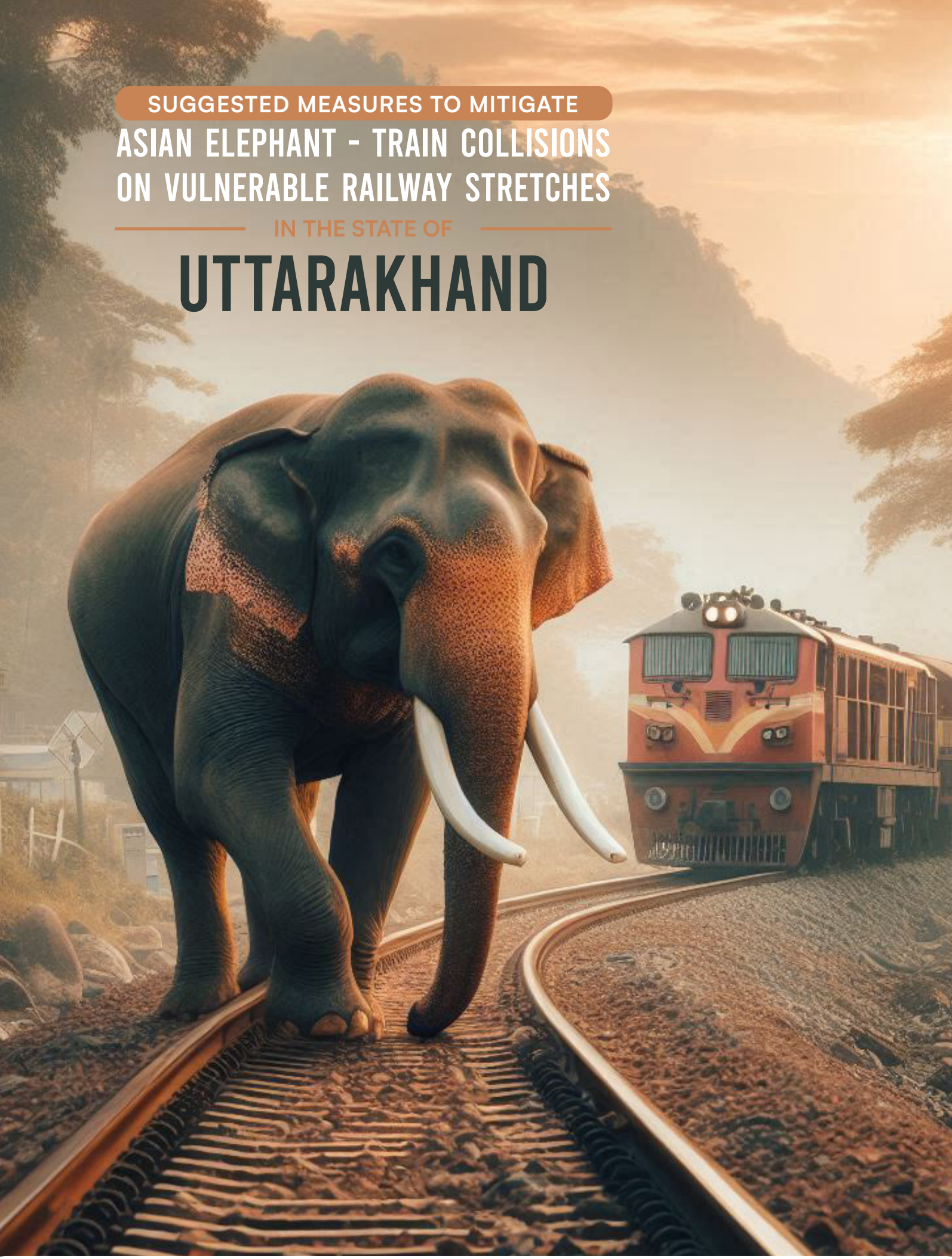
SUGGESTED MEASURES TO MITIGATE

ASIAN ELEPHANT - TRAIN COLLISIONS ON VULNERABLE RAILWAY STRETCHES

IN THE STATE OF

UTTARAKHAND



सत्यमेव जयते

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

AUGUST 2024

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To minimize the risk of collisions between elephants and trains, the Ministry of Environment, Forest and Climate Change and the Ministry of Railways in India have jointly undertaken several measures. These include the construction of underpasses and overpasses for safe elephant passage, setting up of signage boards to warn locomotive drivers, and speed regulations in elephant corridors. Further, efforts have also been made to sensitize train drivers and railway staff about elephant movements and using technology to track and predict elephant movements near railway tracks .These collaborative efforts aims to safeguard elephant populations while ensuring the smooth operation of railway services, and are part of a comprehensive strategy to reduce train-elephant collisions.

By implementing early warning systems like DAS, underpasses, overpasses, level crossings and installing barriers at vulnerable points along railway tracks, the Ministry of Environment, Forest and Climate Change and the Ministry of Railways aim to create a safer environment for elephants while maintaining efficient rail operations.

The collaboration between the Ministry of Environment, Forest and Climate Change and the Ministry of Railways underscores the importance of inter-departmental cooperation in wildlife conservation. By aligning their efforts, these ministries are working towards a sustainable solution to mitigate the risk of elephant-train collisions.

A combination of technological innovations, such as the use of thermal imaging cameras and automated alert systems, & traditional methods, like patrolling and community involvement, are being employed by the Ministry of Environment, Forest and Climate Change and the Ministry of Railways to protect elephants from train accidents.

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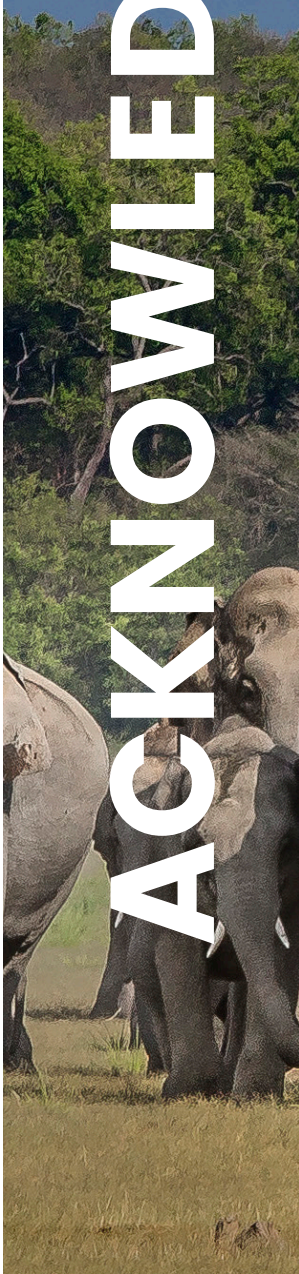

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CONTENTS

01. Introduction

Based on a meeting on 17th August 2022, the Hon'ble Minister of Railways, Government of India, instructed the Ministry of Environment, Forest and Climate Change (MoEF&CC) to provide at least 100 locations of existing railway segments across sensitive elephant and tiger landscapes in the country for construction of permanent mitigation measures in view of wildlife-train collisions (Proceedings under Ministry of Railways letter No. 2022/CE-IV/Elephant Pass dated 30th September 2022). Consequently, details of sensitive stretches for constructing permanent and temporary mitigation measures were provided by the MoEF&CC (vide OM F.No. 12-1/2019-PE (Part-I), dated 30th August 2022). Further PCCF (WL) and CWLW, Uttarakhand (vide letter 895/698Dehradun, dated 31st October 2022) provided a list of sensitive locations for construction of permanent measures to mitigate wildlife rail collisions in the state.

A. Railway lines near Haldwani

Of the nine priority segments for mitigation on railway lines in Uttarakhand state, two segments both starting at Lalkuan station, were visited during the field survey. There have been regular incidents of wild animal mortality on the tracks recently and in the past. The Lalkuan to Gularbhoj railway line (segment 1 hereafter) connects Kashipur in Uttarakhand to Lalkuan via Sultanpur and Gularbhoj. A 16 km segment of the railway line lies within elephant habitat in the Terai East Forest Division. The Lalkuan to Chhatarpur railway line (Segment 2 hereafter) connects Rampur in Uttar Pradesh to Lalkuan via Bilaspur (UP) and Rudrapur (UK). An 8 km segment of the railway line passes through elephant habitat. Additionally, the railway intersection near the Indian Oil (IOCL) premises was flagged as a potential conflict point where regular elephant movement has been observed (Fig. 1).

The Terai Arc Landscape supports a sizeable elephant population, that has increasingly come into conflict with humans because of habitat fragmentation. Further the Central Terai Forest Division is also considered a major source of tigers for the Western Terai Arc Landscape. Linear infrastructure such as roads and railway lines have further fragmented elephant movement pathways, leading to elephant mortalities especially through collisions with trains. Elephant and wildlife movement within the Terai Central Forest Division is hampered because of the aforementioned railway lines, leading to several wildlife mortalities in the two sections (Table 1). Further, the railway line (Haldwani to Kathgodam) and National Highway 109 near the IOCL premises intersect elephant movement pathways between Central Terai and the Gola range (via the Gola River corridor). These human developments, including the Haldwani township, have compromised connectivity within the landscape.

A female elephant was injured after colliding with a train on the eve of Diwali (13th November 2023). The incident necessitated a swift need to take urgent steps to mitigate the railway tracks passing through forested areas in the landscape. Consequently, a team from WII, Forest Department and railways officials visited the railway tracks during 20th and 21st November 2023.

The main objective of the survey was to assess use of habitat near both railway lines by elephants and other wildlife, and subsequently determine locations, types and dimensions of mitigation measures for priority stretches.

B. Railway lines vulnerable to elephant-train collisions in Uttarakhand

A list of railway lines along with proposed mitigation measures appropriate for the sites was shared by the Uttarakhand Forest Department, attached as Appendix II.

Figure 1: Railway segments inspected near the Central Terai Forest Division during the field visit.

Table 1: Mortality of elephants and other wildlife on the Lalkuan to Gularbhoj, and Lalkuan to Chhatarpur railway line passing through forests of the Terai Central Forest Division as reported by the railways and forest department.

S.No.	Date	Chainage/Range	Details
Lalkuan-Gularbhoj			
1.	18.08.2021	13/2	Female elephant and calf run over
Lalkuan-Chhatarpur			
2.	17.04.2017	57/8-10	Two elephants dead
3.	11.03.2018	61/1-2	Two elephants dead
4.	27.05.2018	60/3-4	One elephant dead
5.	18.08.2021	13/2	Female elephant and calf run over
6.	20.02.2022	62/1-2	Elephant herd crossing, one dead
7.	18.12.2022	64/08	Elephant calf injury by collision
8.	08.05.2023	63/5-6	Elephant collision
9.	21.09.2023	66/6-7	Elephant injury by collision
Terai Central Forest Division			
10.	04.12.2002	Tanda	One male elephant
11.	21.10.2010	Tanda	One male elephant
12.	08.09.2021	Tanda	One female elephant
13.	18.12.2022	Tanda	One female elephant
14.	29.11.2022	Rudrapur	One female leopard

02. Field Survey

* The objective of the field survey was to minimise elephant-train collisions either by constructing underpasses and overpasses wherever possible, by reducing the time taken by elephants to cross the railway tracks by easing movement across the track through construction of ramps and level crossings, and by implementation of technology for early detection and warning systems.

Prior to the survey, the Forest Department provided us with locations of 11 points along both railway lines that they considered priority wildlife crossing zones. Thereafter, we walked along both railway lines with Railway officials and Forest Department personnel, and collected data on animal signs on and near the railway tracks, information of previous railway line crossings and use of trails near railway lines by elephants and other wildlife. The GPS coordinates and chainages of these sites were noted down. We also collected records of previous wild animal mortality and wildlife sightings on the railway track from the Department and Railways.

We collated the aforementioned information in the GIS-domain to determine priority high-use railway segments. Mitigation measures were then suggested based on width of crossing zone, track height of the railway line, presence of drainage structure and human infrastructure (potential for conflict) in that segment.

03. Site-Specific Findings & Mitigation Measures

3.1. Lalkuan to Gularbhoj railway line

The railway track along this segment is relatively flat with regard to the surrounding terrain. Based on the field survey, discussions and data obtained from the Forest Department and Railways, majority of segment 1 was found suitable for wildlife movement, since most of the crossing sites have similar characteristics in terms of track height and adjacent vegetation. Multiple sites of elephants crossing the track were reported by the railways, FD ground staff and observed on field. Two wildlife mortality sites were also reported, that coincided with the priority crossing zones flagged by the FD (Fig. 2).

Consequently, given the importance of almost entire stretch of segment 1 for wildlife movement, and the relatively flat track, we recommend construction of ramps that would help wild animals, especially elephants, quickly cross the railway track. Ramps are to be constructed on the following ten priority sensitive stretches (Table 2). These stretches are indicative of the aggregations of signs and sightings of elephants and other wildlife as observed and reported, and ramps may be constructed on other suitable sites along this track as well. **One ramp with rubberised level crossing is to be constructed every 250 m within these segments wherever the maximum slope gradient can be maintained** (Fig. 3). The width of the crossing should be 25 m (at the top). DAS-based (Distributed Acoustic Sensing) IDS (Intrusion Detection System) should be installed on the railway section on priority to monitor wildlife movement across the railway track to avoid future collisions and deaths. Cable laying for this intrusion system should be done at least 200-250 m away from railway track. i.e. in forest land so that sufficient reaction time is available to disseminate information to train operation staffs.

Table 2: Approximate start and end GPS coordinates of stretches of the Lalkuan to Gularbhoj railway line segment considered sensitive with respect to presence and movement of elephant and other wildlife.

S. No.	Start GPS	End GPS	Length (m)
1.	29° 4'39.82"N 79°30'23.73"E	29° 4'41.34"N 79°29'57.17"E	700
2.	29° 4'42.78"N 79°29'29.96"E	29° 4'45.89"N 79°28'34.13"E	1500
3.	29° 4'47.22"N 79°28'8.84"E	29° 4'47.75"N 79°27'59.56"E	250
4.	29° 4'48.86"N 79°27'37.94"E	29° 4'48.40"N 79°27'46.34"E	225
5.	29° 4'49.38"N 79°27'29.68"E	29° 4'49.65"N 79°27'23.40"E	170
6.	29° 4'50.41"N 79°27'7.78"E	29° 4'52.36"N 79°26'30.93"E	1000
7.	29° 4'54.97"N 79°25'42.99"E	29° 4'55.71"N 79°25'31.13"E	320
8.	29° 4'56.92"N 79°25'3.64"E	29° 5'8.03"N 79°24'0.74"E	1740
9.	29° 5'9.80"N 79°23'52.94"E	29° 5'20.46"N 79°23'6.43"E	1300
10.	29° 5'26.09"N 79°22'40.76"E	29° 5'39.99"N 79°21'38.39"E	1740

Figure 2: Representation of wildlife sightings as reported by the Railways (green circles), animal signs recorded during field survey by WII team (green pins), and sensitive animal crossing zones identified by the UK Forest Department (blue pins), on Segment 1 (Lalkuan to Gularbhoj).

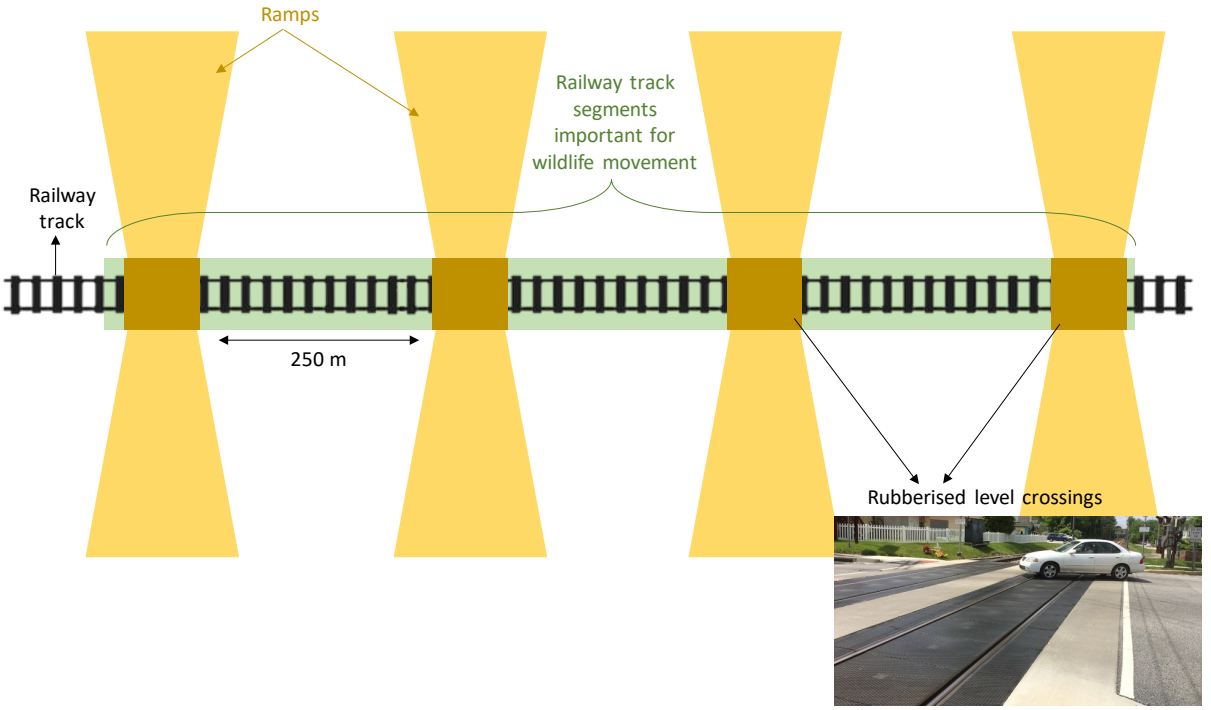


Figure 3: Diagrammatic representation of layout of ramps, spaced 250 m apart, on identified priority elephant movement stretches on the Lalkuan to Gularbhoj railway segment.

3.2. Lalkuan to Chhatarpur

During the field survey, we observed fairly regular elephant movement near and on the railway track, in addition to signs of tigers and leopards. Regular movement was also reported from the section after the curve near chainage 61.00 km (approximate), where the track borders the Pantnagar airport and the G.B. Pant University of Agriculture and Technology (Fig. 4). Facilitating movement near this segment would elevate conflict of elephants with humans, and it is therefore **suggested to fence the railway track on both sides after the curve (approx. chainage 61.00 km) till the end of the forested segment of the railway track (approx. chainage 57 km).**

Mitigation measures from Lalkuan station till chainage 61.00 km:

The track height varies between 3.25 and 5.5 m in this section, which later decreases to 2 to 3.5 m towards Chhatarpur. Thus, the segment of the railway track where structural mitigation would be beneficial for wildlife and elephants is the segment between Lalkuan station and till chainage 61.00 km (approximate). All drainage structures in this segment should be made suitable for animal movement, most of which are currently waterlogged (Fig. 5).

Animal underpasses:

Additionally, eight animal underpasses are recommended on the stretch. The underpasses should measure 30 m in width. The height of the underpasses should be 6 m. The height of the underpasses should not be achieved by digging as it would lead to further water logging, rendering the underpasses unusable by wildlife. Further, water logging is to be avoided under these passages by any required means.

The GPS locations of the recommended structures is provided below (Table 3). Before construction of the structures, the exact locations should be verified and validated on-field in consultation with the Forest Department.

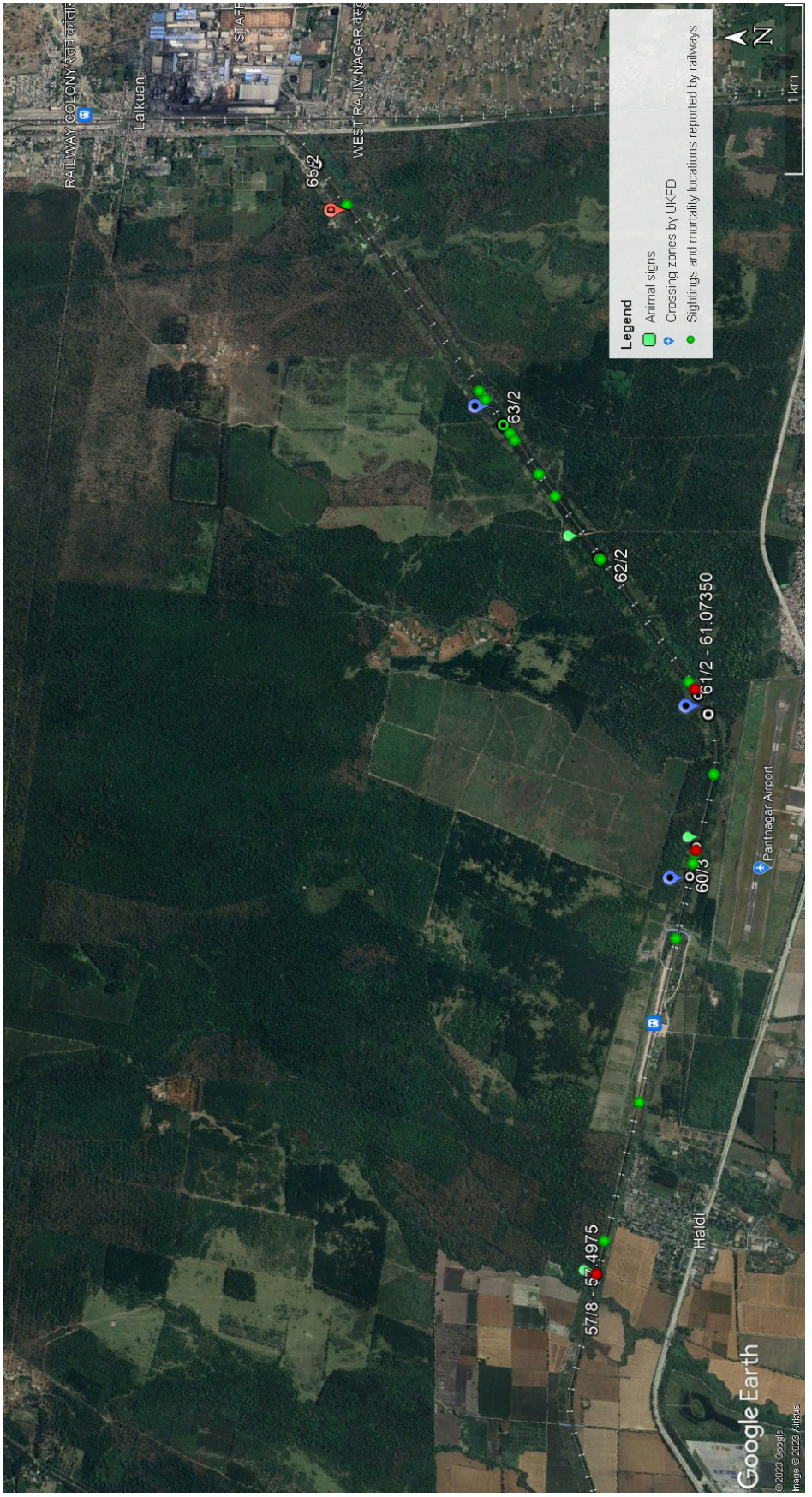


Figure 4: Representation of wildlife sightings as reported by the Railways (green circles), animal signs recorded during field survey by WII team (green pins), and sensitive animal crossing zones identified by the UK Forest Department (blue pins), on Segment 2 (Lalkuan to Chhatarpur).

Figure 5: Water logging on both sides of the railway embankment on the Lalkuan-Chhatarpur railway track can make the drainage structures unusable by wildlife.

Clearing land for animal movement:

Presently, water has accumulated on both sides of the railway track on this stretch. This would prevent wildlife from using the existing drainage structures and those proposed (Table 3). Therefore, it is important to drain this water from both sides to facilitate wildlife movement across the track.

For this purpose, we suggest installation of pipe culverts measuring 1 m in diameter to ensure free flow of water across the railway line. The pipe culverts are to be placed every 300 – 500 m depending on degree of water logging. Waterlogging can also be cleared through mechanical ways or by creating channels to drain water away from the railway embankment. Creation of channels and drains to ensure that water flows during monsoon season, and is not stagnant

Table 3: Recommended animal underpasses on the railway line segment from Lalkuan station to (approx.) chainage 61.00 km

S. No.	GPS Location (mid-point)
1.	29° 3'19.79"N 79°30'37.36"E
2.	29° 3'9.66"N 79°30'20.77"E
3.	29° 3'1.52"N 79°30'7.33"E
4.	29° 2'50.61"N 79°29'49.34"E
5.	29° 2'44.59"N 79°29'39.48"E
6.	29° 2'32.10"N 79°29'19.07"E
7.	29° 2'27.28"N 79°29'11.29"E
8.	29° 2'14.28"N 79°28'50.00"E

after, can reduce water logging, thus enabling wild animals to use the bridges as crossing structures. Thereafter, the ditches on both sides of the railway track should be filled with soil or other material to prevent further waterlogging. Additionally, suitable native herb and shrubs may be planted to stabilise the soil in these ditches.

Coordination between the Forest Department and Railways would be required to carry out this exercise and to maintain dry passageways for wildlife.

Fencing, and light and sound barriers:

Additionally, light and sound barriers are to be provided along the railway track from Lalkuan to chainage 61.00 km. Elephant-proof fencing should be constructed along the entire track, so that only the crossing structures are used for movement by wildlife.

Further, fencing should be continued towards the entire segment from the curvature (chainage 61.00 km) till the end of the forested segment of the railway track. This would also act as a fence to deter elephant movement across the track towards Pantnagar airport and university. Further, in case future expansion (to double track) or upgradation of the Lalkuan to Chhatarpur railway track is planned, it is recommended to realign the segment from outside the forest (Fig. 6).

Figure 6: Suggested realignment of Lalkuan to Chhatarpur railway track in case upgradation or double-tracking is proposed in the future.

3.3. Railway crossing near IOCL

A 375 m long overpass is recommended on this stretch to enable elephant movement from the forest on the west towards the small forest patch lying after the IOCL boundary wall, that would connect the East Terai Forest with the forests of the Gola range (Fig. 7). The overpass may be arch-shaped too. Fencing, preferably made of train track barriers, along the boundaries of the forest on both sides of the overpass should be provided to funnel elephant and wildlife movement towards the overpass. Additional light and sound barriers should be added on both sides of the overpass to encourage wildlife movement on the overpass.

It is further recommended to reclaim the agricultural land lying within the corridor leading to the Gola range (Fig. 8).

Figure 7: Suggested location of the wildlife overpass over the NH 109, railway track and IOCL compound (green polygon) and fencing (yellow lines) funnel wildlife movement towards the overpass.

Figure 8: Indicative area (green polygon) where land reclamation for inclusion in the corridor may be helpful to restore animal movement across the Central Terai Forest Division towards the Gola range via the Gola River.

04. Mitigation Measures Design Specifications

Ramps

Ramps should be made of compressed soil, and cement wherever feasible. Ramps should be at least 25 m wide at the top, and the slope of the ramps should not be more than 25°. Adequate land may be acquired to ensure that a gradual incline is provided at both ends of the overpass.

The ramps should be maintained regularly to check for erosion and breakage. Ramps should be revegetated using native grass species, and landscaping should be done in such a way so as to make the overpass appear contiguous with the surrounding landscape.

The orientation (direction) of the ramp can be perpendicular or oblique with respect to the railway track considering the land and slope available to flatten the ramp to a navigable slope.

Intrusion Detection System

Use of animal sensors such as Intrusion Detection System (IDS) that is integrated with the communication system of the train that are already in use by several railway divisions (e.g. North East Frontier Railway and East Coast Railway) in elephant landscapes should be explored. The system would provide a long-term viable solution to mitigate incidences of wildlife-train collisions. https://nfr.indianrailways.gov.in/view_detail.jsp?lang=0&dcd=2184&id=0,4,268).

Fencing

The fences to be installed along the railway stretches should be elephant-proof, i.e., resistant to damage by elephants. For this purpose, fences made of used railway tracks (like those used for crash barriers on highways) should be used. The fences should be placed in three vertical rows, and the height of the topmost barrier should be approximately 2-3 m (shoulder height of adult elephant).

05. Additional Measures to be Implemented

A. Watch towers for patrolling and protection purposes are to be made along the tracks. The locations of the proposed watch towers have been provided below (Table 4).

B. Regular clearing and pruning of trees and bushes along both railway tracks up to 30 m from the railway track must be undertaken. This would help decrease the possibility of accidents by increasing visibility for both train drivers and wild animals.

C. Two control rooms are to be set up along both the railway tracks – one on the Lalkuan-Gularbhoj segment in Pipalpadav range, and the other on the Lalkuan-Chhatarpur segment at Tanda range. The exact location of the control rooms may be finalised in collaboration with the Forest Department.

D. Additionally, resources such as wireless and communication network, 2-wheelers, manpower, and other equipment for patrolling the railway track and adjacent forest area would be required by the Forest Department. The specifics of these may be finalised in collaboration with the Forest Department.

Table 4: Locations propose for construction of watch towers along the railway lines.

Range & plot	GPS Location
Tanda Range Gangapurpatiya Plot No. 20	29° 2'57.86" 79° 29'52.38"
Tanda Range Tanda Plot No. 16	29° 3'5.26"N 79°30'30.64"E
Pipalpadav Range Pipalpadav Plot No. 17	29° 5'58.75"N 79°22'8.14"E

06. General recommendations for all sites

The following blanket recommendations are to be implemented across all sites:

1. Distributed Acoustic Sensing (DAS) – based Intrusion Detection Systems (IDS) are to be implemented on all sensitive stretches on priority. Further all level crossings and ramps should incorporate the DAS IDS system as well.

2. Sign boards on the sensitive stretches should be erected to alert loco pilots, along with indications of specific wildlife-crossing zones.

3. Goods trains should be scheduled for the daytime as much as possible or during the time period when the activity of the wildlife species especially elephants is at its minimum.

4. For construction of structural mitigation measures (underpasses, overpasses, level crossings and ramps), the WII report on specifications of mitigation measures should be referred.

5. Regular clearing of vegetation till at least 30 m on either side of the railway tracks is to be done to increase visibility for both loco pilots and elephants. The frequency and responsibility of carrying out pruning may be decided mutually by both parties.

6. Strict restriction and fines on disposal of garbage, especially food items, from operating trains on railway tracks in sensitive stretches and railway stations near them should be imposed.

7. Joint teams of railways and forest department personnel should be formed for all critical stretches. The team would be responsible for joint patrolling on the track of elephant presence, coordination and information sharing, and regular cleaning of railway tracks. This can be achieved by creating WhatsApp groups for each region comprising of senior officials and frontline staff of the railways and forest department.

8. There should be regular cooperation and exchange of information between forest department and railways staff. Regular sensitization workshops for railway staff, especially loco pilots and ground staff should be conducted.

9. Most railway tracks in the surveyed areas are in the process of getting electrified. Adequate measures (insulation and proofing of all electric infrastructure) should be taken to avoid incidents of electrocution of wildlife because of the railway electric infrastructure.

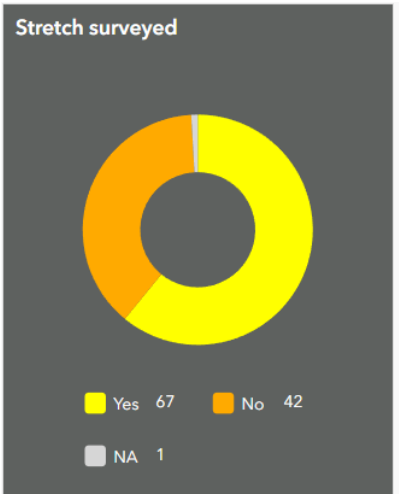
10. To discourage use of wildlife-friendly ramps and level crossings by people and vehicles, concrete barrier poles and/or other barriers should be built that are high enough to block passage of 2 and 4-wheelers, but low enough to allow elephants to pass.

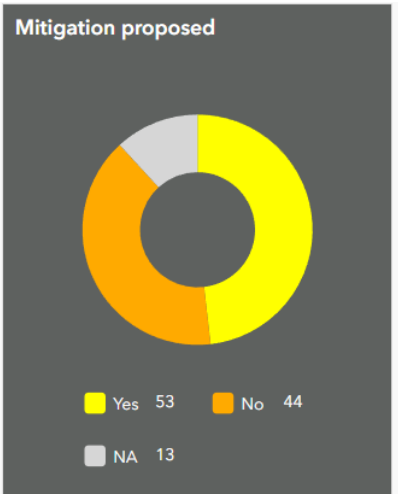
11. Incidences of elephant and wildlife injury and mortality should be documented by both parties, with complete details on GPS location, chainage, date and time of day.

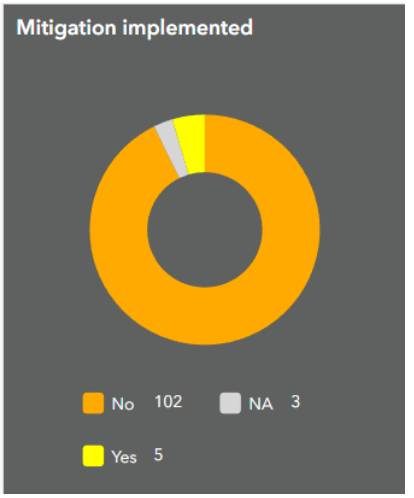
12. In the future, all metre-gauge to broad-gauge conversion projects in elephant landscapes should include comprehensive elephant mitigation plans.

13. In the future, railway stretches posing collision and barrier risks to wildlife should be identified that exist beyond elephant reserves and protected areas, such as corridors.

07. Dashboard for monitoring implementation of mitigation measures







Crossing zone details

Serial No	Name of area	State	Crossing zone width (m)	Stretch surveyed	Mitigation proposed	Mitigation implemented	Remarks	ReportLink
1	Elephant reserve	Uttarakhand	8.60	Yes	Yes	No		https://drive.google.com/file/d/1PZ2YCcHrQKnVcRywn7iyoOgDLiYQQkpe/view?usp=drive_link
2	Elephant reserve	Uttarakhand	14.30	Yes	Yes	No		-
3	Elephant reserve	Uttarakhand	28.90	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
4	Elephant reserve	Uttarakhand	4.50	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
5	Elephant reserve	Uttarakhand	21.30	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
6	Elephant distribution	Uttarakhand	5.90	Yes	No	No	Stretch falls within Kathgodam city limits	-
7	Elephant distribution	Uttarakhand	4.40	Yes	Yes	No	Surveyed by Forest Deparment	https://drive.google.com/file/d/1tFYaY4n5kYA9OhcBqeO5eqHMzqTTJWlt/view?usp=sharing
8	Elephant distribution	Uttarakhand	39.80	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
9	Elephant distribution	Uttarakhand	30.70	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
10	Elephant reserve	Uttar Pradesh	7.60	No	No	No		
11	Elephant distribution	Uttar Pradesh	7.60	No	No	No		
12	Elephant distribution	Uttar Pradesh	3.30	No	No	No		
13	Elephant distribution	Uttar Pradesh	10.30	No	No	No		
14	Elephant distribution	Uttar Pradesh	49.80	No	No	No		
15	Elephant distribution	Uttar Pradesh	19.00	No	No	No		

India is a megadiverse country, with only 2.4% of the world's land area, but accounts for 7-8% of all recorded species of the world, including about 91,000 species of animals and 45,500 species of plants. India is also the second-most populous country in the world with a population of over 1.3 billion people! To transport and cater to the needs of such a large population, the Indian Railway is the main artery of inland transportation in India. In 2020, it carried a total of 808.6 crore passengers! Indian Railways is also the single largest employer in India and the eighth largest in the world, employing approximately 13 Lakh people. It is the country's lifeline for large-scale traffic movement – freight and passengers. Railways are at the core of India's economic development and make it possible to conduct many activities like business, sightseeing, and pilgrimage along with the transportation of goods over longer distances. In fact, the Indian Railways is among the world's largest rail networks and runs thousands of trains daily. To cater to India's fast-growing economy, the railway sector has envisaged Vision 2024 to achieve targets of 2024 MT freight loading by 2024. The railway also aims to electrify the entire network.

Recognized as economic, energy-efficient, and environment-friendly relative to other means of transport such as roads and air, the expansion and upgrading of railways is seen as an important measure in supporting development through large-scale movement of people and goods. However, railway construction and operation has its ecological effects, and a range of impacts on wildlife and habitats have also been documented. Several of India's passenger

and freight trains crisscross through some of the country's most sensitive wildlife habitats, particularly protected areas and corridors that are home to critically endangered tigers and elephants, amongst other animals. The extensive network of our Railways cuts through several of these forested landscapes, compromising the connectivity of the landscape and resulting in a barrier effect.

To reduce the impact of railways on our wildlife, it is important to come together and develop measures that can protect India's rich biodiversity and also help to develop a system that is more sustainable and effective in minimizing mortalities and reducing barrier effects across the railways tracks passing through sensitive habitats in India

Project Elephant Division of MoEF&CC in coordination with Ministry of Railways and Wildlife Institute of India has identified sensitive stretches which need prioritization for mitigation planning. The portal is developed to monitor the progress of implementation of mitigation measures from the beginning. The process involves joint surveys of the identified stretches by officials of the Forest Department, Railways and Wildlife Institute of India, recommendation of mitigation measures and implementation of the mitigation measures. The mitigation proposed on the stretches surveyed by various team has been upload on the dashboard. The dashboard can be accessed at Railway Crossing Zones Dashboard (arcgis.com)

The purpose of the dashboard is to monitor the implementation of the mitigation measures on the surveyed stretches. The officers are requested to update the information on the dashboard developed for the purpose. In case of any issues please reach us at projectelephant.moef@gmail.com or elephantcell@wii.gov.in

08. List of State Forest Department and Indian Railways officials consulted during the survey

Forest Department of Uttarakhand:

1. Shri Himanshu Bagdi, *DFO, Tarai Central Forest Division, Haldwani*
2. Shri Roopnarayan Gautam, *RFO Tanda*
3. Shri Bhopal Singh Keda, *RFO Rudrapur*

Indian Railways:

4. Shri Harish Rartoliya, *Senior DOM, Izzatnagar*
5. Shri Pravesh Kumar, *Senior DST, Izzatnagar*
6. Shri Arun Kumar, *Senior DEN Izzatnagar*
7. Shri Subodh Thapliyal, *ADEN, Kashipur*
8. Shri Vineet Kumar, *Senior DEE, Izzatnagar*

09. References

Project Elephant, MoEF&CC, Government of India (2023), Elephant Corridors of India 2023 (Edition – 1/2023).

WII, (2024). General Guidelines for Suggesting Mitigation Measures on Existing Railway Tracks Through Elephant Habitats in India.

APPENDIX 1

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

GENERAL GUIDELINES

FOR SUGGESTING MITIGATION MEASURES ON EXISTING RAILWAY TRACKS THROUGH ELEPHANT HABITATS IN INDIA

MAY 2023

General Guidelines for Suggesting Mitigation Mesaurs on Railways Tracks through Elephant Habitats in India

Railway lines passing through elephant habitats can alter movement patterns and cause collisions of elephants with trains. Considering the threats to both elephant and human life, WII in consultation with Project Elephant Division of MoEFCC and State Forest Departments has identified 105 stretches of railway lines cutting through elephant reserves and elephant distribution beyond elephant reserves. Subsequently, the Ministry of Environment, Forests and Climate Change (MoEF&CC) and the Ministry of Railways (MoR) in a joint meeting directed that surveys by the railway officials, respective state forest department officers, and WII should be conducted within these stretches. The objectives of the joint field surveys would be to identify specific elephant crossing zones on these stretches and to suggest site-specific mitigation measures based on the location and the extent of these crossing zones.

In the case of existing railway lines, designing and locating structural mitigation measures for wildlife are confounded by several factors. Most critical among these is the limitation of the track height i.e., the height of the railway track with respect to surrounding terrain, making it difficult to allocate the minimum underpass height of 6 m required for animal underpasses in elephant landscapes. Additionally, excavating the ground under the track to achieve the prescribed height makes structures vulnerable to damage by rainwater, and also renders the structures unusable by wildlife. Thus, the choice of mitigation measures on existing railway lines has to be based on multiple factors that include wildlife, landscape as well as railway track design considerations. However, in the case of new railway lines, allocating adequate height to the railway tracks to incorporate wildlife mitigation measures along the line should be ensured.

In light of these factors, the following general pointers are prescribed to guide the Railway and Forest Officials in designing and choosing between different structural mitigation measures in the identified critical elephant zones intersected by railway lines. The choice of mitigation measures can be based on landscape, topography, railway track height, and other logistics.

1. Level crossings

The coarse ballast used on railway tracks is unsuitable for movement by wildlife, particularly elephants. For this reason, level crossings for elephants built using suitable material (soil, cement) and with smooth gradient can help ease movement across the railway track at grade. Level crossings are ideally located where the surrounding land is at level (flat) with the railway track and coincides with a known/identified elephant crossing area. Rubberized level crossings[1] (Fig. 1) may also be used in place of cement and soil.

[1] Functional Specification for Rubberised Surface at Level Crossings. 2019. Ministry of Railways, Govt of India. https://rdso.indianrailways.gov.in/

Figure 1. A level crossing with a rubberised surface that can be replicated on level crossings for wildlife.

2. Ramps

At most elephant crossing locations intersected by railway lines, the elevation in track height and the additional layer of ballast makes it difficult for a large-bodied hoofed animal like an elephant to make quick decisions and move away from a railway track in the event of an approaching train, leading to elephant-train collisions. At such locations, ramps using suitable material (soil, cement) may be constructed that flattens towards the top of the track, and allow for smooth and quick movement by elephants. It is important to include a level crossing instead of ballast at the top of the ramp (near the railway track) to ensure smooth movement by elephants. The sites for construction should be based on identified animal crossing zones and suitable terrain. Ramps should be levelled with the surrounding terrain by smoothening out the slope (Fig. 2). Additionally, in areas with human presence, the ramps may be fenced to funnel elephant movement across the railway track.

The orientation of the ramps with respect to the railway track may be oblique or perpendicular, depending on the land available for flattening the ramp to a navigable slope. The width of ramps and level crossings for elephants should be at least 50 m wide. Early warning systems or wildlife sensors may be provided at these places as additional measures to detect elephant movement and to avoid collision with trains.

Figure 2. An example of a ramp built for aiding elephant movement across a railway line near Coimbatore, Tamil Nadu, India (Top) and an elephant group using a ramp constructed for ease of movement in Deepor Bheel Assam, India (Bottom).

3. Wildlife underpasses

The term wildlife underpass can be used to describe different types of structures built below the railway track to facilitate wildlife movement. These can be box culverts, viaducts, or bridges with natural drainage of different heights and widths, depending on the target wild species or community. In elephant landscapes, the minimum height of an underpass should be 6 m, with adequate width (minimum 30 m) to allow for the movement of large elephant herds (Fig. 3). However, the actual size would depend on the width of the crossing zone and feasibility of construction of underpass considering track height and curvature. Nonetheless, all efforts should be made to maintain a minimum width of 30 m. At locations where the track height is suitable, the topography of the adjacent land should be such to avoid flooding of the underpass by rainwater. Additionally, light and sound barriers should be installed above the railway track to reduce the disturbance due to train traffic on animals using underpasses.

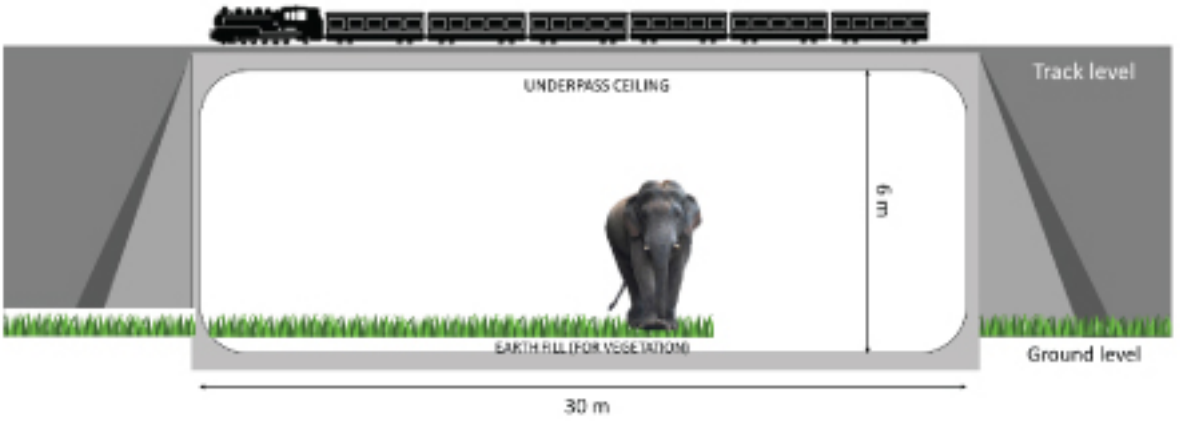


Figure 3. Graphic representation of an underpass for elephants below a railway track.

4. Wildlife overpasses

Wildlife overpasses are bridge-like structures built at a height across linear infrastructure (roads and railway lines) to allow wildlife to move across the gap in the habitat. Such structures are usually enhanced with natural habitat features such as native vegetation, rocks and logs. Wildlife overpasses are less confining, quieter and have ambient natural conditions of light and weather as compared to wildlife underpasses. Since wildlife overpasses are built at a height, construction of overpasses requires adequate height on either side of the road/railway line. Thus, overpasses should be built at locations with suitable height (> 7m) and topography on either side. A wildlife overpass should not be less than 30 m wide, and may be wider in case of double or triple parallel railway lines.

Overpasses should ideally be built using pre-fabricated material and installed on-site. The overburden from the construction site or excavated from other sites may be used for filling. Further a suitably thick layer of soil should be laid on top of the pre-fabricated material. Revegetation should then be carried out using native grasses and shrubs on the substrate to provide a natural movement path. Either side of the top of the

overpasses should be fenced with light and sound barriers (Fig. 4). The slope/approach of the overpass should be not more than 30 degrees at any point. If the overpass is to be constructed across two or more railway tracks, a supporting pillar/post may be provided for structural support (Fig. 5).

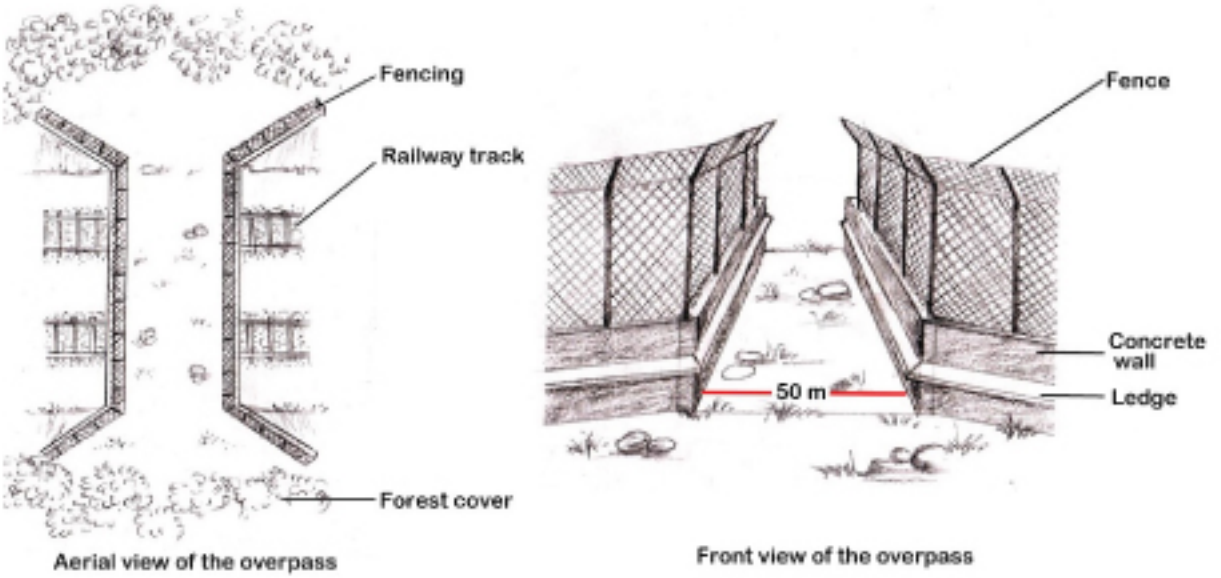


Figure 4. Aerial and front view of overpasses on railway tracks, with fencing/noise and sound barrier details.

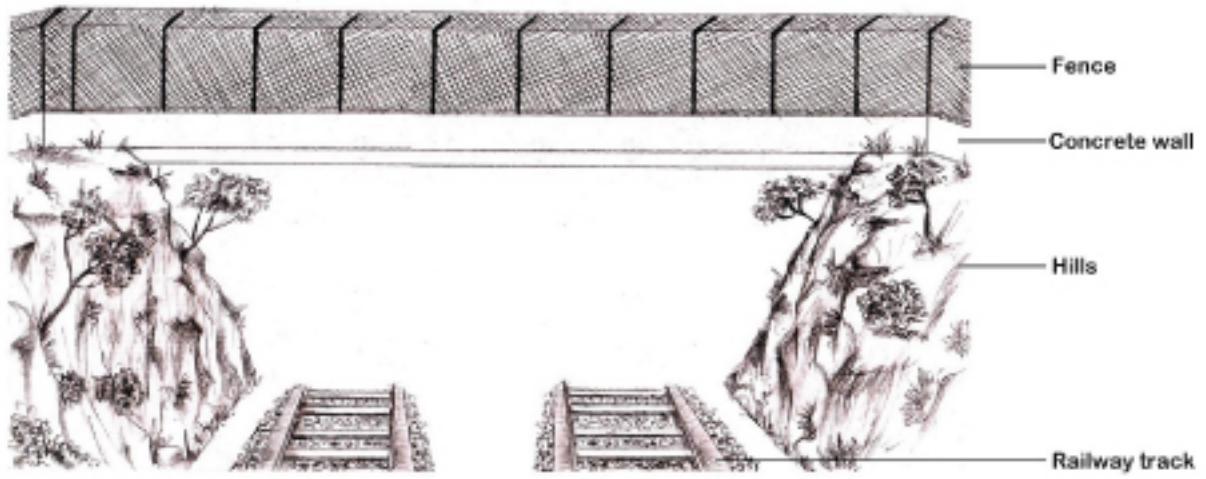


Figure 5. Lateral view of a wildlife overpass on a double-track railway line.

5. Installation of Distributed Acoustic Sensing (DAS) System

Irrespective of the type of mitigation measures to be employed across the sensitive railway stretches, all the sensitive stretches have to be installed with DAS. The system developed by railways to detect the presence and movement of the elephants along the railway tracks is basically an intrusion-based detection system based on Distributed Acoustic Sensing (DAS). A DAS monitoring interrogator converts a standard communications single-mode fiber into thousands of extremely sensitive

acoustic and vibration sensors. The Distributed Acoustic Sensor connected to one end of the fiber uses a laser to send thousands of short pulses of light along the fiber every second. A small portion of the light traveling in fiber is reflected by the process known as Rayleigh Backscatter. The concept of securing a network from malicious entities by capturing and monitoring data packets was first employed by James Anderson in 1980. Since then, researchers have developed various approaches to enhance the performance and accuracy of intrusion detection.

Vibrations from the surrounding environment will disturb the light in the fiber and will therefore be observed by the DAS interrogator. The events that are of concern are reported to the alarm server. As the data is processed in real-time, advanced algorithms can recognize the unique signatures of each type of event.

The system can show the precise location of the event, and information about what event has taken place, which means the laser pulse frequency, pulse width, and many other parameters. These parameters can be controlled, enabling the system to be tuned to the desired requirement. Integrated with machine learning and artificial intelligence, the system can differentiate even between minor variations in the scatter. The optic fiber cable running along infrastructure and other important assets can give uninterrupted and real-time feedback on activities occurring along and around them.

The recommendations of the MoEFCC committee constituted vide office order No. WL-8/28/2022-WL on 3rd January 2023 needs to be considered for the implementation of the DAS.

****

APPENDIX 2

कार्यालय प्रमुख वन संरक्षक, वन्यजीव/मुख्य वन्यजीव प्रतिपालक, उत्तराखण्ड, देहरादून।
85 राजपुर रोड, देहरादून, फोन नं० 0135–2742884 फैक्स नं० 0135–2746691 ईमेल–cwlwua@yahoo.co.in

पत्रांकः 895 / 6-18 देहरादून, दिनांक 31 अक्टूबर, 2022

सेवा में,

Dr. K. Muthamizh Selvan,
Scientist 'E' (Project Elephant),
6th Floor, Vayu Wing, Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj, New Delhi.

विषयः– Information requested regarding sensitive locations for construction of permanent measures to mitigate wildlife-rail collisions – reg.

संदर्भः– आपका पत्रांक F.NO. 12-1/2019-PE दिनांक 18 अक्टूबर 2022

महोदय,

उपरोक्त संदर्भित पत्र से राज्य के अन्तर्गत sensitive locations for construction of permanent measures to mitigate wildlife-rail collisions की वांछना की गई थी। उक्त के क्रम में वांछित सूचना संलग्न कर प्रेषित की जा रही है।

भवदीय,

31/10

(डा0 समीर सिन्हा)
प्रमुख वन संरक्षक (वन्यजीव)/
मुख्य वन्यजीव प्रतिपालक,
उत्तराखण्ड।
31/10/22

पत्रांक 895 /6-18 तद्दिनांकित।

प्रतिलिपिः निदेशक, भारतीय वन्यजीव संस्थान, देहरादून को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

31/10

(डा0 समीर सिन्हा)
प्रमुख वन संरक्षक (वन्यजीव)/
मुख्य वन्यजीव प्रतिपालक,
उत्तराखण्ड।
31/10/22

Dr Bilal
2/11/2022

DWII OFFICE
DIARY NO. 2947
DATE 2/11/22

CWLW 2022/
General 2022

Information on Sensitive locations for construction of permanent measures to mitigate wildlife-rail collisions

State: UTTARAKHAND

S. No.	Area/landscape/Protected Area	Crossing Zone Priority (I/II/III)	Focal Species	Crossing zone width (m)	GPS location (mid-point)	Structure Proposed (Underpass/ Overpass)	Size of structure required (length x width x height)
1-	Dehradun Forest Division/Lachhiwala Range/Lachhiwala Compt.No. 13A	III	Sambhar, Barking Deer	20	N- 30°06'57.1'' E-78°06'56.9''		
2-	Dehradun Forest Division/Lachhiwala Range/Lachhiwala Compt.No. 13A	III	Sambhar, Barking Deer	20	N- 30°13'18.9'' E-78°07'42.2''		
3-	Dehradun Forest Division/Lachhiwala Range/Lachhiwala Compt.No. 9A	III	Sambhar, Barking Deer	20	N- 30°12'43.24'' E-78°07'48.6''		
4-	Dehradun Forest Division/Rishikesh Range/Lalpani Compt. No. 2	III	Elephant, Sambhar, Barking Deer	100	N- 30°05'5.472'' E-78°15'45.804''		
5-	Dehradun Forest Division/Rishikesh Range/Veerbhadra Compt. No. 1	III	Elephant, leopard	100	N- 30°04'27.624'' E-78°15'80.7''		
6-	Dehradun Forest Division/Rishikesh Range/Veerbhadra Compt. No. 2C	III	Elephant, leopard	80	N- 30°04'42.463'' E-78°15'29.608''		
7-	Dehradun Forest Division/Rishikesh Range/Bibiwala Compt. 1b	III	Elephant, leopard, Sambhar & Barking Deer	20 15	N- 30°11'75'' E-78°27'95'' N- 30°10'21'' E-78°27'53''		
8-	Dehradun Forest Division/Rishikesh Range/Rishikesh Compt. No. 3	III	Elephant	5	N- 30°09'87'' E-78°27'77''		
9-	Haridwar Forest Division/Haridwar Range/Laksar-Dehradun Railway line	Jamalpur Railway Crossing	-	-	N- 29°50'17'' E-78°04'01''	Label Crossing	
10-	Haridwar Forest Division/Haridwar Range/Laksar-Dehradun Railway line	Pathri Subhash Railway Crossing			N- 29°54'06'' E-78°06'16''	Label Crossing	
11-	Tarai West FD Ramnagar near CTE	Plot No. 19 to Plot no. 16	Elephant, Leopard, Tiger etc.	270	N- 29°19'09.58'' E-79°02'10.63''	Under Pass	105856mt

S. No.	Area/landscape/Protected Area	Crossing Zone Priority (I/II/III)	Focal Species	Crossing zone width (m)	GPS location (mid-point)	Structure Proposed (Underpass/ Overpass)	Size of structure required (length x width x height)
12-	Tarai West FD	Nafa to Plot No. 15	Elephant, Leopard, Tiger etc.	320	N- 29°18'75.78'' E-79°01'39.99''	Under Pass	105856mt
13-	Tarai Central FD/Thimari East Plot No. 47B	I	Elephant	50	N29°05'15" E079°23'32"	Level crossing with Barriers	50 mtr width ramp
14-	Tarai Central FD/ Thimari East Plot No. 48A	I	Elephant	50	N29°5'16.24" E079°23'24.44"	Level crossing with Barriers	50 mtr width ramp
15-	Tarai Central FD/ Thimari East Plot No. 48A	I	Elephant	50	N29°5'17.16" E079°23'21.11"	Level crossing with Barriers	50 mtr width ramp
16-	Tarai Central FD/ Thimari East Plot No. 48A	I	Elephant	50	N29°5'15.82" E079°23'26.97"	Level crossing with Barriers	50 mtr width ramp
17-	Tarai Central FD/ Thimari East Plot No. 45	I	Elephant	50	N29°5'28.20" E079°22'30.46"	Level crossing with Barriers	50 mtr width ramp
18-	Tarai Central FD/ Thimari West Plot No. 56a(IV)	I	Elephant	50	N29°4'55.17" E079°25'40.74"	Level crossing with Barriers	50 mtr width ramp
19-	Tarai Central FD/ Gangapur Patiya Plot No. 57	I	Elephant	50	N29°4'49.32" E079°27'24.58"	Level crossing with Barriers	50 mtr width ramp
20-	Tarai Central FD/ Gangapur Patiya Plot No. 59	I	Elephant	50	N29°4'44.51" E079°29'11.25"	Level crossing with Barriers	50 mtr width ramp
21-	Tarai Central FD/ Gangapur Patiya Plot No. 20	I	Elephant	50	N29°2'51.86" E079°29'52.38"	Level crossing with Barriers	50 mtr width ramp
22-	Tarai Central FD/ South Haldu Chor Plot No. 23	I	Elephant	50	N29°2'11.62" E079°28'45.04"	Level crossing with Barriers	50 mtr width ramp
23-	Tarai Central FD/ South Haldu Chor Plot No. 7b	I	Elephant	50	N29°2'14.58" E079°28"7.30	Level crossing with Barriers	50 mtr width ramp
24-	Rajaji TR (Motichur Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	1500	N=30°0'50'49" E=78°11'47.41"	Overpass	1500x15x20
25-	Rajaji TR (Motichur Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	4000	N=30°3'11.21" E=78°11'27.23"	Overpass	1500x15x20

S. No.	Area/landscape/Protected Area	Crossing Zone Priority (I/II/III)	Focal Species	Crossing zone width (m)	GPS location (mid-point)	Structure Proposed (Underpass/ Overpass)	Size of structure required (length x width x height)
26-	Rajaji TR (Kansaro Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	15	N=30^{0}06'26.62" E=78^{0}07'03.34"	Overpass	40x15x30
27-	Rajaji TR (Kansaro Range)	II	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	12	N=30^{0}06'10.49" E=78^{0}07'12.70"	Underpass	15x12x15
28-	Rajaji TR (Kansaro Range)	II	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	10	N=30^{0}05'47.81" E=78^{0}07'26.62"	Overpass	40x10x30
29-	Rajaji TR (Kansaro Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	18	N=30^{0}05'22.96" E=78^{0}07'46.61"	Underpass	20x18x15
30-	Rajaji TR (Kansaro Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	15	N=30^{0}05'16.28" E=78^{0}07'52.87"	Underpass	20x15x15
31-	Rajaji TR (Kansaro Range)	III	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	15	N=30^{0}05'09.93" E=78^{0}07'49.50"	Underpass	20x15x15
32-	Rajaji TR (Kansaro Range)	I	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	15	N=30^{0}04'41.82" E=78^{0}08'33.41"	Underpass	40x15x30
33-	Rajaji TR (Kansaro Range)	II	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	20	N=30^{0}04'32.41" E=78^{0}08'47.85"	Overpass	20x20x15
34-	Rajaji TR (Kansaro Range)	III	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	18	N=30^{0}04'01.79" E=78^{0}09'34.21"	underpass	20x18x15
35-	Rajaji TR (Kansaro Range)	II	Elephant, Leopard, Tiger, Hayna, Chital, Sambhar etc.	16	N=30^{0}03'36.98" E=78^{0}10'20.50"	underpass	20x16x15

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India