvement, upgradation and construction of Ganeshpur-Dehradun road (NH-72A) in the State of Uttarakhand (Km 16.115 to Km 19.746) to 4 lane configuration. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life. The representative of NHAI present during the meeting agreed with the mitigation measures suggested by the Chief Wild Life Warden.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. Barrier on both side of road to block and absorb noise and light pollution.
2. Staggered plantation (preferably bamboo plantation) needs to be done on both sides of road to funnel animals toward the underpasses and culvert.
3. Dedicated monitoring for next 2-3 years to monitor animal road kills and man-wildlife conflict in nearby areas.
4. Funds for the (2) & (3) need to be provided to the forest department by the user agency.

B. **Condition imposed by the NTCA:**

1. Project proponent shall take appropriate mitigation measures for maintaining the habitat connectivity and animal passage as suggested by the Chief Wild Life Warden, Uttarakhand.

C. The animal passage plan submitted by the Project Proponent shall be implemented in toto.

D. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.5.8 Proposal for stone crusher unit located village- Gangapur, Tehsil-Haldwani, district Nainital, Uttarakhand within 10 kms of Nandhaur Wildlife Sanctuary by LSC Infratech Ltd. [File No. 6-95/2020WL; Proposal No. FP/UK/Others/4608/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 2.021 ha for stone crusher unit located at village-Gangapur, Tehsil-Haldwani, district Nainital, Uttarakhand within 10 kms of Nandhaur Wildlife Sanctuary by LSC Infratech Ltd. He further informed that the ESZ for the Nandhaur Sanctuary has been finally notified. Hon'ble NGT vide order dt.04.01.2019 has directed the user agency to obtain SCNBWL recommendations.

The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal.

60.5.9 Improvement, upgradation and construction of Ganeshpur-Dehradun road (NH72A) in the state of Uttar Pradesh (Km 0.0 to Km 16.160) to 4 lane configuration, Uttar Pradesh. [File No. 6-168/2020WL; Proposal No. FP/UP/ROAD/45282/2020]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 47.7054 ha forest land for improvement, upgradation and construction of Ganeshpur-Dehradun road (NH72A) in the state of Uttar Pradesh (Km 0.0 to Km 16.160) to 4 lane configuration. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life. The representative of NHAI present during the meeting agreed with the mitigation measures suggested by the Chief Wild Life Warden.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. As forest land and trees standing over it are also involved in the project, Forest Clearance as per provisions of Forest (Conservation) Act 1980 will also be required.
2. User agency will comply with all conditions stipulated in forest clearance under Forest (Conservation) Act 1980.
3. User agency shall provide 2% of the project's proportionate cost of the area falling in eco-sensitive zone for mitigation of negative impact and ecological development of wildlife habitat area as per guide line of

Government of India.

4. Apart from above the conditions, following wildlife mitigation measures shall to be followed by user agency:

a. Protection and mitigation measures for wildlife should be ensured as standard practice in such case.
b. Land shall not be used for any other purpose other than specified in the proposal.
c. Rules and regulation of the concerned department for establishing the project shall be complied.
d. The instruction/orders passed by the State Government/Central Government and the directions passed by Hon'ble Court/Supreme Court from time to time regarding such project shall be complied with.
e. User agency will ensure that the project personnel engaged in the project shall observe the provisions of the Wild Life (Protection) Act 1972 & Rules made thereafter.
f. Construction waste materials will not be thrown inside the eco-sensitive zone area or the movement corridor of wildlife.
g. User agency will take all precautions including technical measures to contain the noise and air pollution, protection from fire due to construction activities.
h. The project proponent shall obtain consent to establish and to operate from U.P. Pollution Control Board and effectively implement all the conditions stipulated therein.
i. The project proponent shall undertake plantation/forestation work by planting the native species in the area adjacent to project area/sanctuary for which necessary finance will be provided by the user agency.
j. No labour camp shall be established in the sanctuary/forest area of other sensitive areas.
k. Blasted Ammunition Materials will not be carried by user agency in wildlife area.
l. In addition to this, mitigation measures for development of Delhi-Dehradun Highway (NH-72A) in the Shivalik hills have been provided by WII, Dehradun.
m. No work shall be allowed from sunset to sunrise.
n. The user agencies shall extend all support to forest department in case of any forest & wildlife offence.

B. **Condition imposed by the NTCA**

    1. The project proponent shall take appropriate mitigation measures for maintaining the habitat connectivity and animal passage as suggested by the Chief Wild Life Warden, Uttar Pradesh.

C. The animal passage plan submitted by the Project Proponent shall be implemented in toto.

D. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

AGENDA ITEM No.6 – Any other item with permission of Chair

60.6.1 Protected Forest Land Proposed to be diverted for Construction of Bridge for Proposed Rapti Canal on Tulsipur-Jarva Road at KM.72.820, at Village: Madharwa, District: Balrampur. [File No. 6-169/2020WL; Proposal No. FP/UP/CANAL/40793/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 116.4288 ha for construction of Bridge and Canal in Madharwa village of Balrampur district. The project area also includes 0.2112 ha of forest land. The proposed project falls within ESZ of Sohelwa Wildlife Sanctuary. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to the following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. The land shall not be used for any purpose other than that specified in the proposal.
2. The personnel working on the site should be well aware and will be bound to follow the provisions of Wild Life (Protection) Act, 1972.
3. The project also involves 0.2112 ha. of protected forest land and 04 number of trees are also required to be cut, therefore, Forest Clearance as per provisions of Forest (Conservation) Act 1980 will also be required for the forest area.
4. Amount of Net Present Value (N.P.V.) shall be paid by the User Agency as per directions contained in G.O. No. writ 526/14-2-2008 dated- 22-8-2008 of UP.
5. User agency shall provide 2% of the project's proportionate cost of the project falling in eco-sensitive zone for implementation of mitigation measures and wildlife conservation plan duly approved by Chief Wild Life Warden, U.P.
6. The user agency will ensure that no labour camp shall be established inside the sanctuary or any other sensitive area in eco-sensitive zone. Neither firewood nor any other forest produce from the forest will be used.
7. The user agency will arrange all necessary equipments for survey &

demarcation.

8. The user agency will keep firefighting equipments as well as equipments for minimizing air and noise pollution at the site.
9. During the construction period, the user agency will establish one temporary forest check post along with the required manpower at its own cost.
10. The excavated pit shall be properly fenced so as to avoid injury/death of wild animals in the sanctuary/forest area. These pits shall be levelled upon completion for the work so that there is no hindrance to the movement of wild animals.
11. User agency will fix sign boards at appropriate points of the project.
12. No work shall be allowed from sunset to sunrise.

B. The animal passage plan submitted by the project proponent shall be implemented in toto.
C. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.6.2 Construction of Canal passing through forest land in villages Thakurapur, Jamdhara and Sugaon in KM.80.0- 98.0 in District Balrampur Under National Saryu NaharPariyojna (Rapti Main Canal). [File No. 6-170/2020WL; Proposal No. FP/UP/CANAL/38823/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 74.20 ha land for construction of canal in villages Thakurapur, Jamdhara and Sugaon in Balrampur District. The project area also includes 6.072 ha forest land. The project falls within ESZ of Sohelwa Wildlife Sanctuary. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to the following.

A. **Conditions imposed by the Chief Wild Life Warden:**

1. The land shall not be used for any purpose other than that specified in the proposal.
2. The personnel working on the site should be well aware and will be bound to follow the provisions of Wild Life (Protection) Act, 1972.
3. The project also involves 6.072 ha. of reserve forest land and 57 number of trees are also required to be cut, therefore, forest clearance as per provisions of Forest (Conservation) Act 1980 will also be required for the forest area.
4. Amount of Net Present Value (N.P.V.) shall be paid by the User

Agency as per directions contained in G.O. No. writ 526/14-2-2008 dated- 22-8-2008 of UP.

5. User agency shall provide 2% of the project's proportionate cost of the project falling in eco-sensitive zone for implementation of mitigation measures and wildlife conservation plan duly approved by Chief Wild Life Warden, U.P.
6. The user agency will ensure that no labour camp shall be established inside the sanctuary or any other sensitive area in eco-sensitive zone. Neither firewood nor any other forest produce from the forest will be used.
7. The user agency will arrange all the necessary equipments for survey & demarcation.
8. The user agency will keep firefighting equipments as well as equipments for minimizing air and noise pollution at the site.
9. During the construction period, the user agency will establish one temporary forest check post along with the required manpower at its own cost.
10. The excavated pit shall be properly fenced so as to avoid injury/death of the wild animals in the sanctuary/forest area. These pits shall be levelled upon completion for the work so that there is no hindrance to the movement of wild animals.
11. User agency will fix sign boards at appropriate points of the project.
12. No work shall be allowed from sunset to sunrise.

B. The animal passage plan submitted by the project proponent shall be implemented in toto.

C. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.6.3 Construction of Campierganj Branch Canal in between km.51 to 62.106 under Saryu Nahar Pariyojna in District: Maharajganj. [File No. 6-171/2020WL; Proposal No. FP/UP/CANAL/44512/2020]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 21.864 ha land for construction of Campierganj Branch Canal in between km.51 to 62.106 under Saryu Nahar Pariyojna in District Maharajganj. The project area also includes 0.4 ha forest land. The project area falls in ESZ of Sohagibarwa Wildlife Sanctuary. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life but the details are missing. He also stated that the PA is rich in biodiversity and home to megafauna like tigers and the proposal requires further examination.

Decision taken: After discussions, the Standing Committee decided that due to the importance of protected area for its biodiversity and presence of wild animals like tiger, a study might be conducted by the NTCA and report submitted within a month.

60.6.4 Construction of Integrated Bus Terminus cum Commercial complex on plot no. 3, sector 9a, Vashi, Navi Mumbai, dist. Thane by Navi Mumbai Municipal Transport. [File No. 6-1/2021WL; Proposal No. FP/MH/Others/4592/2019]

The Member Secretary briefed the Standing Committee and stated that the proposal is for use of 1.03 ha land for Construction of Integrated Bus Terminus cum Commercial complex in Vashi, Navi Mumbai, dist. Thane by Navi Mumbai Municipal Transport. The plot is located 3.15 Km away from the boundary of Thane Creek Flamingo Sanctuary. The proposal has been recommended by the Chief Wild Life Warden and the State Board for Wild Life. The proposed area is outside the notified draft ESZ for the Thane Creek Flamingo Sanctuary.

Decision taken: After discussions, the Standing Committee decided to recommend the proposal subject to the following:

A. **Conditions imposed by the Chief Wild Life Warden:**

1. Project personnel, engaged in the project work shall observe the provisions of all the existing legal provisions' especially the Environment (Protection) Act, 1986, Wild Life (Protection) Act, 1972 and rules made there under & also take all precautionary measures for conservation & protection of flora, fauna in the vicinity of the project.
2. No dumping of debris on wet lands/mud flat and forest area will be done by project proponent.
3. All the other mandatory permissions from different statutory authorities should be obtained prior to commencement of work.
4. The project proponent shall deposit 2% cost of the (Rs.168.00 Crore) proposed project which passes through the deemed ESZ of the Thane Creek Flamingo Sanctuary for management of the sanctuary.

B. The annual compliance certificate on the stipulated conditions should be submitted by the project proponent to the State Chief Wild Life Warden and an annual compliance certificate shall be submitted by the State Chief Wild Life Warden to Government of India.

60.6.5 Advisory on Human Wildlife Conflict Mitigation: [File No. 8-60/2020WL (Part-1)]

The Member Secretary informed that draft Advisory on Human Wildlife Mitigation was discussed in the 59th Meeting held on 5.10.2020. The Standing Committee suggested certain changes. Accordingly, changes have been made in the draft Advisory. The Chair suggested that the advisory should include identification of areas where the incidences of Human Wildlife Conflict are high and the mitigation measures particularly fodder and water augmentation should focus on these priority areas. He further suggested that funding support from CAMPA and other schemes may be sought by the State Governments for Human Wildlife Conflict Mitigation measures in such areas on priority basis.

Director General of Forests and Special Secretary, Member informed that the Advisory has the provision for identification of hotspots of Human Wildlife Conflict and provision for augmentation of fodder, water and all other resources in these areas. The Advisory also stresses on the need for inter-departmental co-ordination for mitigation of Human Wildlife Conflict.

Decision Taken: After discussions, the Standing Committee decided to recommend the Advisory as at **ANNEXURE IV**.

60.6.6 Issue of Upgradation of Laldhang to Chillakhal road in buffer zone of Rajaji Tiger Reserve:

Dr. Sukumar, Member informed that the upgradation of Laldhang to Chillarkhal road was recommended by the Standing Committee in the 56th meeting held on 17.12.2019. However, there are certain differences with regard to the animal passage plan as per the guidelines of the WII and as recommended by the NTCA. The Chief Wild Warden had also suggested to relook into the mitigation measures suggested by the NTCA. Dr. Sukumar suggested that the recommendations for animal passage plan may be made more specific which could also be economical.

The Member Secretary informed that the issue has also been raised repeatedly by the Chief Wild Life Warden, Uttarakhand. He further suggested that a committee comprising of NTCA, WII NHAI and Government of Uttarakhand may be constituted to look into the issue and suggest mitigation measures.

Decision Taken: After discussions, the Standing Committee decided that Ministry shall constitute a committee comprising of Dr. Sukumar, representatives from NTCA, WII and NHAI and representative of Government of Uttarakhand to examine the matter and suggest site-specific mitigation measures within a period of 30 days.

60.6.7 Issue of de-notification of Shivalik Elephant Reserve:

Dr. Sukumar informed that there have been reports regarding de-notification of Shivalik Elephant Reserve in Uttarakhand. It is broader conservation issue and it is not known exactly what has been the decision of the State Government of Uttarakhand. The Member Secretary informed that the Ministry has sought report from the State Government, Uttarakhand and the report is yet to be received. Once, the report is received, a meeting of the Elephant Steering Committee would be convened under the Chairmanship of the Hon'ble Minister and the matter would be looked into through the Project Elephant Division of the Ministry.

Decision Taken: After discussion, the Standing Committee recommended that the Project Elephant Division shall convene a meeting of the Steering Committee after expeditious receipt of the report from the State Government on the issue of de-notification of Shivalik Elephant Reserve.

ANNEXURE I

LIST OF PARTICIPANTS

1	Shri Prakash Javadekar, Hon'ble Minister for EF&CC	Chairman
2	Shri R P Gupta, Secretary, MoEF&CC	Member
3	Shri Sanjay Kumar, DGF&SS, MoEF&CC	Member
4	Shri Soumitra Dasgupta, AGF(WL), MoEF&CC	Member Secretary
5	Prof R Sukumar,	Member
6	Dr H S Singh	Member
7	Shri R D Kamboj	Member
8	Dr Dhananjay Mohan	Member
9	Dr S P Yadav, ADGF (PT) & Member Secretary (NTCA)	Invitee
10	Shri Sisir Kumar Ratho, ADG(FC)	Invitee
11	Shri Rohit Tiwari, IGF(WL)	Invitee
12	Mr Brijendra Swaroop, IGF(PE)	Invitee
13	Shri Prateep Kumar , PCCF&HoFF, Andhra Pradesh	Invitee
14	Shri Amit Sahai, HoEF, Assam	Invitee
15	Shri Prabhat Kr Gupta, Chief Wild Life Warden, Bihar	Invitee
16	Shri Surendra Kumar, Chief Wild Life Warden, Kerala	Invitee
17	Shri Ajay Mishra, Chief Wild Life Warden, Karnataka	Invitee
18	Shri Nitin Kakodkar, Chief Wild Life Warden, Maharashtra	Invitee
19	Mrs R. Shoba, PCCF&HoFFF, Telangana	Invitee
20	Shri M.L Meena, Chief Wild Life Warden, Rajasthan	Invitee
21	Shri Sunil Pandey, Chief Wild Life Warden, Uttar Pradesh	Invitee
22	Shri J.S. Suhag, Chief Wild Life Warden, Uttarakhand	Invitee
23	Shri Rakesh Kr Jagenia, DIGF(WL), MoEF&CC	Invitee
24	Shri Surender Gugloth, Scientist D, MoEF&CC	Invitee

December 2020

MITIGATION MEASURES
FOR DOUBLING OF THE
TINIAGHAT – CASTLEROCK – CARONZOL
SWR RAILWAY TRACK, KARNATAKA

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

"I strongly believe that tiger conservation, or conservation of nature, is not a drag on development. Both can happen in a mutually complementary manner. All we need is to re-orient our strategy by factoring in the concerns of the tiger in sectors where tiger conservation is not the goal. This is a difficult task but can be achieved. Our genius lies in "smartly" integrating the tiger and wildlife safeguards in various infrastructures at the landscape level. This essentially takes us to the much needed "Smart Green Infrastructure", while adopting a landscape approach".

Shri. Narendra Modi
Hon'ble Prime Minister of India

12th April 2016; New Delhi
3rd Asian Ministerial conference
on Tiger Conservation

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Photo Credits:
Dr. Bilal Habib

Citation: *Wildlife Institute of India (2020): Mitigation measures for doubling of the Tiniaghat – Castlerock-Caronzol, SWR Railway Track, Karnataka. Technical Report, Wildlife Institute of India, Dehradun. Tr. No.2020/18, Pp. 108.*

MITIGATION MEASURES

Major Bridges

No. = 2

Total Length = 67 m

Average Size = 33.5 ± 4.31 (m)

% of Total Mitigation = 2.69 %

Animal Overpasses

No. = 4

Total Length = 75 m

Average Size = 18.75 ± 2.5 (m)

% of Total Mitigation = 3.00 %

Tunnels

No. = 6

Total Length = 1610 m

Average Size = 268 ± 162.80 (m)

% of Total Mitigation = 64.66 %

Animal Underpasses

No. = 3

Total Length = 80 m

Average Size = 26.6 ± 20.81 (m)

% of Total Mitigation = 3.21 %

RCC Box & Slab Culverts

No. = 47

Total Length = 374.6 m

Average Size = 7.79 ± 5.59 (m)

% of Total Mitigation = 15.0 %

Level Crossing

No. = 6

Total Length = 285 m

Average Size = 47.5 ± 6.12 (m)

% of Total Mitigation = 11.4 %

The proposed mitigation measures are aimed at minimising the presence of herpetofauna on the railway track, thus reducing rail induced mortality.

To enhance to connectivity for arboreal species in the landscape, provision of canopy bridges has been recommended at every kilometer of the railway track.

Wildlife crossing structures have been recommended at an average distance of 250 - 300 meters all across the railway track.

Acknowledgments

We acknowledge the support from the Chief Wildlife Warden, Govt. of Karnataka, and the field staff of Kali Tiger Reserve during our field survey. We are thankful to Field Director Kali Tiger Reserve for all required permissions and extending necessary support during our field survey. We are thankful to the local railway department and RVNL for all the necessary support.

Scientific and Technical Team
Wildlife Institute of India

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Contents

Executive Summary

The Indian Railway network, spread across 1,23,542 km (as of 2018-2019), is a vital component of transportation infrastructure since its inception in 1850. The railways have been pivotal in integrating markets, increasing trade, shaping finances besides serving as the backbone of linear transportation services. Even though railways are regarded to be an environmentally friendly option when compared to other forms of linear infrastructure, the development and expansion of rail networks pose challenges to the environment and biodiversity of the forest areas it passes through. Railways can pose both physical and behavioral barriers to wildlife and have negative impacts such as disturbance and mortality on populations living in proximity.

The Railway Vikas Nigam Limited (RVNL) has proposed the doubling of the existing railway track between Hospet, Tinaighat, and Vasco Port that measures 345 km in length. The sanctioned project consists of 2 main phases: doubling of a line between Hospet and Tinaighat (Phase I) and between Tinaighat and Vasco (Phase II). At present, the existing single line limits the capacity of running trains in the critical *ghat* (hilly) section. Given the terrain of the region, landslides during the monsoons interfere with the functioning of the line. RVNL has justified the doubling of the railway track by stating that in addition to improving mobility and all-weather rail links in the region, the proposed doubling would also increase connectivity, trade, and commerce, enhance tourist flow, augment intermediate railway station facilities, and reduce bottlenecks of railway traffic in the *ghat* section.

The Western Ghats that extend along the south-western parts of India, is known to harbour a wide diversity of flora and fauna and is one of the four biodiversity hotspots of the Indian subcontinent. In terms of faunal diversity, the area is home to about 30% of Asian elephant population, about 33% of India's wild tiger population and about 26% of India's leopard population (Jhala et al., 2019; Jhala et al., 2020). The landscape forms one of the largest and most contiguous protected area networks in the country. Within the Western Ghats, the Anshi-Dandeli-Sharavathi Valley complex consists of the protected areas of Mollem-Netravali, Anshi-Dandeli, Sharavathi Valley-Mookambika along with reserved forests of Goa which continue to the Sahyadri Tiger Reserve in Maharashtra. The major tiger source population in the complex is that of the Anshi National Park and Dandeli WLS (Qureshi et al., 2014) that together form the Kali Tiger Reserve. Among the important tiger source populations in the landscape is the Anshi and Dandeli tiger population that provides a critical link to the northern Western Ghats, extending up to Goa and South Maharashtra (Sahyadris), which is threatened by anthropogenic activities such as land-use conversion and construction of linear infrastructure.

The landscape is also home to 252 species of amphibians with 90% endemics, 108 species of reptiles with 56% endemics (Dahanukar & Molur, 2020; Srinivasulu et al. 2015), and about 600 species of evergreen woody plants with more than 60% endemic. In the past decade, more than 100 species of amphibians and ~50 species of reptiles have been discovered from Western Ghats (Aengles et al., 2018; Dahanukar & Molur, 2020; reptiledatabase.org). The area where the railway doubling is proposed falls in the Uttara Kannada region of the northern Western Ghats which is known to harbor approximately 50 species of amphibians that constitute almost one-fourth of the total Western Ghats amphibian diversity (Ramachandra et al., 2012). The approved alignment of the proposed line is parallel to the existing railway line and mostly lies within the railway land. However, the new railway

line is deemed to pass through the Kali (formerly Anshi-Dandeli) Tiger Reserve in the Uttar Kannada district of Karnataka and would impact the ecosystem during the construction and operational phase.

Considering the irreplaceable ecological importance of the landscape and the critical link it provides for the Western Ghats, the project was required to obtain environmental clearance that included an environmental impact assessment study and a mitigation plan to reduce, offset and mitigate the negative impacts of the proposed doubling. A biodiversity assessment for the proposed line was then conducted by the Indian Institute of Science (IISc) during the years 2017-2020.

Environmental and Biodiversity Assessment by IISc

Two environmental assessment reports were submitted by IISc (Sukumar and Sitharam, 2017 and Suresh et al., 2020), detailing the floral and faunal studies of the project area in two stretches of the proposed railway track (Kulem to Castlerock, and Castlerock to Tinaighat). The authors carried out detailed assessments on the vegetation of the area during both study periods, and the structural and functional aspects of vegetation, and forecasts of a loss of vegetation in alternative rail alignment scenarios were reported. For mammals, sign surveys, camera trapping, and opportunistic sightings were recorded to assess the presence of mammals near the railway track and to identify areas of high animal activity and movement. As a result, stretches of railway tracks specified by chainages and critical animal crossing zones were reported. General recommendations for mitigation were proposed for such areas. For the herpetofaunal component, the studies documented the diversity and rail kills of amphibians and reptiles in and around the study area. However, no specific mitigation measures were provided aimed at reducing the impacts on amphibians and reptiles.

Directives to WII

The Wildlife Institute of India (WII) was subsequently requested to undertake the task of proposing mitigation measures for the proposed railway track doubling project by the DIG (Wildlife), Ministry of Environment, Forest and Climate Change, Government of India vide Letter F. No. 6-55/2020WL(part) dated 28th August, 2020 recommending that "*detailed study for prescribing mitigation measures in this difficult terrain may be conducted by Wildlife Institute of India, Dehradun. The study may cover the entire 25 km stretch of the project area from Castlerock in the Karnataka side to Kulem in Goa. The detailed study should focus on structural and non-structural mitigation measures, use of deterrents (audio-visual), an early warning system for animal detection, speed restrictions etc*." as suggested by NTCA in its O.M. No. NTCA O.M. F.No.7-12/2020-NTCA dated 22th July 2020. Subsequently, the National Board of Wildife in its 59th meeting held on 5th October 2020 decided to defer the proposal of the Tinaighat-Castlerock-Caranzol railway doubling of South Western Railways, Karnataka, and a request to WII was made to conduct a detailed study for prescribing mitigation measures in the terrain and to submit a report vide lette File No.6-55/2020WL(part) dated 20th October 2020 of the Ministry of Environment, Forest and Climate Change. Thereafter, a proposal for the present study on the aforementioned stretch of was submitted by WII.

Field assessment by WII

With this background, the objective of the study by WII was to assess the length of existing and proposed railway track to suggest site-specific mitigation measures that will reduce the barrier effect,

allow permeability for wildlife movement across the railway, and minimize rail-induced mortality. We carried out a rapid survey from 19th November to 5th December 2020. The main aims of the exercise were:

1. To assess potential animal crossing zones along the existing and proposed railway track.

2. To carry out inventory of herpetofauna along the railway track, identify potential microhabitats along the track.

3. Coalesce information obtained from field survey with baseline data in IISc assessment reports (2017, 2020), and

4. Suggest site-specific mitigation measures based on the intensive track survey, information obtained from field study and IISc reports.

To identify potential animal crossing zones, we carried out camera trapping and sign surveys along the railway tracks. We also used rail mortality data from the Karnataka forest department and any opportunistic sighting or sign encountered during the survey to identify such areas. Visual encounter surveys, opportunistic surveys, stratified plot sampling, and collection of opportunistic rail kill data to assess the herpetofaunal diversity and identify critical zones for mitigation. We also surveyed the entire length of the existing alignment accompanied by a railway engineer to assess the proposed rail alignment, and review the crossing and drainage structures proposed by the railways in terms of suitability for animal crossing. The scope of constructing additional mitigation structures based on topography, probability of animal movement and engineering constraints was discussed on field.

Summary of results

Camera trapping spanning 660 trap nights yielded 156 captures of 17 mammals species along the railway track. We recorded 203 animal signs through sign surveys of 175 habitat plots near the railway track. A total of 47 species of herpetofauna was recorded during the survey. This number is expected to be higher since the study was conducted within a short period during the non-breeding season. The study revealed that perennial and seasonal streams, and ephemeral water bodies were crucial habitats for herpetofauna. Camera trap data indicated that tunnels along the railway track are being used as natural passages by animals for their movement across the landscape.

Hotspots of animal activity were visualized by overlapping all animal signs, sightings, photo-captures and mortality data using kernel density analysis on GIS-platform. These were then combined with the hotspots identified in the IISc reports, and potential multi-taxa animal crossing zones were thus delineated.

Mitigation measures for the railway track

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

Given below are details of the proposed mitigation measures on the existing and proposed railway track (Tables 1 & 2; Figures 1 & 2). It is important to assert that the recommended measures are to be implemented on both the existing and the proposed railway track for the measures to be effective. Once the mitigation measures are completed on the new track, railways can initiate the construction of mitigation measures on the existing track in a phased manner. Areas between mitigation measures need to be fenced to avoid animal hits by rail, and to funnel animals towards the mitigation measures. This would also discourage animals from entering the railway track.

Table 1: Mitigation measures recommended on the existing and proposed railway tracks in the Tinaighat to Castlerock segment (Chainage 12/000 to 25/000)

S. No.	Chainage	Structures on Existing Railway Track		Structures Planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)
1.	12/233	Arch culvert	1 x 1.52 x 4.25	RCC box	1 x 1.52 x 4.25	RCC box	2 x 5 x 4.5
2.	12/350	Pipe culvert	1 x 2 x 0.8	RCC box	1 x 2 x 2	RCC Box	1 x5 x 2
3.	12/702	Pipe culvert	1 x 2 x 0.3	RCC box	1 x 1.55 x 1.80	RCC box	1 x 1.55 x 1.80
4.	12/795	NIL		NIL		Level crossing	30-35 (width)
5.	12/812	RCC slab	1x 2 x 1.46	RCC box	1 x 3.760 x 1.5	RCC box	1 x 3.760 x 1.5
6.	13/118	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55
7.	13/597	RCC box	2 x 1.25 x 1.5	RCC box	1 x 3.05 x 1.8	RCC box	2 x 5 x 2
8.	13/772	RCC pipe	1 x1 x 1.2	RCC box	1 x 1.2 x 1.5	RCC box	3 x 5 x 2.5
9.	13/993	RCC box	1 x 1.02 x 0.625	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 2
10.	14/230	RCC pipe	1x 2 x 1.22	RCC box	1 x 3 x 1.8	RCC box	1 x 5 x 5
11.	14/295	RCC box	1 x 2.55 x 2.3	RCC box	1 x 2.55 x 2.3	Underpass	1 x 20 x 4.5
12.	14/550	RCC box	1 x 3.08 x 1.55	RCC box	1 x 3.08 x 1.8	RCC box	1 x 3.08 x 1.8
13.	14/650	NIL		NIL		Level crossing with early warning system	50 (width)
14.	15/213	RCC box	1 x 2.35 x 2.65	RCC box	1 x 2.35 x 2.65	RCC box	4 x 5 x 3
15.	15/552	RCC box	1 x 2.45 x 2.0	RCC box	1 x 2.45 x 2.0	RCC box	2 x 5 x 4.5
16.	15/962	RCC box	1 x 2.4 x 1.85	RCC box	1 x 2.4 x 1.85	RCC box	3 x 5 x 4.5
17.	16/188	Pipe culvert	1 x 2 x 1.25	RCC box	1 x 2.92 x 1.8	RCC box	2 x 5 x 2.5
18.	16/688	RCC box	1 x 1.83 x 2.88	RCC box	1 x 1.83 x 2.88	RCC box	2 x 5 x 3
19.	17/074	RCC pipe	1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 5 x 2
20.	17/280	NIL		NIL		Underpass	2 x 5 x 3
21.	17/950	NIL		NIL		Underpass	1 x 50 x 5.5
22.	18/251	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6
23.	18/800	NIL		NIL		Level crossing with early warning system	50 (width)
24.	19/060	NIL		NIL		Level crossing with early warning system	50 (width)

25.	19/292	RCC pipe for culvert	1 X 2 x 1.2	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 3.5
26.	19/520	RCC box	1 x 2.35 x 2.5	RCC box	1 x 2.35 x 2.5	RCC box	5 x 5 x 3.5
27.	19/850		NIL		NIL	Level crossing with early warning system	50 (width)
28.	20/190	RCC pipe culvert	1 X 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	2 x 2 x 2
29.	20/350		NIL		NIL	Level crossing with early warning system	50 (width)
30.	21/002	RCC box	2 x 2.6 x 3.65	RCC box	1 x 5.5 x 3.65	RCC box	3 x 5 x 5
31.	21/381	RCC pipe for culvert	1 x 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 4 x 2
32.	21/655	RCC pipe for culvert	1 x 1.2 x 2.85	RCC box	1 x 1.2 x 2.85	RCC box	2 x 4 x 4
33.	21/978	Arch	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2
34.	22/301	RCC box	1 x 1.52 x 3.72	RCC box	1 x 1.52 x 3.72	RCC box	1 x 5 x 5
35.	22/630	RCC pipe for culvert	1 x 1 x 0.9	RCC box	1 x 0.9 x 1.5	RCC box	2 x 3 x 2
36.	22/860	RCC box	1 x 2.42 x 2.13	RCC box	1 x 2.42 x 2.13	RCC box	3 x 3 x 3
37.	23/279	RCC slab	1 x 4 x 7	RCC slab	2 x 4 x 7	RCC slab	3 x 5 x 7
38.	23/495	RCC pipe culvert	1 x 3 x 1.2	RCC box	1 x 4.7 x 1.5	RCC box	2 x 5 x 2.5
39.	23/450		NIL		NIL	Overpass with light and sound barrier	20 (width)
40.	24/887	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2

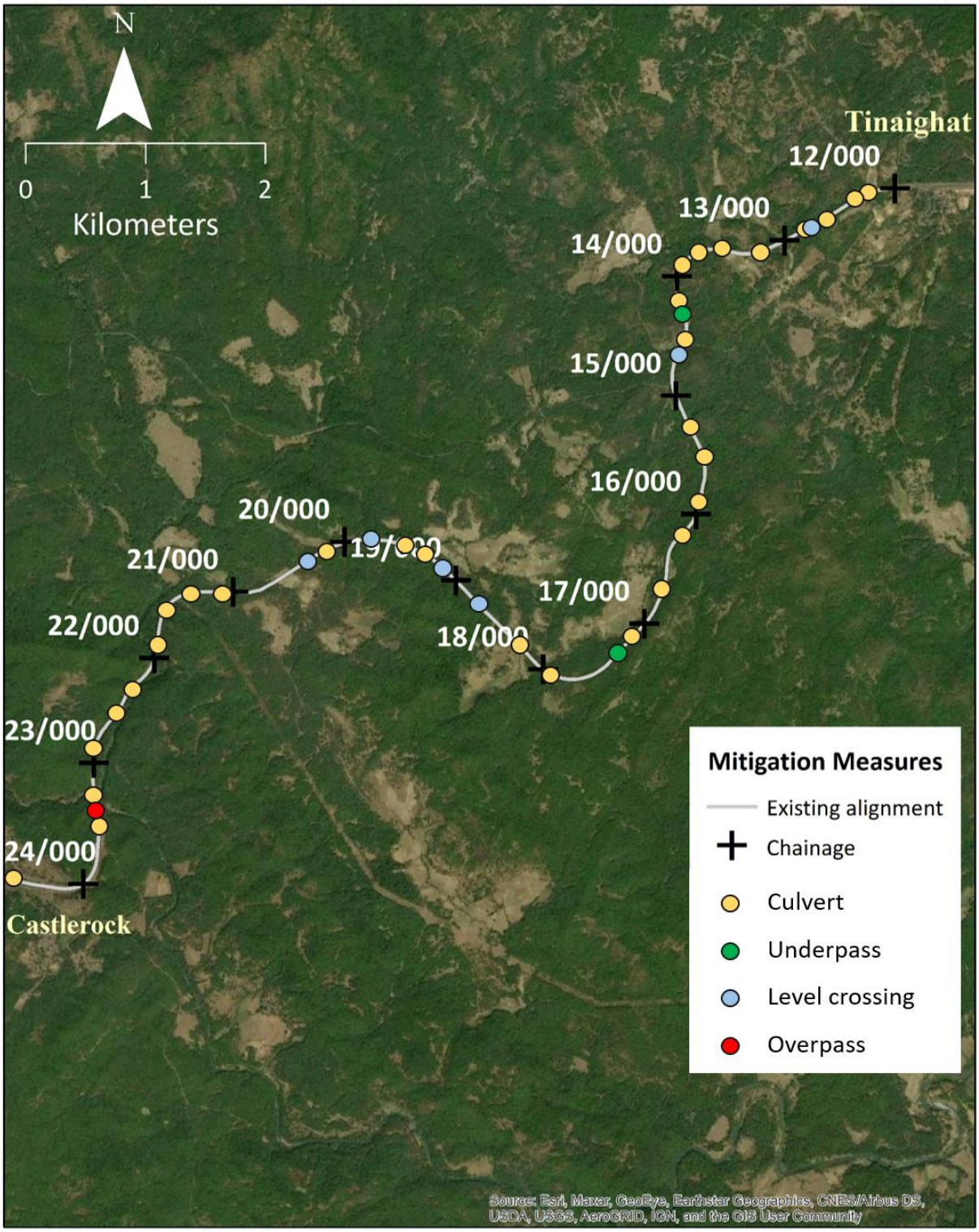

Figure 1: Mitigation measures recommended on the existing and proposed railway tracks in the Tinaighat to Castlerock segment (Chainage 12/000 to 25/000)

Table 2: Mitigation measures recommended on the existing and proposed railway tracks in the Castlerock-Caranzol segment (Chainage 25/000 to 29/900)

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure Type	Dimension (m) (No. x Width x Height)	Chainage	Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)
1.	25/450	RCC box	1 x 2 x 2.97	25/455	RCC box	2 x 3.0 x 3.0	RCC box	3 x 5 x 4
2.	25/710	RCC pipe culvert	1 x 1 x 0.61	25/708	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 4
3.	26/015	RCC box	1 x 1 x 2.54	26/005	RCC box	1 x 3 x 3	RCC box	1 x 6 x 5
4.	26/110	RCC pipe	1 x 1 x 1.22	26/100	RCC box	1 x 1.2 x 1.2	RCC box	1 x 2.4 x 1.5
5.	26/220	RCC slab	1 x 1 x 1.98	26/212	RCC box	2 x 1.2 x 1.2	RCC box	1 x 3 x 1.2
6.	26/380	RCC slab	1 x 2 x 1.22	26/378	RCC box	2 x 1.2 x 1.2	RCC box	2 x 2.5 x 1.2
7.	26/482	RCC box	1 x 1 x 2.44	26/480	RCC box	1 x 3 x 3	RCC box	1 x 5 x 5
8.	26/535	NIL			NIL		Overpass	20 (width)
9.	26/634	RCC slab	1 x 1 x 3.05	26/635	RCC box	1 x 3 x 2	RCC box	1 x 3 x 3
10.	26/733	RCC pipe	1 x 1 x 0.61	26/732	RCC box	1 x 1.2 x 1.2	RCC box	1 x 1.2 x 1.2
11.	26/790	RCC box	1 x 1 x 2.44	26/787	RCC box	1 x 3 x 2	RCC box	1 x 6 x 3
12.	26/903	Arch	1 x 1 x 2.45	26/902	RCC box	1 x 3 x 4	RCC box	1 x 5 x 4
13.	26/960	NIL			NIL		Overpass	15 (width)
14.	27/032	RCC slab	1x 1 x 3.05	27/033	RCC box	1 x 3 x 2	RCC box	1 x 5 x 3
15.	27/150	Composite girder	1 x 12.29 + 1 x 18.29	27/130	Composite Girder	1 x 18.3 + 1 x 12.2	Composite Girder	1 x 18.3 + 1 x 12.2
16.	27/400	RCC pipe culvert	1 x 1 x 1.2	27/373	RCC box	1 x 2 x 1.8	RCC box	2 x 4 x 2
17.	27/836	RCC pipe culvert	1x 4 x 1.22	27/813	RCC box	2 x 3 x 2	RCC box	2 x 5 x 5
18.	27/180 – 27/275	Tunnel	95	27/150 – 27/335	Tunnel	185		
19.	28/122	RCC slab	1x 1 x 2.21	28/100	RCC box	1 x 3 x 4	RCC box	1 x 5 x 5
20.	28/300	RCC slab	1 x 1 x 0.91	Alignment in tunnel				
21.	28/765	Arch	1 x 1 x 2.59					
22.	28/908	RCC box	1 x 2 x 3.05					
23.	28/300 – 28/710	Tunnel	410	28/160 – 28/750	Tunnel	590	Tunnel	590
24.	28/925 – 29/100	Tunnel	175	28/900 – 29/100	Tunnel	200	Tunnel	200
25.	29/110	RCC box	1 x 1 x 0.91	29/104	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 3
26.	29/177	RCC Arch	1 x 1 x 2.4	29/177	RCC box	1 x 3 x 3	RCC box	1 x 4 x 5
27.	29/345	NIL			NIL		Overpass	20 (width)
28.	29/433	RCC slab	1 x 1 x 2.47	Alignment in tunnel				
29.	29/513	RCC slab	1 x 1 x 3.05					
30.	29/613	RCC girder	4 x 18.29	29/613	Composite girder	2 x 18.3	Composite girder	2 x 18.3
31.	29/818	RCC pipe	1 x 2 x 1.22	Alignment in tunnel				
32.	NIL	NIL	NIL	29/275 – 29/550	Tunnel	275	Tunnel	275
33.	NIL	NIL	NIL	29/680 – 29/830	Tunnel	150	Tunnel	150
34.	NIL	NIL	NIL	29/925 – 30/135	Tunnel	210	Tunnel	210

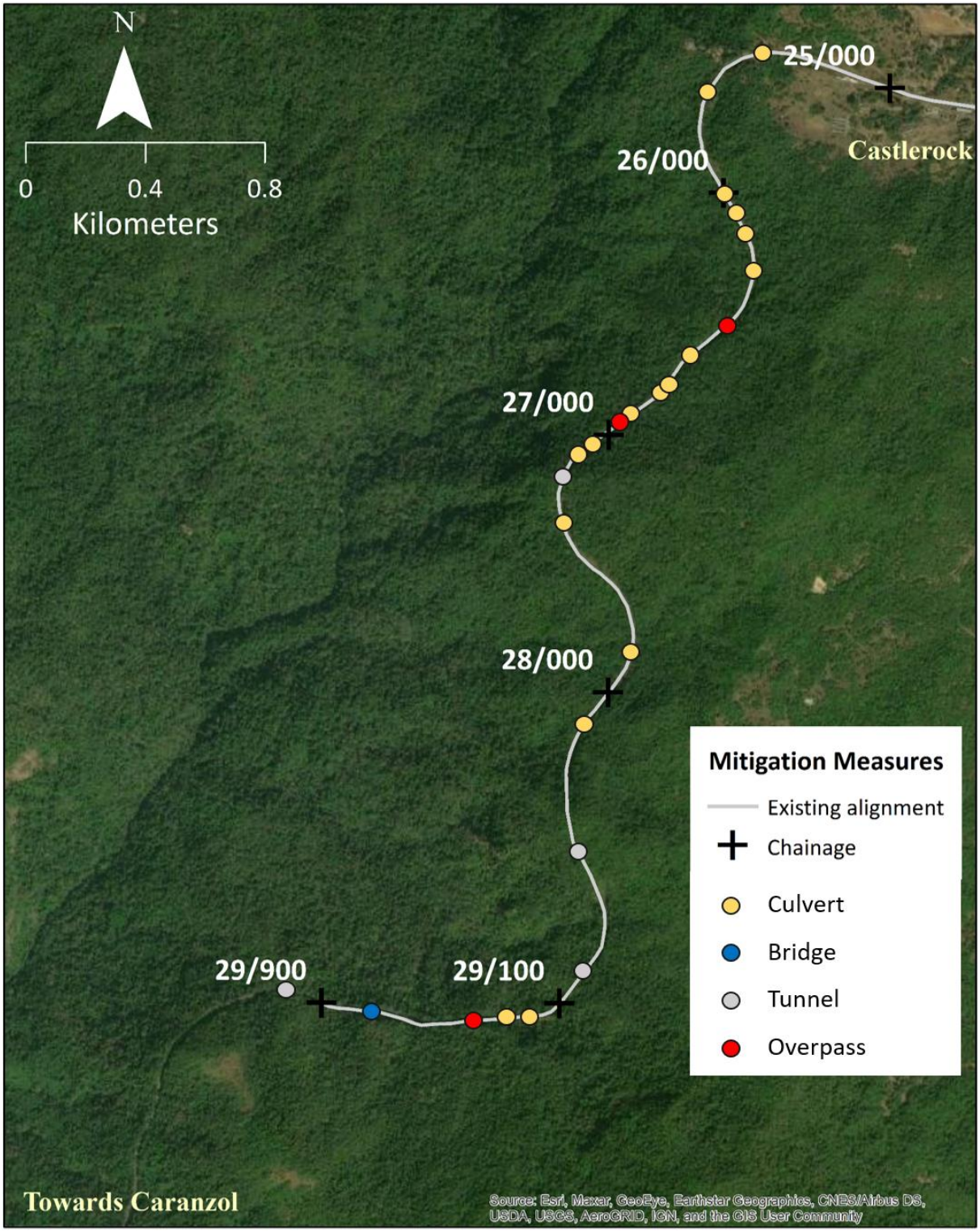

Figure 2: Mitigation measures recommended on the existing and proposed railway tracks in the Castlerock-Caranzol segment (Chainage 25/000 to 29/900)

CONSTRUCTION SUGGESTIONS FOR STRUCTURES PROPOSED TO BE MODIFIED TO FUNCTION AS ANIMAL CROSSING STRUCTURES

1. **The structure on the existing railway line can be extended as such to the new alignment. Our recommended structure should be constructed as an additional structure near the existing structure as per the suggested dimensions.**

2. **The suggested modifications can be constructed in front of the existing structure on the new alignment. But the opening of the structure can be temporarily blocked to avoid any issue due to the wide opening of the new structure on the upstream side. The opening on the new alignment can be fully operational as mitigation measures when the construction of the mitigation measures as per recommended dimensions are undertaken on the existing track.**

CHAPTER I: Introduction

The railway system is a vital service in many societies across the globe and forms the core of transportation in a sustainable economy. Even for India, the railways remain a vital mode of transportation since its inception in 1850. This mode of transportation has been pivotal in integrating markets, increasing trade, shaping finances besides serving as the backbone of linear transportation services. The Indian Railway network is spread across 1,23,542 km (as of 2018-2019) which makes it the second largest railway networks in the world under a single management (MoSPI, 2019). Even though railways are regarded to be an environment friendly option when compared to roadways and airways, construction of new tracks, development and expansion of the networks poses new challenges to the environment and biodiversity of the adjacent areas.

The ill effects of railway construction and expansion has been well documented (Lucas et al., 2017; Borda-de-Água et al., 2017; Plămădeală & Slobodeaniuc, 2019). Railways can pose both physical and behavioural barriers to wildlife (Barrientos and Borda-de-Água, 2017) and have negative impacts on populations living in proximity. Evidence show that disturbance to wildlife can occur at various stages of life cycle because of the vibrations, noise and light associated to such constructions and operations (Rooyen, 2009; Wiacek et al., 2015).

Project Background

During the initial days when the metre gauge was being constructed for this route, earth work and tunnels were planned for a double track. However, this fore sight of the planners did not materialise since the line was to connect the British frontier to Bellary on a single line. So, in order to maintain uniformity of the track these structures which were planned never came in to existence (South Western Railway Press Release, 2020). Railway Vikas Nigam Limited (RVNL) proposed doubling of the existing railway track between Hospet, Tinaighat and Vasco Port that measures 345 km in length. The sanctioned project consists of 2 main phases: doubling of line between Hospet and Tinaighat (Phase I) and between Tinaighat and Vasco (Phase II). The proposed line is parallel to the existing railway line and lies within the railway land except for a few places and is deemed to pass through natural forests of the Western Ghats

The Railway Board of India stated that the land on which the track is proposed was owned by the Railways before 1980, the year in which the Forest Conservation Act was passed (FCA). The FCA, prohibits the usage of forested land for non-forested activities without prior approval from the Central Government. However, since the land was pre-owned by the Railways, the Act did not apply to the land. The Railways further clarified in a recent press release that no new land was being acquired for the proposed project (South Western Railway Press Release, 2020). However, RVNL had appointed IISC to conduct Environmental Impact Assessment (EIA) for the proposed doubling of the railway track before planning the project.

Economic Importance of the Project

The railway line for which doubling has been proposed is an important link of transportation between the Southern states and the State of Goa, and holds historical importance. The latter half of the nineteenth century saw the Portuguese trying to convince the British to build a railway track that would link Portuguese India (Goa) to British India. The Anglo-Portuguese Treaty of 1878 gave these negotiations a defined shape, and soon enough railway stations and a single railway track came up and started functioning.

At present the existing single track limits the capacity of running trains in the critical *ghat* section. Given the terrain of the region, landslides during the monsoons interfere with the functioning of the track. RVNL elaborated that in addition to improving mobility and all-weather rail links in the region, the proposed doubling would also increase connectivity, trade and commerce, enhance tourist flow, augment intermediate railway station facilities, and reduce bottlenecks of railway traffic in the *ghat* section.

Project Site

The proposed railway track passes through ecologically sensitive areas of the Western Ghats (Figure 1). The proposed doubling of railway track lies between the forested tracts of Tinaighat and Caranzol. Tinaighat is a small village on the Panjim (Goa)- Belgavi (Karnataka) highway. The forests of Tinaighat lie within Dandeli Wildife Sanctuary. Dandeli earned the status of a Wildlife Sanctuary in the year 1956. Part of the area was carved out from Anshi National Park in 1987. In 2007, both these areas were together declared as a Tiger Reserve and were renamed as Kali Tiger Reserve in 2015. Today, Kali Tiger Reserve along with other forested areas in both Goa and Maharashtra covers as area of about 2200 km^2. The existing railway track between Tinaighat and Caranzol section lie within the Protected Area of Castlerock Range which is a part of Kali Tiger Reserve. The forest parts of Tinaighat and Castlerock are evergreen in nature and ecologically valuable for many herpetofauna, avifauna and mammals. Evergreen forests are seen in the Ghats of Castlerock, steep slopes and deep valleys. Most trees are of softwood species, which are relatively slender with clear boles in the deep soil.

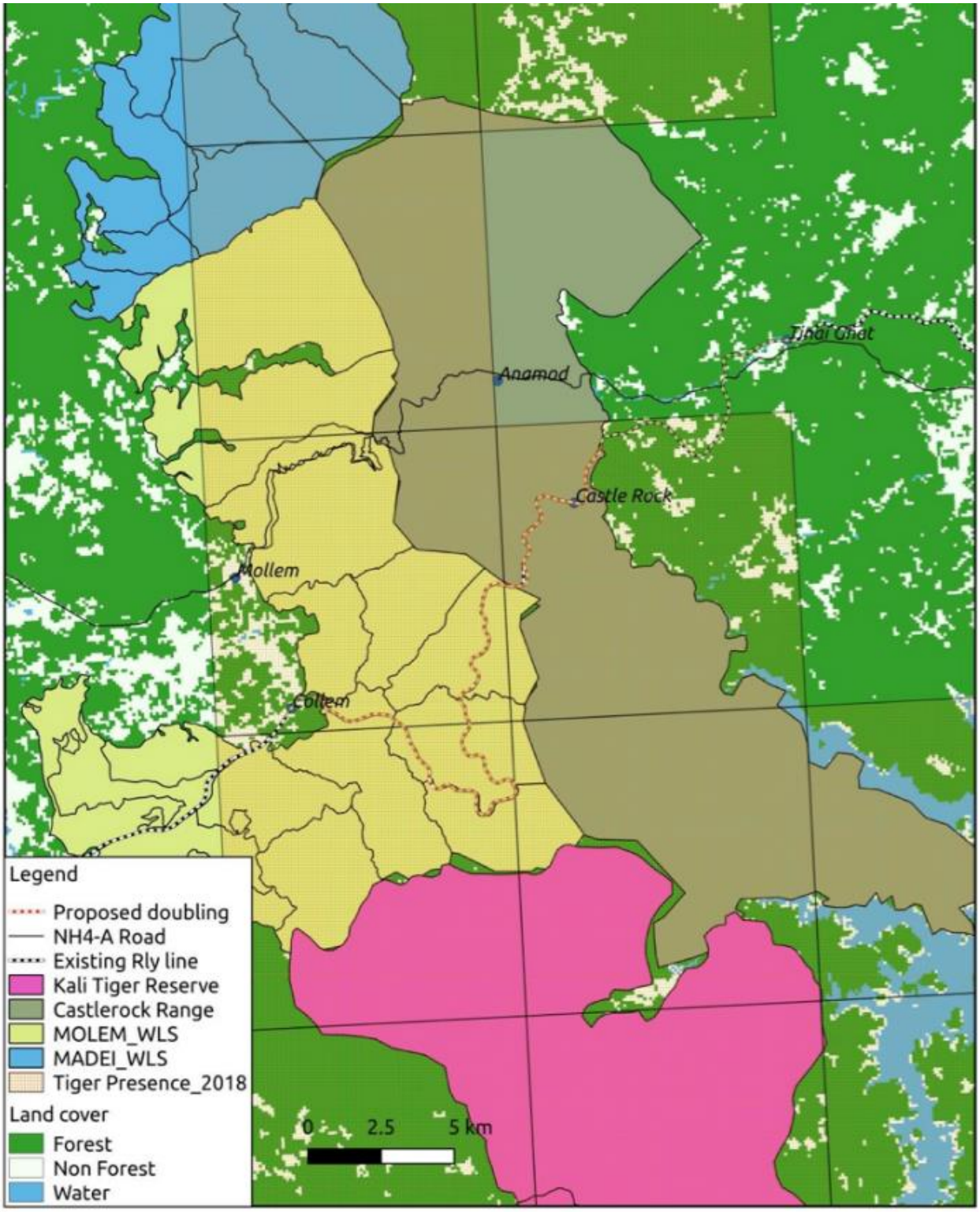

Figure 1: Alignment of proposed doubling of railway track passes through ecologically sensitive areas of the region viz., Kali Tiger Reserve, Molem Wildlife Sanctuary and Castlerock Range.

Topography and Rainfall

The topography of the region is predominantly undulating with flat terrain in some stretches of the section. The stretch between Tinaighat to Castlerock is relatively flatter while the terrain from Castlerock towards Caranzol is undulating with cliffs and gorges. The study area receives high rainfall during the monsoons (June-September) due to the active southwest monsoon winds (Figure 2).

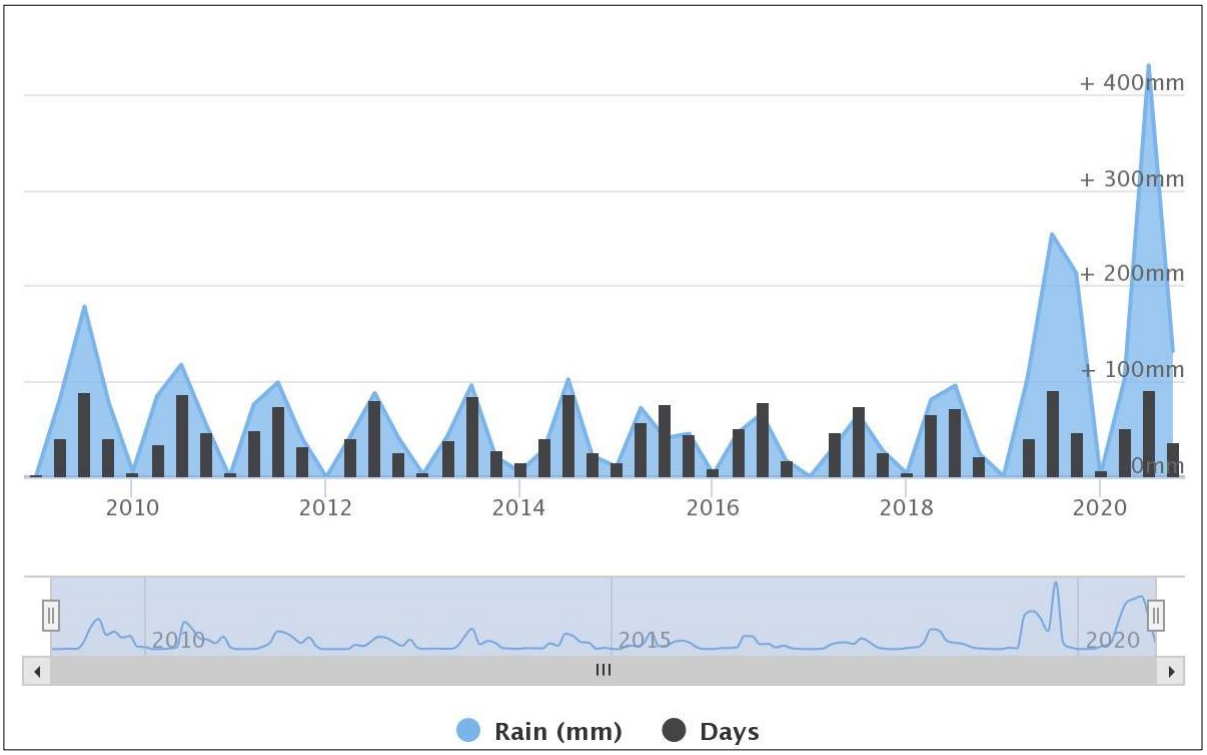

Figure 2: Observed annual rainfall around Castlerock area for 2010-2020 (Source: World Weather Online, 2020)

Ecological Significance of Landscape

The Western Ghats that extends along the south-western parts of India, are known to harbour a wide diversity of flora and fauna. In terms of faunal diversity, the area is home to about 30% of Asian elephant population, 33% of India's wild tiger and about 26% of India's leopard population (Jhala et al., 2020a; Jhala et al., 2020b). Spread across 9 notified Tiger Reserves, 20 National Parks and about 68 Wildlife Sanctuaries (UNESCO, 2012), the landscape forms one of the largest and most contiguous protected area networks in the country. The railway track along which doubling is proposed passes through Castlerock range of the Kali (formerly Anshi-Dandeli) Tiger Reserve in the Uttar Kannada district of Karnataka. It is part of the Western Ghats Tiger conservation unit (Qureshi et al., 2014). Among the important tiger source populations in the landscape is the Anshi and Dandeli tiger population that provides a critical link to northern Western Ghats, extending up to Goa and South Maharashtra (Sahyadris).

Within the Western Ghats, the Anshi-Dandeli-Sharavathi Valley complex consists of the protected areas of Mollem-Netravali, Anshi-Dandeli, Sharavathi Valley-Mookambika along with reserved forests of Goa which continue to the Sahyadri Tiger Reserve in Maharashtra. The major tiger source population in the complex is that of the Anshi National Park and Dandeli WLS (Qureshi et al., 2014) that together form the Kali Tiger Reserve.

Though the Western Ghats tiger populations are more connected with each other when compared to tiger populations in other landscapes, this connectivity is threatened by several anthropogenic activities such as plantations, agriculture, and infrastructure development. It is thereby critical to maintain the contiguity of the landscape for long-term conservation of tigers and associated species in this important landscape.

Floral wealth

The entire biogeographic zone of Western Ghats incorporates a major genetic estate with a high degree of biodiversity and endemism (Bossuyt et al., 2004). The Tinaighat-Caranzol area is a part of this zone where the forest types can be classified into three distinct categories i.e., southern tropical evergreen forests, west coast semi-evergreen forest and moist deciduous forest. The southern tropical evergreen forests consist of tall trees with marked stratification. Important canopy species include *Holigarna grahamii*, *Canarium strictum*, *Garcinia* spp. *Diospyros* spp., *Syzygium* spp. The middle story includes *Polyalthia fragrans*, *Syzygium laetum*, *Memecylon* spp., *Psychotria dalzelii*, *Ixora nigricans* etc. Along the stream species such as *Calophyllum* spp. *Lophopetalum wightianum* and *Hydnocarpus pentandrus* are found. Important lianas of this forest type include *Entada rheedi*, *Ancistrocladus heyneanus*, *Paramignya monophylla* and *Toddalia asia*.

The west Coast semi-evergreen forest patches are present in between Southern tropical evergreen forest and moist deciduous forest. Important species include *Actinodaphne angustifolia*, *Lagerstroemia microcarpa*, *Macaranga peltata*, *Pterospermum diversifolium* etc. Shrub layer in this forest has species such as *Glycomis pentaphylla*, *Maesa inica*, *Leea indica*, *Gnidia glauca*. Some of the common herbs are *Asystacia* sp., *Impatiens* sp., and several grasses. Moist deciduous forest is frequent in lower elevations. Dominant species of this type include *Xylia xylocarpa*, *Lagerstroemia microcarpa*, *Dillenia pentagyna*, *Terminalia crenulata*, *Grewia* spp. etc. In the second story are found species such as *Catunaregam spinosa*, *Xantolis tomentosa*, *Strychnos nux-vomica*, *Canthium* spp. etc. Ground flora is rich in species belonging to families such as *Leguminosae*, *Rubiaceae*, *Euphorbiaceae* and *Asteraceae*.

According to the most conservative figures, the proposed project area has about 721 species of wild plants belonging to 490 genera and 119 families (Datar & Lakshminarasimhan, 2013). The entire forest tract can be broadly classified into four distinct categories- Southern tropical wet evergreen forest (1A), Southern tropical semi evergreen forest (2A), Tropical moist deciduous teak forest (3B), and Southern tropical dry deciduous forest (5A). Tinaighat to Caranzol division can be classified as the moist deciduous type which falls under the class of peninsular moist dry deciduous type (Champion and Seth, 1968). They are economically most valuable forests. Valuable timber species like *Tectona grandis, Dalbergia sissoo, and Terminalia elliptica* etc. Here, the top canopy of the deciduous species but lower and middle storeys are of semi evergreen growth, mainly due to the shrubs and medium size trees present in there. In the high canopy section *Tectona grandis*, *Terminalia elliptica*, *Lagestroemia lanceolata*, *Xylia xylocarpa*, *Terminalia paniculata*, *Dalbergia latifolia*, *Haldina cordifolia*, *Ougeinia dalbergioides*, *Mitragyna parviflora*, *Terminalia bellerica*, *Pterocarpus marsupium*, *Albizia procera* etc. species are frequent. In the middle canopy section *Anogeissus latifolia*, *Kydia calycina*, *Emblica officinalis*, *Buchanania lanzan*, *Semecarpus anacardium*, *Holorrhaena antidysenterica* are recurrent species. In the bottom section *Murraya koenigii*, *Glycosmis pentaphylla*, *Helicteres isora* and weeds like *Eupatorium* are more prevalent. Dominant shrub species include *Leea indica*, *Glycosmis pentaphylla*, and *Phychotria* sp.

Herpetofaunal wealth

Western Ghats biodiversity hotspot is known for its diverse assemblage of reptiles and amphibians (Bhupathy & Babu, 2013; Vasudevan, 2015; Krishna et al., 2019). There are 252 species of amphibians with 90% endemics and 108 species of reptiles with 56% endemics (Dahanukar & Molur, 2020; Srinivasulu et al., 2015; amphibianweb.in). Faunal inventory took a pace since the last decade, whereby

more than 100 species of amphibians and around 50 species of reptiles have been discovered from the Western Ghats (Aengles et al., 2018; Dahanukar & Molur, 2020; reptiledatabase.org). Northern Western Ghats in Uttara Kannada region is known to harbor approximately 50 species of amphibians and approximately 40 species of reptiles, that constitute almost one-fourth of the total Western Ghats amphibian and reptilian diversity (Ramachandra et al., 2012, Pande et al., 2019). Castlerock was one of the key settlements during colonial period from where several herpetofaunal species were collected. These served as materials for taxonomic description of several herpetofaunal species making Castlerock as a type locality (Table 1 and Figure 3).

Table 1: Type locality of herpetofauna species reported earlier in Tinaighat-Castlerock area

Class	Species	IUCN status	Reference
Amphibia	*Nyctibatrachus petraeus*[1]	Least Concern	Das & Kunte, 2005
	Raorchestes bombayensis[2]	Vulnerable	Annandale, 1919
Reptilia	*Hypnale hypnale*[3]	Not Evaluated	Merrem, 1820
	Dendrelaphis giri[4]	Least Concerned	Vogel & Van Rooijen, 2011
	Ahaetulla borealis[5]	Not Evaluated	Mallik et al., 2020

[1] *A stream frog, that grows up to 44mm in length. Lays eggs in rock crevices, on hanging leaves above stream during July-August. A new mode of amplexus has been discovered in this species, termed as dorsal straddle. the male does not embrace the female but straddles over her back with his hand holding or resting on substrates such as a leaf, branch, or tree trunk.*

[2] *One of the smallest bush frog species grows up to 23mm. Their breeding season ranges from June-August and they are known for their direct development. We have also encountered metamorphs during survey. One of the threatened species recorded during study.*

[3] *It is unique in having an upturned snout among other Indian pit vipers. It has 20-30 oval or triangular marks on the flanks. It is ovoviviparous in nature.*

[4] *Dirunal, arboreal snake grows up to 653 mm. Described from Castlerock but known only from Karnataka, Tamilnadu & Maharashtra state. Described from just single male specimen, its taxonomic position is still questionable.*

[5] *Diurnal, arboreal snake grows up to 592 mm in length. Earlier Ahaetulla nasuta population of the study area has been assigned to this new species based on molecular evidence.*

Figure 3: Herpetofaunal species of Castlerock as a type locality (A. *Nyctibatrachus Petraeus* B. *Hypnale hapnale* C. *Raorchestes bombayensis* D. *Dendrelapsis girii* [photo copyright: S.R. Ganesh & S.R. Chandramouli] E. *Ahaetulla borealis*)

Ecological Importance of Castlerock in relation to herpetofauna habitat

Microhabitats such as leaf litters, fallen logs, rock crevices, streams (riffle, run, cascade, stream boulders & bedrocks), shrubs, bushes, tree holes, tree branches etc. are important niches for herpetofaunal species. Some of them show ecological specificity towards certain microhabitats depending on their unique biological needs. Species such as *Nyctibatrachus petraeus* are dependent on stream pools and riffles for their breeding purpose. *Micrixalus* sp. are specific to stream boulders. It has been documented that each individual of this species occupies single boulder as their territory during breeding season (Biju et. al. 2014). Moist leaf litters around riparian areas serve as good niche for amphibian species like *Clinotarsus curtipes*, *Minervarya* sp., and reptiles like *Hypnale hypnale* etc. Fallen logs are good hideouts for lizards like *Cnemaspis* sp., several *Hemidactylus* sp. (*H. triedrus, H. prashadi* etc.), snakes (*Lycodon* sp.*, Uropeltis* sp.). Arboreal habitats as in tree branches, liana strangles are niche to unique species of herpetofauna such as amphibians like *Rhacophorus malabaricus, Polypedates* sp. etc. and among snakes *Ahaetulla borealis* (endemic to northern Western Ghats, Mallick et al., 2020), *Boiga* sp.,

Trimeresurus malabaricus (Western Ghats endemic). Endemic bush frog members such as *Raorchestes bombayensis*, *Pseudophilautus amboli* are intricately dependent on shrubs and bushes for their life cycle. Streams and associated pools are home to tadpoles of species such as *Clinotarsus curtipes*, *Indosylvirana* sp., *Rhacophorus malabaricus* etc. Aquatic snakes such as *Rhabdops*, *Fowlea* sp. are also largely dependent on streams and other waterbodies. All these representative habitats and microhabitats are present along the 'Ghat' section of Castlerock range and most of the northern Western Ghats herpetofaunal species are present along these areas (see Appendix-I for an overview).

CHAPTER 2: Environment Assessment by IISC Bangalore

Summary of Environmental Assessment undertaken by Indian Institute of Science, Bangalore during 2017 and 2020

An environmental assessment of the railway track was undertaken by Indian Institute of Science, Bangalore (IISc), and subsequently they submitted two reports to RVNL (Sukumar & Sitharam, 2017 and Suresh et al., 2020). These reports detailed the floral and faunal studies of the project area in two stretches of the proposed railway track (Kulem to Castlerock, and Castlerock to Tinaighat). The authors carried out detailed assessments on the vegetation of the area during both study periods, and the structural and functional aspects of vegetation, and forecasts of loss of vegetation in alternative rail alignment scenarios were reported. For mammals, sign surveys, camera trapping and opportunistic sightings were recorded to assess the presence of mammals near the railway track and to identify areas of high animal activity and movement. As a result, stretches of railway tracks specified by chainages and animal crossing zones were identified. For the herpetofaunal component, the studies documented the diversity and rail kills of amphibians and reptiles in and around the study area. However no specific mitigation measures were aimed at reducing the impacts on amphibians and reptiles. The study provided general broad measures such as culvert construction and drainage structures to facilitate movement of smaller animals including anurans, reptiles, and small mammals.

This chapter is divided in to three parts. In the first part, general findings (mammals, herpetofauna and vegetation) have been summarised based on the previous IISc reports. In the second part, railway stretches that require mitigation have been identified based on these reports. In the last part, a summary of the suggested mitigation measures given in the reports have been provided.

General findings

Mammals

Tinaighat to Castlerock:

To identify areas of high use by mammals, IISc conducted camera trap, sign surveys and collected opportunistic mammal presence data along the existing railway track from the Tinaighat to Castlerock section (Suresh et al., 2020). The camera trap study carried out over 72 trap nights in this section captured 23 images belonging to 5 mammal species including gaur, porcupine, sambar, small Indian civet, and chital. Indirect signs (n = 406) including pug/hoof marks, pellets/scats/droppings and feeding signs for mammals such as gaur, langur, sambar, and leopard were recorded during the study on transects laid parallel to the railway track up to 10 m. Direct sightings (n = 10) of mammals such as gaur, langur, barking deer, porcupine and bonnet macaque were also recorded during the study. On the basis of animal evidence collected, Suresh et al. (2020) identified 3 main clusters of animal activity/movement along the study section (Figure 4), details of which are given in the Table 2.

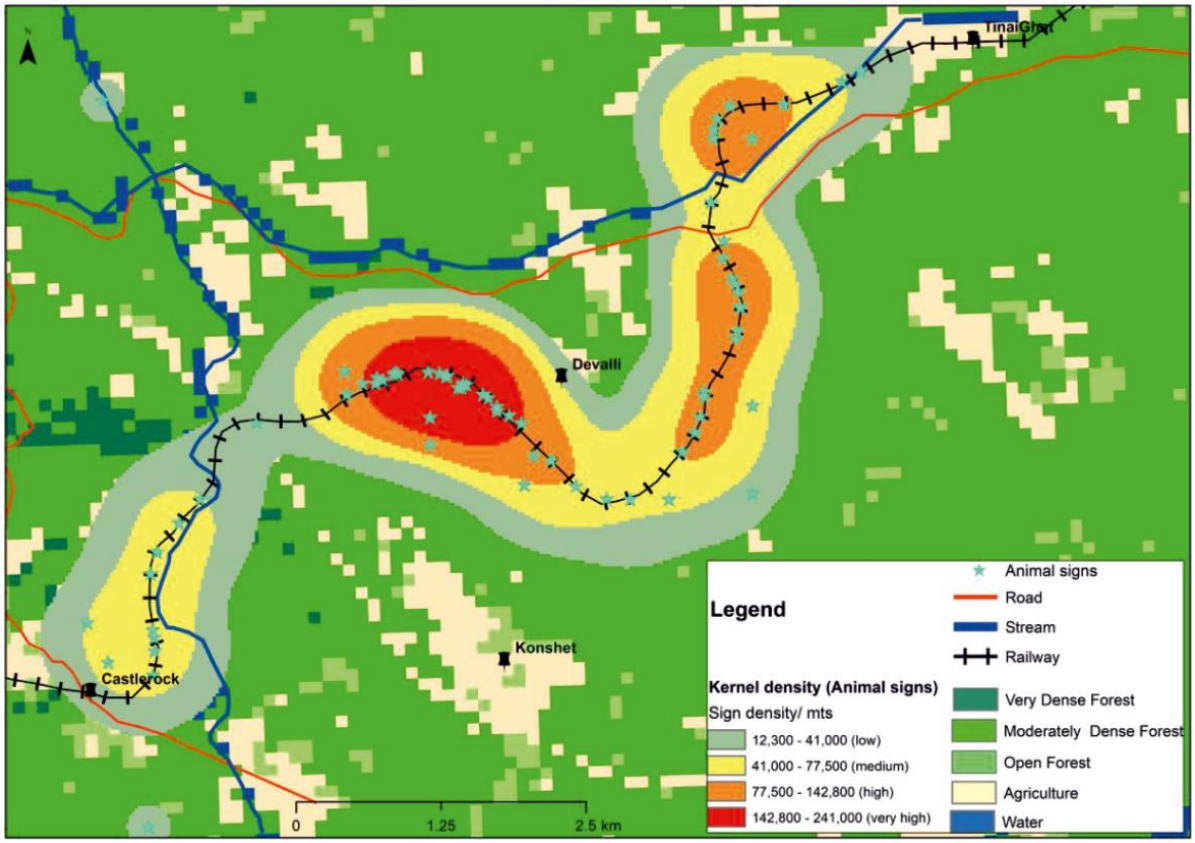

Figure 4: Kernel density of signs collected by IISc during their survey in 2019 between Tinaighat-Castlerock. The clusters were classified as low (light green), medium (yellow), high (orange), and very high (red) based on density of signs found (Source: Suresh et al., 2020)

Table 2: Details of animal clusters identified by IISc (Suresh et al., 2020) along the railway track in the Tinaighat to Castlerock segment

Cluster Number	Chainage	Length of cluster (km)	Category
1	13/3 – 14/4	1.024	High
2	15/1 – 17/0	2.91	High
3	18/2 – 20/6	1.47	Very high

The report has also listed out locations of 'caution zones' originally issued by the railways of probable animal presence to be followed by their loco pilots (Table 3). According to the report, these locations also overlap with sensitive locations identified through their kernel density analysis of animal signs.

Table 3: Location of 'caution zones' on the Tinaighat – Castlerock railway section (Source: Suresh et al., 2020)

S. No.	Caution Zone		
	From	To	Length (m)
1	23/600	24/000	400
2	21/300	22/800	1500
3	21/300	22/300	1000
4	14/200	16/500	2300
5	15/900	16/300	400
6	14/800	15/600	800
7	14/200	14/600	400
8	12/600	13/000	400
9	12/000	12/500	500
	Total		**770**

Based on the animal hotspots and caution zones identified through field survey and consultation with railway officials, 5 main zones (formed by overlapping 3 animal clusters and 4 caution zones) can be delineated (Figure 5).

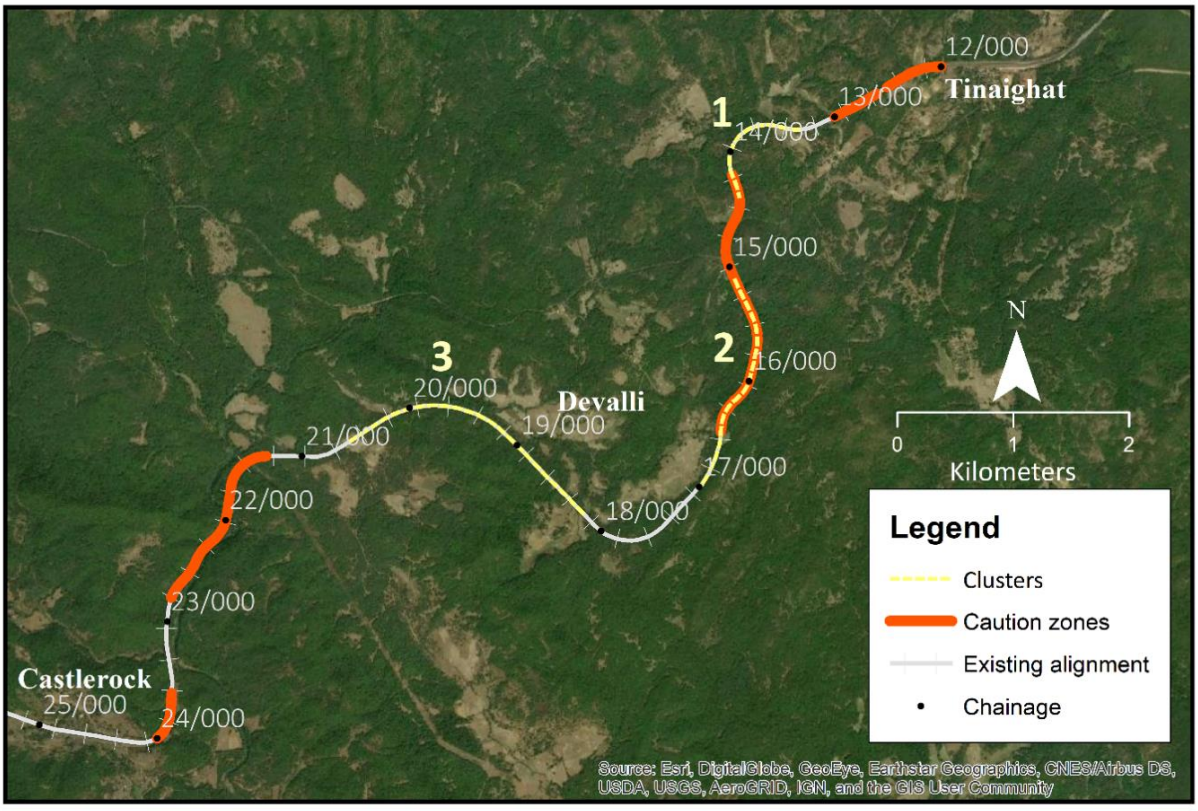

Figure 5: Consolidated map of the animal hotspots and caution zones identified (Suresh et al., 2020) on the Tinaighat – Castlerock section.

***Castlerock to Caranzol* (*includes results for Caranzol to Kulem section)**

Indirect animal signs (n = 49) including dung/pellet, scat, den, digging, scratch marks for sambar deer, langur, porcupine and civets were recorded on the study section using belt transects (100 m * 10m). [**NOTE: the maps in the report (Sukumar & Sitharam, 2017) on which animal signs were plotted did not show any signs on the section between Castlerock and Caranzol (Karnataka-Goa border**)]

Direct sightings (n = 37) of mammals such as bonnet macaque, Malabar giant squirrel and Hanuman langur were also recorded during the study. [**NOTE: the maps in the report (Sukumar and Sitharam, 2017) on which animal sightings were plotted did not show any sightings on the section between Castlerock and Caranzol (Karnataka-Goa border**)].

Five mammal species viz., wild boar, small Indian civet, mouse deer, brown palm civet and Indian porcupine were recorded via camera trapping (n = 5). [**NOTE: the maps in the report (Sukumar and Sitharam, 2017) on which camera trap locations were plotted did not show any camera traps deployed on the section between Castlerock and Caranzol (Karnataka-Goa border**)]

Animal movement paths or crossing points were recorded based on animal signs and paths. Two (2) animal crossing points were identified on the Castlerock-Karnataka-Goa border (near Caranzol) section (Figure 6). Area outlined in red is the railway section relevant to the study area for the present assessment during November-December 2020 (Castlerock - Caranzol).

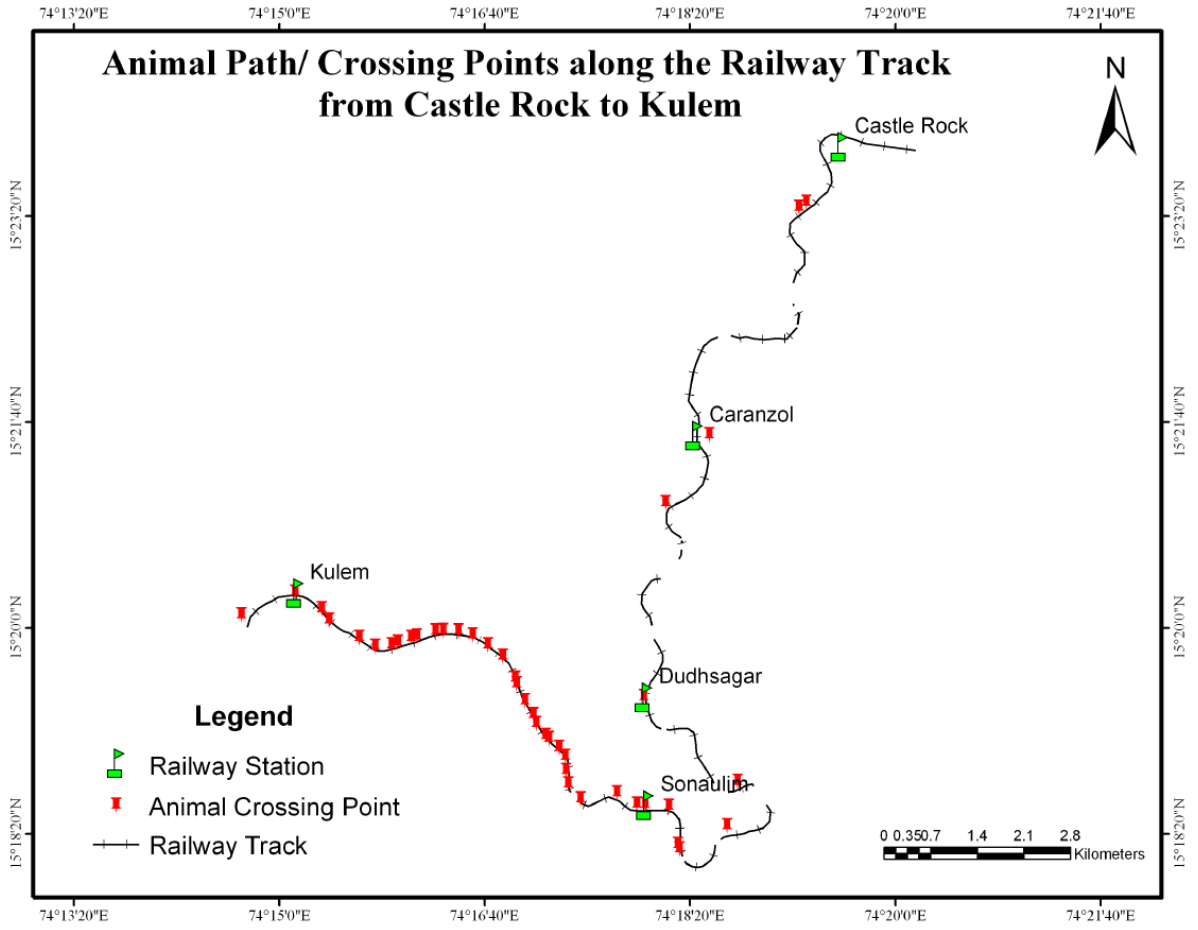

Figure 6: Locations of animal crossing points on the Castlerock – Kulem railway track identified in Sukumar and Sitharam (2017).

Herpetofauna

Indian Institute of Science (IISC), Bangalore had conducted herpetofaunal surveys from Castlerock to Kulem during 2013 and 2014 as a part of their proposed study (Sukumar & Sitharam, 2017). The study documented 24 species (total 137 individuals) of Amphibians (14 endemics to Western Ghats) and 27 species (total 81 individuals) of reptiles (Annexure I). Visual Encounter Survey (VES) technique and opportunistic encounters were carried out to document herpetofaunal species richness, relative abundance, habitat dependency and diversity indices (for amphibians only) along the existing Castlerock-Kulem railway line (Sukumar & Sitharam, 2017). The study documented three dead snakes along the railway track, including Checkered keelback and Bronzeback Tree snake (*sic* Sukumar & Sitharam, 2017). There were no specific recommendation on mitigation on herpetofauna specifically in the regions of Caranzole & Tinaghat section.

Vegetation characteristics between Kulem-Castlerock section in Goa-Karnataka (Sukumar and Sitharam, 2017)

For vegetation evaluation and classification standard, belt transect was followed by the IISC research team. They used sample plots of 0.1 ha (250 x 4m), to the proposed alignment in strips of 50 m. Geo-coordinates were obtained for each transect by the research team and all woody individuals >1.0 cm dbh (diameter at breast height) including woody climbers were identified and measured for size. Canopy was estimated along the transect line at every 10 m interval. A total of 8593 individuals belonging to 255 different species were identified. Among the canopy trees, *Hopea wightiana*, *Diospyros candolleana*, *Xylia xylocarpa* and *Terminalia paniculata* were dominant.

In the moist deciduous forest type, a total of 14 sample plots were laid and 2284 individuals >1cm dbh belonging to 119 species and 42 families of flowering plants were identified. Dominant trees include *Xylia xylocarpa* and *Terminalia paniculata.* Mean species richness of this forest type was 28 ± 11.4 species/plot and Shannon-Weiner's heterogeneity index was 2.50 ± 0.62. Mean density per plot was 163.07 ± 65.94 individuals >1 cm dbh with a mean height of the canopy of 25 m.

Seven 0.1 ha sample plots were laid in semi-evergreen forests, resulting in 1508 individuals >1 cm dbh belonging to 111 species and 42 families of flowering plants. Abundant species include *Memecylon umbellatum* and *Psychotria dalzellii,* among the canopy trees *Hopea wightiana*, *Aporosa lindleyana* and *Diospyros candolleana* are dominant. Mean number of species in the semi-evergreen forest type was 37.4 ± 5.09 was and Shannon-Weiner's diversity index was 2.85 ± 0.23. Mean density of stems >1 cm dbh was 215 ± 42 with a mean height of the canopy was 27 m.

In the evergreen forest type 17 sample plots of 0.1 ha were laid, a total of 4801 individuals >1 cm dbh belonging to 207 species spread across 61 families of the flowering plant. Family Lauraceae and Myrtaceae are the most frequent species in this forest type. Mean species richness of evergreen forest was 42.8±10.2 and Shannon-Weiner's index was 2.92 ± 0.48. Mean density of stems >1 cm dbh was 282.4 ± 94.1 with a mean height of the canopy 30.5 m.

The analysis and findings of the IISc report showed an inverted J shape graph where the basal area was concentrated in the higher size classes. Most richness of biomass was observed in evergreen plots (364.4 ± 97.53 tons/ha) followed by semi-evergreen forests (290.7 ± 86.62 tons/ha) and moist deciduous forests (272.1 ± 54.77 tons/ha) respectively. According to the project proposal of RNVL and the predictions of IISC, 53,255 woody stems >1 cm dbh under Scenario 1 (parallel track) and 175896 stems>1 cm dbh under Scenario 2 (non-parallel track) are to be cut for doubling of the railway line parallel to the existing track.

Vegetation Survey between the Tinaighat and Castlerock of Karanataka (Suresh et al., 2020)

Similar methods were used to understand the characteristics of vegetation along the proposed railway track between Tinaighat and Castlerock section. In this report, the random forest transect was analyzed for species composition, diversity parameter, structural parameter, C stock and biomass.

A total of 13 transects of 0.1 ha (250 x 4 m) dimension were laid along the railway track between Castlerock and Tinaighat section. A total of 3480 individuals >1cm dbh belonging to 137 species of different flowering plants were identified. Most abundant species were *Terminalia bellirica* (Combreteceae) with nearly 240 individuals followed by *Leea indica* (Leeaceae) with 234 individuals and *Aporosa lindleyana* with 233 individuals. Of the total studied species, 43.07% were canopy species, followed by 41.6% of understory and 15.3% of species were both shrub and climbers together. Summary statistics of diversity parameters and the different life forms of the vegetation along the Tinaighat and Castlerock railway stations were also calculated (Table 4) in the IISC report, submitted in March 2020.

Table 4: Characteristics of different life-forms along the Tinaighat and Castlerock railway stations (Suresh et al., 2020)

Life-Form	Number of Species (%)	Number of Individuals (%)	Total Basal Area (%)
Canopy	43.07	46.38	82.06
Climber	5.11	3.28	0.61
Shrub	10.22	18.91	2.00
Understory	41.61	31.44	15.33
Total	100	100	100

Table 5: Summary statistics of diversity parameters of the vegetation between Tinaighat and Castlerock railway stations (Suresh et al., 2020)

Parameter	Mean ±SD	Range (N = 13)	Coefficient of variation (CV)
Number of species	40.4 ±7.33	31 – 56	18.12
Dominance	0.07 ±0.03	0.05 – 0.19	48.5
Simpson's Index	0.92 ±0.03	0.80 – 0.94	3.98
Shannon's Index	3.07 ±0.19	2.57 – 3.33	6.29
Fisher's Alpha	13.65 ±1.84	11.06 – 18.48	13.48
Chao 1	51.5 ±15.9	34.2 – 95.4	30.9

Mean number of individuals >1 cm dbh among the transects was 267.6±97.5, with a mean basal area was 5.49±3.81 m^2/0.1 ha, mean canopy cover ranges between 7.8% to 74.3% along different paths. In the study, the mean number of species ranges from 40.4±7.33 (range = 31 – 56 species, N = 13), Simpson/s index was 0.92±0.03 (range = 0.80- 0.94, N = 13), Shannon's Index of heterogeneity 3.07±0.19 (range = 2.57- 3.32, N = 13) and Fisher's alpha 13.65±1.84 (range = 11.06 – 18.48, N = 13). During the time of IISC survey period they recorded 139 species, out of the 139 species, 77 species (55.4%) showed significant dispersion and 62 species (46.4%) showed random dispersion. Dominant species include *Lagerstroemia microcarpa, Leea indica, Macaranga peltata, Aporosa lindleyana,*

Syzygium cumini and *Terminalia bellirica*.. Species such as *Holigarna arnottiana, Chukrasia tabularis, Calophyllum spp. Aglaia roxburghii* and *Nothopegia beddomei* were among the 19 species that showed significant clumped and very low frequency of occurrence. Size class cluster analysis showed 57.3% of the stems were below 5 cm dbh and 79.4% of the stems were less than 10 cm dbh and 4.1% stems were above 30 cm dbh. Individuals below 10 cm dbh in shrubs contribute to 64.4% of the total basal area.

Mitigation measures suggested for proposed doubling of existing railway track between Tinaighat – Castlerock – Caranzol section by IISc

A. *Mitigation measures suggested for Tinaighat to Castlerock section*:

1. Low fencing on both sides of railway track at certain places to funnel smaller mammals towards an underpass. Remaining areas, except for high terrain, may be fenced where needed to guide larger animals towards a bigger underpass.

2. Construction of low-cost canopy bridges for arboreal mammals (viz., Malabar giant squirrel and bonnet macaque and South Indian grey plains langur).

3. For designing appropriate type of structures for allowing animals of different body sizes to cross, "Eco-friendly measures to mitigate the impacts of linear infrastructure on wildlife" (WII, 2016) may be taken as standard reference.

4. Kernel density zones (Figure 3) and caution zones (Table 3) need to be given emphasis for animal crossings. Extra 2-3 box culverts may be made beside three kernel high density zones as there is no culvert for these sectors.

B. *Mitigation measures suggested for Castlerock to Caranzol section*:

1. Railways should provide whistle boards in forested areas where animals cross the railway track. Crossing points provided in report.

2. Railways should construct underpasses for movement of animals upon the advice of forest department. They should also maintain existing culverts, underpasses and other drainage structures along the railway line or improve upon the existing structures if required.

3. Upon the advice of the forest department, railways should construct barricades in designated localities to prevent animal crossing tracks at locations where such crossings are risky for the animals.

4. Construction should be undertaken in segments with gaps in between to allow animals to find alternative paths to cross the railway track. The length of each segment can be decided in consultation with the local forest officials.

5. Railways should de-weed along the tracks to improve the visibility for the loco-pilots so as to reduce the risks of accidents with wildlife.

6. Railways should carry out an awareness campaign regarding the cleanliness along the track for the passengers.

7. Water logging along the tracks should be avoided as this could attract animals which could then be at enhanced risk of being run over by trains.

8. Train speeds should be restricted by the Railways to safe limits in the flat sectors in consultation with the respective forest departments.

Given the need for definitive measures required during the construction and functioning phase of the project, several other recommendations pertaining to maintaining air quality, noise levels, soil conservation and other important precautions have been highlighted on page 203 in the report "Biodiversity and Environmental Assessment of proposed doubling of railway track between Kulem and Castlerock in Goa-Karnataka" (Sukumar & Sitharam, 2017)

CHAPTER 3: *Mitigation Measures for the doubling of the Tinaighat-Castlerock-Caranzol SWR Railway Track*

Rapid assessment of fauna and habitat to suggest mitigation measures for the doubling of the Tinaighat-Castlerock-Caranzol SWR railway track

The Wildlife Institute of India (WII) was subsequently requested to undertake the task of proposing mitigation measures for the proposed Tinaighat-Castlerock-Caranzol railway track doubling project by the DIG (Wildlife), Ministry of Environment, Forest and Climate Change, Government of India vide Letter F. No. 6-55/2020WL(part) dated 28th August, 2020 recommending that "detailed study for prescribing mitigation measures in this difficult terrain may be conducted by Wildlife Institute of India, Dehradun. The study may cover the entire 25 km stretch of the project area from Castlerock in the Karnataka side to Kulem in Goa. The detailed study should focus on structural and non-structural mitigation measures, use of deterrents (audio-visual), an early warning system for animal detection, speed restrictions etc." as suggested by NTCA in its O.M. No. NTCA O.M. F.No.7-12/2020-NTCA dated 22th July 2020. Subsequently, the National Board of Wildife in its 59th meeting held on 5th October 2020 decided to defer the proposal of the Tinaighat-Castlerock-Caranzol railway doubling of South Western Railways, and a request to WII was made to conduct a detailed study for prescribing mitigation measures in the terrain and to submit a report vide lette File No.6-55/2020WL(part) dated 20th October 2020. Thereafter, a proposal for the present study on the aforementioned stretch of was submitted by WII.

Scope and aims of present study:

With this background, the objective of the study was to assess the length of existing and proposed railway track to suggest site-specific mitigation measures that will reduce the barrier effect, allow permeability for wildlife movement across the railway, and minimise rail-induced mortality. The main aims of the exercise were:

1. To assess potential animal crossing zones along the existing and proposed railway track.

2. To inventory of herpetofauna along the railway track, identify potential microhabitats along the track.

3. To coalesce information obtained from field survey with baseline data in IISc assessment reports (2017, 2020), and

4. To suggest site-specific mitigation measures based on intensive track survey, information obtained from field study and IISc reports.

We carried out a rapid survey from 19th November to 5th December 2020. In order to identify potential animal crossing zones, we carried out camera trapping exercise and conducted sign surveys along the railway tracks. We also used rail mortality data procured from the Karnataka Forest Department and any opportunistic sighting or sign encountered during the survey to identify such areas. Visual encounter surveys, opportunistic surveys, stratified plot sampling and collection of opportunistic rail kill data were conducted to assess the herpetofaunal diversity and based on this we identified critical crossing over zones. We surveyed the entire length of existing railway alignment accompanied by railway engineers to evaluate the suitability of areas for crossing zones. We also evaluated the suitability of existing structures on the railway track as possible mitigation measures and to suggest any change if required to make them more suitable for animal use. The scope of constructing additional mitigation structures based on topography, probability of animal movement and engineering constraints was discussed in field.

Identification of potential animal crossing zones

A. Use of camera traps

***Introduction*:**

To identify animal (mammal) crossing zones along the railway, we carried out camera trapping along the study section of the railway track i.e., from Tinaighat to Caranzol railway station between Goa-Karnataka border (chainage 12/000 to 29/900).

We deployed 44 camera traps all along the study section for a period of 15 days (20.11.2020 to 4.11.2020; Figure 7). Camera traps were deployed on animal trails, or trails intersecting water channels, drainage structures, and on tunnels, where possibility of animal movement was possibly high. Cuddeback C1 (white flash) cameras were used for the exercise that were set to capture interval of 3s (minimum interval) to maximise animal captures. We attempted to deploy one camera trap every 250 m of the track length, however additional camera traps were also deployed if more than one potential site was observed within 250 m. Camera traps were not deployed along railway track sections with retaining walls, steep slopes and human habitation on either side.

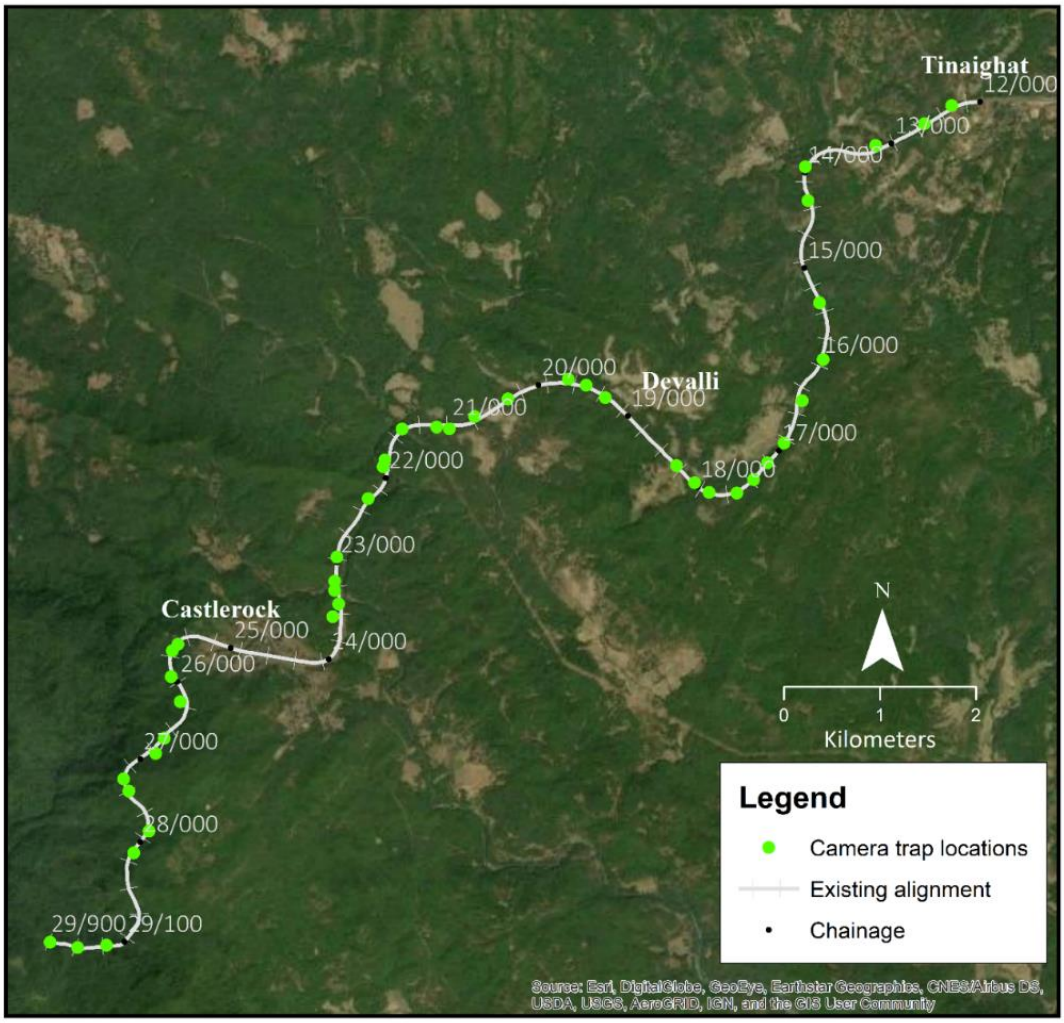

Figure 7: Locations of camera traps deployed during the present study along the existing railway track on the Tinaighat-Castlerock-Caranzol section (Chainage 12/000 – 29/900) from 20.11.2020 - 04.12.2020

Analytical methods:

The images retrieved from the camera traps were arranged into folders identified by the corresponding camera IDs. The images were then sorted into folders identified by the name of the species. We also classified images of human and related activities viz. humans, dogs, cattle, railway personnel separately. A record table of the data was then generated using package CamtrapR (Niedballa et al, 2016) on statistical software RStudio (Version 4.0) using function 'recordTable'. The function uses the EXIF information of an image to generate a table containing information about the camera ID, species captured, date and time of capture, and other ancillary information. The table was then used to summarise the results of the exercise.

We further used the function 'detectionMaps' to generate a spatial view of species-specific captures at the camera trapping points, by integrating information from the record table and a camera table containing the GPS locations of the camera traps. A species-wise and composite map of spatial capture history was thus generated.

Results & Discussion

We recorded 156 photo captures of 17 mammal species over a period of 660 trap nights (15 days x 44 cameras). The species captured include the endemic brown palm civet or Jerdon's palm civet (*Paradoxurus jerdoni*), ungulates such as gaur (*Bos gaurus*), chital (*Axis axis*), sambar (*Rusa unicolor*), mouse deer (*Moschiola indica)* and wild pig (*Sus scrofa*), carnivores such as leopard (*Pathera pardus*), jackal (*Canis aureus*), wild dog (*Cuon alpinus*), Small Indian civet (*Viverricula indica*), side-striped mongoose (*Herpestes vitticollis*) and black-naped hare (*Lepus nigricollis*) (Table 6; Figure 8 a-l). Humans and associated species such as livestock and dogs were also captured in certain areas.

Table 6: Summary of wild animal species captured during the camera trapping exercise conducted during the present survey from 20.11.2020 - 04.12.2020.

S. No.	Species	Captures
1.	Barking deer	6
2.	Bonnet macaque	8
3.	Brown palm civet	2
4.	Chital	7
5.	Gaur	8
6.	Black-naped Hare	15
7.	Jackal	2
8.	Langur	7
9.	Leopard	9
10.	Leopard cat	1
11.	Side-striped mongoose	3
12.	Mouse deer	14
13.	Porcupine	26
14.	Sambar	22
15.	Small Indian civet	8
16.	Wild dog	2
17.	Wild pig	12
18.	Unidentified	4
	Total	156

Black-naped hare and porcupine were the most frequently captured small mammal species, while sambar and mouse deer were the most frequently captured ungulate species. While chital was captured predominantly in the railway section where surrounding terrain was flat (Tinaighat area), sambar presence was widespread. Mouse deer captures were mostly obtained from in/near the Castlerock Sanctuary area. Wild pig captures were obtained from areas near agricultural fields (Figure 9 a-q).

An interesting finding was the capture of six mammals on the camera trap deployed on top of a tunnel (Tunnel 1 towards Caranzol from Castlerock station). These included large mammals such as gaur, sambar and leopard, and other species such as mouse deer, barking deer and porcupine. This indicates that tunnels and tunnel-like features (overpasses) would provide an undisturbed, unobstructed, and natural passage above a railway track.

Figure 8 (a – f): Camera trap images of mammals captured during the camera trapping exercise: a. Barking deer, b. Brown palm civet, c. Chital, d. Gaur, e. Jackal, f. Leopard.

Figure 8 (g – l): Camera trap images of mammals captured during the camera trapping exercise: g. Side-striped mongoose, h. Mouse deer, i. Sambar, j. Small Indian civet, k. Wild dog, and l. Wild pig.

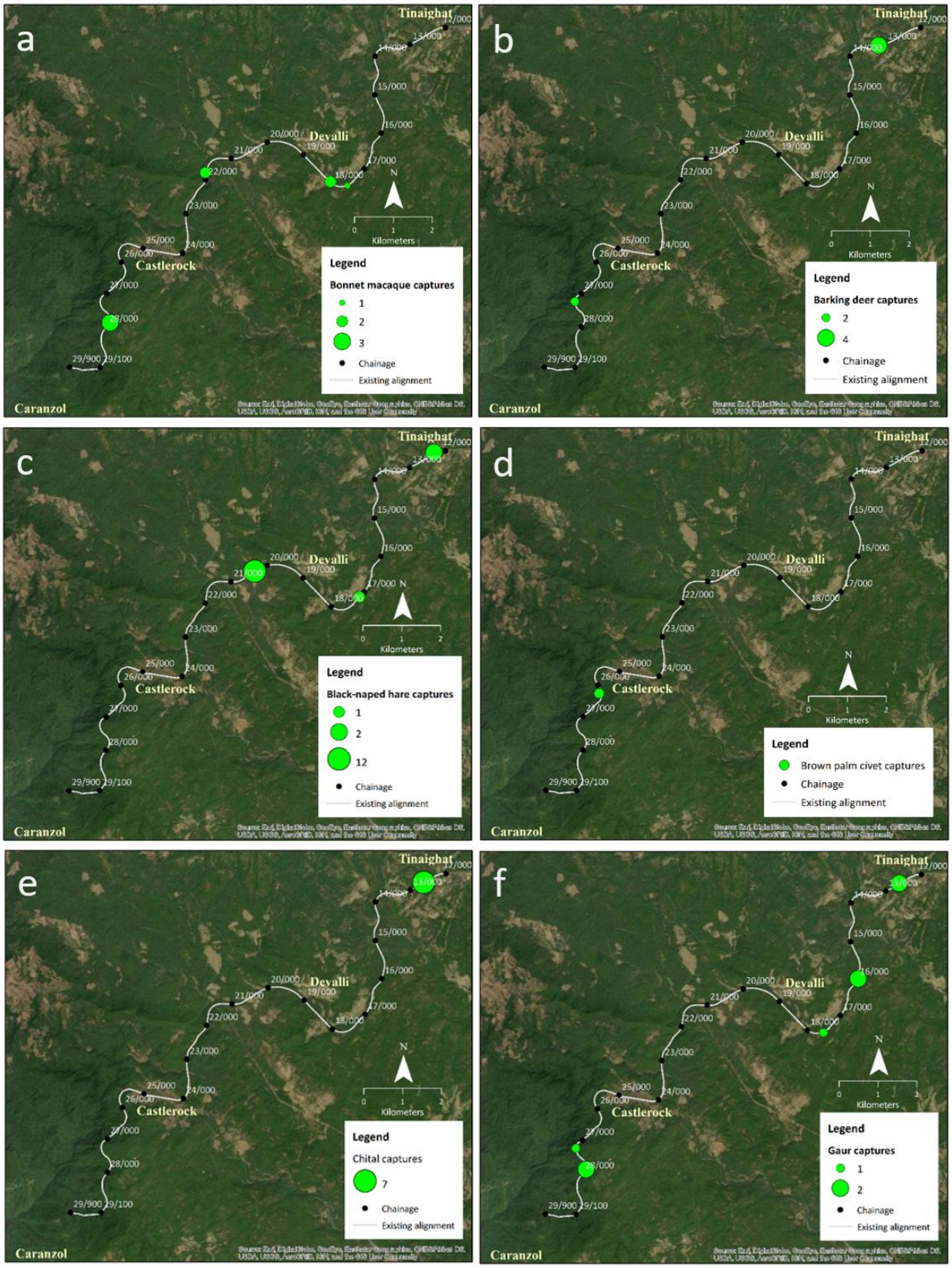

Figure 9 (a – f): Spatial detection maps of mammals captured during the camera trap survey: a. Bonnet macaque, b. Barking deer, c. Black-naped hare, d. Brown palm civet, e. Chital, f. Gaur.

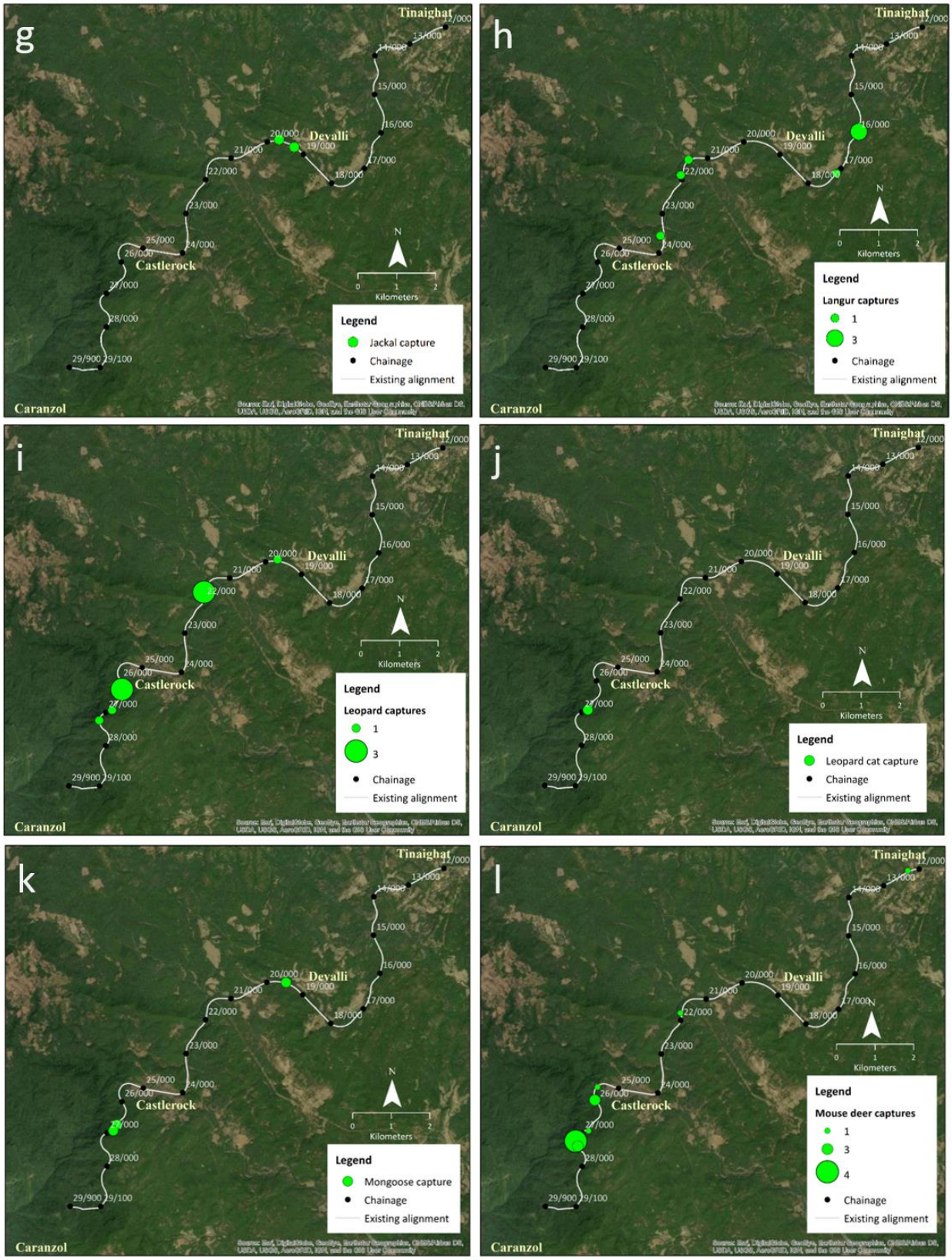

Figure 9 (g – l): Spatial detection maps of mammals captured during the camera trap survey: g. Jackal, h. Langur, i. Leopard, j. Leopard cat, k. Side-striped mongoose, l. Mouse deer.

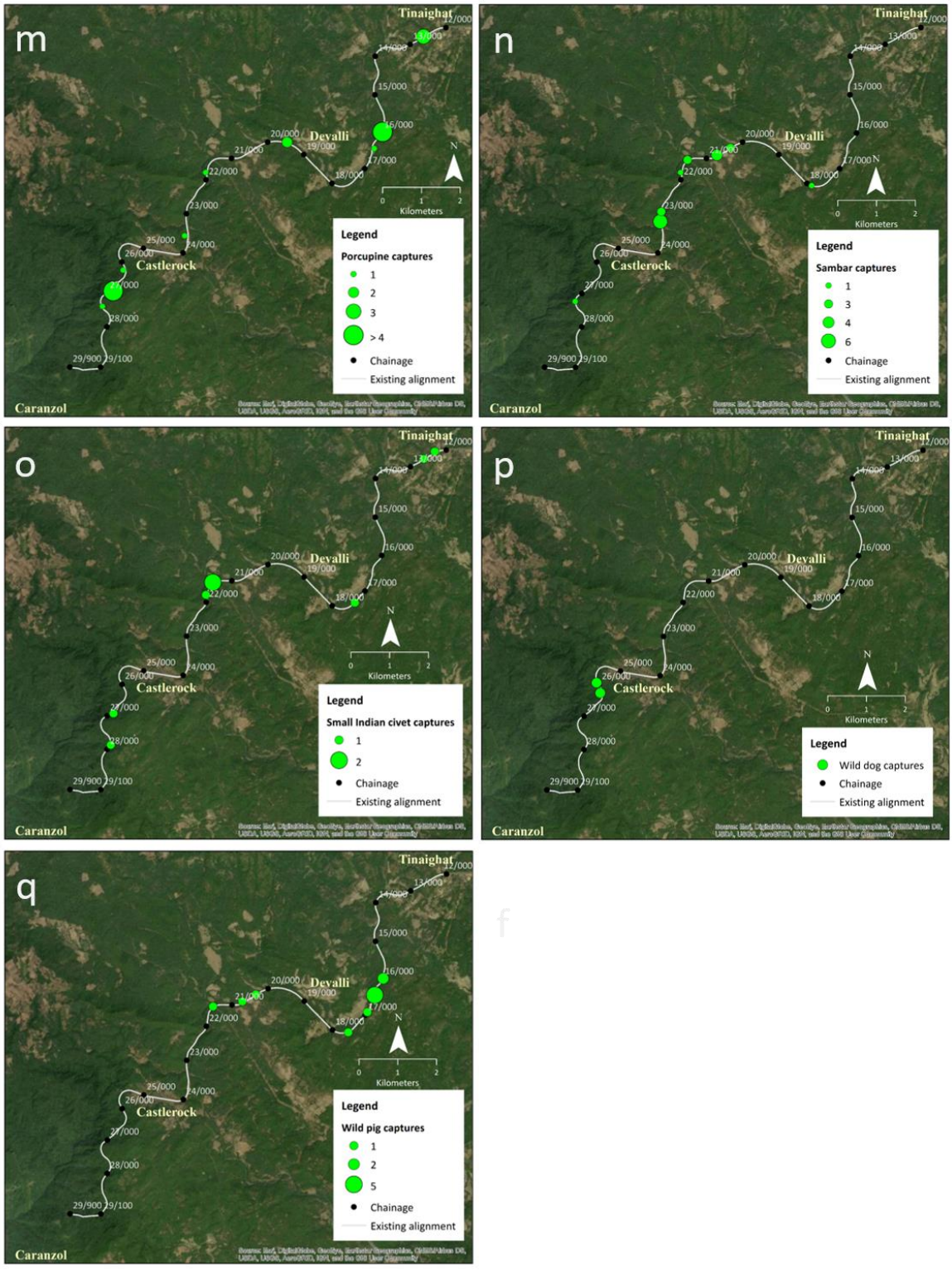

Figure 9 (m – q): Spatial detection maps of mammals captured during the camera trap survey: m. Porcupine, n. Sambar, o. Small Indian civet, p. Wild dog, and q. Wild pig.

B. Plot-based sampling for indirect animal signs

Field Methods:

The rapid survey to suggest mitigation measures against the proposed doubling of railway track was carried out between Tinaighat and Caranzol stretch (25km). To understand habitat characteristics, we laid circular plots of 10 m radius along forest edge on both side of the railway track. We also laid plots along forest trails across the tracks. The circular plots were laid every 200m apart on either side of the track for the 25 km stretch (Figure 10 a-b). Along the trail a maximum of three plots were laid every 50 m apart. We looked for the presence of any mammalian signs (e.g., scats, pellets, pug mark/hoof mark/footprint, scratch mark) in each of the circular plots. We also noted the tree cover, shrub cover, ground cover estimates and other factors influencing animal presence.

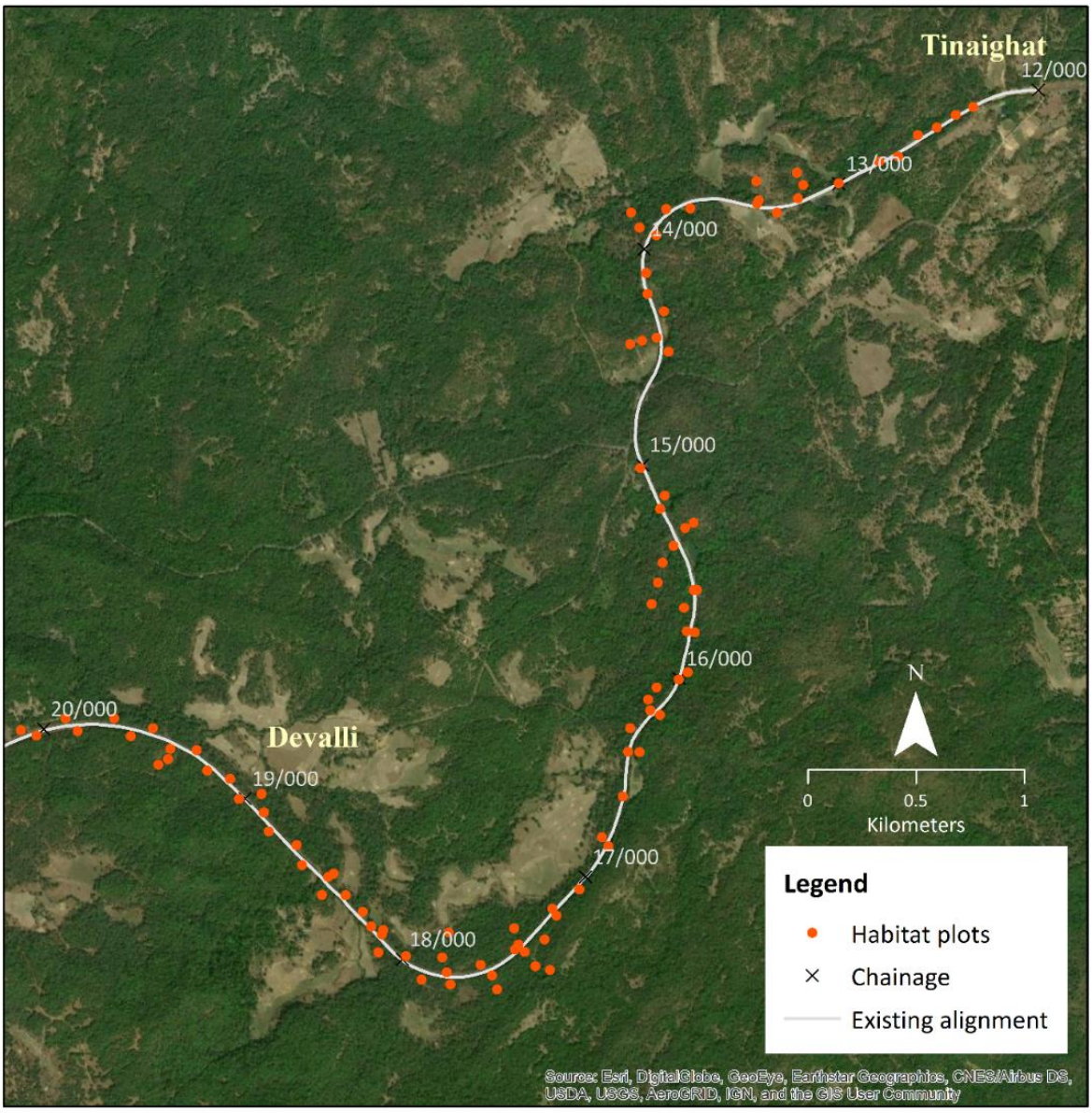

Figure 10 (a): Locations of plots along railway track for recording habitat and vegetation characteristics, and animal signs between chainages 12/000 and 20/000 during the present survey from 19.11.2020 – 04.12.2020.

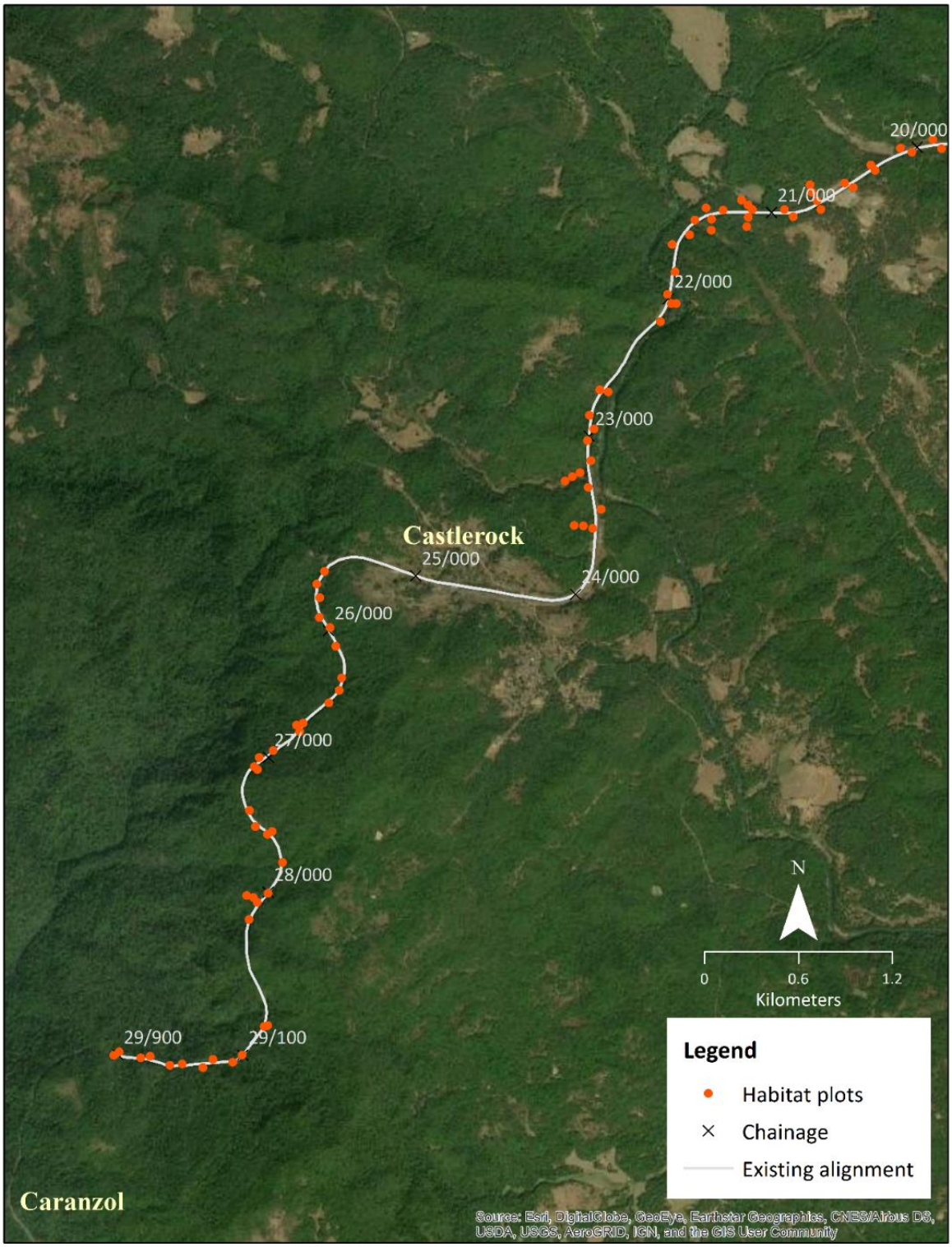

Figure 10 (b): Spatial location of plots along railway track for recording habitat and vegetation characteristics, and animal signs between chainages 20/000 and 29/900 during the present survey from 19.11.2020 – 04.12.2020.

Analytical methods:

To understand species-habitat relatioship, we analysed species presence and pellet count data as a surrogate for abundance along the forest edge of the existing railway track. We calculated the euclidean distance from each plot to the railway track and to human settlements. We then averaged the distance of species presence for all major species found in the plots. We also analysed the species presence data with respect to slope to understand the configuration of terrain in species distribution along the track. For analysis, we used species presence, pellet count data, species distance from the railway track, human settlement, and slope to see the correlation between species-habitat relationship with respect to railway track. We did non-metric multidimensional scaling (NMDS) analysis of ordinal data. NMDS is an indirect gradient analysis approach that produces an ordination based on a distance or dissimilarity matrix. All the data analysis was carried out in program R 3.6.3 (R Core Team, 2020).

Results and Discussion

A total of 203 animal signs across 12 mammal species on 175 habitat plots were recorded. The spatial detection maps of species whose indirect signs were most recorded in habitat plots along the railway track are shown in Figure 11. Along the Tinaighat-Caranzol section, the total number of species presence and frequency of occurrence are shown in the Figure 12. The abundance of pellet count was found to be higher for sambar, followed by porcupine and was least for gaur. However, gaur was found to use areas close to the railway track followed by porcupine and sambar respectively (Figure 13). A three-dimensional graphical plot of species pellet abundance with respect to the human settlement and distance to the existing railway line is given in the Figure 14. Gaur used areas close to the railway track with average distance of 10 m followed by porcupine and sambar, respectively. The relationship between species presence with respect to distance to railway track and human settlement was found to be highly correlated (non-metric fit: R^2 = 0.98). Similarly, when we did NMDS for species presence with respect to slope, porcupine used areas with flat terrain (0°-10° slope). For gaur it used area with gentle slope of between (20°-40°) while sambar used areas with moderate slopes of between 40°-60° (Figure 15). It is evident from our results that species such as gaur, sambar, and porcupine are present in terrain with gentle to moderate slopes and uses area around railway track more frequently as compared to other species in the landscape. Gaur being the most abundant species found close to the railway track, it should be considered as priority species for mitigation along the railway track.

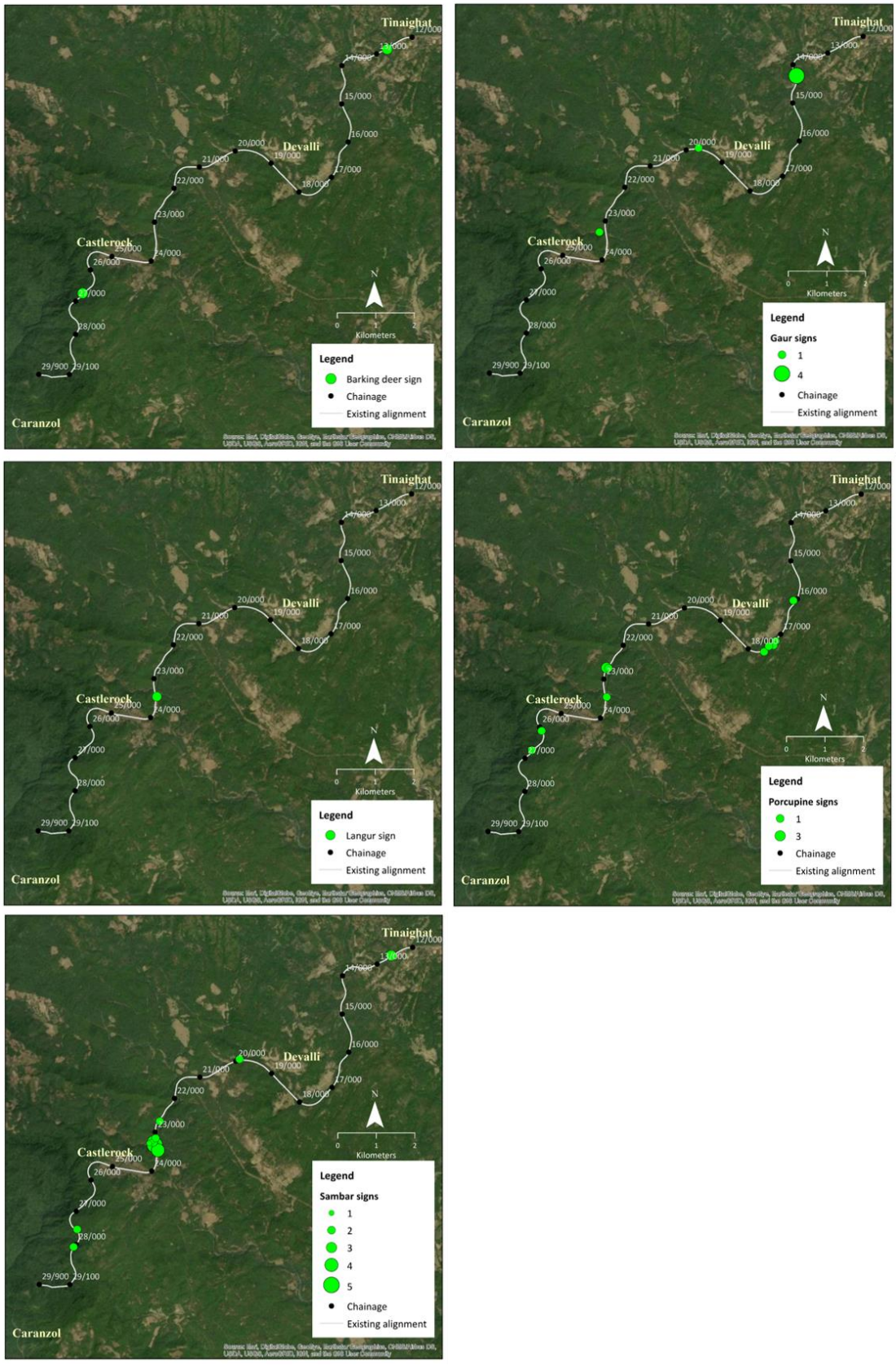

Figure 11. Spatial detection maps of species whose indirect signs were most recorded in habitat plots laid along the railway track between Tinaighat-Castlerock-Caranzol section during 19.11.2020 – 04.12.2020

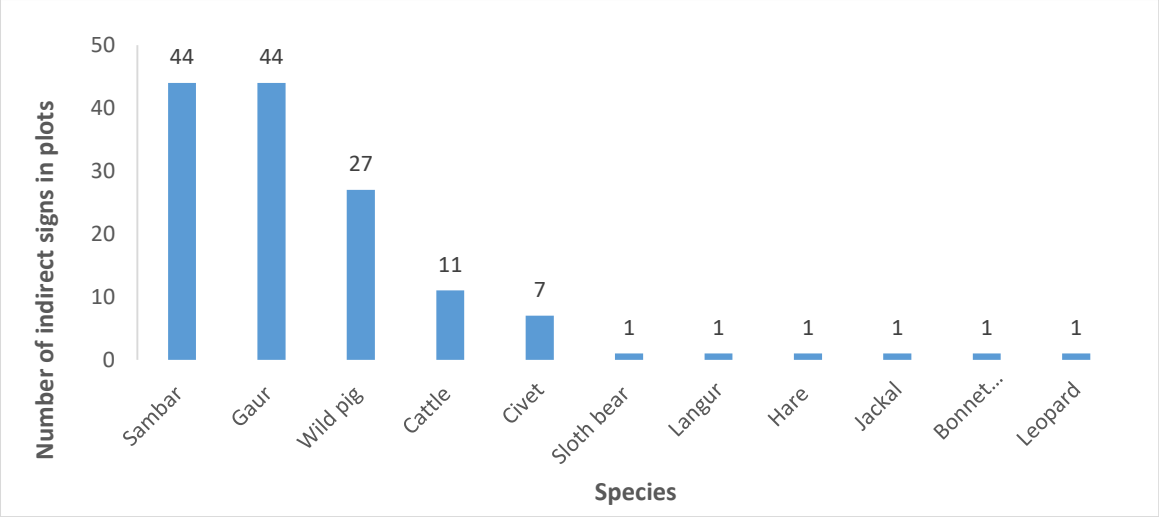

Figure 12. Number of indirect signs of mammalian species found along the forest edge plots between Tinaighat-Caranzol railway line stretch

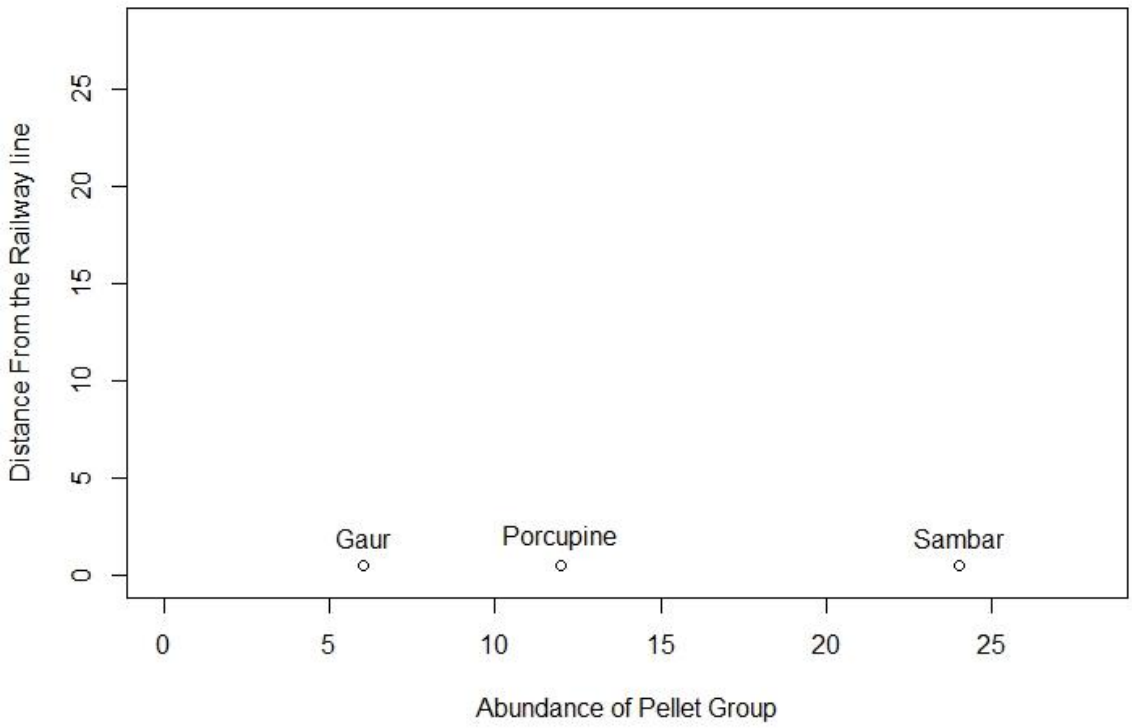

Figure 13. Pellet abundance along the forest edge with respect to the distance to existing railway line between Tinaighat-Caranzol sections

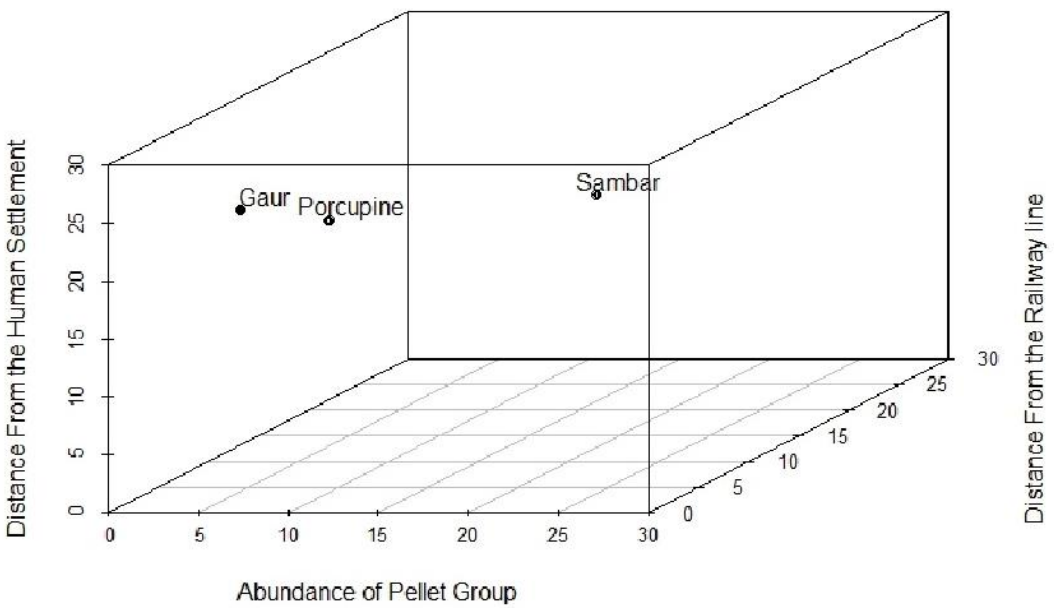

Figure 14. A three-dimensional plot of species presence with respect to the human settlement and distance to the existing railway line between Tinaighat-Caranzol section

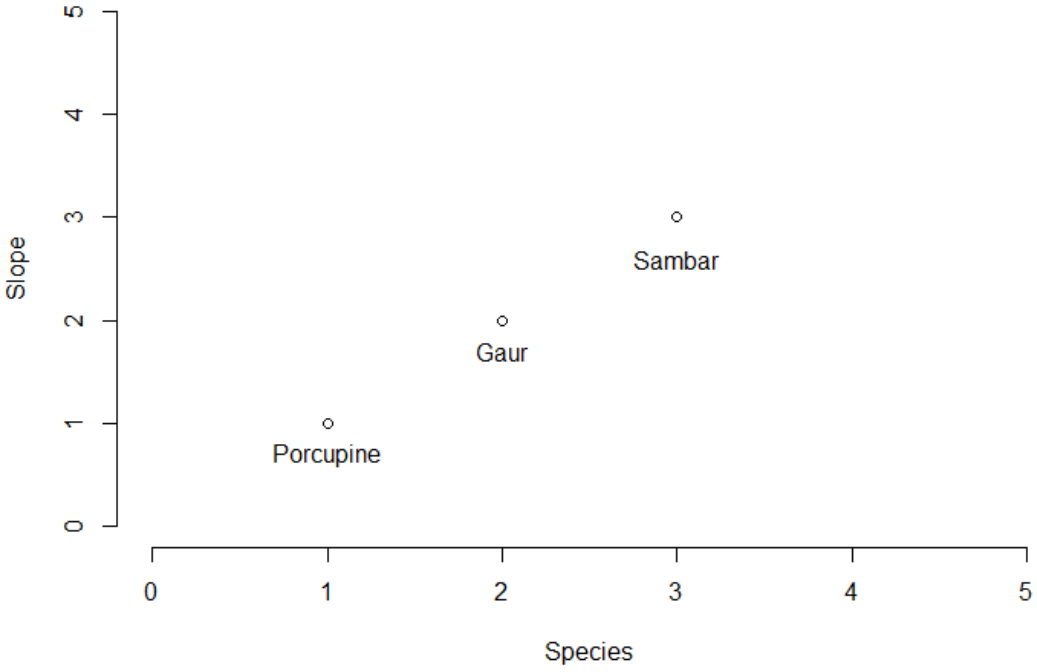

Figure 15. Species presence with respect to slope between Tinaighat-Castlerock-Caranzol Section. (Slopes are in scale of 1-5 where 0-1 flat terrain, 2-gentle slope, 3-moderate slope, 4-steep slope and 5-very steep slope).

C. Assessment of herpetofauna along railway track

We conducted a rapid herpetofaunal assessment for 15 days (19.11.2020 - 04.12.2020). The main aim of the survey was to provide effective mitigation measure for herpetofauna between Tinaighat-Castlerock-Caranzol railway track. The objectives that were fulfilled are as follows:

- Rapid assessment of herpetofaunal diversity based on visual encounter surveys and opportunistic encounters.

- To identify potentially suitable sites for herpetofaunal species alongside existing track for proposing mitigation measure.

Field Methods:

The survey was conducted along the Tinaighat (N 15.44884, E 74.39846) to Caranzole (N 15.37305, E 74.31129) railway track and its adjacent areas in Karnataka State to record species richness, diversity, relative abundance, ecological status, railway mortality of amphibians & reptiles. The study area has a composition of unique and diverse habitats from moist deciduous to semi evergreen forest structure as one descends down from Castlerock in Karnataka to Kulem in Goa. Systematic & opportunistic samplings were carried out between 18 November 2020 till 4 December 2020 which coincides with the drier season of Western Ghats. The temperature range during the study period was 19-29° C and average humidity was 70%. The areas extensively surveyed for herpetofaunal diversity is given in the Table 7.

Table 7: The areas surveyed for herpetofauna diversity taking a buffer of at least 50 m on each side of the existing railway track between Tinaighat and Caranzol railway track

Site ID	Place	GPS loc.	Habitat type
A	Nature camp- Castlerock	N 15.40065, E 74.32416	Perennial Stream
B	Castlerock (25/5) railway track to Caranzol	N 15.39995, E 74.32324	Railway track buffer land & forest edges
C	Castlerock rail-gate	N 15.40503, E 74.33783	Perennial Stream
D	Devali Underpass (17/8)	N 15.41587, E 74.37054	Perennial Stream
E	Nature Camp IB	N 15.40122, E 74.320327	Perennial stream
F	Near Duski River (21/0 chainage)	N 15.41947, E 74.3488	Perennial Stream
G	26/5 Culvert Underpass- to Caranzol	N 15.39265, E 74.32339	Perennial Stream
H	Devali Underpass (18/9)	N 15.4221, E 74.36343	Perennial stream
I	Tunnel2 (from Castlerock to Caranzol)	N 15.37436, E 74.3197	Perennial stream
J	Tinaighat Section 1	N 15.41349, E 74.37545	Railway track buffer land & forest edges
K	Tunnel 3 (from Castlerock to Caranzol)	N 15.37217, E 74.31396	Seasonal stream
L	Tinaighat section 2 (15/8 chainage)	N 15.4240, E 74.38264	Railway track buffer land & forest edges

Sampling methods:

Visual Encounter Survey: We conducted time constrained visual encounter survey (VES) (Crump & Scott,1994) for sampling of herpetofaunal species. The surveys were executed for one hour preferably from evening onwards, mostly between 1900 hrs. to 2200 hrs. (3 men/h). We concentrated search activities along all potential herpetofaunal habitats. Areas such as railway tack, forest trails, perennial and seasonal streams, temporary water pools were extensively surveyed to record the presence of individuals. All the habitat characters were also being noted down along with species encountered. For few snake species, ventral, dorsal and head scales were counted in order to aid in species level identification.

Opportunistic Survey: Opportunistic herpetofaunal sightings were also been accounted in all the localities where regular surveys were conducted. We pooled opportunistic records of amphibians and reptiles with survey data to document the maximum possible species richness of the area. GPS locations and additional habitat characters have also been noted down.

Mortality on Railway Track: Documentation of dead herpetofauna were made during the regular track assessment surveys. Amphibians and reptiles that were found dead on and aside railway tracks with certain signs (lacerations, desiccation etc.) were considered to be killed due to railway track and associated movements. All findings of dead amphibians and reptiles were photographed and georeferenced.

Identification of Amphibians & Reptiles: All the documented species were identified on field or through photographs of each species and comparing it with available literature and field guides viz. Smith (1934 & 1943), Whitaker & Captain (2004,2008), Gururaja (2012), Biju et al., (2014); Das & Kunte (2005).

Analytical methods:

Species abundance, richness, encounter rates were calculated with habitat characteristics. Diversity index such as Shannon's diversity index, Simpson's diversity index and species accumulation curve for all the species were also calculated. All data were analysed in R studio (version 3.4.1).

Results

Total 13 surveys were conducted from Tinaighat-Castlerock-Caranzol in 12 selected sites. Altogether 39 man-hours of efforts were dedicated for visual encounter surveys (Table 8). We encountered maximum counts of 198 individuals and 13 species of herpetofauna amongst all the sites.

Diversity indices such Shannon's and Simpon's Index were also enumerated to show herpetofaunal assemblages (Table 9). Species accumulation curve (Figure 16) shows that the species richness has not reached asymptote. X- axis in the following graph denotes number of sites surveyed (i.e., Site "A" =1, Site "B" = 2, Site "C" = 3 etc.).

Table 8: Effort of Visual Encounter Survey (VES) along the Tinaighat-Castlerock-Caranzol railway line section

Site ID	Number of surveys	Person-hours	Number of individuals	Number of species
A	2	6	103	13
B	1	3	14	5
C	1	3	64	9
D	1	3	198	8
E	1	3	21	8
F	1	3	186	9
G	1	3	30	11
H	1	3	78	12
I	1	3	115	11
J	1	3	19	13
K	1	3	15	5
L	1	3	20	6

Table 9: Diversity Index (DI) of herpetofauna from all survey sites from Tinaighat- Castlerock-Caranzol section.

Site	Species Richness	Species Encounter Rate	Individuals Encounter Rate	Shannon's Index	Simpson's Index
A	13	2.17	16.67	1.91	0.81
B	5	1.67	4.67	1.53	0.77
C	9	3.00	22.00	1.67	0.76
D	8	2.67	66.00	0.95	0.52
E	8	2.67	8.00	1.89	0.82
F	9	3.00	61.67	1.02	0.44
G	11	3.67	9.67	2.08	0.84
H	12	4.00	24.00	1.22	0.47
I	11	3.67	38.00	1.35	0.62
J	13	4.33	6.33	2.35	0.88
K	5	1.67	5.00	1.2	0.6
L	6	2.00	7.33	1.48	0.71

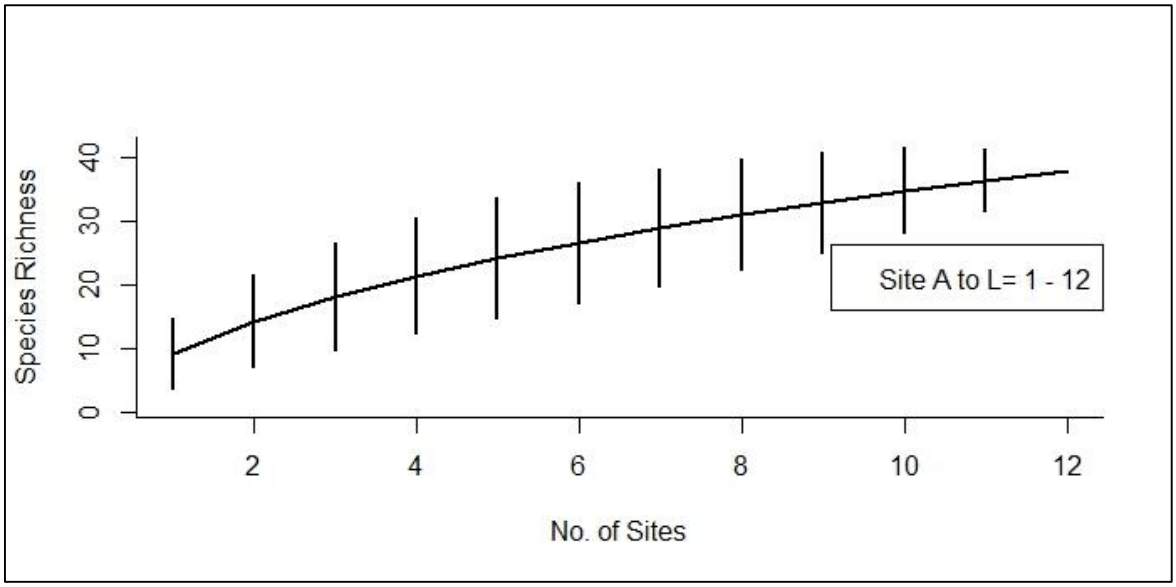

Figure 16: Species accumulation curve of herpetofauna for all survey sites between Tinaighat-Castlerock-Caranzol section.

Encounter rates of frequently sighted herpetofauna was calculated, where *Euphlyctis cyanophlyctis* was found to be most frequently recorded species among all amphibians and *Ahaetulla borealis* was recorded most frequently among all other reptiles. Whereas encounter rates for reptiles like *Monilesaurus rouxii*, *Boiga* sp. etc. were very less during the survey period (Table 10).

Table 10: Encounter rate of herpetofaunal species recorded during survey between Tinaighat- Castlerock-Caranzol

Species	No. of individuals per man-hour effort
Raorchestes bombayensis	1.67
Pseudophilautus. cf. *amboli*	0.13
Nyctibatrachus petraeus	1.28
Indosylvirana cf. *caeseri*	2.36
Indirana cf. *salelkari*	2.41
Indirana cf. *chiravasi*	0.13
Micrixalus cf. *uttaraghati*	0.41
Minervarya cf. *kudremukhensis*	1.64
Minervarya cf. *caperata*	0.51
Minervarya cf. *sahaydris*	0.03
Fejervarya sp.	0.05
Euphlyctis cf. *cyanophlyctis*	9.21
Clinotarsus curtipes	0.54
Hydrophylax malabaricus	0.18
Uperodon mormorata	0.05
Microhyla ornata	0.03
Polypedates cf. *maculatus*	0.15
Rhacophorus malabaricus	0.03
Hoplobatrachus tigerinus	0.03
Duttaphrynus melanostictus	0.03
Calotes sp.	0.05
Monilesaurus rouxii	0.03
Eutropis carinata	0.03
Eutropis macularia	0.03
Hemidactylus prashadi	0.13
Hemidactylus frenatus	0.03
Hemidactylus cf. *triedrus*	0.03
Cnemaspis sp.	0.03
Ahaetulla borealis	0.41
Trimeresurus malabaricus	0.13
Oligodon taeniolatus	0.03
Ptyas mucosa	0.03
Lycodon aulicus	0.03
Bungarus caeruleus	0.03
Fowlea piscator	0.08
Rhabdops sp.	0.05
Boiga sp.	0.03
Melanochelys trijuga	0.03

Discussion

Our record of herpetofaunal species is perhaps just representative and not exhaustive in the context of Western Ghats biodiversity due to following reasons-

1. The survey was conducted for a short period for 15 field days
2. The survey was restricted by a time of non-breeding season of most herpetofaunal species.

Species accumulation curve also indicates the inventory is far from complete (Figure 16). Long term and multi-seasonal survey would likely record species that are seasonal in their activity pattern, such as those in genera *Pedostibes*, *Rhacophorus, Sphaerotheca,* Caecilians (such as *Indotyphlops*) *Calliophis, Uropeltis* etc. During our study, 47 species of herpetofauna belonging to 23 species (19 genera and 10 families) of amphibians and 24 species (19 genera, 8 families) of reptiles were recorded (Annexure-I; see Figures 18 and 19). Out of these reptilian diversity family, Colubridae dominated the species list (10 spp.) followed by family Gekkonidae (5 spp.) (Annexure-I), whereas in case of amphibian diversity, family Dicroglossidae (6 spp.) were majority followed by family Rhacophoridae (5 spp.) (Annexure-I).

Our systematic sampling of VES along the railway track has revealed that perennial and seasonal streams, ephemeral water bodies were by far most crucial habitats for herpetofauna in terms of species richness, encounter rates and diversity indices. The maximum species diversity (13 spp.) recorded was from both Site A and Site J (Table 9). In terms of individual encounter rate, site- D (66/man-hour) was highest followed by site- F (61/man-hour) and site- I. Our analysis also showed that most diverse survey area was site- J (H= 2.35, D= 0.88), followed by site G (H=2.08, D= 0.84) and site- A (H=1.91, D= 0.81) [Table 9]. All these values suggest that streams and waterbodies from sites “A”, “C”, “F”, “G”, “H”, “I” are particularly important with respect to all amphibian species and few specific reptile species who are largely dependent on these kinds of water bodies for their various ecological needs.

During our surveys, *Euphlyctis cyanophlyctis* was found to be most common amphibian species based on encounter rate (9.2/man-hour), followed by *Indirana* sp. (2.4/man-hour), *Indosylvirana* sp. (2.3/man-hour) etc. among all sites. However, record of most of the reptile species were based on single individual sighting. Although, *Ahaetulla borealis* was most frequently encountered (0.4/man-hour) among all other reptiles, followed by *Trimeresurus malabaricus* (0.12/man-hour) (Table 10).

Niche preferences of encountered herpetofauna

Amongst the recorded herpetofaunal diversity 43% of the species (14 spp.) were found to be along the streams and its riparian zones (Figure 17). Streams and riparian habitats are important specifically for amphibians and also for few species of reptiles. All these stream and waterbodies lie in near vicinity (≤50 meter) to the existing railway track and some streams are even passing the railway line through culverts.

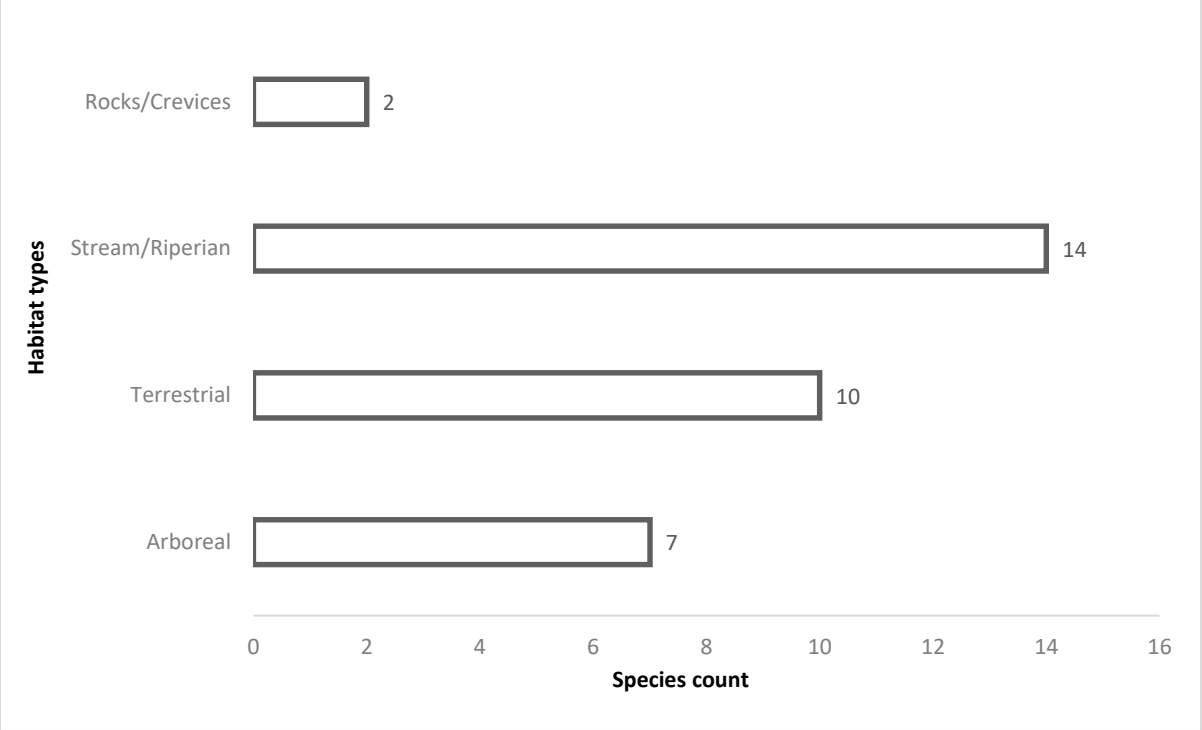

Figure 17: Encountered niche of all recorded herpetofauna during our survey between Tinaighat-Castlerock-Caranzol section

***Opportunistic herpetofaunal encounters on railway tracks**:*

Total 12 species of herpetofauna (6 spp. of amphibians, 6 spp. of reptiles) were recorded (Annexure-II; Figure 20). Species wise, snake was the maximum rail killed taxa, and in terms of individualistic count *Indosylvirana* sp. has been frequently encountered (5 individuals) as rail kill. Snakes were found to be most frequently killed on the railway track, as they may be using the track (warm railway lines, sleepers etc.) for thigmothermy (mode of passive thermoregulation). Our preliminary investigation is just indicative but not exhaustive of the actual rail kill scenario which could be much higher during rainy season. The highest representative (as in no. of individuals) of *Indosylvirana* appearing as a rail kill is perhaps due to their ongoing breeding season which we have encountered in our stream survey. This reflects a snapshot of the scenario where more number individual of a species might face unfortunate death on railway tracks during their respective breeding seasons.

It is fairly understandable from our survey results that all streams along the railway tracks are of paramount importance due to its habitat heterogeneity and species assemblages. Streams serve as breeding ground for many species of amphibians (for endemics such as e.g., *Nyctibatrachus petraeus* etc; Willaert et al., 2016) and niche for several species of snakes found over here. Species that are rather widespread in the landscape and relatively abundant species such as *Indosylvirana* sp., *Indirana* sp., *Clinotarsus* sp. etc. are vulnerable to railway traffic throughout the season impacting their population by way of restricting adult migration and juvenile dispersal. The species that are also prone to get killed on railway tracks are mostly snakes, that are using it as a surface for thermoregulation. Railway tracks may also serve as death traps for those animals that are less vagile and might get desiccated while trying to cross the stretch of railway line (for e.g., Caecilians; Figure 18).

Doubling of railway track will significantly impact in habitat loss that are along the existing railway lines. Associated impacts of this extension might indirectly impact on species that are dependent on auditory

clues for breeding activities as traffic related noise known to create auditory masking in amphibians (Bee et al., 2017).

Pollution and diversion of streams, due to construction of railway tracks and additional effects might lead to modification of habitats to an extent, where it can impose negative impacts for amphibians and reptiles that were inhabiting closer to railway tracks and are microhabitat specific. Western Ghats being global biodiversity hotspot, serious efforts need to be provided for minimizing the impact of any developmental activities that may directly or indirectly impact any native fauna (Vide Chapter- 4 Suggested Mitigation measure).

Figure 18: Amphibians of Castlerock (**A:** *Clinotarsus curtipes*, **B:** *Hydrophylax malabaricus,* **C:** *Nyctibatrachus petraeus,* **D:** *Indosylvirana* cf *caeseri*, E: *Pseudophilautus amboli,* **F:** *Indirana* sp., **G:** *Polypedates maculatus,* **H:** *Gageneophis* sp).

Figure 19: Reptiles of Castlerock (**A:** *Hebius beddomei*, **B:** *Oligodon taeniolatus*, **C:** *Hypnale hypnale*, **D:** *Ahaetulla borealis*, **E:** *Trimeresurus malabaricus*, **F:** *Melanochelys trijuga*, **G:** *Hemidactylus* cf. *triedrus* , **H:** *Monilesaurus rouxii*).

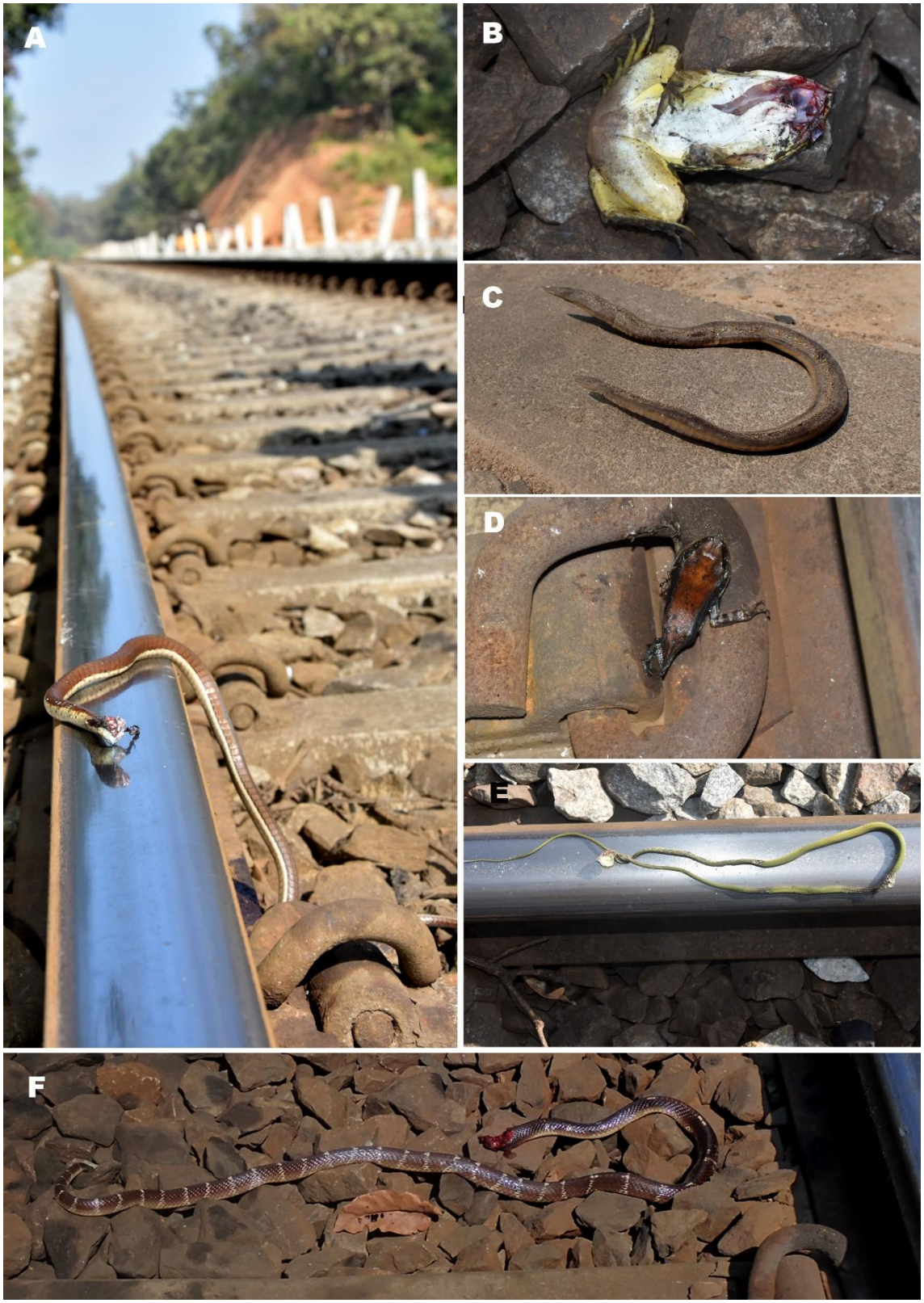

Figure 20: Snapshot of rail killed herpetofauna (**A.** *Dendrelaphis* sp., **B.** *Hoplobatrachus tigerinus.*, **C**. *Ichthyophis* sp. (dessicated), **D.** *Hydrophylax malabaricus*, **E.** *Ahaetulla borealis,* **F.** *Bungarus caeruleus*).

D. Assessment of indirect animal signs through opportunistic data

During the course of the survey, we also recorded opportunistic data viz., animal signs, sightings and rail/road mortality encountered during track surveys, as well as data from the Forest Department of Karnataka viz., rail mortality records and camera trap captures of mammals near the railway track. These data points were plotted and further used to identify potential animal crossing zones along the existing railway track (Figures 21, 22 and 23). Amphibian and reptile mortality data collected during the survey were also used.

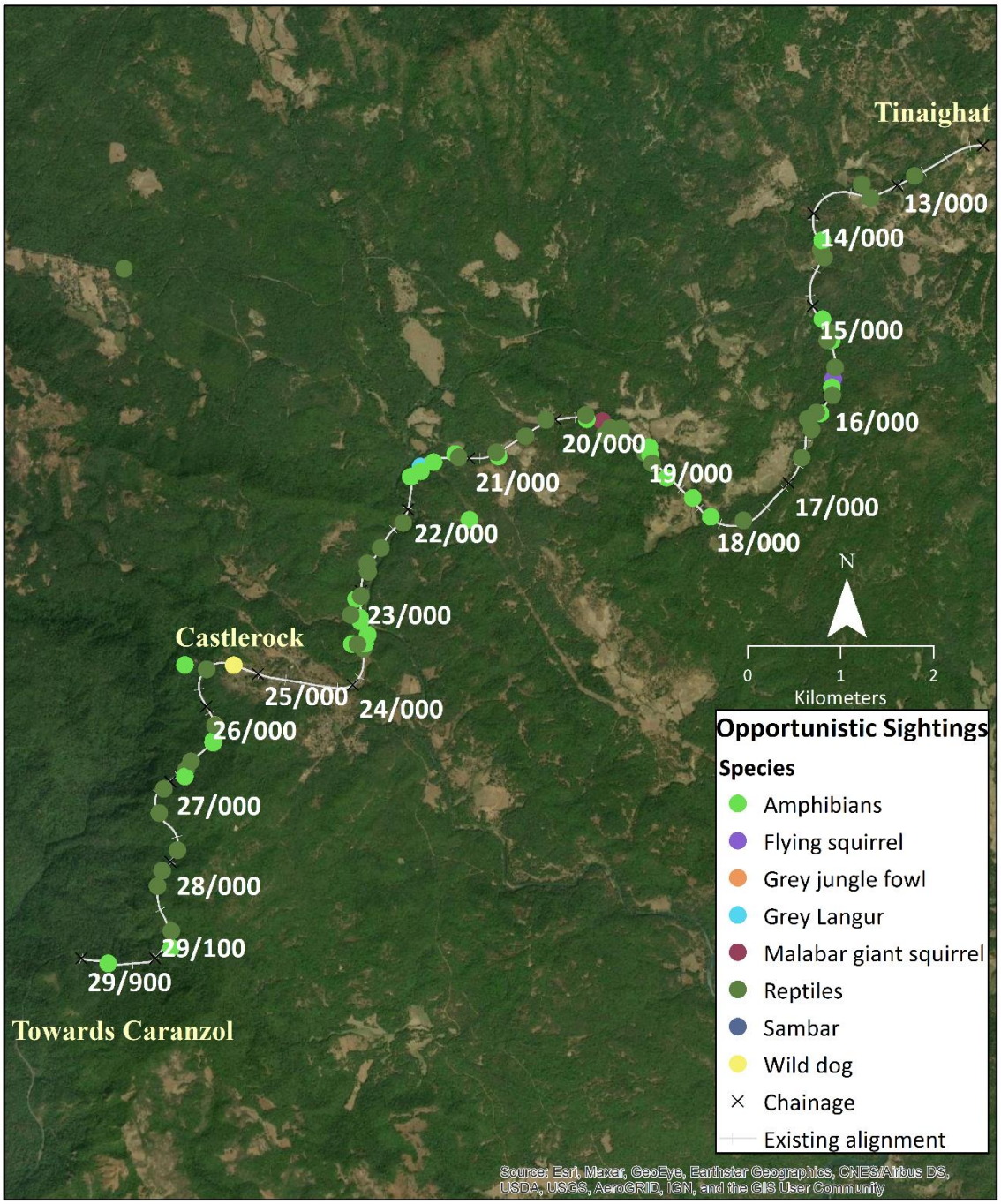

Figure 21: Opportunistic sightings of species recorded during the survey from Tinaighat to Caranzol section between 19.11.2020 – 04.12.2020

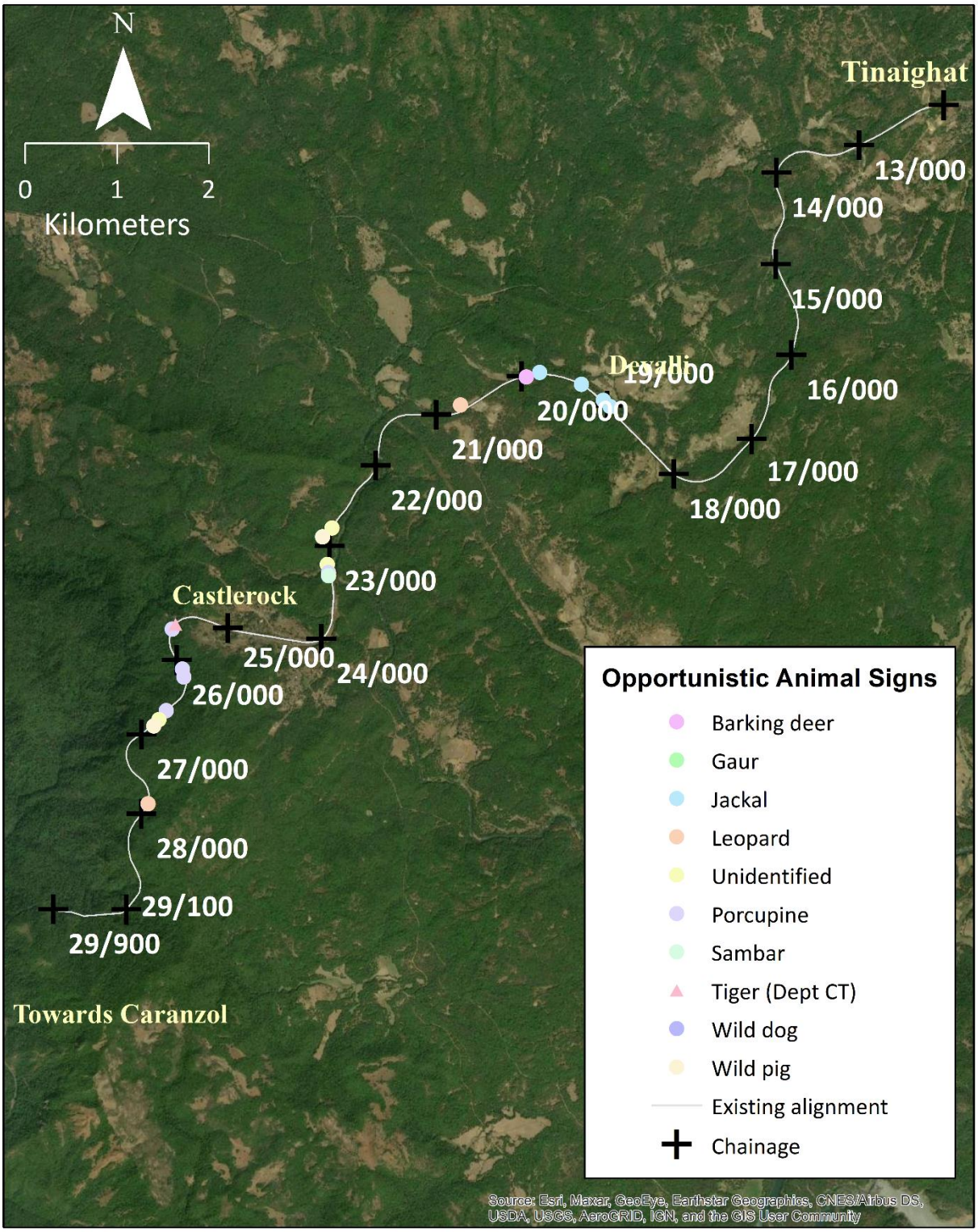

Figure 22: Opportunistic indirect signs recorded during the survey from Tinaighat to Caranzol section between 19.11.2020 – 04.12.2020. The map also includes the locations of two tiger captures obtained by camera set up by the Forest Department near the railway track.

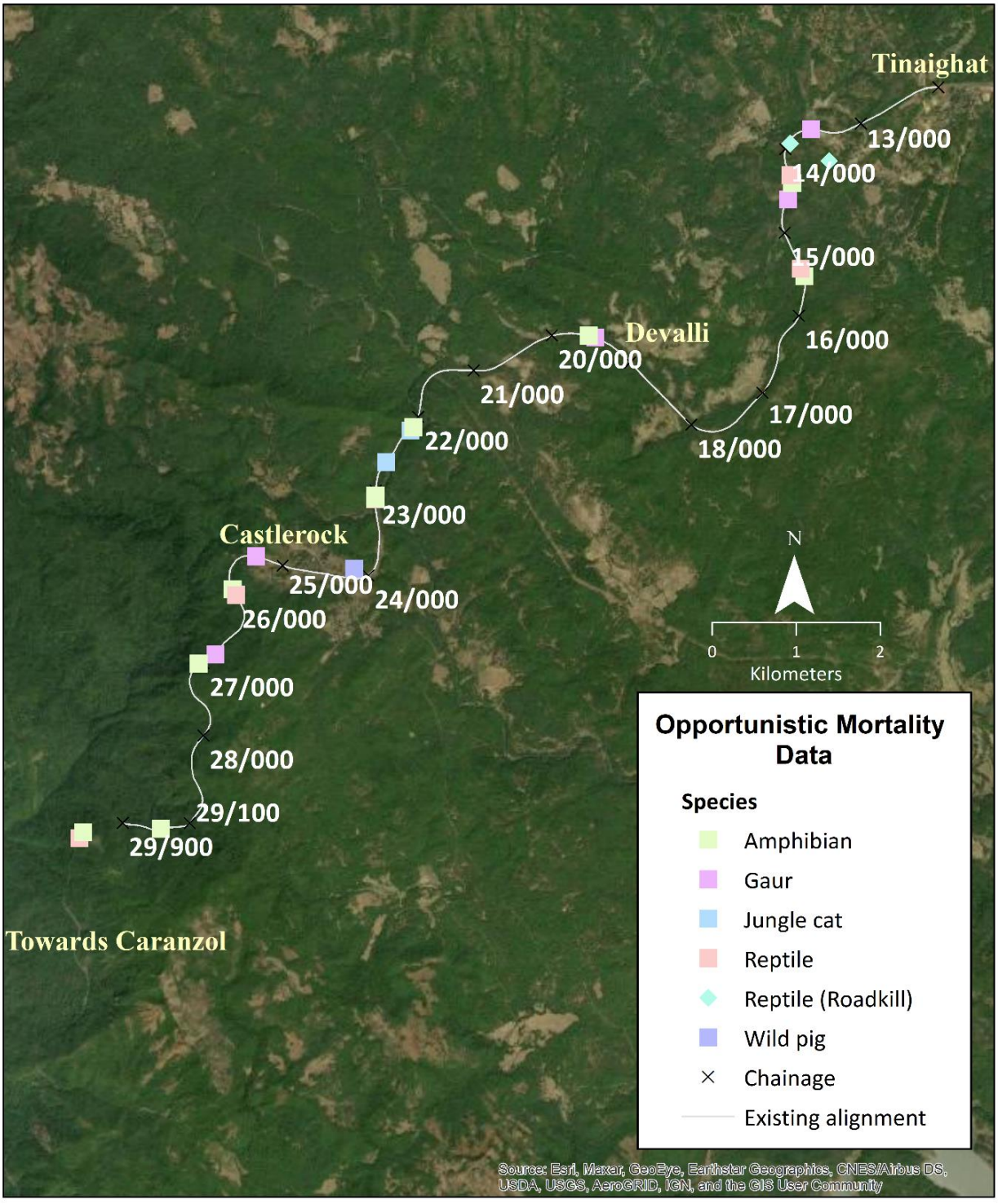

Figure 23: Animal mortality reported along the railway track and road (collected from the Karnataka Forest Department) and recorded during the survey by the team during 19.11.2020 – 04.12.2020 along the Tinaighat-Caranzol section.

Crossing Zones for Herpetofauna and Mammals along the railway track

Hotspots of animal activity/presence (herpetofauna– Figures 24 and 25; and mammals – Figures 26 and 27) were visualised by overlapping all animal signs, sightings, photo-captures and mortality data using kernel density analysis in GIS-platform. We used an optimum search radius of 150 m around each presence location to create hotspots of animal presence. These were then combined with the hotspots identified in the IISc reports (Sukumar and Sitharam, 2017), and potential animal crossing zones were thus delineated. Details of these potential animal crossing zones are given in Table 11.

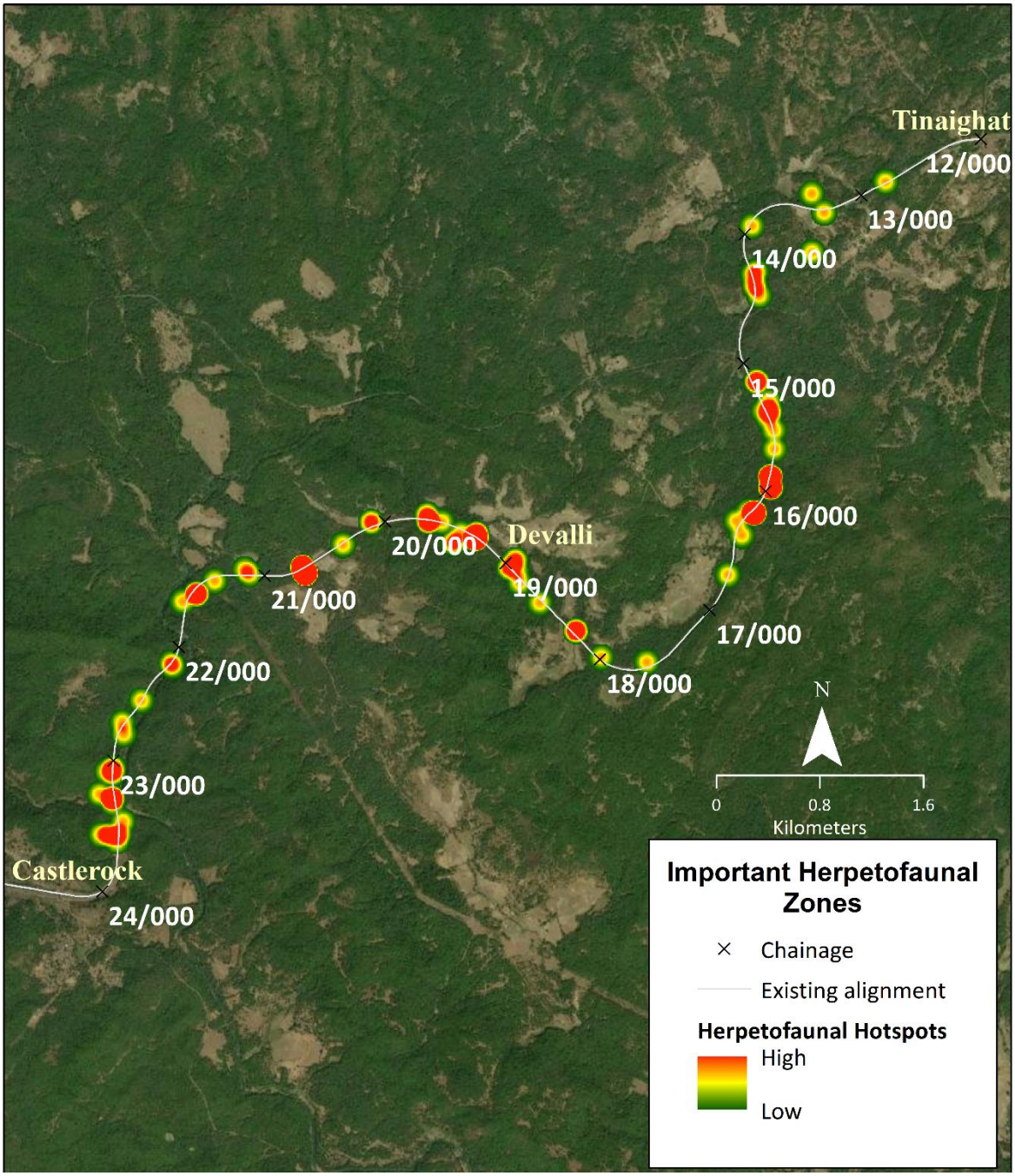

Figure 24: Herpetofaunal hotspots identified during the study on the Tinaighat – Castlerock railway section

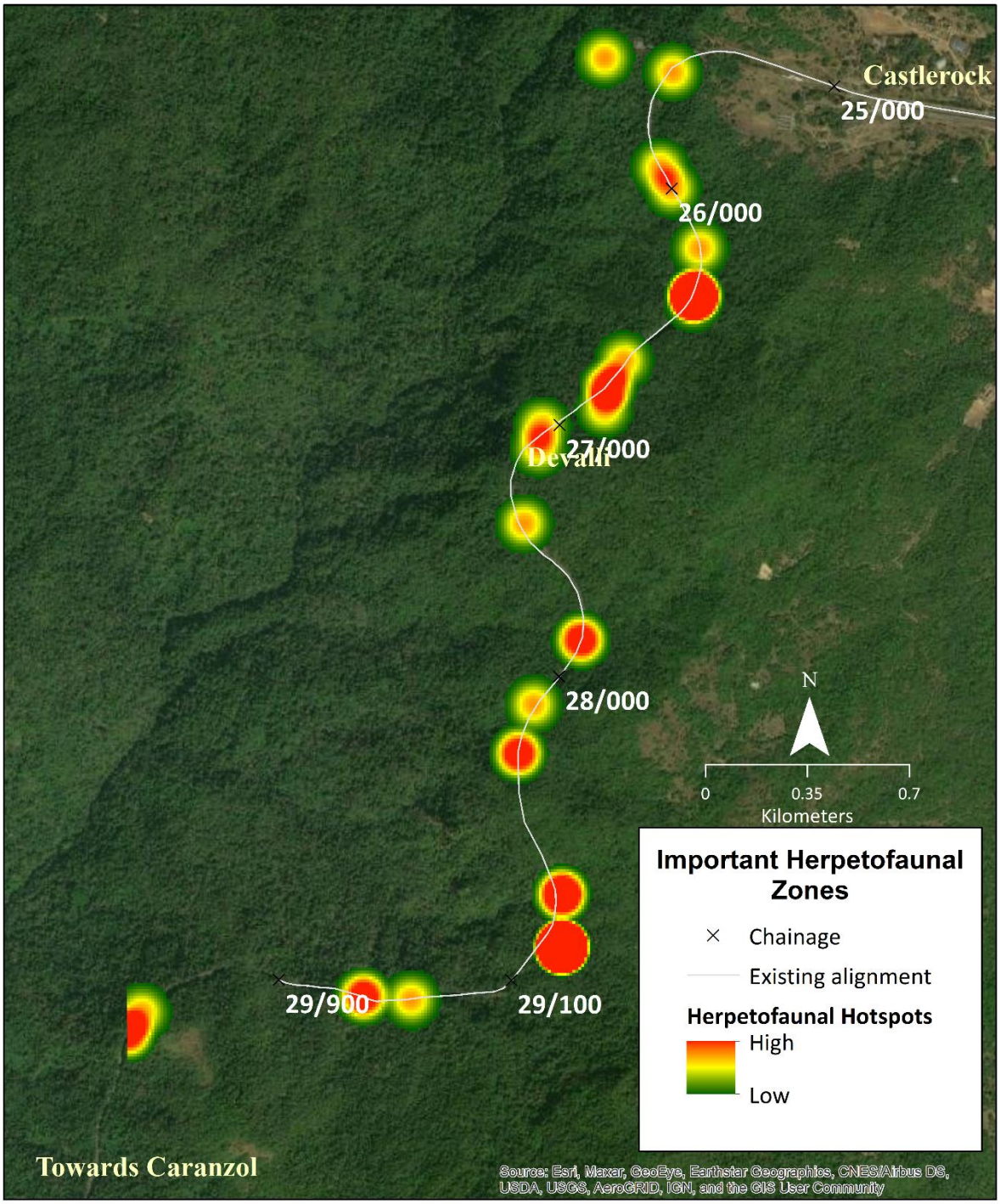

Figure 25: Herpetofaunal hotspots identified during the study on the Castlerock - Caranzol railway section

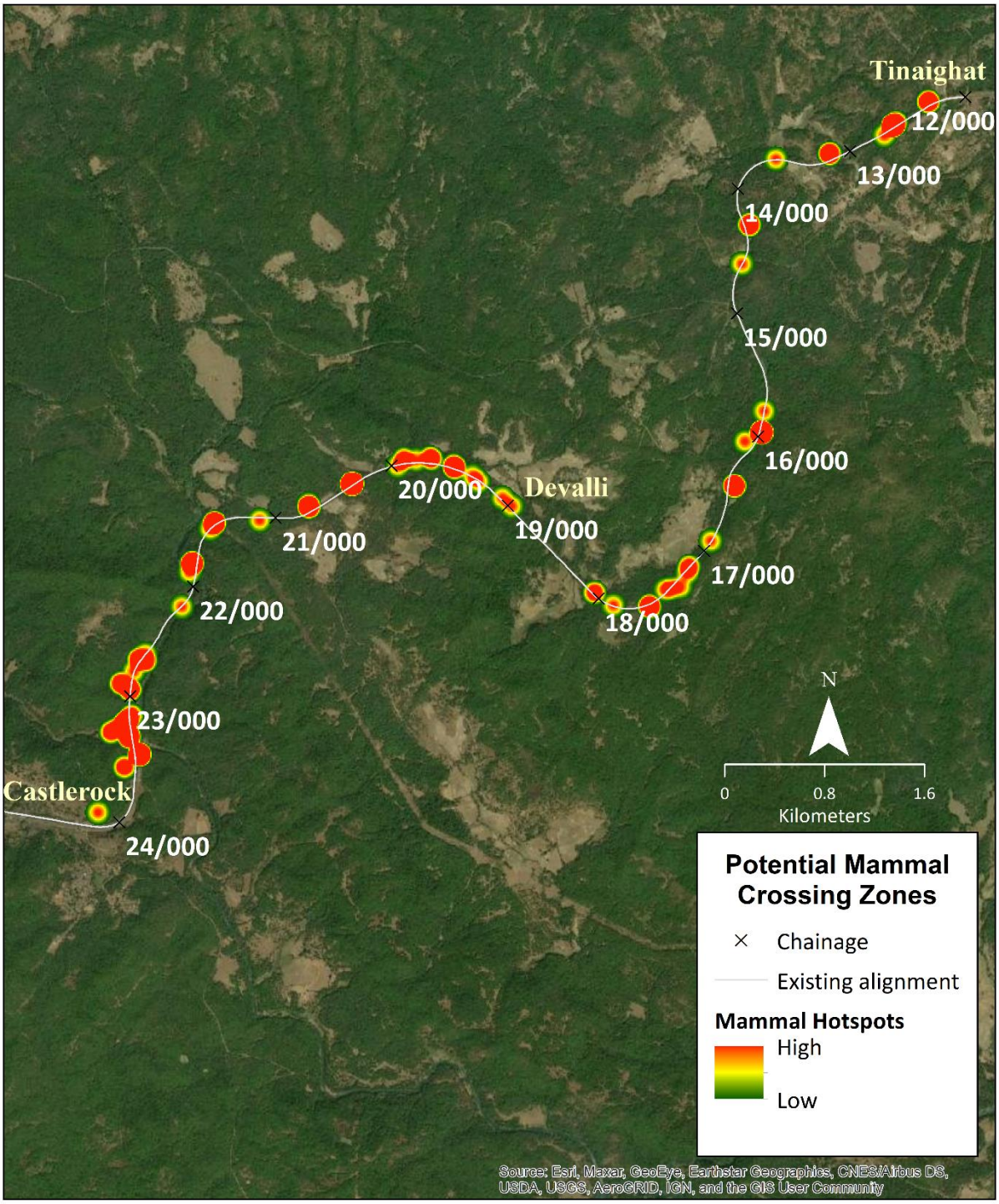

Figure 26: Hotspots of mammal presence/movement identified during the study on the Tinaighat – Castlerock railway section

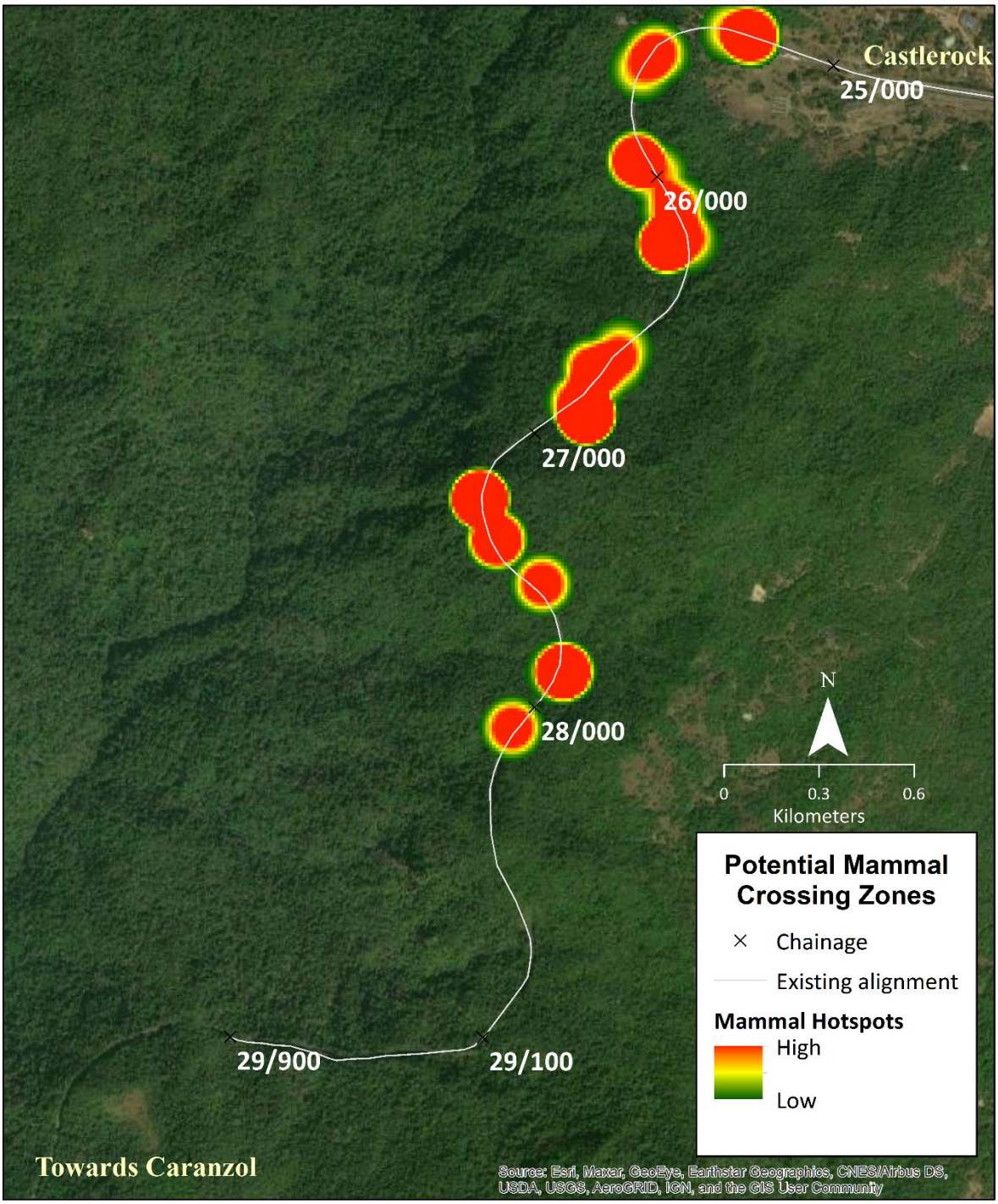

Figure 27: Hotspots of mammal presence/movement identified during the study on the Castlerock - Caranzol railway section

Based on the mammal hotspots thus obtained, major mammal presence hotspots and potential crossing were delineated based on the combined evidence of the present survey and IISc surveys.

Table 11: Hotspots of animal activity/presence indicating potential animal crossing zones along existing railway line.

Zone ID	Location	Chainage	Length (m)	Category
1	Tinaighat to Castlerock	12/000 – 13/000	1000	High
2		13/100 – 14/200	1100	Medium
3		14/200 – 14/400	200	High
4		14/400 – 15/000	600	Medium
5		15/000 – 16/550	1550	High
6		16/550 – 17/100	550	Medium
7		17/100 – 18/100	1000	High
8		18/100 – 19/300	1200	Medium
9		19/300 – 20/000	700	High
10		20/000 – 20/200	200	Medium
11		20/200 – 20/450	250	High
12		20/600 – 20/800	200	High
13		20/450 – 21/350	900	Medium
14		21/350 – 21/950	600	High
15		21/950 – 22/600	650	Medium
16		22/600 – 23/600	1000	High
17		23/600 – 24/300	700	Medium
18	Castlerock to Caranzol	25/100 – 26/300	1200	High
19		26/300 – 26/600	300	Medium
20		26/600 – 26/950	350	High
21		26/950 – 27/200	300	Medium
22		26/200 – 28/200	2000	High
23		28/200 – 29/900	1700	Medium

We identified 12 major potential crossing zones along the entire stretch of the railway track within 'high' category, and 11 minor potential crossing zones within the 'medium' category. Of these 17 potential crossing zones were identified in the Tinaighat to Castlerock segment while 6 were identified in the Castlerock to Caranzol segment. Railway segments falling within the 'high' animal hotspot identified during the present study and overlapping with either of the caution zones or animal activity clusters identified by IISc were assigned category 'high'. Segments falling within the medium-low animal hotspot identified during the present study and overlapping with either of the caution zones or animal activity clusters identified by IISc were assigned category 'medium'.

CHAPTER 4: Railway Track Evaluation for Mitigation Measures

Evaluation of railway track from Tinaighat to Caranzol for mitigation measures

For mitigation measures on the proposed railway track that runs parallel to the existing track, we collated the information on animal presence, crossing and use from our camera trapping exercise, habitat plot for indirect animal signs, opportunistic and systematic herpetofaunal surveys (for e.g. within habitat plots, visual encounter surveys on streams and along existing railway catchment areas). The information was then used to map areas of potential animal use along the proposed railway track.

The track assessment survey was carried out by walking along the entire length of the Tinaighat-Castlerock-Caranzol railway line and assessing each 100 m stretch in terms of habitat type, topography on either side of the track, presence of natural drainage, animal trails, and structures on existing track.

Areas of intensive animal use resulting from the present survey were combined with those mentioned in Sukumar and Sitharam (2017) and Suresh et al. (2020) These areas were then overlapped with the existing railway alignment in order to suggest modification of existing structures to act as mitigation measures and propose new structures according to identified multispecies crossing zone.

Given below is kilometre by kilometre description of the existing and proposed railway tracks, and the mitigation measures proposed. Needless to say, the mitigation measures would have to be constructed on the existing railway track also in order for the measures to be effective.

The details of designs of crossing structures, fences, overpasses, level crossings canopy bridges have been provided in the subsequent sections with illustrations.

A. Chainage-wise mitigation measures for existing and proposed railway track from Tinaighat to Castlerock

Proposed mitigation measure from chainage 12/000 – 13/000

The chainage 12/000 is at the end of the Tinaighat railway station and railway yard. A contiguous patch of forests is present on the right side of the track, while the left side has a forest patch with agricultural areas towards Tinaighat railway station. The terrain along this section is flat.

Suresh et al. (2020) identified two 'caution zones' (Table 3) on the railway track within this chainage- one zone from chainage 12/000 to 12/500 (measuring 500 m) and the second one from chainage 12/600 to 13/000 (measuring 400 m).

We found barking deer and sambar signs from our habitat plots, and multiple mammalian species viz., chital, gaur, black-naped hare, mouse deer, porcupine, and small Indian civet through our camera trapping exercise. Therefore, this segment is an important potential crossing zone for mammals. In this section, one perennial stream exists at chainage 12/233 which can serve as a potential breeding habitat of amphibians.

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 12 and shown in Figure 28.

Increase in dimensions with ledges for structures 1 and 2 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

A level crossing for animals is proposed at 12/795 with a width of approximately 30 – 35 m, equipped with cattle guard and automated animal detection and warning system to repel animals from the track of an incoming train (Approximate mid-point GPS is 15° 26.756, 074° 23.512).

For structures 3 and 5, there is no scope to increase the dimensions of the proposed structure.

Table 12: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 12/000 – 13/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	12/233	Arch culvert	1 x 1.52 x 4.25	RCC box	1 x 1.52 x 4.25	RCC box	2 x 5 x 4.5
2.	12/350	Pipe culvert	1 x 2 x 0.8	RCC box	1 x 2 x 2	RCC Box	1 x 5 x 2
3.	12/702	Pipe culvert	1 x 2 x 0.3	RCC box	1 x 1.55 x 1.80	RCC box	1 x 1.55 x 1.80
4.	12/795	NIL	NIL	NIL	NIL	Level crossing	30-35 (width)
5.	12/812	RCC slab	1x 2 x 1.46	RCC box	1 x 3.760 x 1.5	RCC box	1 x 3.760 x 1.5

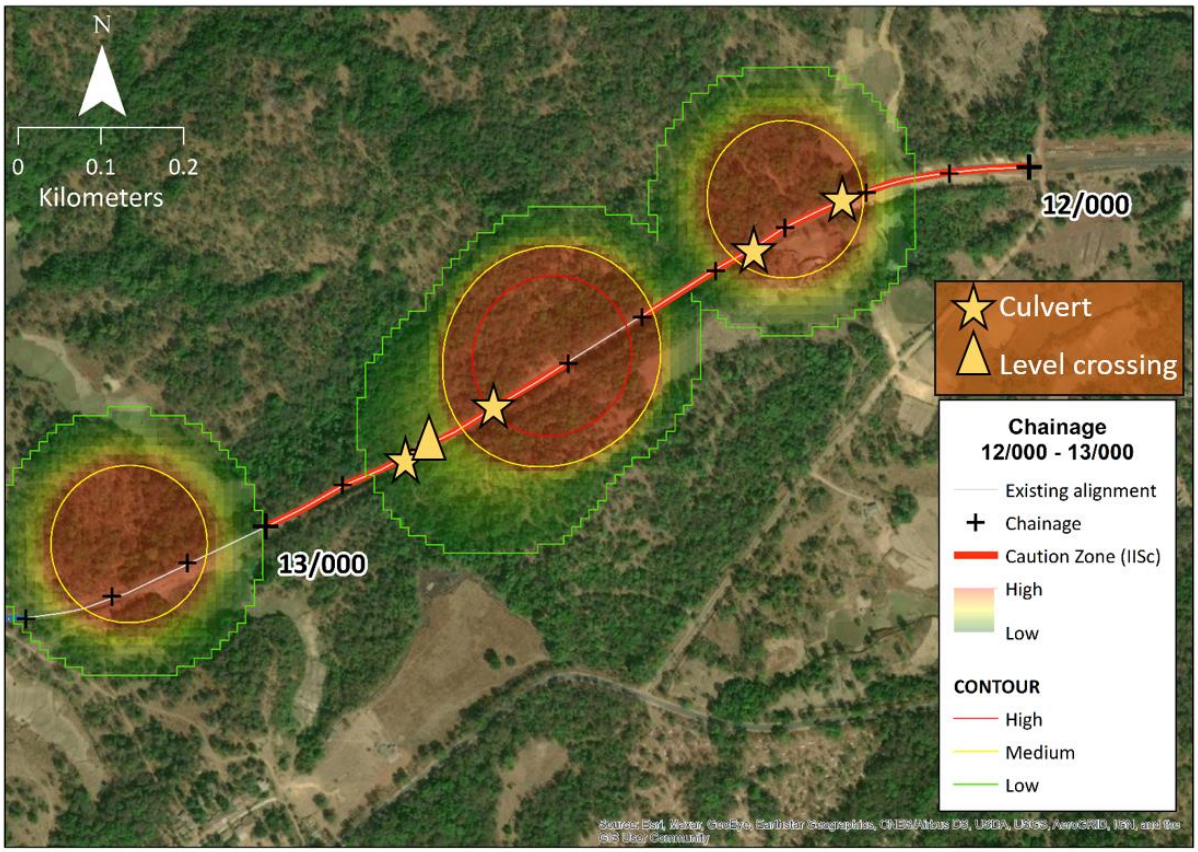

Figure 28: Locations of mitigation measures on chainage 12/000 – 13/000 to be constructed on existing and proposed railway track (NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 13/000 – 14/000

This section has a mixed land use type. The relatively straight section has agriculture on one side, while the major curve (13/500-14/000) has forest on both sides.

Suresh et al. (2020) have identified a part of this section as an important cluster of animal activity/movement. The section from chainage 13/300 – 14/400 has been classified to have 'high' animal activity.

We found barking deer captures in this segment through our camera trapping exercise. We also found several reptilian evidences (direct sightings and roadkill) during the survey. A gaur rail kill was also reported from this section (near chainage 13/250) in August 2020. A perennial stream is present at the chainage 13/188 which can be an important breeding habitat for amphibians. Therefore, this segment is an important potential crossing zone for mammals as well as an important herpetofaunal hotspot.

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 13 and shown in Figure 29.

An increase in dimensions for structures 2, 3 and 4 is recommended with ledges to make the structures more suitable for use by animals. The RCC pipe culvert at chainage 13/772 should be converted to an RCC box culvert measuring 3 x 5 x 2.5 m. The additional culverts should be constructed to the right of the existing culvert (towards Tinaighat).

For structure 1, there is no scope to increase the dimensions of the proposed structure.

Table 13: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 13/000 – 14/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	13/118	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55
2.	13/597	RCC box	2 x 1.25 x 1.5	RCC box	1 x 3.05 x 1.8	RCC box	2 x 5 x 2
3.	13/772	RCC pipe	1 x 1 x 1.2	RCC box	1 x 1.2 x 1.5	RCC box	3 x 5 x 2.5
4.	13/993	RCC box	1 x 1.02 x 0.625	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 2

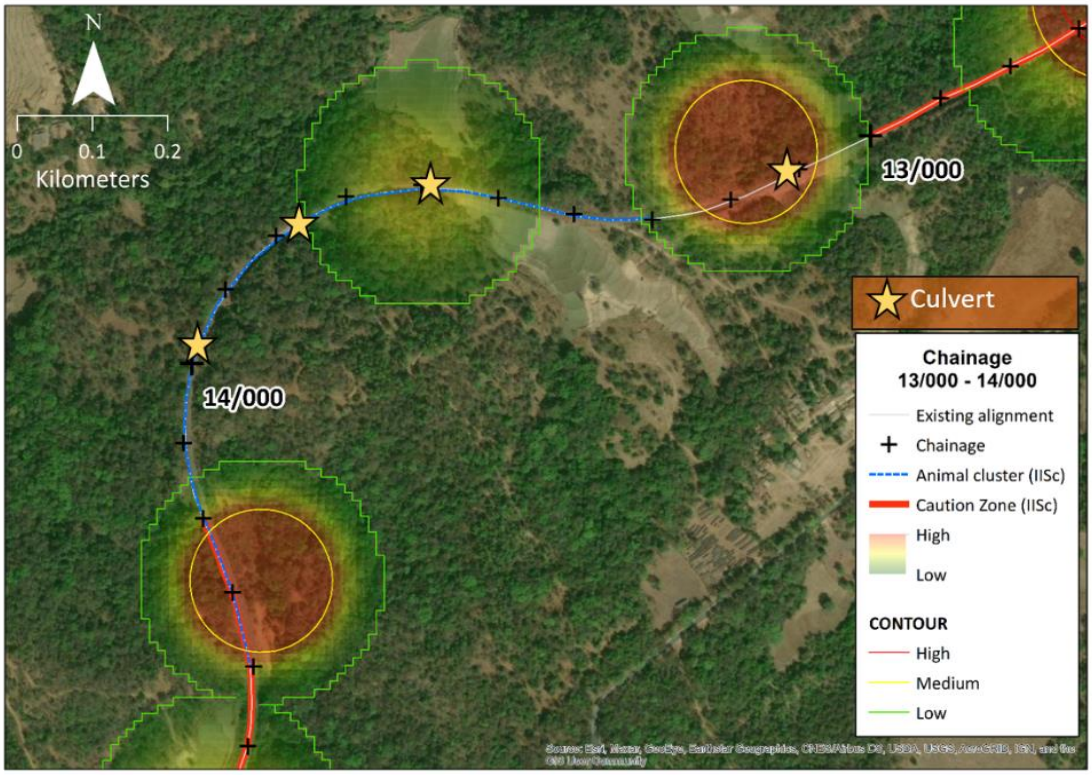

Figure 29: Locations of mitigation measures on chainage 13/000 – 14/000 to be constructed on an existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 14/000 – 15/000

This is a relatively flat section of the railway track. Forests lie on both sides of the track on this section with the exception of the stretch between 14/400 and 14/600.

In this section, we found gaur signs from our habitat plots. A gaur rail kill was also reported from this section (near chainage 14/600) in October 2019. We have also recorded herpetofaunal species such as *Ptyas* sp., as well as direct evidences of rail kills such as *Ahaetulla* sp., *Duttaphrynus* sp. during the survey. Therefore, this segment is an important potential crossing zone for mammals as well as an important herpetofaunal hotspot.

Increase in dimensions for structures 1 and 2 is recommended to make the structures more suitable for use by animals. The two drainage structures between 14/230 and 14/295 may be merged as one long underpass spanning 20 m in width. Ledges are to be provided within all crossing structures.

For structure 3, there is no scope to increase the dimensions of the proposed structure. Thus the RCC box culvert at 14/550 may be retained in the proposed dimensions. The details of structures are given in Table 14 and Figure 30.

The level crossing of the Panjim-Balgaum road at 14/650 is proposed to be decommissioned after the construction of the flyover at 14/940. The road across the railway line would also get decommissioned. In such a scenario, it is proposed to maintain the road level crossing of 50 m width as a level crossing for wild animals. Other specifications for the animal level crossing have been provided in the section 'General Recommendations'.

For the highway flyover being constructed at chainage 14/940, it is recommended to install adequate noise and sound barriers.

Table 14: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 14/000 – 15/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	14/230	RCC pipe	1 x 2 x 1.22	RCC box	1 x 3 x 1.8	RCC box	1 x 5 x 5
2.	14/295	RCC box	1 x 2.55 x 2.3	RCC box	1 x 2.55 x 2.3	Underpass	1 x 20 x 4.5
3.	14/450	Nil	Nil	Nil	Nil	Level crossing with early warning system	50 (width)
4.	14/550	RCC box	1 x 3.08 x 1.55	RCC box	1 x 3.08 x 1.8	RCC box	1 x 3.08 x 1.8

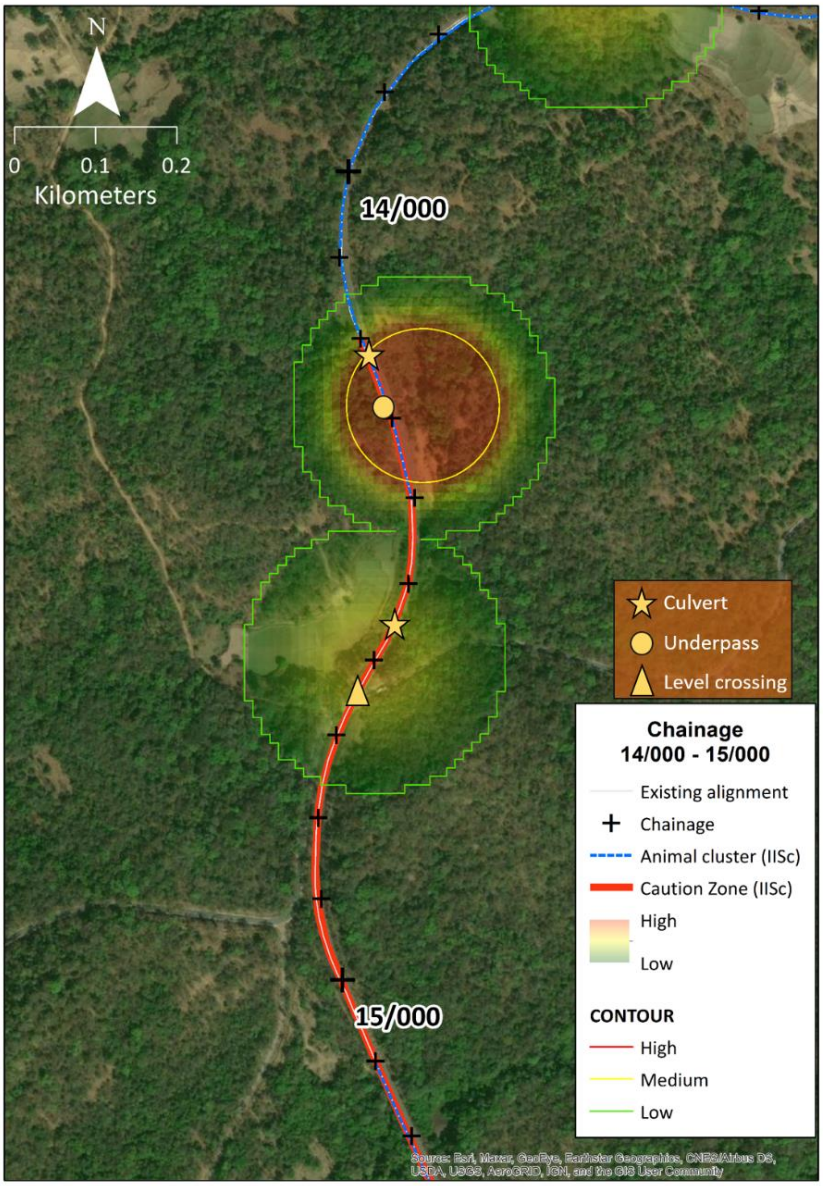

Figure 30: Locations of mitigation measures on chainage 14/000 – 15/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 15/000 – 16/000

This section of the railway track has good forest cover on both sides. The terrain is relatively flat.

Suresh et al. (2020) have classified the section from chainage 15/100 to 17/000 as a 'high' animal activity/movement zone. This section has also been identified as a 'caution zone' in the report.

In this section, we found multiple captures of gaur, langur, porcupine and wild pig during our camera trapping exercise, as well as sighting of the elusive Malabar flying squirrel. Three perennial streams are existing in this section at the chainages 15/962, 15/552, and 15/213 which are crucial habitat for herpetofauna especially for amphibians during the breeding season. In this section we have recorded around 10 species of herpetofauna, as well as rail kill of *Dendrelaphis* sp. Thus this section is important for mammals, arboreal species and herpetofauna. The details of structures are given in Table 15 and Figure 31.

Increase in dimensions for all three structures is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

Table 15: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 15/000 – 16/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Structure type (No. x width x height)
1.	15/213	RCC box	1 x 2.35 x 2.65	RCC box	1 x 2.35 x 2.65	RCC box	4 x 5 x 3
2.	15/552	RCC box	1 x 2.45 x 2.0	RCC box	1 x 2.45 x 2.0	RCC box	2 x 5 x 4.5
3.	15/962	RCC box	1 x 2.4 x 1.85	RCC box	1 x 2.4 x 1.85	RCC box	3 x 5 x 4.5

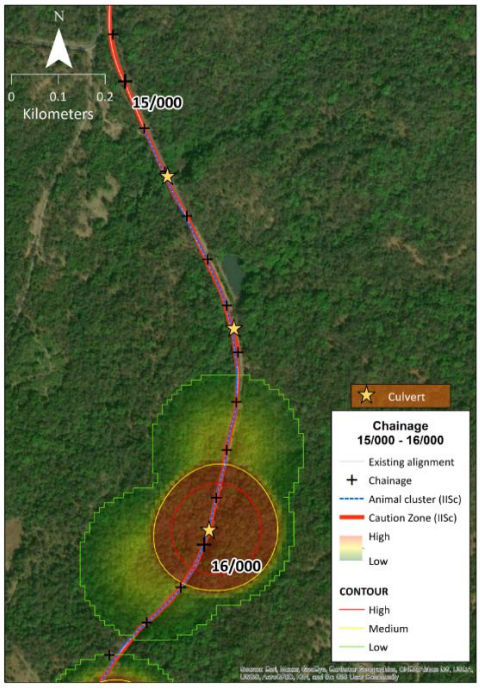

Figure 31: Locations of mitigation measures on chainage 15/000 – 16/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 16/000 – 17/000

This section of the railway track has good forest cover in the beginning, followed by agricultural area on one side.

In this section, camera traps revealed presence of porcupine and wild pig, as well as multiple indirect signs of porcupine. In this section, arboreal reptiles such as *Ahaetulla borealis* were frequently recorded on the vegetation along the railway track.

This section falls within the 'high' animal activity zone identified by Suresh et al. (2020), and chainage 16/000 – 16/500 within a 'caution zone'.

Increase in dimensions for both structures is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures. The details of structures are given in Table 16 and Figure 32.

Table 16: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 16/000 – 17/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	16/188	Pipe culvert	1 x 2 x 1.25	RCC box	1 x 2.92 x 1.8	RCC box	2 x 5 x 2.5
2.	16/688	RCC box	1 x 1.83 x 2.88	RCC box	1 x 1.83 x 2.88	RCC box	2 x 5 x 3

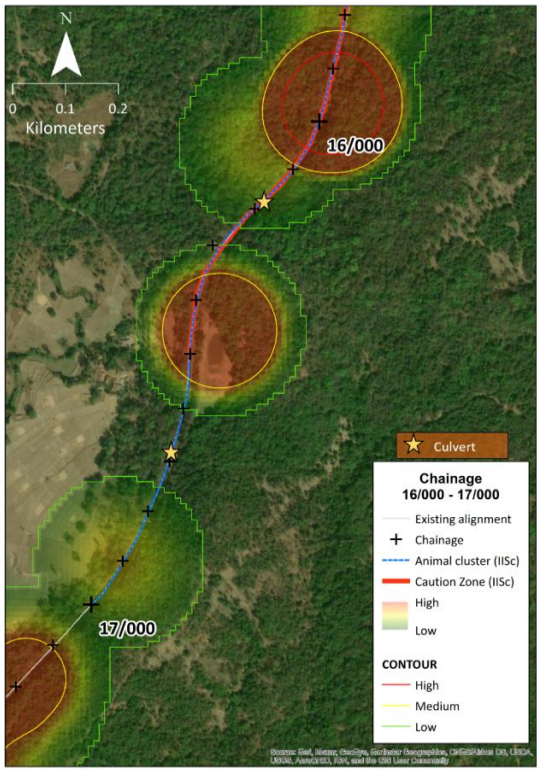

Figure 32: Locations of mitigation measures on chainage 16/000 – 17/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 17/000 – 18/000

This section has a narrow belt of forest along both sides. The latter part of the section is curved.

Camera trapping in this section revealed the presence of multiple mammalian species viz., bonnet macaque, gaur, langur, sambar, small Indian civet and wild pig. Multiple indirect signs of porcupine were also found from the habitat plots. In this section, we have recorded eight species of herpetofauna.

Increase in dimensions for structure 1 is recommended to make the structure more suitable for use by animals. Ledges are to be provided within all crossing structures. The details of structures are given in Table 17 and Figure 33.

Two non-drainage underpasses are recommended at chainages 17/280 and 17/950. Adequate height for the same is available on both sides of the existing track.

Table 17: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 17/000 – 18/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) ((No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	17/074	RCC pipe	1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 5 x 2
2.	17/280	NIL	NIL	NIL	NIL	Underpass	2 x 5 x 3
3.	17/950	NIL	NIL	NIL	NIL	Underpass	1 x 50 x 5.5

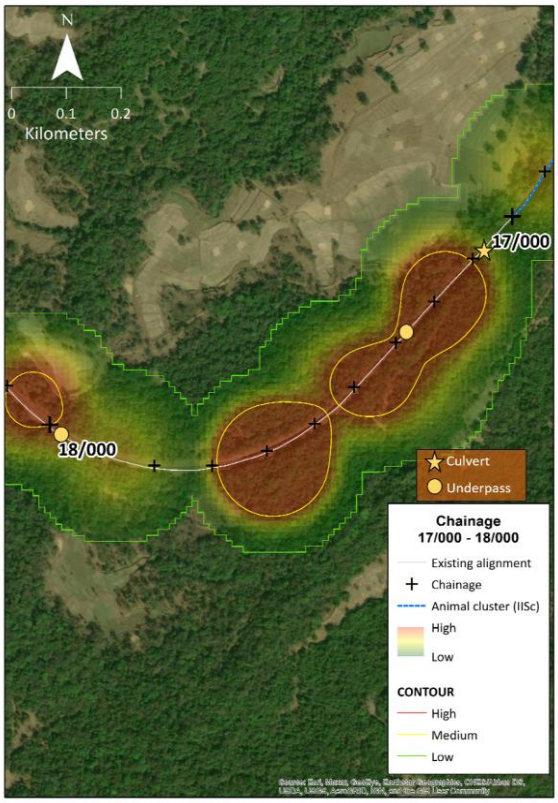

Figure 33: Locations of mitigation measures on chainage 17/000 – 18/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 18/000 - 19/000

This segment of the railway track has both agriculture and forest areas along both sides. The track is straight, and terrain is flat.

Suresh et al. (2020) have identified part of this segment (18/200 – 19/000) as having 'very high' animal activity/movement. A gaur mortality was also reported from this segment (between chainage 18/150 – 18/350) in April 2019.

Camera trapping in this section revealed presence of bonnet macaque, while jackal signs were found on the tracks. In this section a perennial steam exists at the chainage 18/251. We have recorded 12 species of herpetofauna including ground dwelling reptiles such as *Bungarus caeruleus*, *Oligodon taeniolatus*, *Hemidactylus* cf. *triedrus* etc.

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 18 and shown in Figure 34.

For structure 1, there is no scope to increase the dimensions of the proposed structure. Thus, the proposed dimensions are to be retained.

A level crossing for animals is proposed at 18/800 with a width of 50 m, equipped with cattle guard and automated animal detection and warning system to repel animals from the track of an incoming train.

Table 18: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 18/000 – 19/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) ((No. x width x height)	Structure type	Dimension (m) ((No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	18/251	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6
2.	18/800	NIL	NIL	NIL	NIL	Level crossing with early warning system	50 (width)

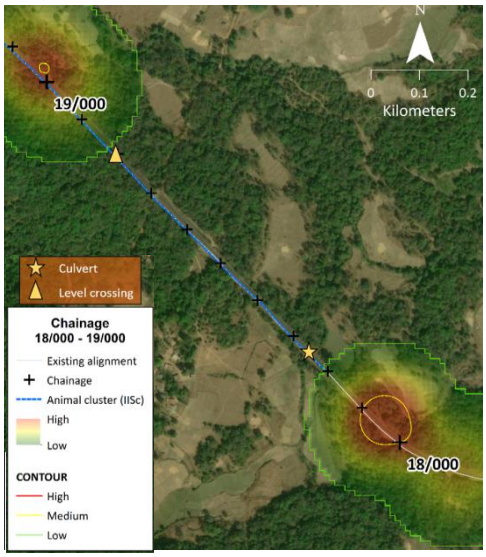

Figure 34: Locations of mitigation measures on chainage 18/000 – 19/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 19/000 - 20/000

This section has good forest cover along the track. Suresh et al. (2020) have identified the entire length of this segment as having 'very high' animal activity/movement.

Camera trapping in this section revealed presence of jackal, leopard, side-striped mongoose and porcupine. We also found indirect evidences of jackal, barking deer, sambar and gaur during the survey. A gaur rail kill was also reported from this section (near chainage 19/500) in May 2019. Perennial streams are present at the chainages 19/292 and 19/520 which are important breeding habitat of amphibians.

Increase in dimensions for structures 2 and 3 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

Two level crossings for animals are proposed at 19/060 and 19/850 each with a width of 50 m, equipped with cattle guard and automated animal detection and warning system to repel animals from the track of an incoming train (Approximate mid-point GPS is 15° 26.756, 074° 23.512). The details of mitigation measures proposed for this chainage are given in Table 19 and shown in Figure 35.

Table 19: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 19/000 – 20/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	19/060		NIL		NIL	Level crossing with early warning signal	50 (width)
2.	19/292	RCC pipe for culvert	1 X 2 x 1.2	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 3.5
3.	19/520	RCC box	1 x 2.35 x 2.5	RCC box	1 x 2.35 x 2.5	RCC box	5 x 5 x 3.5
4.	19/850		NIL		NIL	Level crossing with early warning signal	50 (width)

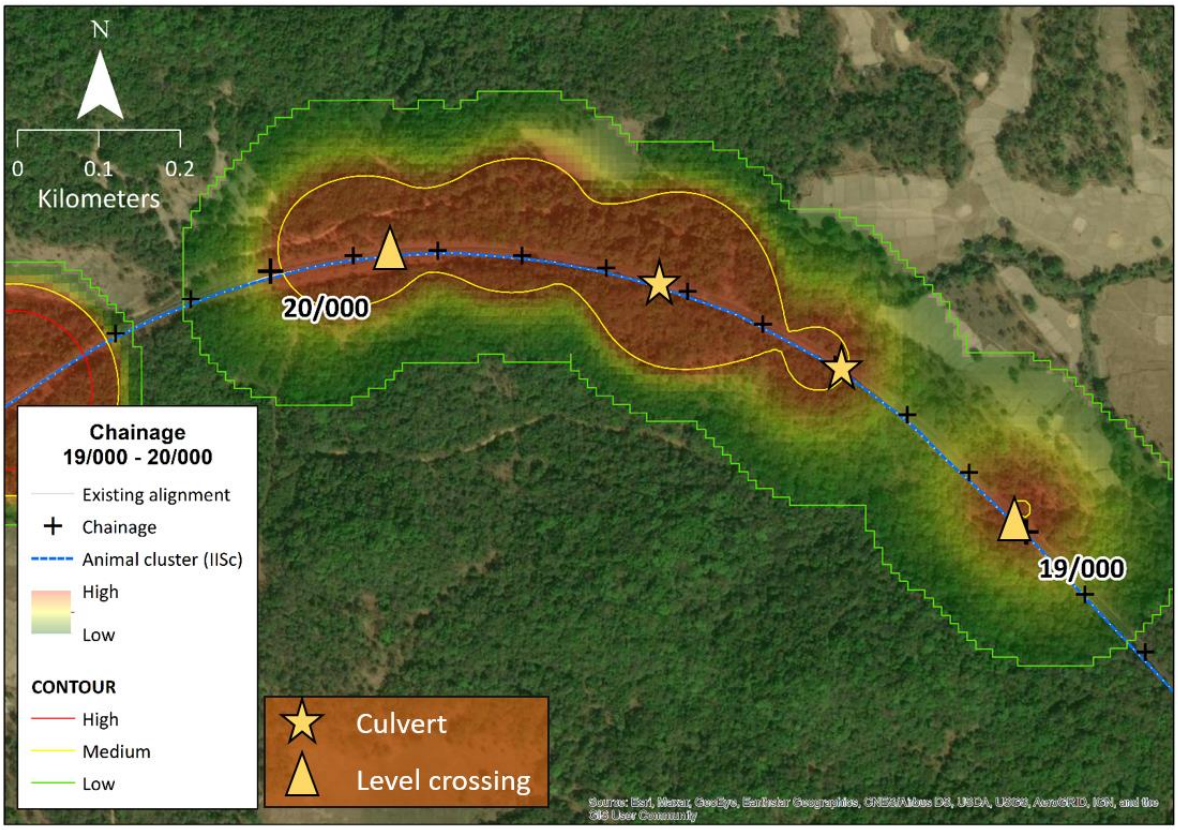

Figure 35: Locations of mitigation measures on chainage 19/000 – 20/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 20/000 – 21/000

This segment consists of two minor curves and is interspersed with forest and agricultural areas along the track. Suresh et al. (2020) have identified part of this segment (20/000 – 20/600) as having 'very high' animal activity/movement.

Camera trapping in this segment revealed presence of black-naped hare, sambar and wild pig. Leopard sign was recorded during the survey, as well as reptile species such as *Ahaetulla borealis* and *Hemidactylus prashadi* were frequently recorded in this section..

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 20 and shown in Figure 36. Increase in dimensions for structure 1 is recommended to make the structure more suitable for use by animals. Ledges are to be provided within all crossing structures. A level crossing for animals is proposed at 20/350 with a width of 50 m, equipped with cattle guard and automated animal detection and warning system to repel animals from the track of an incoming train.

Table 20: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 20/000 – 21/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	20/190	RCC pipe for culvert	1 X 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	2 x 2 x 2
2.	20/350	NIL		NIL		Level crossing with early warning system	50 (width)

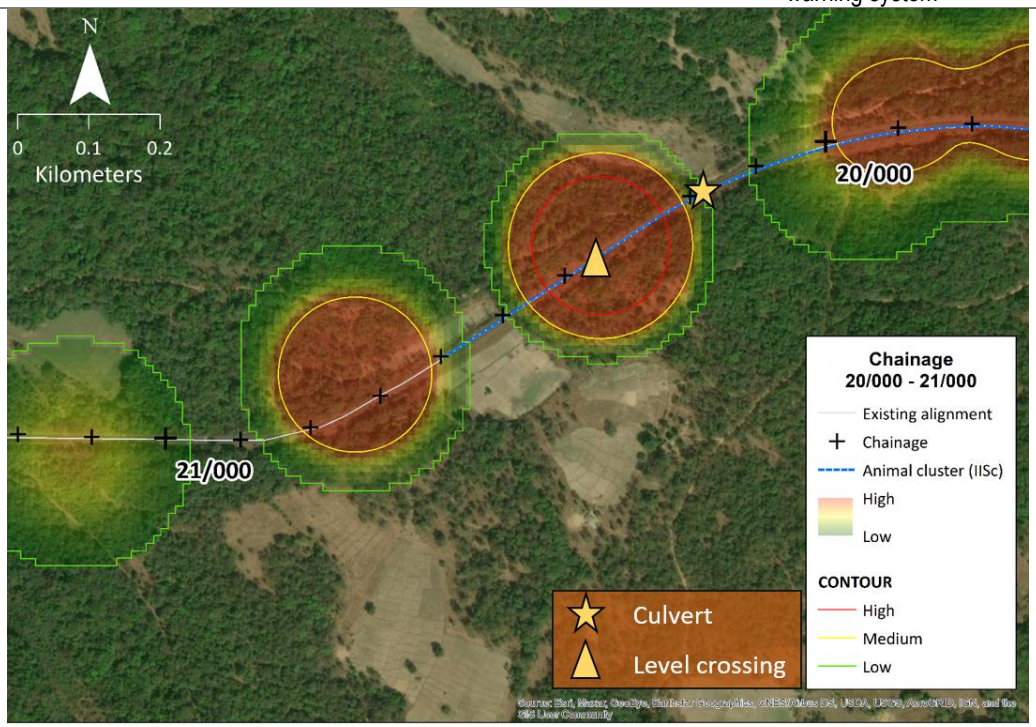

Figure 36: Locations of mitigation measures on chainage 20/000 – 21/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 21/000 – 22/000

This segment of the railway track in on a major curve, and ends near the Duski River. The terrain on both sides of the track is slightly undulating. Suresh et al. (2020) have designated part of this segment (21/300 – 22/000) as a 'caution' zone.

Camera trapping on this segment revealed the presence of bonnet macaque, leopard, mouse deer, porcupine, sambar, small Indian civet and wild pig. A large perennial steam exists at the chainage 21/002 which is an important breeding habitat for amphibian species. Here, we have also recorded large number of individuals of *Euphlyctis* cf. *cyanophlyctis*, *Indosylvirana* cf. *caeseri*, *Clinotarsus curtipes* and tree frogs such *Rhacophorus malabaricus*.

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 21 and shown in Figure 37. Increase in dimensions for structures 1, 2 and 3 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures. For structure 4, there is no scope to increase the dimensions of the proposed structure and is adequate for animal movement in its proposed dimensions, given the provision of ledges along the wall.

Table 21: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 21/000 – 22/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	21/002	RCC box	2 x 2.6 x 3.65	RCC box	1 x 5.5 x 3.65	RCC box	3 x 5 x 5
2.	21/381	RCC pipe for culvert	1 x 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 4 x 2
3.	21/655	RCC pipe for culvert	1 x 1.2 x 2.85	RCC box	1 x 1.2 x 2.85	RCC box	2 x 4 x 4
4.	21/978	Arch	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2

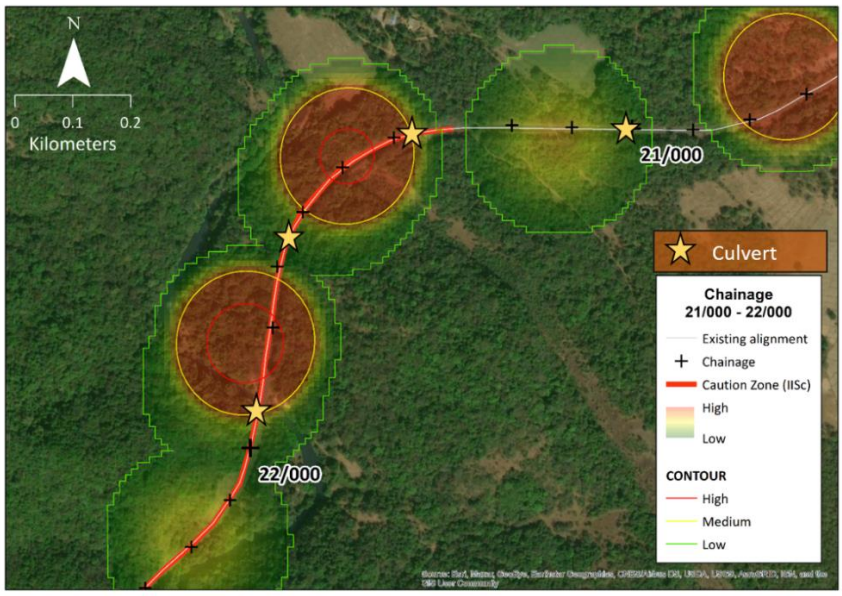

Figure 37: Locations of mitigation measures on chainage 21/000 – 22/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 22/000 – 23/000

This is a relatively straight segment of the railway track with slightly undulating This is a relatively straight segment of the railway track with slightly undulating terrain on both sides of the railway track. This segment lies within the protected area of Castlerock wildlife range. Part of this segment (22/000 – 22/800) has been identified as a 'caution' zone by Suresh et al. (2020).

Camera trapping on this segment revealed presence of sambar. Multiple mammalian signs viz., gaur, porcupine, sambar and wild pig were recorded from this area during the survey. In this section we recorded arboreal reptiles such as *Monilesaurus rouxii* on the vegetation along the railway track. We have also recorded rail kills of reptile (*Lycodon* sp.) and amphibians (*Indosylvirana* sp. and *Hoplobatrachus tigerinus*). Two jungle cat rail kill were also reported from this section (near chainages 22/100 in November 2018 and 22/600 in August 2016).

Considering the above factors, the details of mitigation measures proposed for this chainage are given in Table 22 and shown in Figure 38. Increase in dimensions for all three structures is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

Table 22: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 22/000 – 23/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	22/301	RCC box	1 x 1.52 x 3.72	RCC box	1 x 1.52 x 3.72	RCC box	1 x 5 x 5
2.	22/630	RCC pipe for culvert	1 x 1 x 0.9	RCC box	1 x 0.9 x 1.5	RCC box	2 x 3 x 2
3.	22/860	RCC box	1 x 2.42 x 2.13	RCC box	1 x 2.42 x 2.13	RCC box	3 x 3 x 3

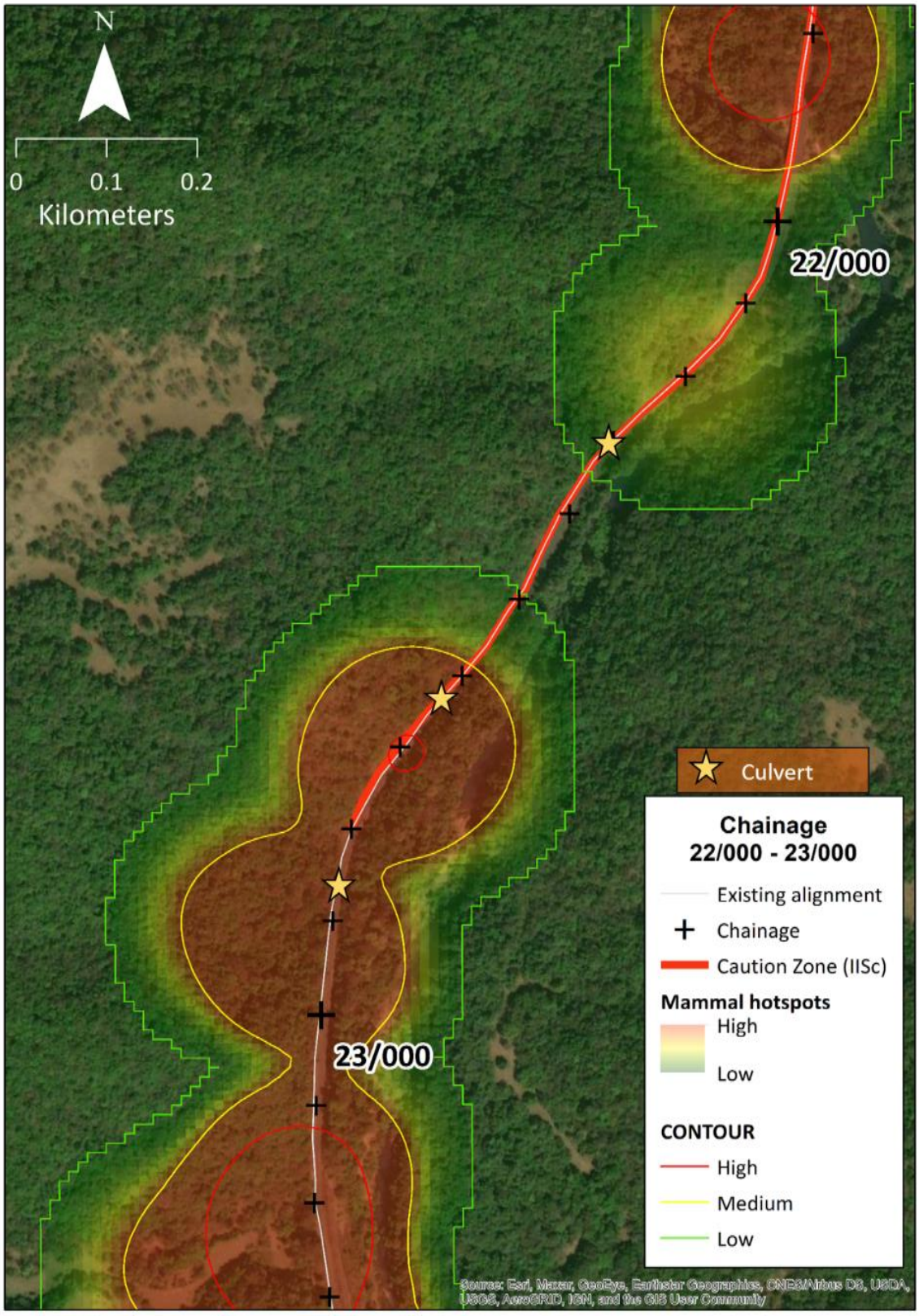

Figure 38: Locations of mitigation measures on chainage 22/000 – 23/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 23/000 – 24/000

This segment is characterised by good forest cover along the track between chainage 23/000 and 23/600, followed by a road level crossing at 23/650. The railway yard begins after about chainage 23/800, where multiple railway tracks, with the distance between the vegetation on both sides varying between 40 – 60 m. Suresh et al. (2020) have reported the area between chainage 23/600 – 24/000 to be a 'caution' zone.

Camera trapping in this segment revealed the presence of langur, porcupine and sambar. Multiple signs of gaur, sambar and porcupine were encountered near this segment. Here a perennial stream exists at the chainage 23/495. We recorded breeding population of amphibian species such as *Indosylvirana* cf. *caeseri*, *Clinotarsus curtipes*, *Euphlyctis* cf. *cyanophlyctis* etc. Among the arboreal reptiles we recorded *Trimeresurus malabaricus*, *Calotes* sp., *Ahaetulla borealis* etc. in this section.

Increase in dimensions for structures 1 and 2 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

An overpass is recommended at chainage 23/450 (approximately; centre point of the structure may be taken as 15° 23.930' N, 74° 20.293' E). The width of the overpass should be 20 m. The details of mitigation measures proposed for this chainage are given in Table 23 and shown in Figure 39.

Table 23: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 23/000 – 24/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) ((No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	23/279	RCC slab	1 x 4 x 7	RCC slab	2 x 4 x 7	RCC slab	3 x 5 x 7
2.	23/495	RCC pipe for culvert	1 x 3 x 1.2	RCC box	1 x 4.7 x 1.5	RCC box	2 x 5 x 2.5
3.	23/450	NIL		NIL		Overpass with light and sound barrier	20 (width)

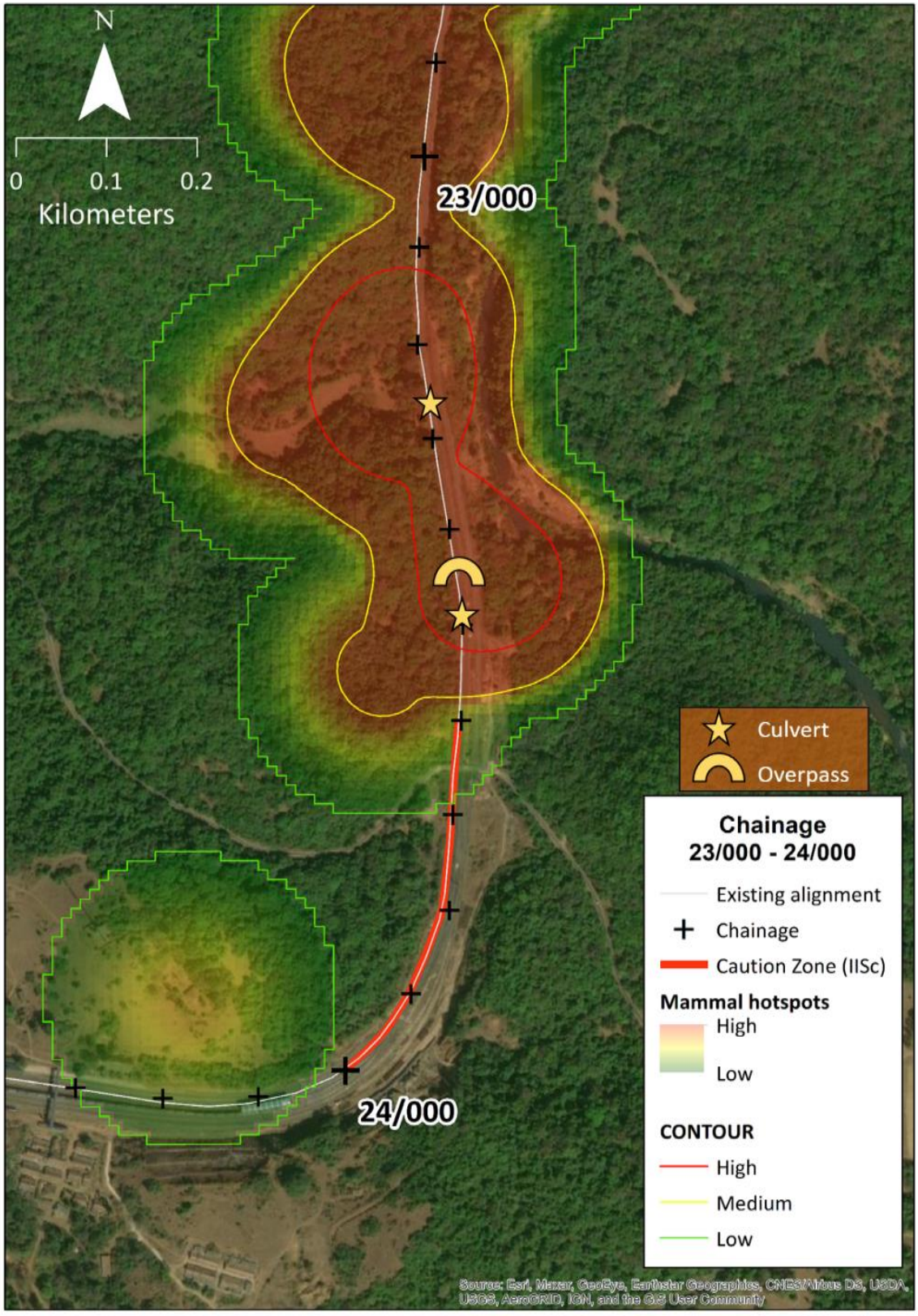

Figure 39: Locations of mitigation measures on chainage 23/000 – 24/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 24/000 – 25/000

This segment mostly passes through the Castlerock railway station.

Not many animal evidences were found in this stretch, except for a rail kill record of a wild pig (near chainage 24/100) in June 2019.

There is human habitation on both sides of the track on the entire stretch of this segment. Therefore, the RCC slab structure at chainage 24/887 may be retained as such, with provision of ledge in the inner wall of the structure for small mammals. the details of mitigation measures proposed for this chainage are given in Table 24 and shown in Figure 40.

Table 24: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 24/000 – 25/000.

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	24/887	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2

Figure 40: Locations of mitigation measures on chainage 24/000 – 25/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 25/000 – 26/000

This segment falls on a major curve just after the Castlerock railway station towards Caranzol. There is forest cover on both sides of the track after chainage 25/400. The terrain is undulating on both sides, after the end of the railway parking yard.

Camera trapping on this segment revealed presence of mouse deer and wild dog. We also recorded direct sighting of wild dogs and sambar near the Castlerock Forest Department campus. Two instances of tigers crossing the railway track in this segment were captured by camera traps deployed by the forest department in September 2020. Amphibian species such as endemic *Nyctibatrachus petraeus*, *Raorchestes bombayensis*, critically endangered *Pseudophilautus amboli* etc. were recorded during the survey. A perennial stream is present at the chainage 25/450 where we recorded turtle species (*Melonchelys trijuga*) as well as 13 other species of herpetofauna. The details of mitigation measures proposed for this chainage are given in Table 25 and shown in Figure 41.

Increase in dimensions for both structures is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.

Table 25: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 25/000 – 26/000.

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure type	Dimension (m) (No. x width x height)	Chainage	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	25/450	RCC box	1 x 2 x 2.97	25/455	RCC box	2 x 3.0 x 3.0	RCC box	3 x 5 x 4
2.	25/710	RCC pipe for culvert	1 x 1 x 0.61	25/708	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 4

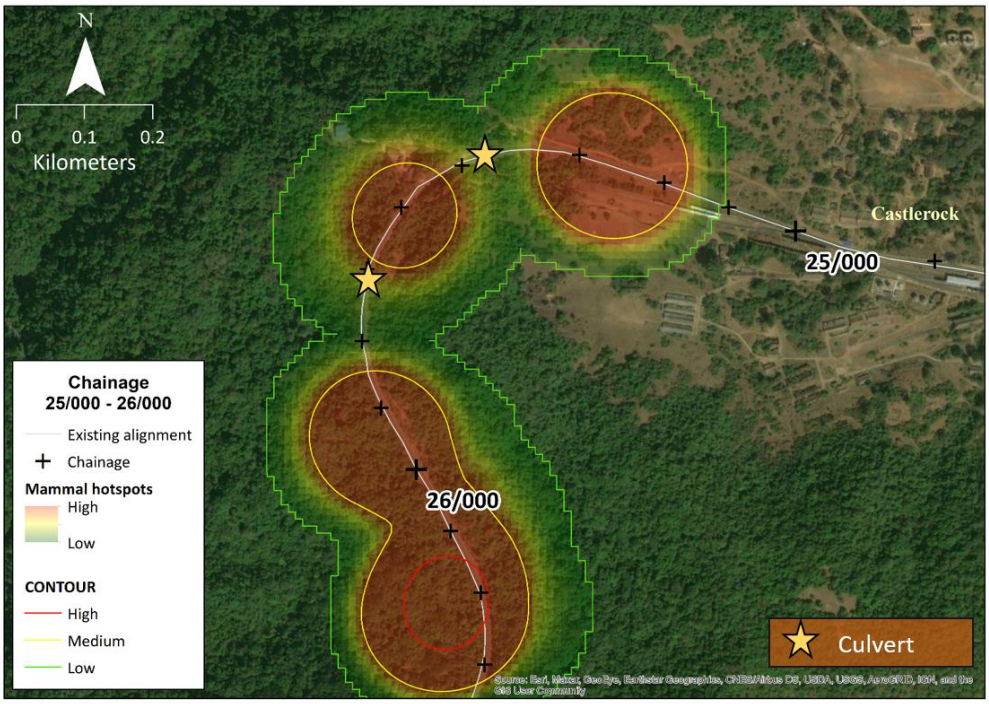

Figure 41: Locations of mitigation measures on chainage 25/000 – 26/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 26/000 – 27/000

This segment of the railway track is slightly curvy, and passes through undulating terrain, with steep downward slopes on one or both sides at different points. Sukumar and Sitharam (2017) have identified two important animal crossing points in this section.

Camera trapping in this segment revealed the presence of brown palm civet, leopard, leopard cat, side-striped mongoose, mouse deer, porcupine, small Indian civet and wild dog. Multiple mammal signs viz., porcupine, wild pig and barking deer were recorded during the survey. Two gaur rail kill were reported in this section- near chainage 26/000 in March 2020, and near chainage 26/850 in May 2020. In this section commonly recorded reptile species were *Cnemaspis* sp., *Hemidactylus prashadi* and *Ahaetulla borealis*. We have also recorded Cat snake (*Boiga* sp.), Hump-nosed Pit Viper (*Hypnale hypnale*), Malabar Pit Viper (*Trimeresurus malabaricus*) here along with evidences of rail killed amphibians such as *Hydrophylax malabaricus*, *Indosylvirana* sp..

Increase in dimensions of all eight structures proposed in this segment is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures.For structure 8, there is no scope to increase the dimensions of the proposed structure.

Two overpasses (measuring 20 m and 15 m wide) have been recommended on this stretch, as the topography is suitable for construction of overpasses with adequate height above the railway line. The details of mitigation measures proposed for this chainage are given in Table 26 and shown in Figure 42.

Table 26: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 26/000 – 27/000.

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure type	Dimension (m) (No. x width x height)	Chainage	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	26/015	RCC box	1 x 1 x 2.54	26/005	RCC box	1 x 3 x 3	RCC box	1 x 6 x 5
2.	26/110	RCC pipe	1 x 1 x 1.22	26/100	RCC box	1 x 1.2 x 1.2	RCC box	1 x 2.4 x 1.5
3.	26/220	RCC slab	1 x 1 x 1.98	26/212	RCC box	2 x 1.2 x 1.2	RCC box	1 x 3 x 1.2
4.	26/380	RCC slab	1 x 2 x 1.22	26/378	RCC box	2 x 1.2 x 1.2	RCC box	2 x 2.5 x 1.2
5.	26/482	RCC box	1 x 1 x 2.44	26/480	RCC box	1 x 3 x 3	RCC box	1 x 5 x 5
6.	26/535	NIL			NIL		Overpass with light & sound barrier	20 (width)
7.	26/634	RCC slab	1 x 1 x 3.05	26/635	RCC box	1 x 3 x 2	RCC box	1 x 3 x 3
8.	26/733	RCC pipe	1 x 1 x 0.61	26/732	RCC box	1 x 1.2 x 1.2	RCC box	1 x 1.2 x 1.2
9.	26/790	RCC box	1 x 1 x 2.44	26/787	RCC box	1 x 3 x 2	RCC box	1 x 6 x 3
10.	26/903	Arch	1 x 1 x 2.45	26/902	RCC box	1 x 3 x 4	RCC box	1 x 5 x 4
11.	26/960	NIL			NIL		Overpass with light and sound barrier	15 (width)

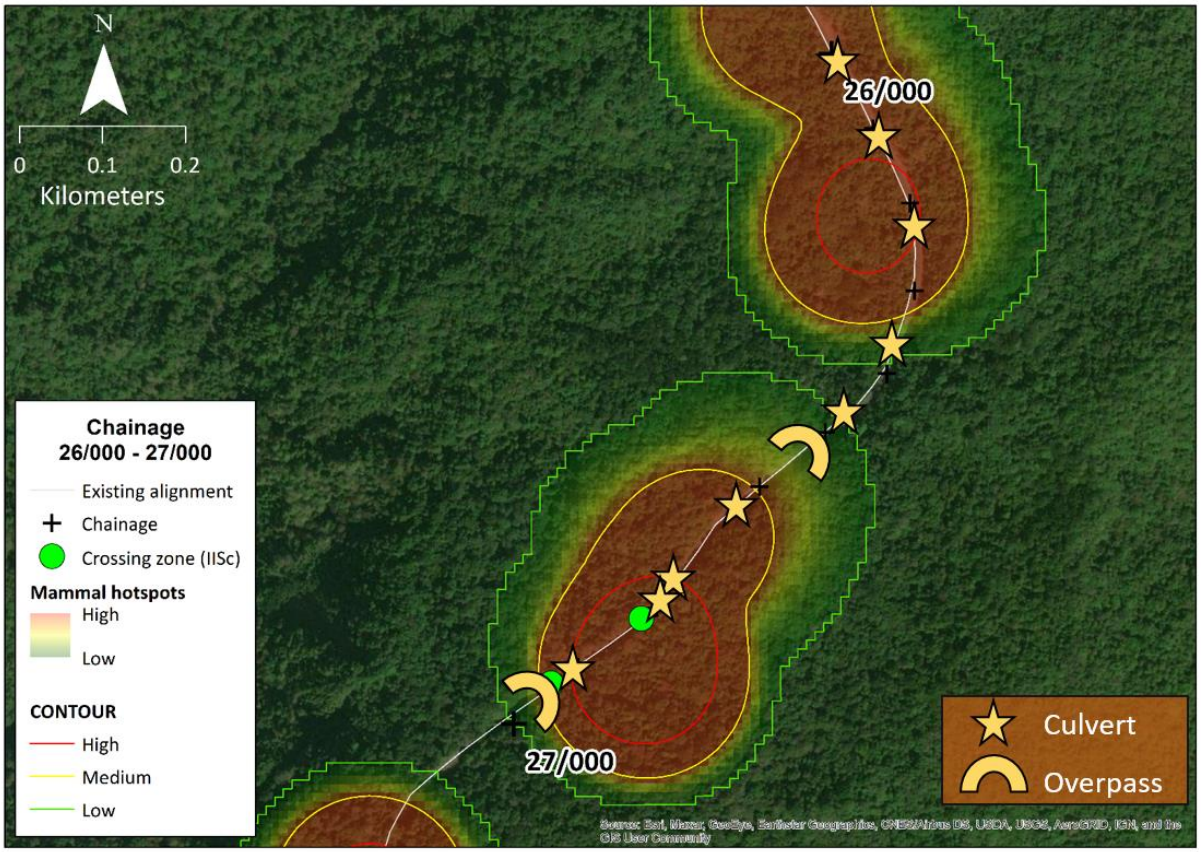

Figure 42: Locations of mitigation measures on chainage 26/000 – 27/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 27/000 – 28/000

This is a curvy segment of the railway track and is highly undulating on both sides. The first tunnel on this section from Castlerock starts at chainage 27/150.

Camera trapping in this segment revealed the presence of barking deer, bonnet macaque, gaur, leopard, mouse deer, porcupine, sambar and small Indian civet. We also found indirect leopard and sambar signs. Several seasonal streams are located in this section which are important for amphibians during the breeding season.

Increase in dimensions for structures 1, 3 and 4 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures. The girder bridge at 27/150 (entrance to tunnel 1) is to be retained as such. The tunnel on the existing track (27/180 – 27/275) measures 95 m. A tunnel on the proposed track is to be constructed at 27/150 – 27/335 measuring 185 m. The details of mitigation measures proposed for this chainage are given in Table 27 and shown in Figure 43.

Table 27: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 27/000 – 28/000.

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure type	Dimension (m) (No. x width x height)	Chainage	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	27/032	RCC slab	1x 1 x 3.05	27/033	RCC box	1 x 3 x 2	RCC box	1 x 5 x 3
2.	27/150	Composite girder	1 x 12.29 + 1 x 18.29	27/130	Composite Girder	1 x 18.3 + 1 x 12.2	Composite Girder	1 x 18.3 + 1 x 12.2
3.	27/400	RCC pipe culvert	1 x 1 x 1.2	27/373	RCC box	1 x 2 x 1.8	RCC box	2 x 4 x 2
4.	27/836	RCC pipe culvert	1x 4 x 1.22	27/813	RCC box	2 x 3 x 2	RCC box	2 x 5 x 5
5.	27/180 – 27/275	Tunnel	95	27/150 – 27/335	Tunnel	185	Tunnel	185

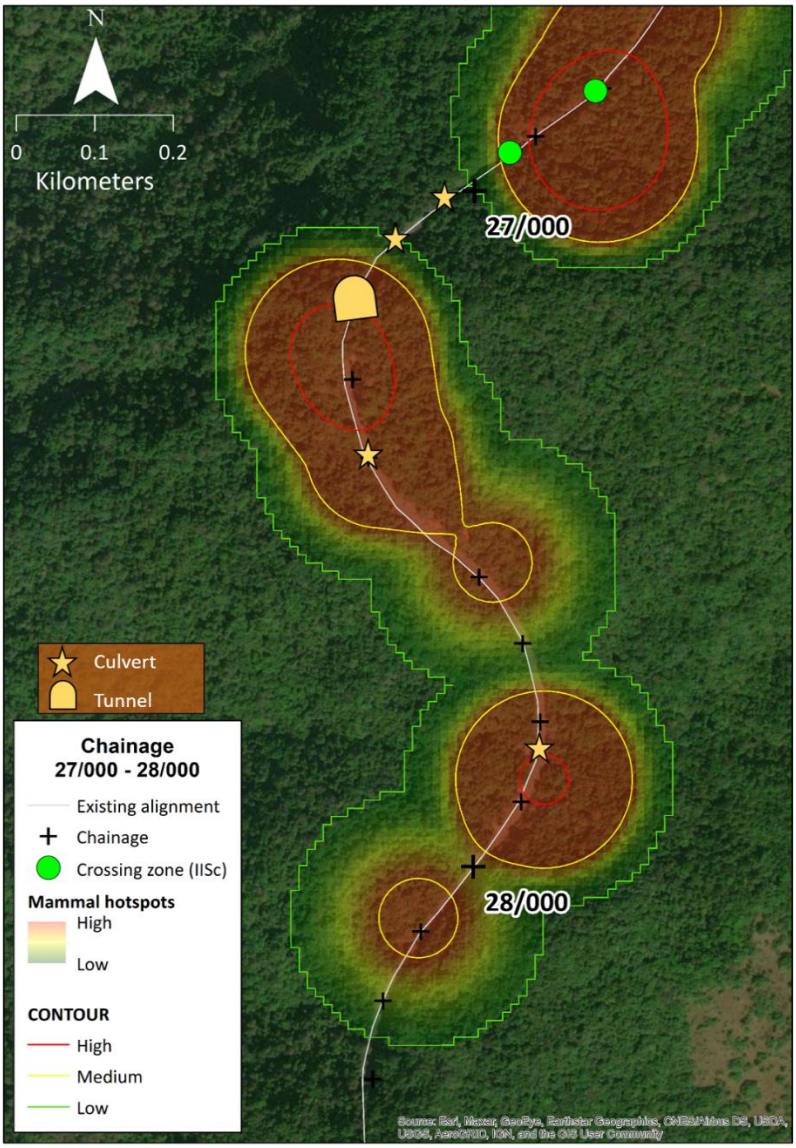

Figure 43: Locations of mitigation measures on chainage 27/000 – 28/000 to be constructed on existing and proposed railway track (NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 28/000 – 29/000

Most of this section is within the Tunnel 2 (chainage 28/300 – 28/710) measuring 410 m. Tunnel 3 (chainage 28/925 – 29/100) also begins in this segment. The terrain on both sides of the segment is highly undulating. We found indirect signs of sambar, and a few herpetofauna on this segment during the survey. A large perennial stream exists at the chainage 28/908. In this section, we have recorded eleven herpetofaunal species of which *Indirana* cf. *chiravasi*, *Micrixalus* cf. *uttarghati*, *Nyctibatrachus petraeus* were frequently encountered along the streams.

Increase in dimensions for structure 1 is recommended to make the structure more suitable for use by animals. Ledges are to be provided within all crossing structures. The other structures on this segment (structures 2, 3 and 4) are not proposed on the proposed railway track since this alignment falls inside the proposed tunnel.

Tunnel on proposed railway line (28/160 – 28/750) measures 590 m. Another proposed tunnel, parallel to Tunnel 3 (28/900 – 29/100) measures 200 m. The details of mitigation measures proposed for this chainage are given in Table 28 and shown in Figure 44.

Table 28: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 28/000 – 29/000

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure type	Dimension (m) (No. x width x height)	Chainage	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	28/122	RCC slab	1x 1 x 2.21	28/100	RCC box	1 x 3 x 4	RCC box	1 x 5 x 5
2.	28/300	RCC slab	1 x 1 x 0.91	Alignment in tunnel				
3.	28/765	Arch	1 x 1 x 2.59					
4.	28/908	RCC box	1 x 2 x 3.05					
5.	28/300 – 28/710	Tunnel	410	28/160 – 28/750	Tunnel	590	Tunnel	590
6.	28/925 – 29/100	Tunnel	175	28/900 – 29/100	Tunnel	200	Tunnel	200

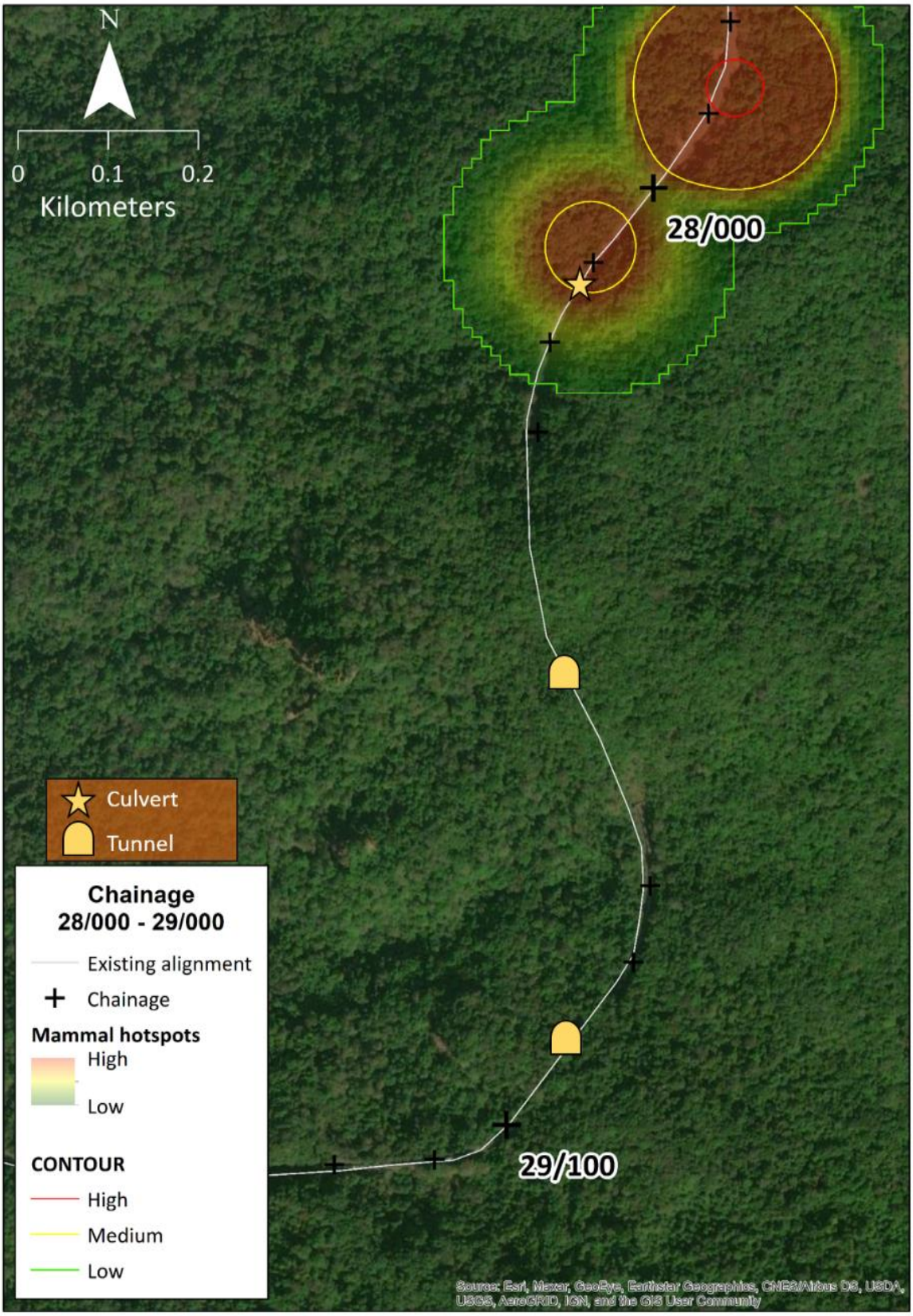

Figure 44: Locations of mitigation measures on chainage 28/000 – 29/000 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

Proposed mitigation measure from chainage 29/000 – 29/900

The segment begins inside Tunnel 3 (28/925 – 29/100) and ends at the mouth of Tunnel 4 (29/940 – 30/078) which is the end of the Karnataka section of the railway line. The topography in this segment is highly undulating. A large perennial stream exists at the chainage 29/680. Numerous seasonal streams are located in this section. An area with rich herpetofaunal diversity. We have recorded reptile species such as *Ptyas mucosa*, *Trimeresurus malabaricus*, *Ahaetulla borealis*. Amphibian species such as *Indirana* cf *chiravasi*, *Micrixalus* cf. *uttarghati* were also being commonly encountered. We have recorded rail kill of amphibian species (*Raorchestes* sp.) in this section.

Increase in dimensions for structures 1 and 2 is recommended to make the structures more suitable for use by animals. Ledges are to be provided within all crossing structures (design in Figure 48).

An overpass of 20 m width is recommended at 29/345 as the topography at this site is suitable for the same. The girder bridge at 29/613 may be retained in its proposed dimensions. Four tunnels are proposed on the new track (Table 29; Figure 45), the remaining tracts of this segment are open. The existing tunnel (mentioned in the previous section) ends at the beginning of this segment.

Table 29: Details of types and dimensions of structures of the Existing Railway Track, Proposed Railway Track and Modification of proposed structure as mitigation measure for chainage 29/000 – 29/900.

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure type	Dimension (m) ((No. x width x height)	Chainage	Structure type	Dimension (m) (No. x width x height)	Structure type	Dimension (m) (No. x width x height)
1.	29/110	RCC box	1 x 1 x 0.91	29/104	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 3
2.	29/177	RCC Arch	1 x 1 x 2.4	29/177	RCC box	1 x 3 x 3	RCC box	1 x 4 x 5
3.	29/345	NIL		NIL			Overpass	20 (width)
4.	29/433	RCC slab	1 x 1 x 2.47	Alignment in tunnel				
5.	29/513	RCC slab	1 x 1 x 3.05					
6.	29/613	RCC girder	4 x 18.29	29/613	Composite girder	2 x 18.3	Composite girder	2 x 18.3
7.	29/818	RCC pipe	1 x 2 x 1.22	Alignment in tunnel				
8.	Nil	Nil	Nil	29/275 – 29/550	Tunnel	275	Tunnel	275
9.	Nil	Nil	Nil	29/680 – 29/830	Tunnel	150	Tunnel	150
10.	Nil	Nil	Nil	29/925 – 30/135	Tunnel	210	Tunnel	210

Figure 45: Locations of mitigation measures on chainage 29/000 – 29/900 to be constructed on existing and proposed railway track
(NOTE: locations are approximated to the nearest chainage).

B. General Measures

1. No construction debris is to be dumped in streams and natural drainages. Water from these natural sources should not be used for construction purposes.

2. To discourage arboreal animals from accessing the electric poles (to be constructed for electrification purposes), all electric poles should be within the fence along the railway line.

3. The divisions between a set of two or more box culverts and underpasses are to be of pillar-type instead of wall-type (Figure 46).

4. Slope stabilisation should be done by revegetating the slopes with native species, and/or by pitching.

5. Major on-site construction activities may be avoided during monsoon season, that is the breeding period of herpetofauna. This would significantly lower the disturbance to herpetofauna and their habitats.

6. On-site construction activities should include provisions of noise-reduction measures such as noise attenuation barriers and noise-reduction devices to reduce noise from machinery, especially in the zones identified as priority zones for faunal presence.

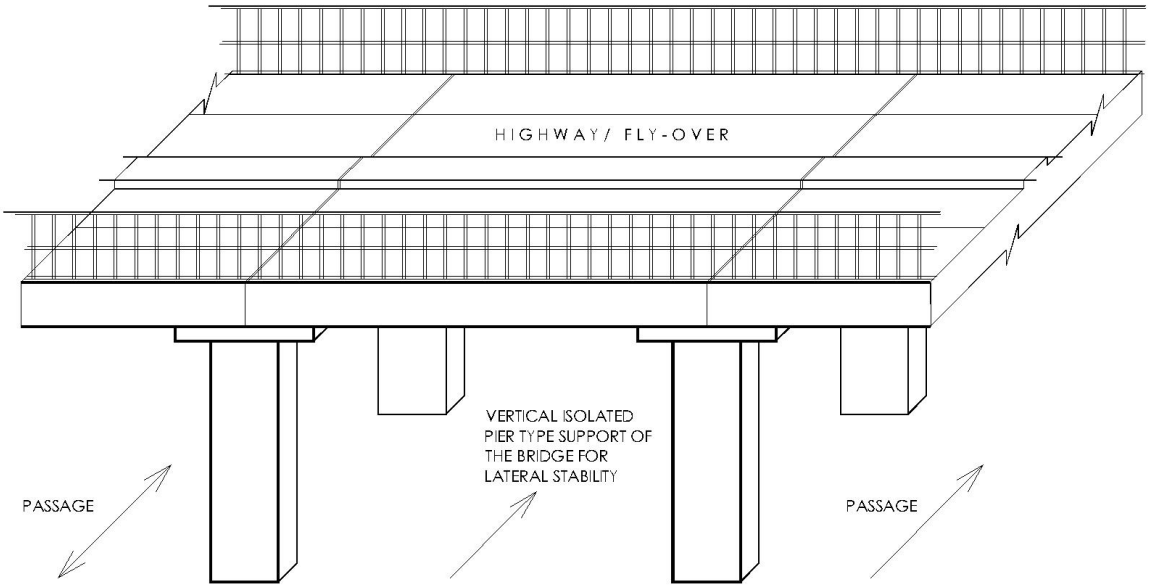

Figure 46: Pillar-type divisions are to be used for culverts instead of wall-type divisions (Source: WII, 2016)

SPECIFIC MEASURES

C. Fencing

Fences are generally provided along linear infrastructure such as roads and railway lines to prevent animal mortality by passing vehicles or trains. Fences are best used in combination with properly located wildlife crossing structures to allow animal movement, and cattle guards, and animal detection and warning systems to prevent instances of animals getting trapped between parallel fences.

Fencing is to be installed along the entire stretch of the railway line, except for downward or upward slope of more than 80 degrees on either side. This fencing is to be provided at an appropriate distance from the outer edges of the parallel railway tracks on both sides. A concrete base of 50 cm is to be constructed on which the chain-link fencing should be installed. The height is the fencing should be a minimum of 3 m height on all open sections. In places where the height of the retaining wall is less than 1 m, a fence of minimum height 2 m is to be added on top of the retaining wall.

Wherever side drainages are present along the railway track, the drain boundary on the outer edge is to be provided with a ledge/outward-turned lip measuring at least 50 cm in order to repel amphibians and reptiles from getting on to the railway track. The same type of ledge should be provided on the entire stretch of the concrete base. All aspects of fencing design are depicted in Figure 47.

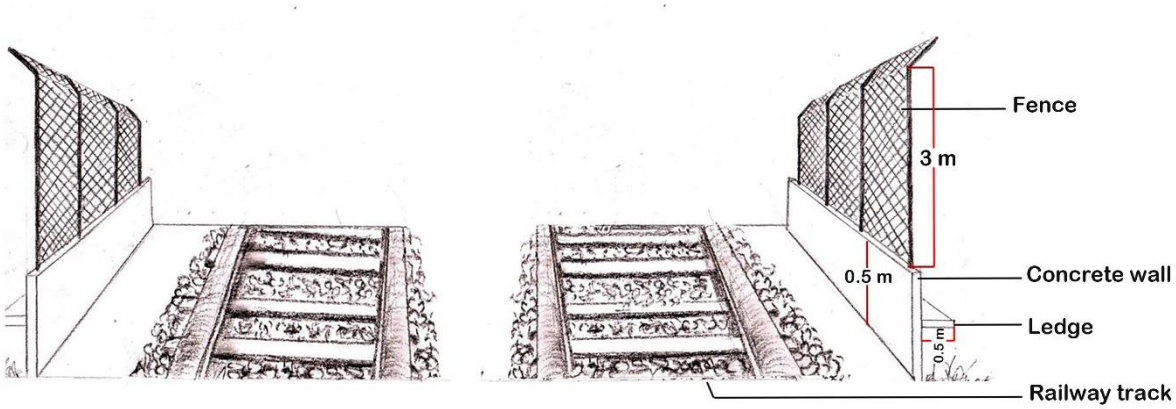

Figure 47: Fencing design for the doubled railway track alignment: The top of the fence should face outwards. A concrete base of 0.5 m height is to be provided above which chain-link fencing (3 m high) should be installed.

D. Canopy bridges

A canopy bridge is a rope, pole or wooden ladder or walkway suspended above a road or railway line, either from vertical poles or trees, and installed for tree-dwelling (arboreal) wildlife species such as primates (langur, macaques), squirrels and civets (WII, 2016). Given correct placement and use of appropriate building material, these structures enable movement of such species across the linear infrastructure, and mitigate the loss of canopy connectivity for arboreal species to some extent. These structures should be tightly stretched (not lagging) and wide enough (about 1m wide) for animals to walk on.

Canopy bridges for arboreal animals is to be provided at regular intervals of 1 km all along the railway track (except at places near railway stations, road crossings, overbridges, tunnels, stretches near tunnels where the gap between parallel tracks may be more than 15 m). A net/mesh like material is to be provided under the canopy bridge to prevent animals falling into the railway track. The design of the canopy bridges is provided in Figure 48.

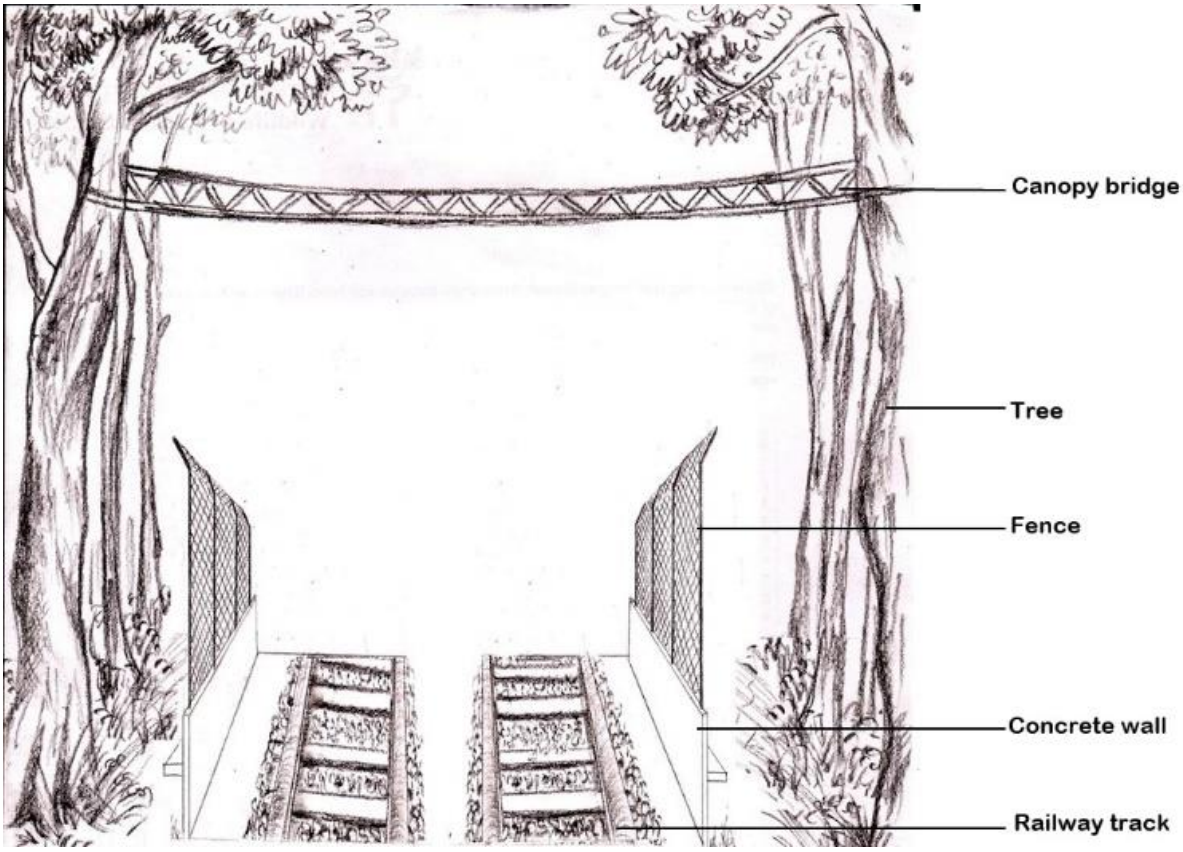

Figure 48: Canopy bridge design to be built across the doubled railway track for arboreal mammals.

E. Ledges

Additional features on crossing structures such as walkways or planks/ledges/shelves are installed on the interior walls of underpasses/crossing and/or drainage structures, to encourage mammals to use culverts built on natural drainage sites (WII, 2016). These structures help animals use the structures in seasons when the culverts may be inundated with water.

Ledges/shelves along the inner walls of all crossing and drainage structures are to be constructed for use by small mammals. These structures should extend up to the exit of the structures and brought to ground level. Fencing above all below-grade crossing and drainage structures is to continue with the railway track (Figure 49).

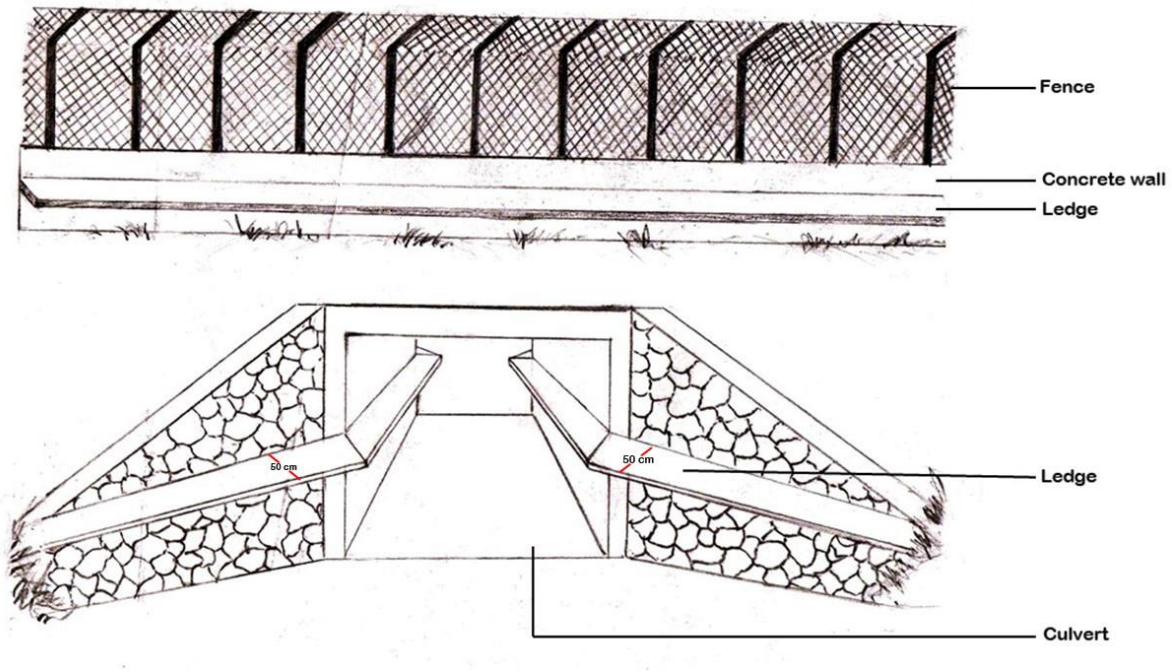

Figure 49: A. Ledges or shelves measuring 50 m wide are to be installed in all crossing and drainage structures. The ends of the shelves should be brought to ground level and fencing along the railway track should continue above all below-grade structures.

F. *Overpasses*

A wildlife overpass is a bridge, typically 30 – 70 m wide that extends above roads and railway lines to facilitate natural animal movement across the linear infrastructure. Such structures are built on natural substrate material, and enhanced with habitat features such as native vegetation, rocks and logs. Such structures allow for natural movement of wildlife as they are less confining as compared to culverts and underpasses, quieter, have ambient natural conditions of rainfall, light and temperature, and can be used by a wide range of wildlife (WII, 2016).

In locations with suitable topography i.e., appropriate height (above 7 m) on either side, overpasses are proposed. These are to be constructed using prefabricated materials that would be installed on-site. The overburden from construction sites may be used as filling material. The lateral view and top view of the proposed overpass is provided in Figure 50 (a, b and c). Either side of the top of the overpasses are to be fenced with light and sound barriers. The substrate of the overpass is to be revegetated with native flora. The slope of the approach of the overpass should not be more than 30 degrees at any point.

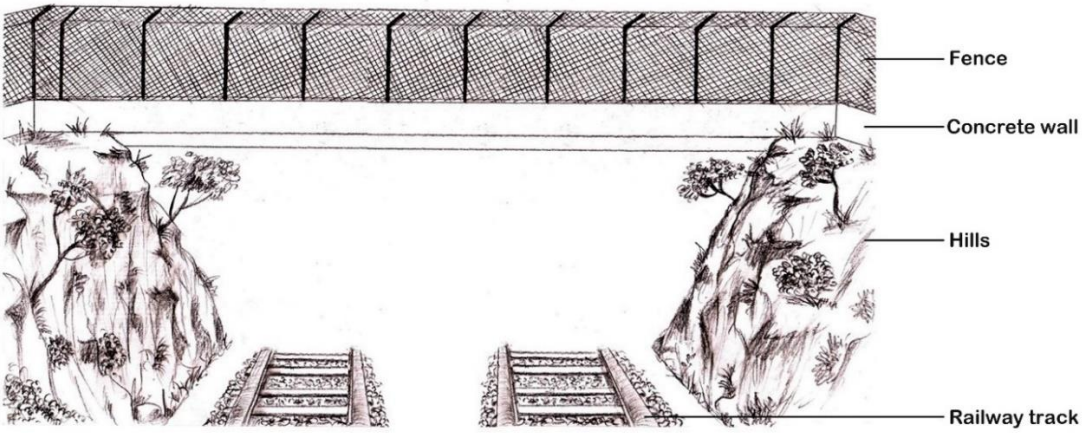

Figure 50 (a): Lateral view of overpass and adjoining features

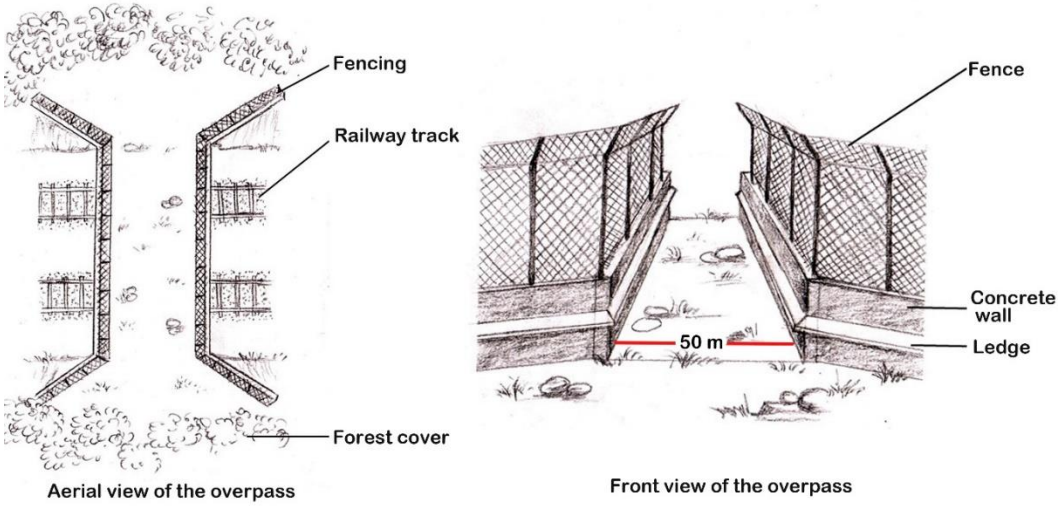

Figure 50 (b): Aerial and frontal view of the overpass.

Figure 50 (c): Overpass representations (https://arc-solutions.org/new-materials/)

G. Level crossings with early warning system

Level-crossings for animals, in combination with fencing, cattle guards and animal warning systems would allow for free and safe movement of wild animals across the railway track. These sites have been selected based on high probability of animal movement and suitable terrain.

The width of the level crossings is to be 50 m. There should be no ballast between the tracks on these crossings, and the ground should be levelled with surrounding area using cement. The track near the end of the fence (at beginning and end of the crossing) should have cattle guards of minimum 3 m width, to discourage animals from entering the fenced portions of the track. The design of level crossings for animals is provided in Figure 51. Early warning systems should be installed at these sites at appropriate locations. These devices must function to emit sounds to dispel any animals present at the site after getting triggered by an approaching train that is within 1 km of level crossing. Cattle guards are to be provided at all places where fencing ends viz., road level crossing.

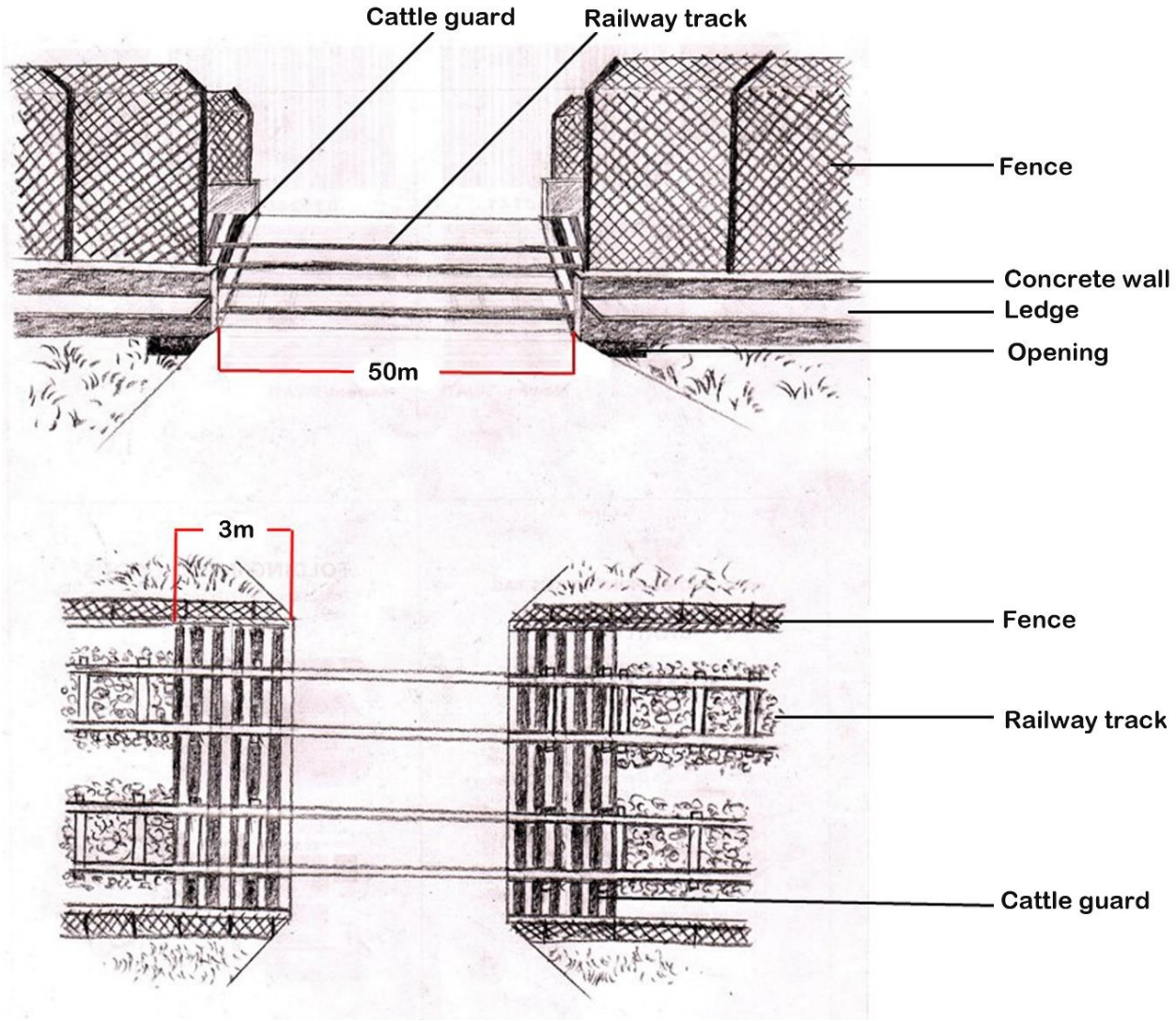

Figure 51: Layout of level crossings for animals.

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ANNEXURE I

Species Checklist (Present Study v/s. Sukumar & Sitharam, 2017 Report)

Sl. No.	Class	Family	Species Name	Present Study	Sukumar & Sitharam, 2017
1.	**AMPHIBIA**	Bufonidae	*Duttaphrynus melanostictus*	✓	✓
2.			*Pedostibes tuberculosus*	×	✓
3.		Microhylidae	*Microhyla ornata*	✓	✓
4.			*Microhyla rubra*	×	✓
5.			*Uperodon mormorata*	✓	✓
6.			*Uperodon taprobanicus*	×	✓
7.		Ranixalidae	*Indirana* cf *salelkari*	✓	×
8.			*Indirana cf chiravasi*	✓	×
9.			*Indirana semipalmata*	×	✓
10.		Ranidae	*Indosylvirana* cf. *caeseri*	✓	✓
11.			*Hydrophylax malabaricus*	✓	✓
12.			*Clinotarsus curtipes*	✓	✓
13.		Dicroglossidae	*Minervarya caperata*	✓	✓
14.			*Minervarya sahyadris*	✓	×
15.			*Minervarya cf kudremukhensis*	✓	×
16.			*Minervarya rufescens*	×	✓
17.			*Fejervarya* sp.	✓	×
18.			*Sphaerotheca breviceps*	×	✓
19.			*Euphlyctis cyanophlyctis*	✓	✓
20.			*Euphlyctis aloysii*	×	✓
21.			*Hoplobatrachus tigerinus*	✓	✓
22.		Rhacophoridae	*Polypedates maculatus*	✓	✓
23.			*Raorchestes bombayensis*	✓	✓
24.			*Raorchetes* sp.	✓	×
25.			*Pseudophilautus amboli*	✓	✓
26.			*Rhacophorus malabaricus*	✓	✓
27.		Nyctibatrachidae	*Nyctibatrachus petraeus*	✓	✓
28.		Micrixalidae	*Micrixalus* cf. *uttarghati*	✓	✓
29.		Indotyphlidae	*Gageneophis* sp	✓	×
30.		Ichthyophidae	*Ichthyophis* sp.	✓	×
31.		Agamidae	*Calotes versicolor*	✓	✓
32.			*Monilesaurus rouxii*	✓	✓
33.		Gekkonidae	*Hemidactylus prashadi*	✓	
34.			*Hemidactylus* sp. (*brookii* complex)	✓	✓
35.	**REPTILIA**		*Hemidactylus* cf. *triedrus*	✓	×
36.			*Hemidactylus frenatus*	✓	✓
37.			*Cnemaspis* cf. *goaensis*	✓	×
38.		Scincidae	*Eutropis carinata*	✓	×
39.			*Eutropis* cf. *macularia*	✓	✓
40.		Varanidae	*Varanus bengalensis*	✓	✓
41.		Colubridae	*Hebius beddomei*	✓	×
42.			*Fowlea piscator*	✓	✓
43.			*Ptyas mucosa*	✓	✓
44.			*Ahaetulla pulverulenta*		✓
45.			*Ahaetulla borealis*	✓	--
46.			*Boiga* sp.	✓	×
47.			*Boiga beddomei*	×	✓
48.			*Rhabdops* sp.	✓	×

49.		*Lycodon aulicus*	✓	✓
50.		*Lycodon travancoricus*	✓	✓
51.		*Olgodon arnensis*	×	✓
52.		*Oligodon taeniolatus*	✓	✓
53.		*Dendrelaphis* cf. girii	✓	×
54.		*Dendrelaphis tristis*	×	✓
55.		*Rhabdops plumbicolor*	×	✓
56.	Viperidae	*Hypnale hypnale*	✓	✓
57.		*Trimeresurus malabaricus*	✓	✓
58.		*Trimeresurus gramineus*	×	✓
59.		*Vipera russelli*	×	✓
60.	Elapidae	*Bungarus caeruleus*	✓	✓
61.		*Naja naja*	×	✓
62.	Uropeltidae	*Uropeltis ellioti*	×	✓
63.	Pythonidae	*Python molurus*	×	✓
64.	Geomydidae	*Melanochelys trijuga*	✓	×

Annexure II

Herpetofaunal Mortality Recorded During Survey

Species Name	Individuals	Lat	Long	Remarks
Ahaetulla borealis	1	15.40641	74.33825	Railkill
***Indosylvirana* sp.**	1	15.40677	74.33827	Railkill
Hydrophylax malabaricus	1	15.39716	74.32301	Railkill
***Indosylvirana* sp.**	1	15.42328	74.36108	Railkill
***Indosylvirana* sp.**	1	15.4294	74.38409	Railkill
Ahaetulla borealis	1	15.39654	74.32338	Railkill
Hebius beddomei	1	15.44307	74.38257	Roadkill; 2 Meter away from railway track
Raorchestes sp	1	15.37247	74.31535	Railkill
Fowlea piscator	1	15.4413	74.38674	10 meters away from railway track
***Indosylvirana* sp.**	1	15.38948	74.31938	Railkill
***Indosylvirana* sp.**	1	15.40655	74.33827	Railkill
Hoplobatrachus tigerinus	1	15.41384	74.3423	Railkill
Dendrelaphis sp	1	15.43017	74.38373	Railkill
Duttaphrynus melanostictus	1	15.43898	74.38281	Railkill
Ahaetulla borealis	1	15.43982	74.38264	Railkill
Lycodon travancoricus	1	15.37149	74.30664	Railkill
Bungarus caeruleus	1	15.37149	74.30664	Railkill
***Ichthyophis* sp.**	1	15.37209	74.30706	Railkill

ANNEXURE III

Mitigation measures recommended on the existing and proposed railway tracks in the Tinaighat to Castlerock segment (Chainage 12/000 to 25/000)

S. No.	Chainage	Structures on Existing Railway Track		Structures planned on Proposed Railway Track		Modification of proposed structure to act as mitigation measures	
		Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)
1.	12/233	Arch culvert	1 x 1.52 x 4.25	RCC box	1 x 1.52 x 4.25	RCC box	2 x 5 x 4.5
2.	12/350	Pipe culvert	1 x 2 x 0.8	RCC box	1 x 2 x 2	RCC Box	1 x5 x 2
3.	12/702	Pipe culvert	1 x 2 x 0.3	RCC box	1 x 1.55 x 1.80	RCC box	1 x 1.55 x 1.80
4.	12/795	NIL		NIL		Level crossing	30-35 (width)
5.	12/812	RCC slab	1x 2 x 1.46	RCC box	1 x 3.760 x 1.5	RCC box	1 x 3.760 x 1.5
6.	13/118	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55	RCC box	1 x 2.55 x 2.55
7.	13/597	RCC box	2 x 1.25 x 1.5	RCC box	1 x 3.05 x 1.8	RCC box	2 x 5 x 2
8.	13/772	RCC pipe	1 x1 x 1.2	RCC box	1 x 1.2 x 1.5	RCC box	3 x 5 x 2.5
9.	13/993	RCC box	1 x 1.02 x 0.625	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 2
10.	14/230	RCC pipe	1x 2 x 1.22	RCC box	1 x 3 x 1.8	RCC box	1 x 5 x 5
11.	14/295	RCC box	1 x 2.55 x 2.3	RCC box	1 x 2.55 x 2.3	Underpass	1 x 20 x 4.5
12.	14/550	RCC box	1 x 3.08 x 1.55	RCC box	1 x 3.08 x 1.8	RCC box	1 x 3.08 x 1.8
13.	14/650	NIL		NIL		Level crossing with early warning system	50 (width)
14.	15/213	RCC box	1 x 2.35 x 2.65	RCC box	1 x 2.35 x 2.65	RCC box	4 x 5 x 3
15.	15/552	RCC box	1 x 2.45 x 2.0	RCC box	1 x 2.45 x 2.0	RCC box	2 x 5 x 4.5
16.	15/962	RCC box	1 x 2.4 x 1.85	RCC box	1 x 2.4 x 1.85	RCC box	3 x 5 x 4.5
17.	16/188	Pipe culvert	1 x 2 x 1.25	RCC box	1 x 2.92 x 1.8	RCC box	2 x 5 x 2.5
18.	16/688	RCC box	1 x 1.83 x 2.88	RCC box	1 x 1.83 x 2.88	RCC box	2 x 5 x 3
19.	17/074	RCC pipe	1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 5 x 2
20.	17/280	NIL		NIL		Underpass	2 x 5 x 3
21.	17/950	NIL		NIL		Underpass	1 x 50 x 5.5
22.	18/251	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6	RCC box	2 x 3.34 x 3.6
23.	18/800	NIL		NIL		Level crossing with early warning system	50 (width)
24.	19/060	NIL		NIL		Level crossing with early warning system	50 (width)
25.	19/292	RCC pipe for culvert	1 X 2 x 1.2	RCC box	1 x 3 x 1.8	RCC box	4 x 5 x 3.5
26.	19/520	RCC box	1 x 2.35 x 2.5	RCC box	1 x 2.35 x 2.5	RCC box	5 x 5 x 3.5
27.	19/850	NIL		NIL		Level crossing with early warning system	50 (width)
28.	20/190	RCC pipe culvert	1 X 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	2 x 2 x 2

29.	20/350		NIL		NIL	Level crossing with early warning system	50 (width)
30.	21/002	RCC box	2 x 2.6 x 3.65	RCC box	1 x 5.5 x 3.65	RCC box	3 x 5 x 5
31.	21/381	RCC pipe for culvert	1 x 1 x 1.2	RCC box	1 x 1.2 x 1.8	RCC box	1 x 4 x 2
32.	21/655	RCC pipe for culvert	1 x 1.2 x 2.85	RCC box	1 x 1.2 x 2.85	RCC box	2 x 4 x 4
33.	21/978	Arch	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2	PSC Slab	1 x 5 x 12.2
34.	22/301	RCC box	1 x 1.52 x 3.72	RCC box	1 x 1.52 x 3.72	RCC box	1 x 5 x 5
35.	22/630	RCC pipe for culvert	1 x 1 x 0.9	RCC box	1 x 0.9 x 1.5	RCC box	2 x 3 x 2
36.	22/860	RCC box	1 x 2.42 x 2.13	RCC box	1 x 2.42 x 2.13	RCC box	3 x 3 x 3
37.	23/279	RCC slab	1 x 4 x 7	RCC slab	2 x 4 x 7	RCC slab	3 x 5 x 7
38.	23/495	RCC pipe culvert	1 x 3 x 1.2	RCC box	1 x 4.7 x 1.5	RCC box	2 x 5 x 2.5
39.	23/450		NIL		NIL	Overpass with light and sound barrier	20 (width)
40.	24/887	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2	RCC slab	1 x 2.4 x 2.2

Mitigation measures recommended on the existing and proposed railway tracks in the Castlerock-Caranzol segment (Chainage 25/000 to 29/900)

S. No.	Structures on Existing Railway Track			Structures planned on Proposed Railway Track			Modification of proposed structure to act as mitigation measures	
	Chainage	Structure Type	Dimension (m) (No. x Width x Height)	Chainage	Structure Type	Dimension (m) (No. x Width x Height)	Structure Type	Dimension (m) (No. x Width x Height)
1.	25/450	RCC box	1 x 2 x 2.97	25/455	RCC box	2 x 3.0 x 3.0	RCC box	3 x 5 x 4
2.	25/710	RCC pipe culvert	1 x 1 x 0.61	25/708	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 4
3.	26/015	RCC box	1 x 1 x 2.54	26/005	RCC box	1 x 3 x 3	RCC box	1 x 6 x 5
4.	26/110	RCC pipe	1 x 1 x 1.22	26/100	RCC box	1 x 1.2 x 1.2	RCC box	1 x 2.4 x 1.5
5.	26/220	RCC slab	1 x 1 x 1.98	26/212	RCC box	2 x 1.2 x 1.2	RCC box	1 x 3 x 1.2
6.	26/380	RCC slab	1 x 2 x 1.22	26/378	RCC box	2 x 1.2 x 1.2	RCC box	2 x 2.5 x 1.2
7.	26/482	RCC box	1 x 1 x 2.44	26/480	RCC box	1 x 3 x 3	RCC box	1 x 5 x 5
8.	26/535	NIL			NIL		Overpass	20 (width)
9.	26/634	RCC slab	1 x 1 x 3.05	26/635	RCC box	1 x 3 x 2	RCC box	1 x 3 x 3
10.	26/733	RCC pipe	1 x 1 x 0.61	26/732	RCC box	1 x 1.2 x 1.2	RCC box	1 x 1.2 x 1.2
11.	26/790	RCC box	1 x 1 x 2.44	26/787	RCC box	1 x 3 x 2	RCC box	1 x 6 x 3
12.	26/903	Arch	1 x 1 x 2.45	26/902	RCC box	1 x 3 x 4	RCC box	1 x 5 x 4
13.	26/960	NIL			NIL		Overpass	15 (width)
14.	27/032	RCC slab	1x 1 x 3.05	27/033	RCC box	1 x 3 x 2	RCC box	1 x 5 x 3
15.	27/150	Composite girder	1 x 12.29 + 1 x 18.29	27/130	Composite Girder	1 x 18.3 + 1 x 12.2	Composite Girder	1 x 18.3 + 1 x 12.2
16.	27/400	RCC pipe culvert	1 x 1 x 1.2	27/373	RCC box	1 x 2 x 1.8	RCC box	2 x 4 x 2
17.	27/836	RCC pipe culvert	1x 4 x 1.22	27/813	RCC box	2 x 3 x 2	RCC box	2 x 5 x 5
18.	27/180 – 27/275	Tunnel	95	27/150 – 27/335	Tunnel	185		
19.	28/122	RCC slab	1x 1 x 2.21	28/100	RCC box	1 x 3 x 4	RCC box	1 x 5 x 5
20.	28/300	RCC slab	1 x 1 x 0.91	Alignment in tunnel				
21.	28/765	Arch	1 x 1 x 2.59					
22.	28/908	RCC box	1 x 2 x 3.05					
23.	28/300 – 28/710	Tunnel	410	28/160 – 28/750	Tunnel	590	Tunnel	590
24.	28/925 – 29/100	Tunnel	175	28/900 – 29/100	Tunnel	200	Tunnel	200
25.	29/110	RCC box	1 x 1 x 0.91	29/104	RCC box	1 x 1.2 x 1.2	RCC box	1 x 5 x 3
26.	29/177	RCC Arch	1 x 1 x 2.4	29/177	RCC box	1 x 3 x 3	RCC box	1 x 4 x 5
27.	29/345	NIL			NIL		Overpass	20 (width)
28.	29/433	RCC slab	1 x 1 x 2.47	Alignment in tunnel				
29.	29/513	RCC slab	1 x 1 x 3.05					
30.	29/613	RCC girder	4 x 18.29	29/613	Composite girder	2 x 18.3	Composite girder	2 x 18.3
31.	29/818	RCC pipe	1 x 2 x 1.22	Alignment in tunnel				
32.	NIl	Nil	Nil	29/275 – 29/550	Tunnel	275	Tunnel	275
33.	NIl	Nil	Nil	29/680 – 29/830	Tunnel	150	Tunnel	150
34.	NIl	Nil	Nil	29/925 – 30/135	Tunnel	210	Tunnel	210

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

ANNEXURE III

Office of the Addl. Principal Chief Conservator of Forest & Chief Wildlife Warden
Aranya Bhawan, Jhalana Institutional Area, Jaipur, Rajasthan
Phone No.: 0141-2700151
e.mail: cwlw.raj@gmail.com

393

No.

Dated :

Minutes of the Meeting

A meeting was held in CWLW Office with the following officers from NHAI on 29.05.2019.

1. Mr. MK Jain (CGM cum RO, Jaipur)
2. Mr. Vaibhav Mittal (GM, NHAI)
3. Dr. Raj Kumar Singh (Consultant, NHAI)
4. Mr. Navneet Kumar (Consultant, NHAI)
5. Ms. Aruna Tageja (Bridge Engineer, Consultant)
6. Mr. Pranav Ranjan (Highway Engineer, Consultant)

The following points were discussed:

1. Bharatmala project covering Delhi-Vadodara Green Field Expressway Highway (NH-148N) involves consideration on wildlife clearance proposals of three Protected Areas, as mentioned below:

I. IDFP/RJ/ROAD/3775/2019 (Ranthambhore National Park and Tiger Reserve)
II. IDFP/RJ/ROAD/3774/2019 (National Chambal Wildlife Sanctuary)
III. IDFP/RJ/ROAD/3771/2019 (Darrah Wildlife Sanctuary)

For the site inspection of the project area, a committee had been constituted vide letter no. 6195 dated 30.03.2019 (Annex-I) of this office which has submitted its report vide letter no. 1310 dated 10.05.2019 with recommendation (Annex-II). The representatives of NHAI made a presentation on the referred points of recommendation and committed to their compliance. It was decided that the proposal will be uploaded online for further processing.

As conditions specific to PAs, officers of NHAI were further conveyed that for Ranthambhore National Park and Tiger Reserve section (324+560 km to 328+500 km), constructional design of the project will be undertaken in phases, so that some undisturbed area may remain available for tiger/wildlife movement at all times.

For Mukundara Hills Tiger Reserve Section (422+200 km to 425+750 km = 3.55 km); the tunnel will cause almost one year disturbance for movement of wildlife in the valley. This valley is a critical connect between northern and southern parts of Mukundara Hills Tiger Reserve, like a corridor. The project may be recommended with the additional condition that NHAI will provide CSR funds for relocation of Girdharpura and Damodarpura villages.

2. For proposal of *'Development of emergency landing Facility on stretch of NH-15 from km 200+600 to km 205+600) (Design Length 5.0 km) on Phalodi-Jaisalmer Section of NH-11 (Old*

NH-15) near village Khara, Jaisamer, it was decided that the matter would be considered as per directions of Govt. of Rajasthan.

3. For the project of *'Widening and Strengthening of Myajlar-Jaisalmer section of NH-11 from Km 0.000 to Km 101.197 (passing through Desert National Park in between km 0+855 to Km 63+615) & Sundara – Myajilar section of NH-70 (passing through Eco – Sensitive Zone of Desert National Park from Km 46+000 to Km 82+600)*; it was conveyed that option of making the road along the PA boundary may be explored to which the NHAI officials agreed.

(*Arindam Tomar*)
Addl. PCCF&CWLW,
Rajasthan, Jaipur

No. 6787-89

Dated : 27/06/19

Copy to: NHAI / CCF&FD, RTR, Sawai Madhopur / CCF&FD, MHTR, Kota for information and necessary action.

Addl. PCCF&CWLW,
Rajasthan, Jaipur