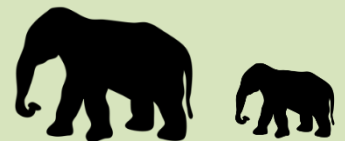


IMPACT OF RAILWAYS ON ASIAN ELEPHANTS: Context-Sensitive Mitigation in Bangladesh



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**PLANNING AND IMPLEMENTATION OF
GREEN TRANSPORTATION PROJECTS IN SOUTH ASIA**
Wildlife Institute of India



PRESENTATION GOALS

- Overview of Asian elephant range-wide and Bangladesh status
- Chittagong-Cox's Bazar Railway Project overview
- Mitigation Hierarchy overview
- Assessment of railway project impacts
- Context-sensitive mitigation strategies



ASIAN ELEPHANT RANGE-WIDE STATUS

- IUCN Endangered species
- An *iconic* Asian species ingrained deeply in many cultures, societies, and religions



ASIAN ELEPHANT RANGE-WIDE STATUS

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- A “*flagship*” indicator species (for large intact landscapes) and a “*keystone*” species that drives ecosystem function



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- One of last remaining “mega-herbivores”

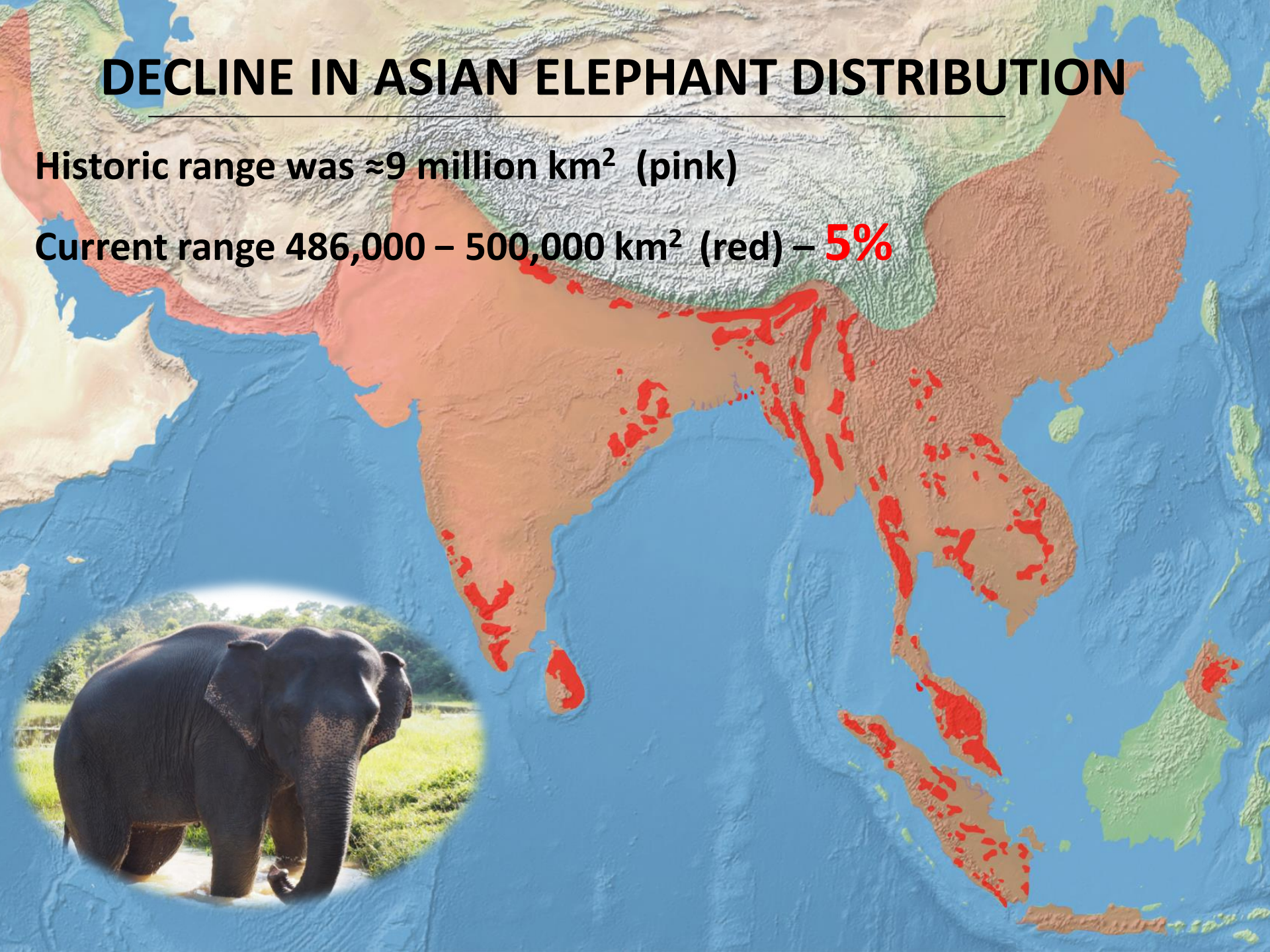
ASIAN ELEPHANT RANGE-WIDE STATUS

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- A “*flagship*” indicator species (for large intact landscapes) and ecological “*Keystone*” species that drives ecosystem function
- One of last remaining “mega-herbivores”
- Long-lived and thus populations “persist” even when viability questionable – imparts an urgency to restoration of fragmented habitats

DECLINE IN ASIAN ELEPHANT DISTRIBUTION

Historic range was ≈ 9 million km^2 (pink)

Current range 486,000 – 500,000 km^2 (red) – **5%**



THREATS TO ASIAN ELEPHANTS



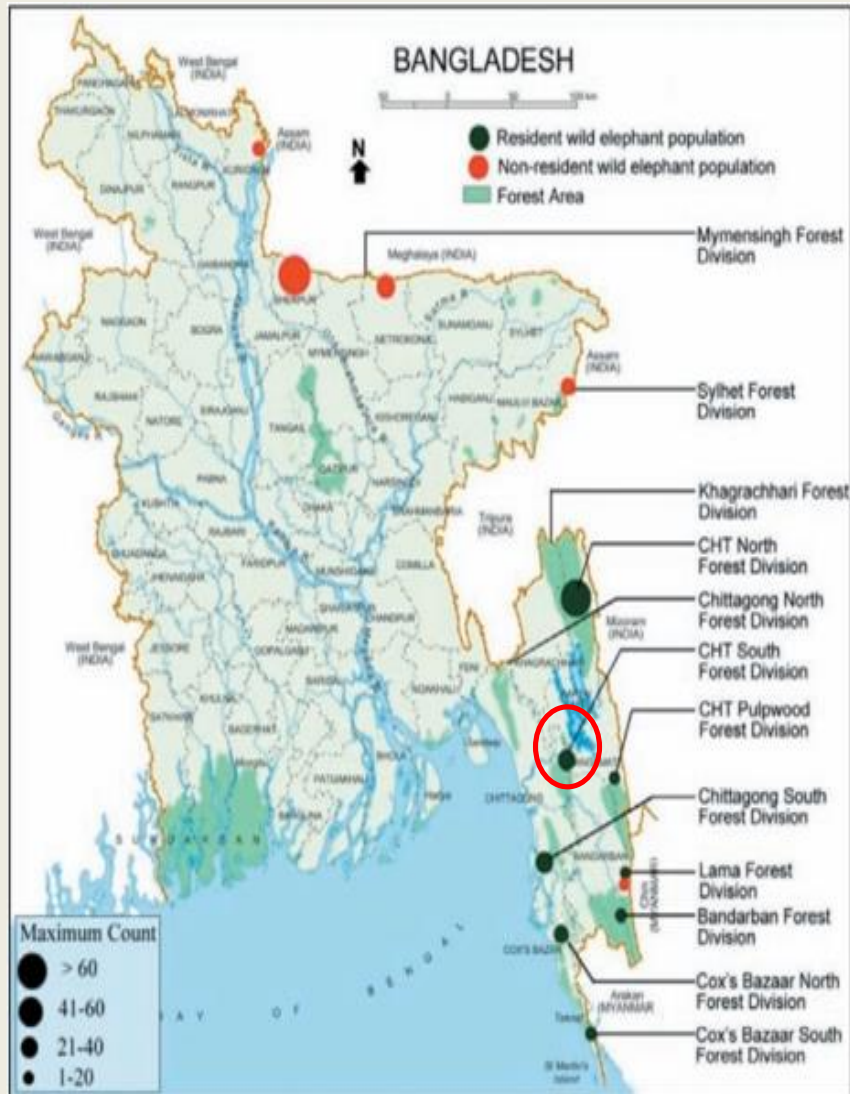
**Forest Fragmentation
and Habitat Loss**

Human-Elephant Conflict
(borne in degraded habitat conditions)



Poaching
(and other mortality, including
from linear infrastructure)

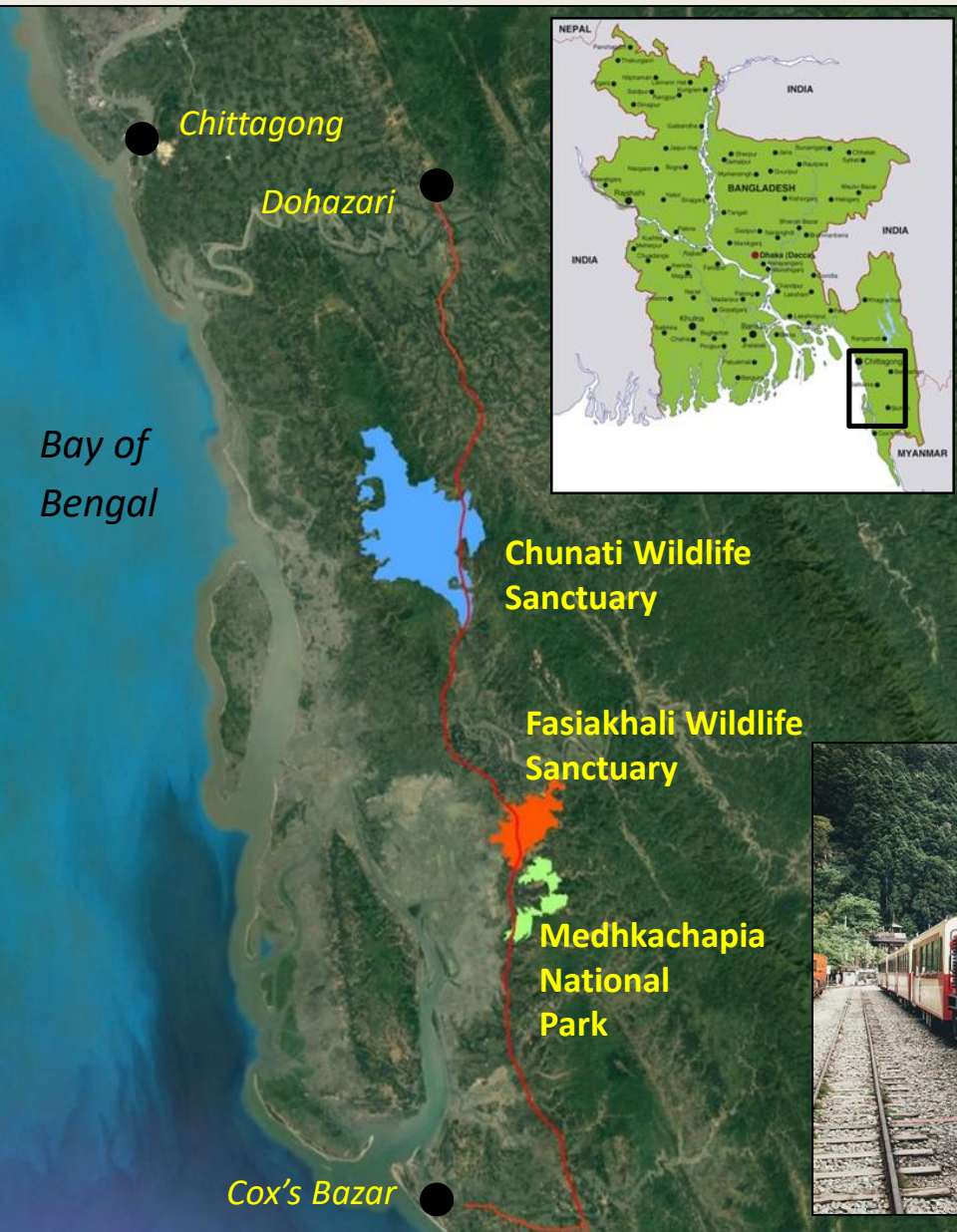
BANGLADESH ASIAN ELEPHANT STATUS



- Critically endangered
- Once widespread, restricted to “less” densely populated southeastern Bangladesh
- Current population 300–350 with as few as **200** residents (augmented by trans-boundary movements) – points to importance of corridors
- One of 5 range states (17 total) with resident population ≤ 200



CHITTAGONG-COX'S BAZAR RAIL PROJECT

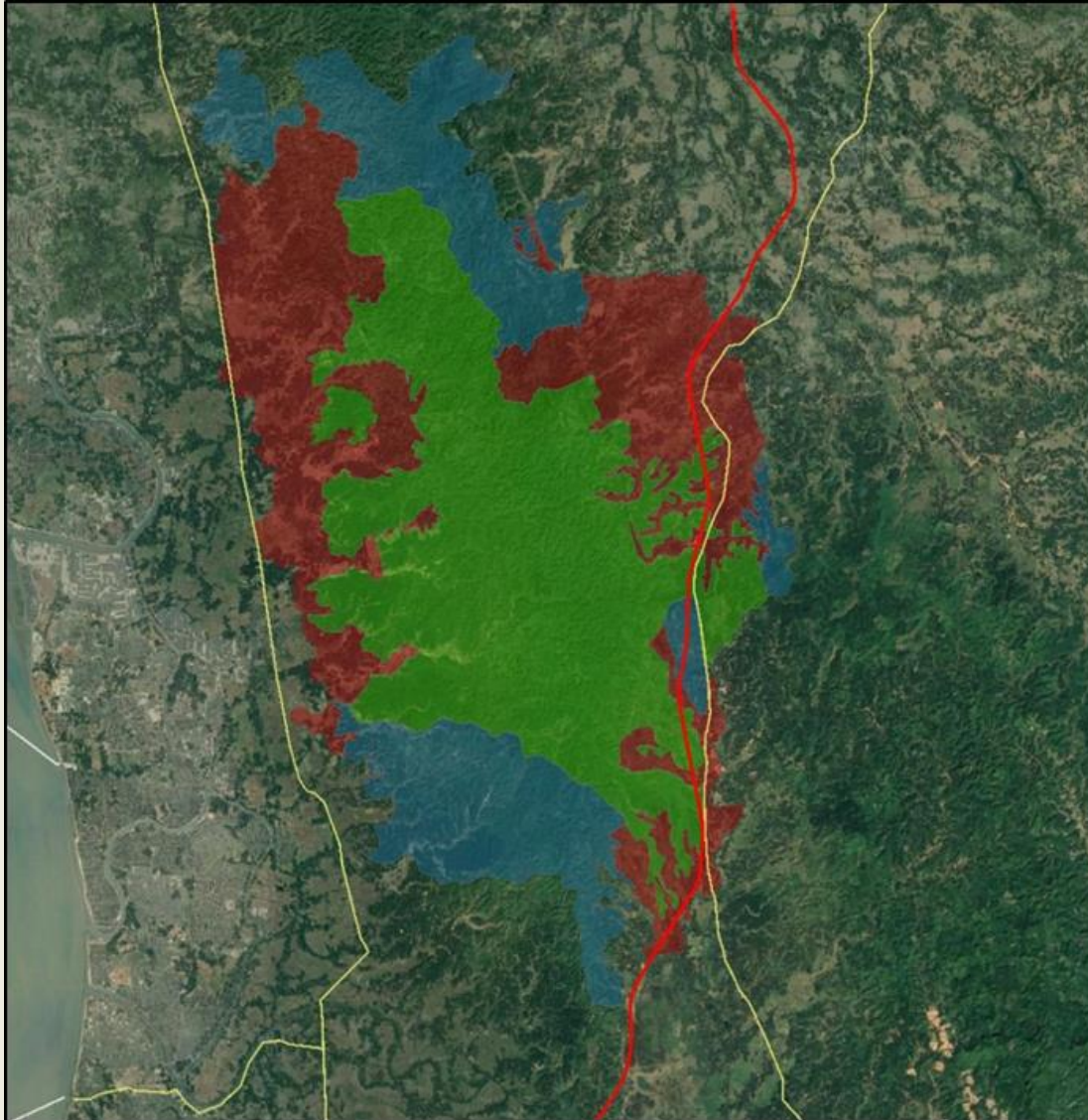


- Single line dual gauge railway from Dohazari to Cox's Bazar
- Total distance of 101 km
- >1/4 (27 km) of railway alignment crosses through 3 protected areas



CHITTAGONG-COX'S BAZAR RAIL PROJECT

Chunati Wildlife Sanctuary



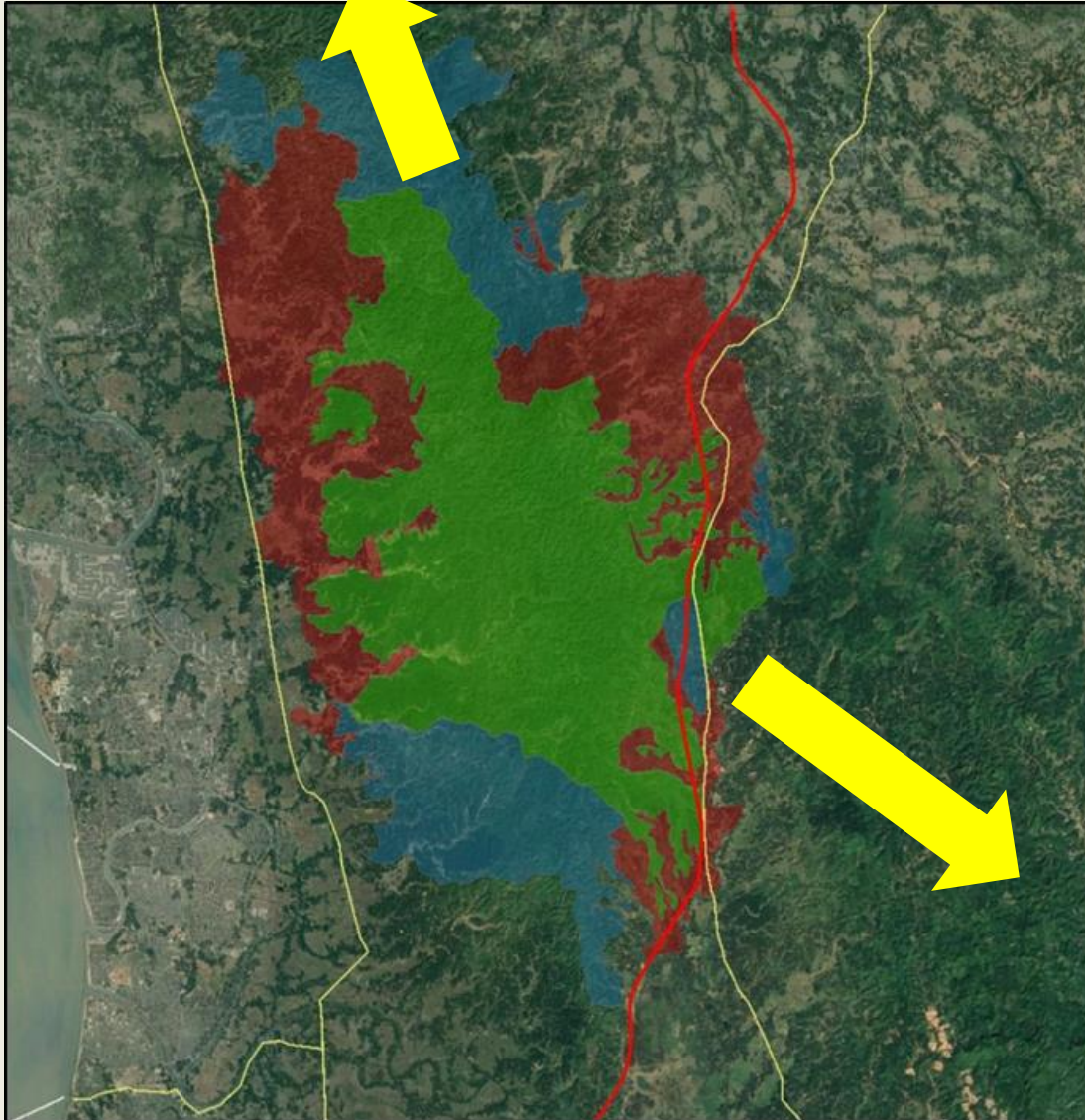
- 18,781 ha in size
(largest of the PA)
- Project crosses
sanctuary along a
16-km long alignment
- 5.3 km (33.5%) crosses
Core Zone habitats

Core Zone habitat



CHITTAGONG-COX'S BAZAR RAIL PROJECT

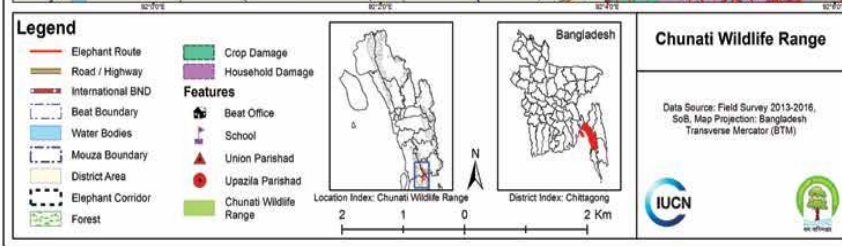
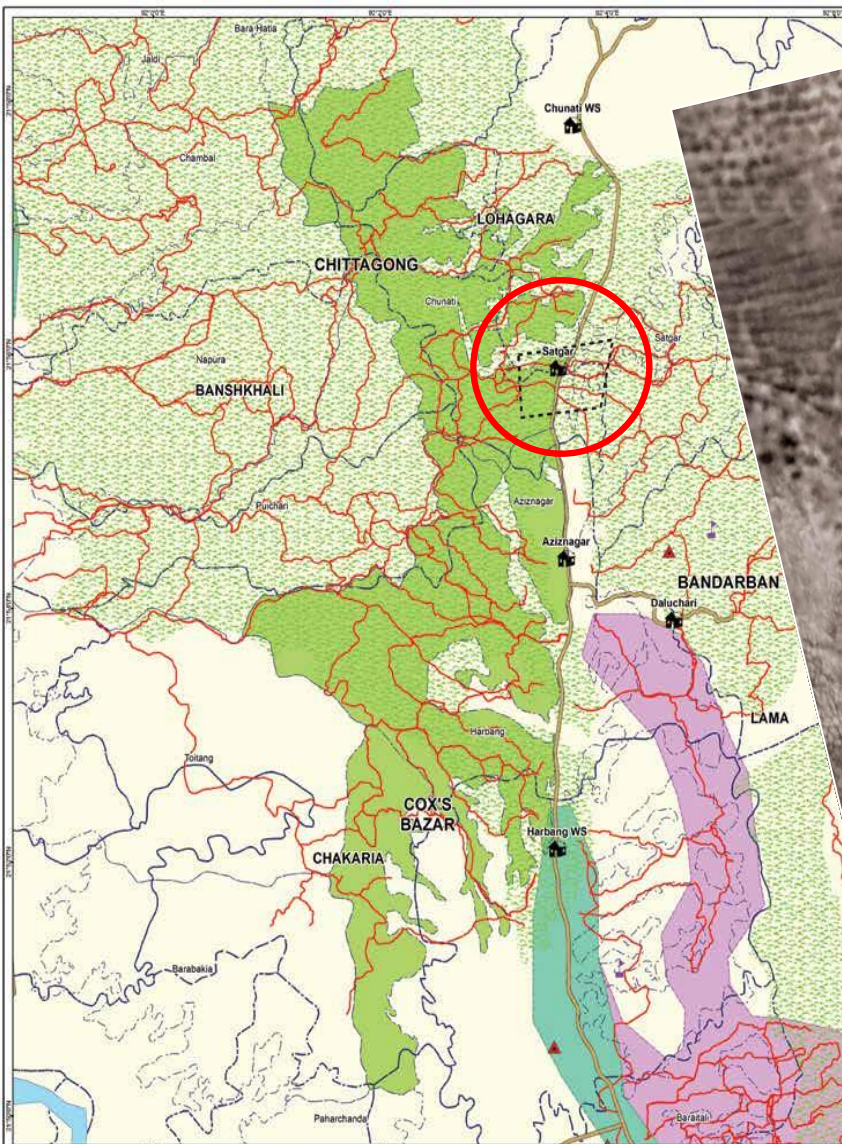
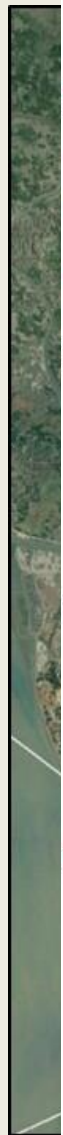
Chunati Wildlife Sanctuary



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Core Zone habitat





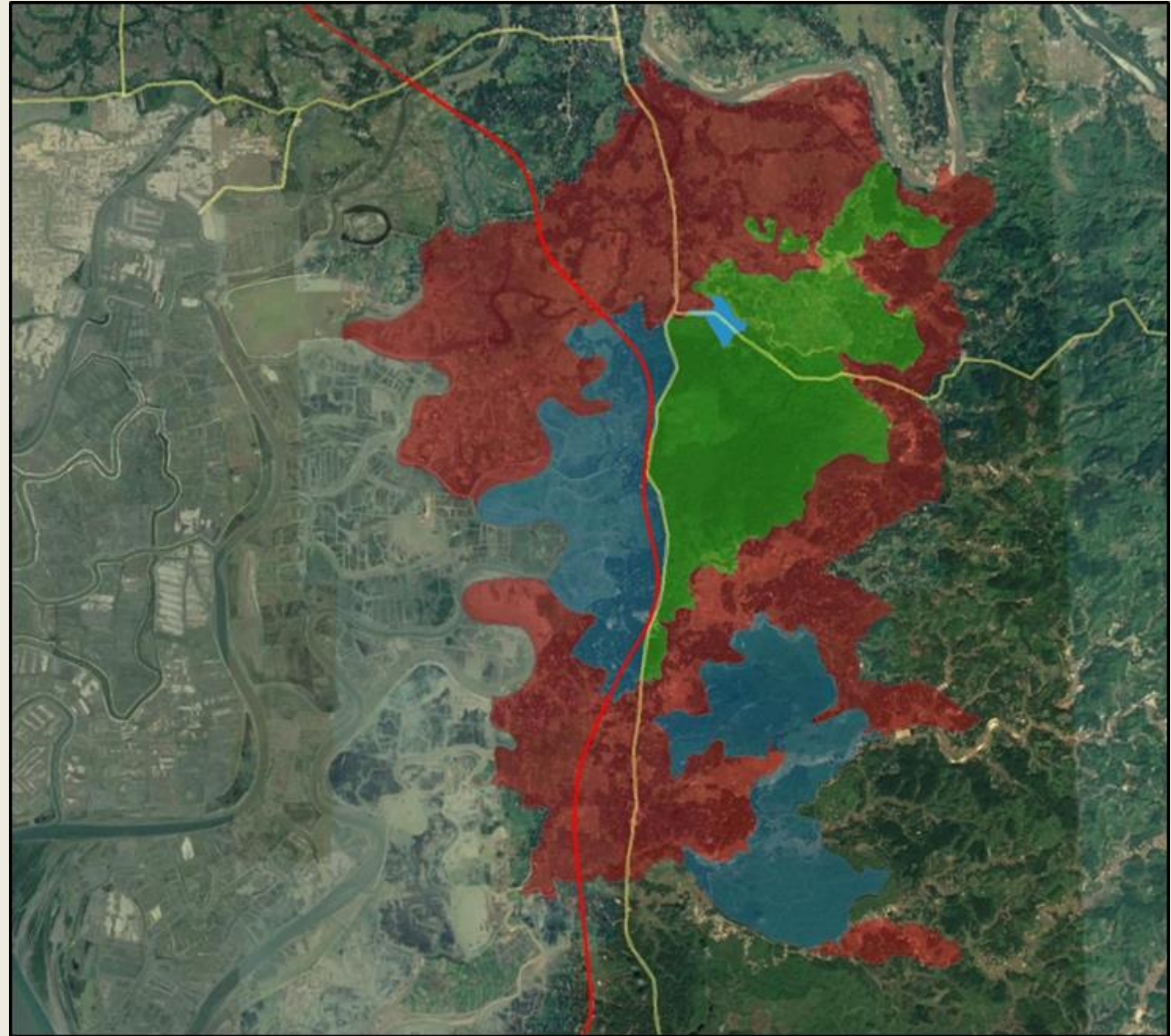
ATLAS

ELEPHANT ROUTES AND CORRIDORS IN BANGLADESH

CHITTAGONG-COX'S BAZAR RAIL PROJECT

Fasiakhali Wildlife Sanctuary

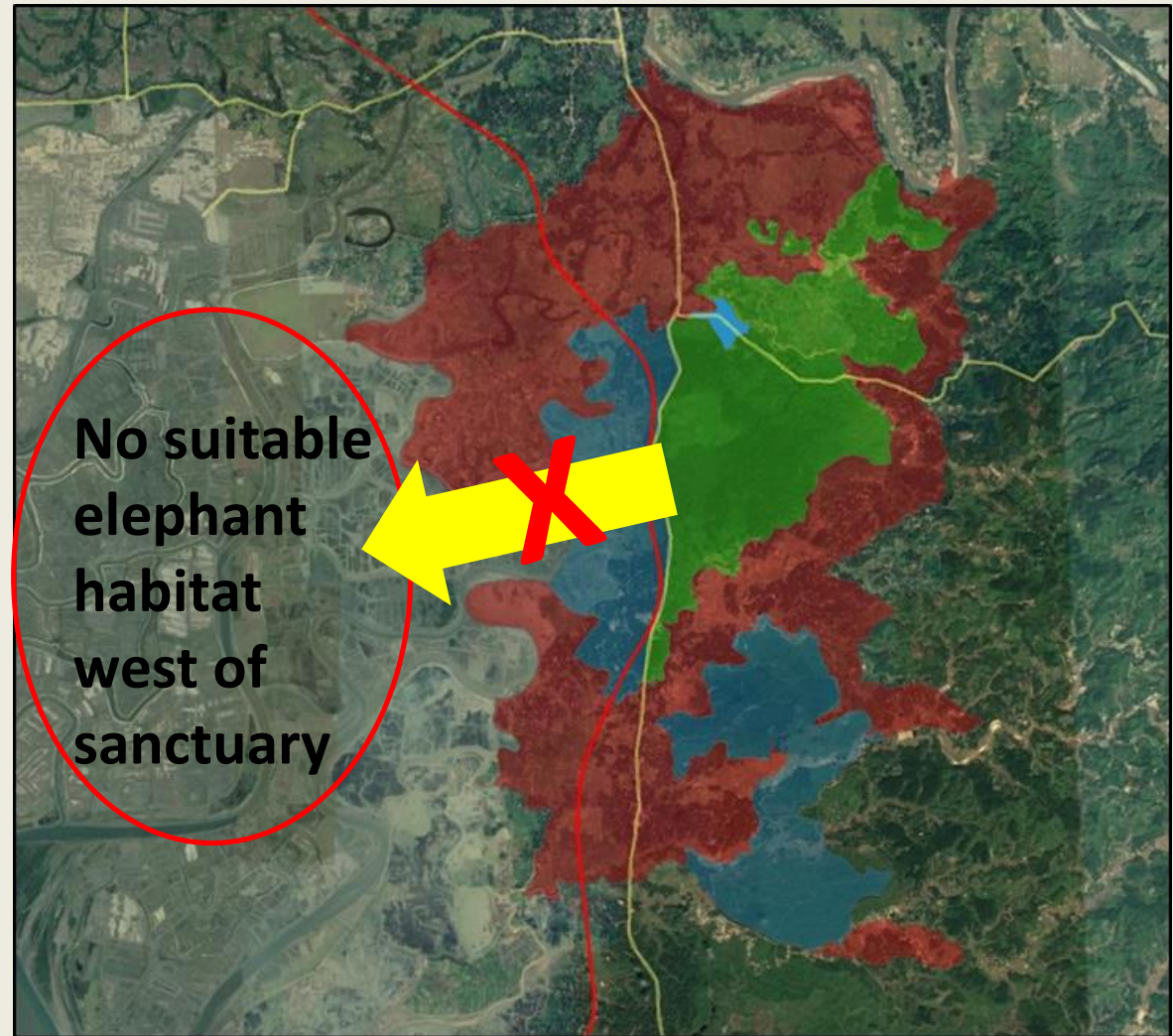
- 7,037 ha in size
- Project crosses sanctuary along a 10.3-km long alignment
 - 5.8 km (56.3%) crosses through Buffer Zone community forest
 - **None** crosses through Core Zone

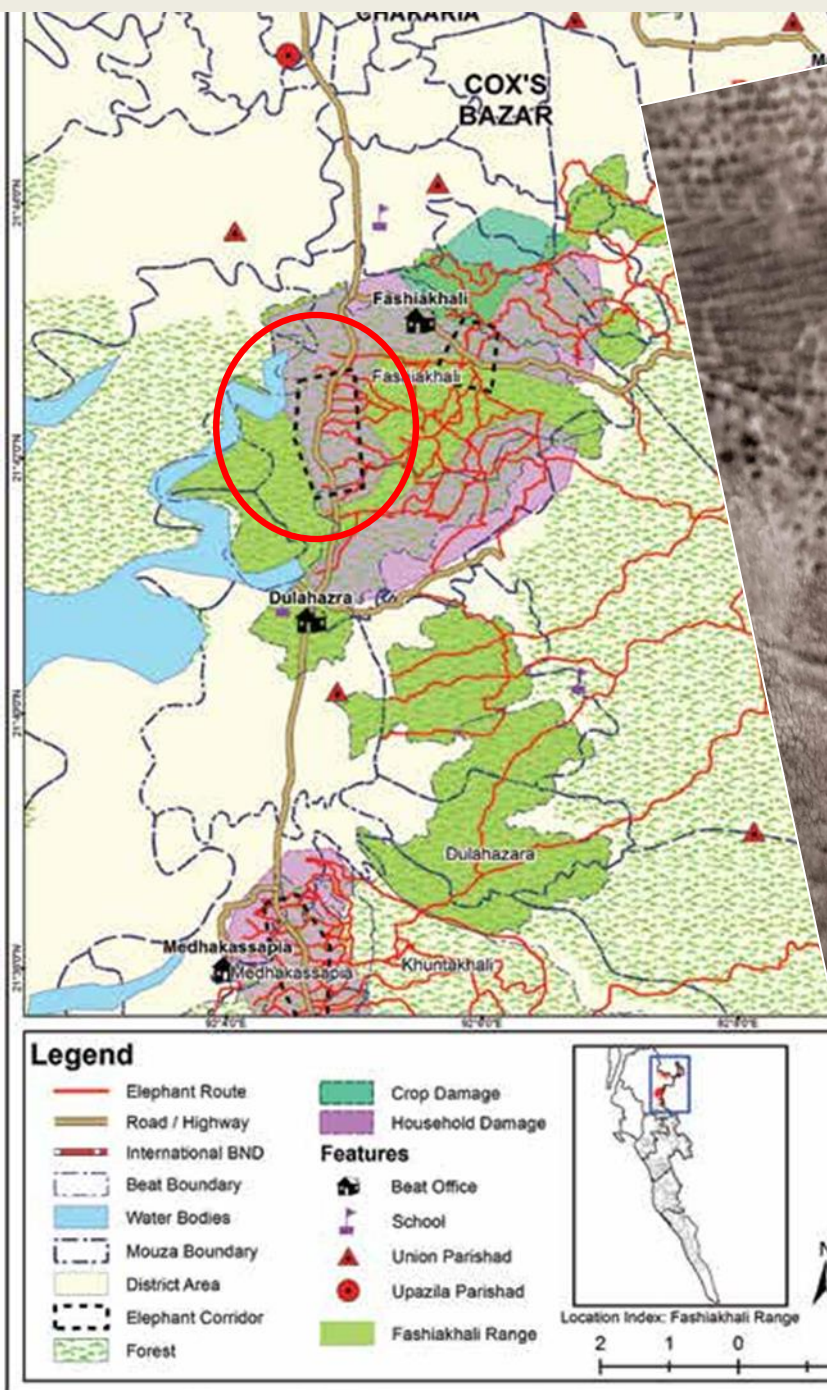


CHITTAGONG-COX'S BAZAR RAIL PROJECT

Fasiakhali Wildlife Sanctuary

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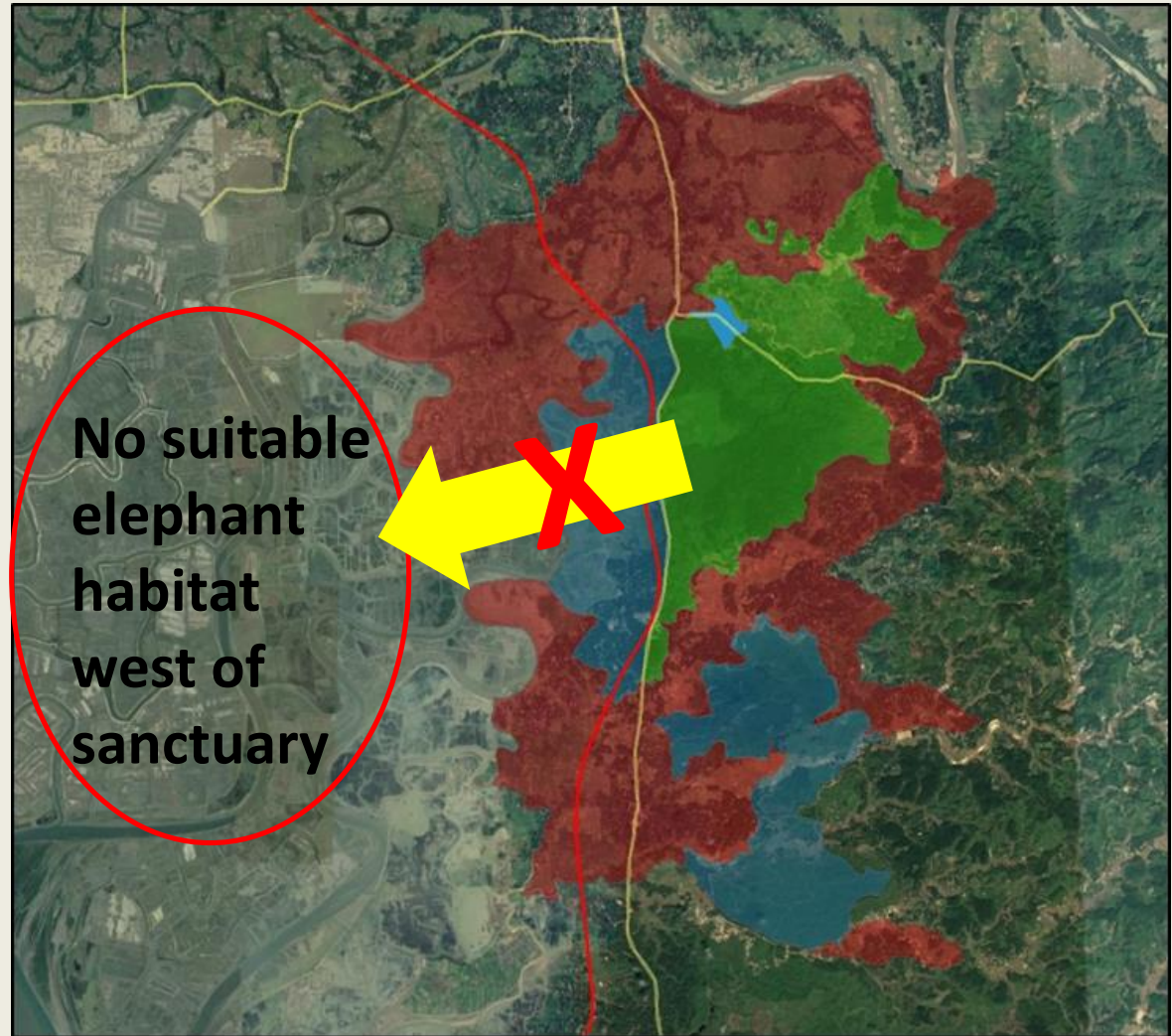




CHITTAGONG-COX'S BAZAR RAIL PROJECT

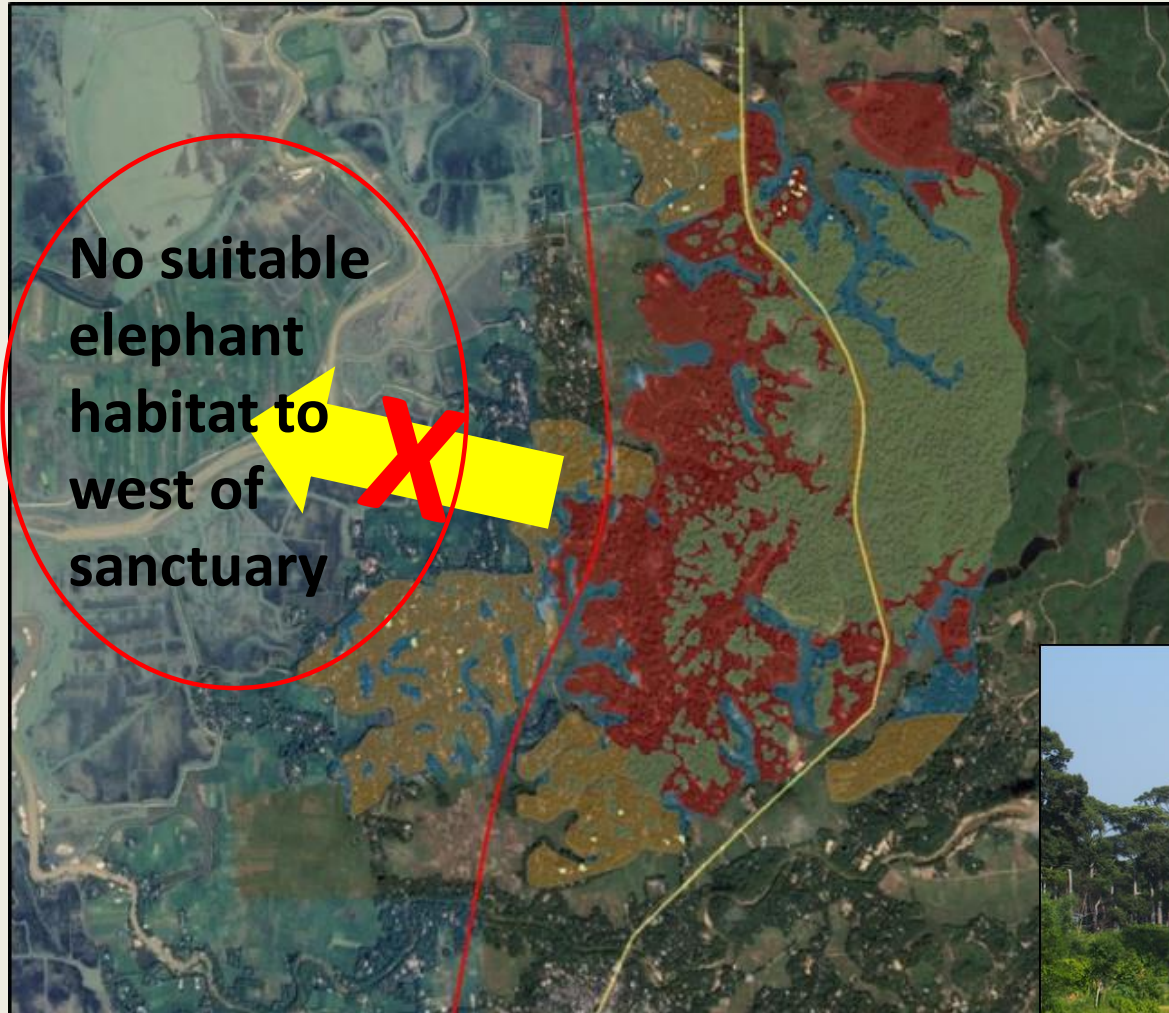
Fasiakhali Wildlife Sanctuary

- 7,037 ha in size
- Project crosses sanctuary along a 10.3-km long alignment
 - 5.8 km (56.3%) crosses through Buffer Zone community forest
 - None crosses through Core Zone
- 30 villages within the sanctuary
- **Highest Human-Elephant Conflict (HEC) of the 3 PA**



CHITTAGONG-COX'S BAZAR RAIL PROJECT

Medhkachapia National Park

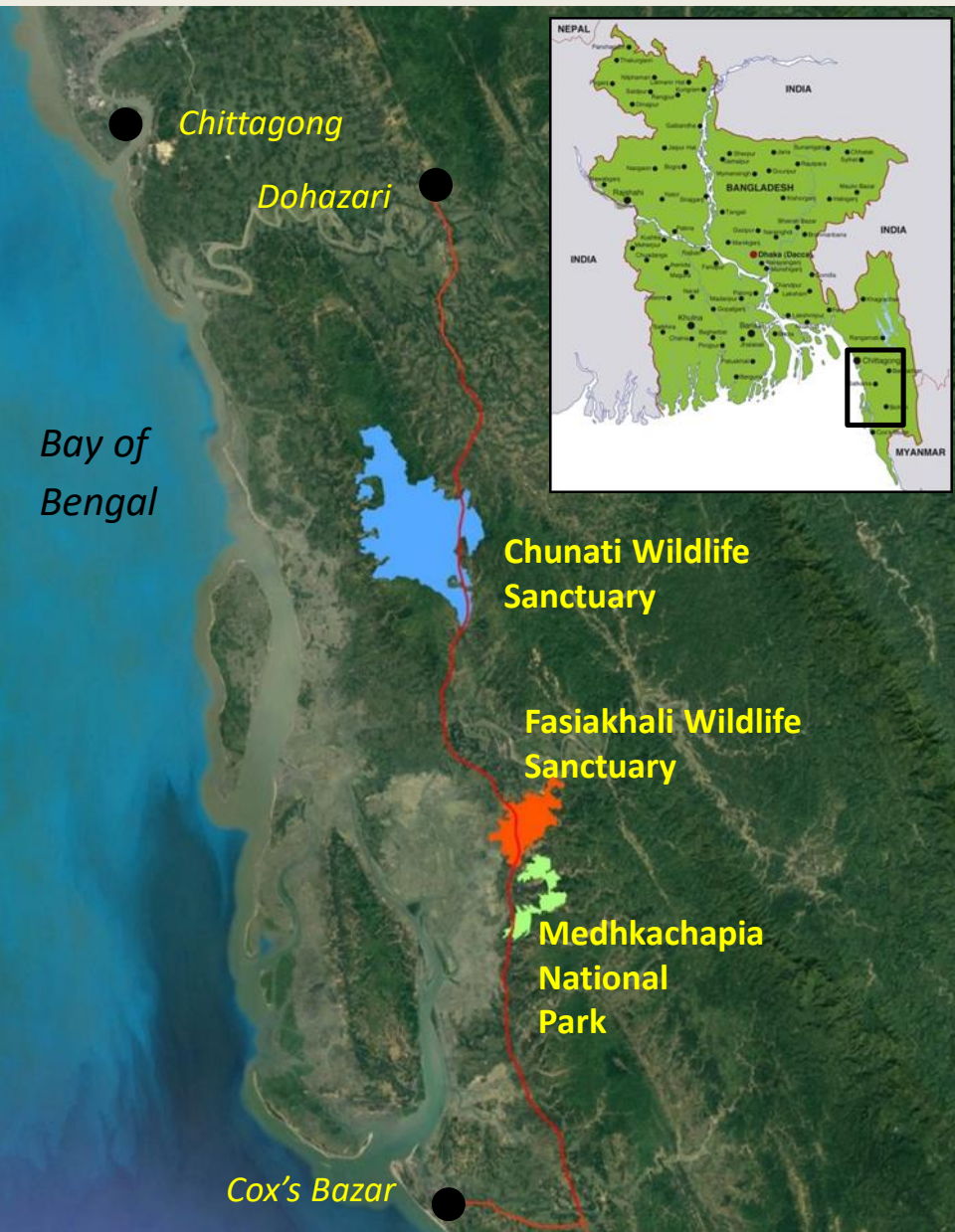


- 396-ha in size (smallest of the PA)
- Established to protect remnant Garjan forest
- Project crosses a 0.9-km long alignment in park
 - 0.3 km (33.5%) through Forest/shrub habitats



Garjan forest

CHITTAGONG-COX'S BAZAR RAIL PROJECT



Legally protected area status

+

Endangered Asian elephant =

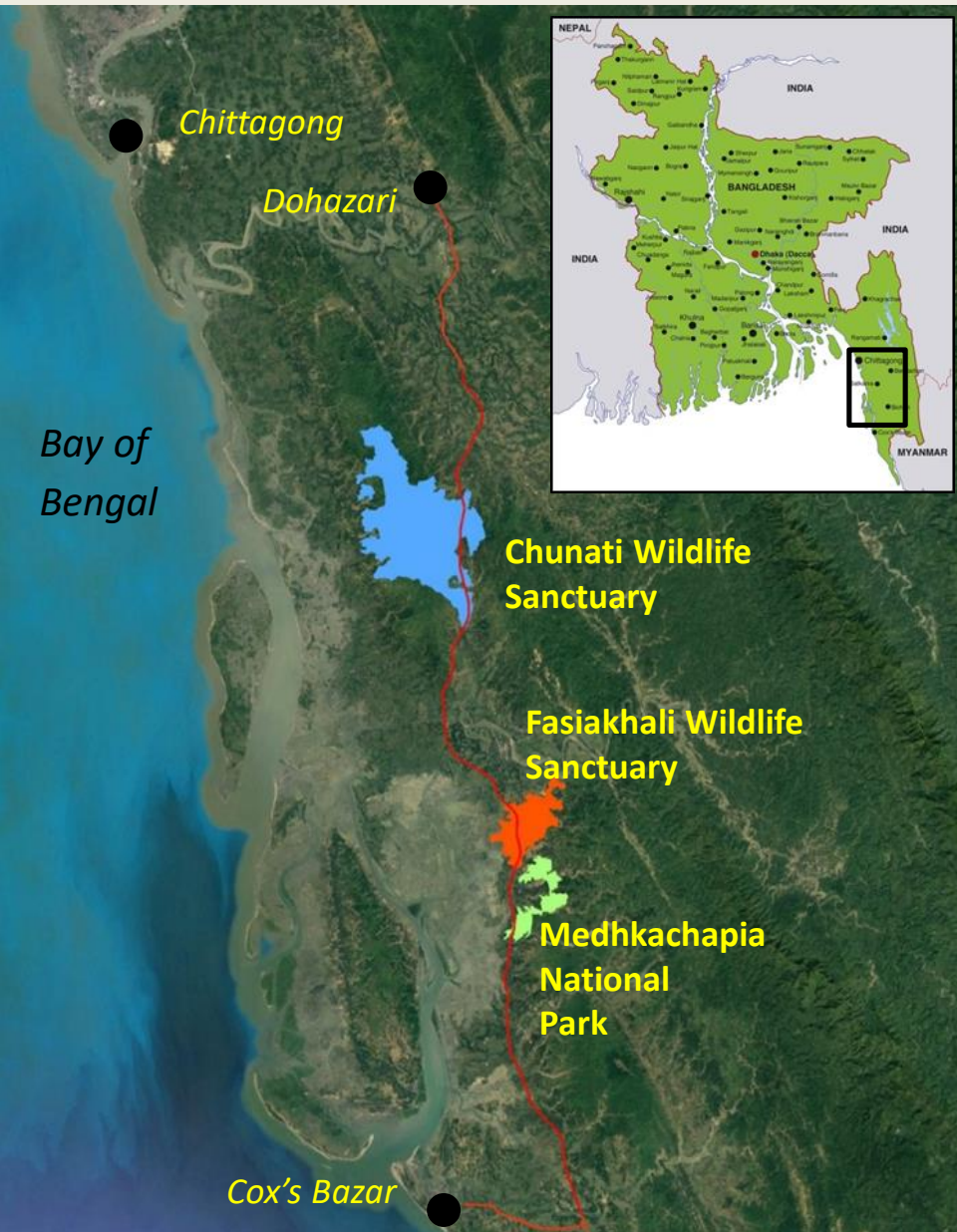
*Biodiversity Baseline Assessment
and Safeguard Policy Statement*
requirements by the Asian
Development Bank, including
mitigations for elephants



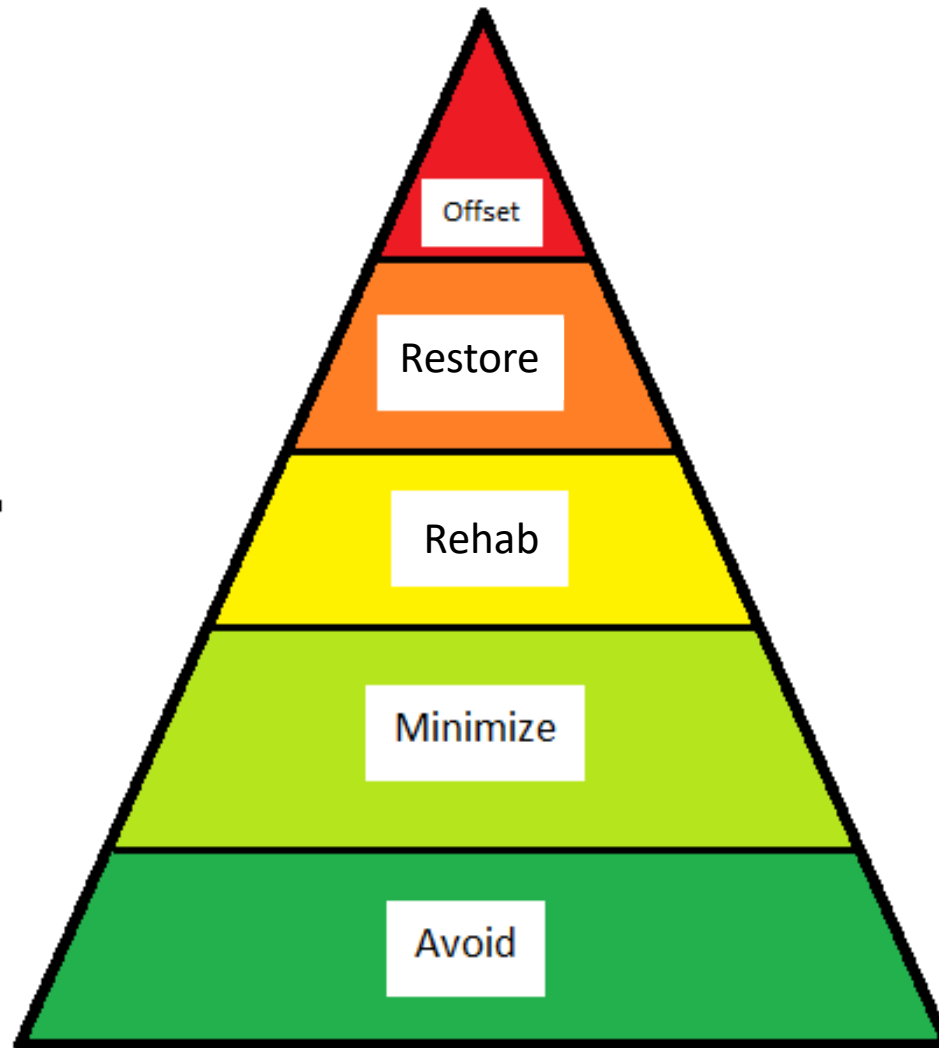
CHITTAGONG-COX'S BAZAR RAIL PROJECT

ADB Safeguard Policy Statement

- Guides determination of *critical habitat* for endangered species
- “Projects may have no adverse impact impairing biodiversity value and ecosystem function, cannot reduce populations or habitat for endangered species, and all lesser impacts are fully mitigated.”

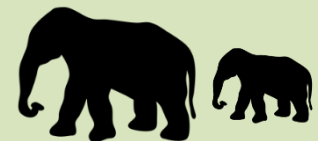


Decreasing preference

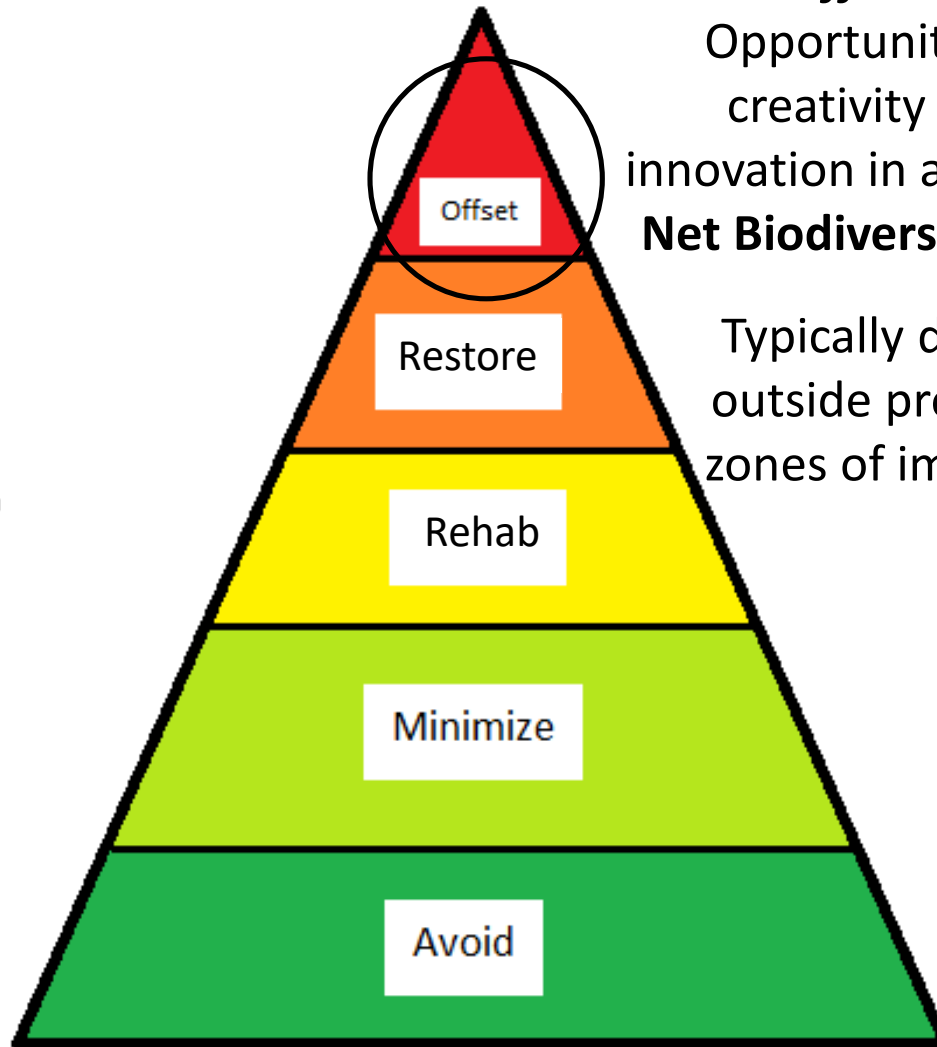


MITIGATION HIERARCHY

PLANNING AND IMPLEMENTATION OF
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Decreasing preference

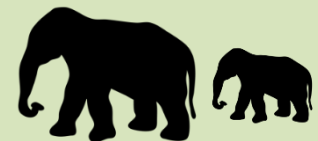


Offsets:
Opportunity for
creativity and
innovation in achieving
Net Biodiversity Gain

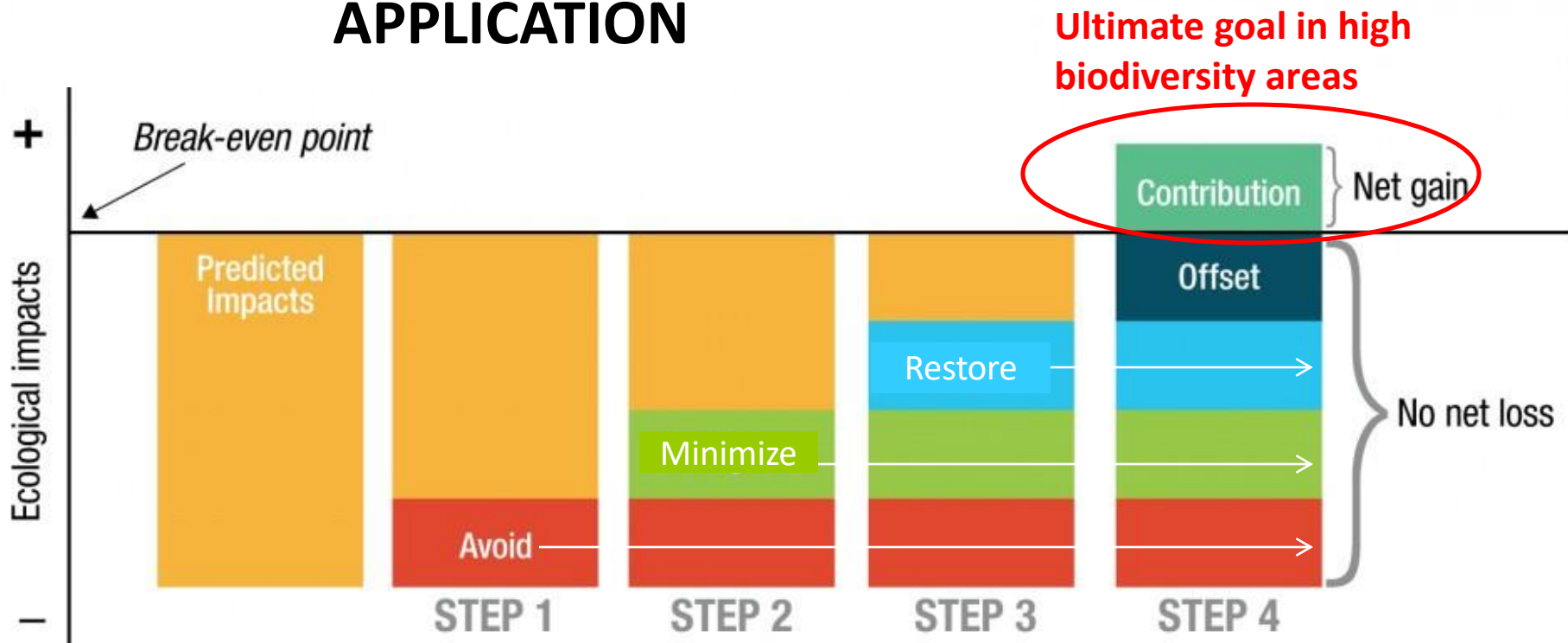
Typically done
outside project
zones of impact

MITIGATION HIERARCHY

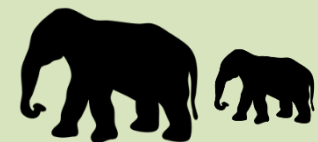
PLANNING AND IMPLEMENTATION OF
GREEN TRANSPORTATION PROJECTS IN SOUTH ASIA
Wildlife Institute of India



MITIGATION HIERARCHY APPLICATION



Employ a mix of mitigation hierarchy action steps to meet a goal of **No Net Loss** of biodiversity value (and preferably to achieve a **Net Gain**)



CHITTAGONG-COX'S BAZAR RAIL PROJECT

Railway Impact to Asian Elephants

DIRECT IMPACT

- Loss of habitat – further fragmentation of habitats
- Animal mortality from wildlife-train collisions



INDIRECT IMPACT

- Barrier to free movement across railway (*permeability*)
- Reduced landscape *connectivity*
- Reduced genetic interchange – reduced population viability



ASSESSMENT OF DIRECT PROJECT IMPACTS



Assessment of project impacts tied to length and width of railway right-of-way (ROW) through the protected areas, by management zone/habitat

Impacts Assessed by GIS Analysis:

- Vegetation clearing (direct impact)
- Potential elephant mortality along cut slope areas (direct impact)
- Barrier effect and loss of connectivity due to cut slopes and filling and (indirect impact) from formation construction

ASSESSMENT OF PROJECT IMPACTS

Direct Habitat Loss from Construction

CWS Management Zone	Railway corridor ROW construction impact	
	Length (%)	Area (%)
Core zone	5.3 km (33.5%)	31.7 ha (36.5%)
Buffer zone	2.0 km (12.7%)	14.1 ha (16.2%)
Impact zone	8.5 km (53.8%)	41.1 ha (47.3%)
All	15.8 km (100.0%)	86.9 ha (100.0%)

FWS Management Zone	Railway corridor ROW construction impact	
	Length (%)	Area (%)
Core zone	0 km (0%)	0 ha (0%)
Buffer zone	5.8 km (56.3%)	27.3 ha (55.3%)
Impact zone	4.5 km (43.7%)	22.1 ha (44.7%)
All	10.3 km (100.0%)	49.4 ha (100.0%)

MNP Land Use categories	Railway corridor ROW construction impact	
	Length (%)	Area (%)
Forest	0 km (0%)	0 ha (0%)
Forest/shrub	0.3 km (33.3%)	2.3 ha (50.0%)
Agriculture	0.5 km (55.6%)	1.7 ha (37.0%)
Settlement	0.1 km (11.1%)	0.6 ha (13.0%)
All	0.9 km (100.0%)	4.6 ha (100.0%)



Total of 140.9 ha impacted by construction at all 3 protected areas – 53.0 ha in *Critical Habitats*

This 53.0 ha of *Critical Habitat* must be mitigated with habitat enhancement as per ADB policy/SPS

ASSESSMENT OF PROJECT IMPACTS

Direct Loss of Forest Vegetation from Construction

Used overstory tree inventory to determine the estimated number of trees to be lost with construction within *Critical Habitat* areas

Protected area	Management Zone/Land Use	Impact area	No. trees/ha inventoried	Total trees harvested
CWS	Core Zone	31.7 ha	799.4 trees/ha	25,341 trees
FWS	Buffer Zone	≈19.0 ha ¹	620.4 trees/ha	11,787 trees
MNP	Forest/shrub	2.3 ha	41.3 trees/ha	95 trees
All		53.0 ha		37,223 trees



ASSESSMENT OF PROJECT IMPACTS

Potential Direct Mortality to Asian Elephants

Greatest potential for Asian elephant mortality from trains - length and depth of cut slope/embankment areas where animals become trapped and vulnerable to collisions

Protected area	Linear distance of cut slopes/embankments by depth to railway formation			
	<2 m deep cuts	2–8 m deep cuts	>8 m deep cuts	PA total (%)
CWS	570 m	500 m	900 m	1,970 m (69.1%)
FWS	160 m	240 m	0	400 m (14.0%)
MNP	60 m	260 m	160 m	480 m (16.8%)
All	790 m	1,000 m	1,600 m	2,850 m



ASSESSMENT OF PROJECT IMPACTS

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All	790 m	1,000 m	1,600 m	2,850 m



Even though only 10% of the total Protected Areas alignment falls in cut slopes, 70% lies in CWS's critical habitat Core Zone where it's also is a **physical barrier to passage (up to 17 m deep)**

BIODIVERSITY ASSESSMENT APPROACH

APRIL & NOVEMBER 2017 ELEPHANT SIGN TRANSECT SURVEYS

- Intensive surveys of Asian elephant sign and plot counts of abundance along the entire rail corridor
 - ✓ Identify crossing locations
 - ✓ Assess sign/crossing types (trails vs. crop raiding/damage)
 - ✓ Compare to 2016 IUCN Elephant Route Study crossings



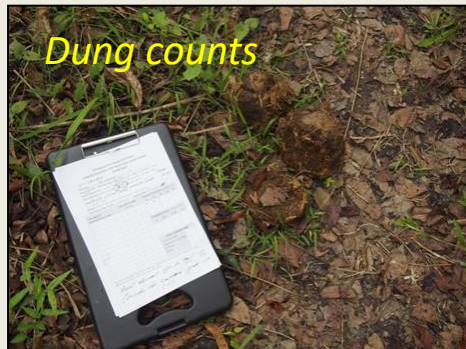
Transects conducted along alignment following concrete monuments and markings, and Google Maps file



Bark stripping & rub trees



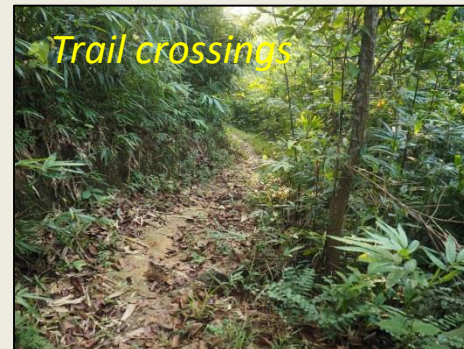
Crop damage assessment



Dung counts



Track counts



Trail crossings

BIODIVERSITY ASSESSMENT APPROACH

CAMERA TRAPPING (July 2017 – June 2018)

- Cameras at 20 sites to:
 - ✓ Assess relative abundance and distribution of elephants to augment sign surveys
 - ✓ Prioritize crossings needing passage structures
 - ✓ Determine temporal activity patterns
 - ✓ Compare elephant use of Core (e.g., trails) and Buffer zone habitats (e.g., for crop raiding)



APRIL & NOVEMBER 2017 ELEPHANT SIGN TRANSECT SURVEYS

Railway alignment chainage (km)	PA	Spring (April) Survey					Fall (October-November) Survey			
		Dung Piles	No. Tracks ¹	Crop damage	Trail		Dung Piles	No. tracks	Crop damage	Trail
25+230	CWS		1	X						
25+700	CWS		1	X	X			2-5	X	X
27+100	CWS							2-5	X	X
27+200	CWS	2	2-5		X		4	>10		X
27+300	CWS		2-5	X				2-5	X	
28+300	CWS		2-5		X		3	2-5		X
28+400	CWS							2-5		X
28+650	CWS	11	6-10		X					
28+800	CWS	6	2-5							
28+900	CWS		2-5		X		1	2-5		X
29+000	CWS	6	2-5		X			6-10		X
29+100	CWS	6	2-5		X			2-5		X
29+200	CWS		2-5	X			2	2-5	X	
55+100	FWS						5	2-5		X
55+520	FWS							6-10	X	
55+550	FWS							6-10	X	
55+900	FWS							2-5	X	
56+400	FWS	3	2-5	X				2-5	X	
56+500	FWS							2-5	X	
59+200	FWS							1		
64+800	MNP	3	2.5		X		3	2-5		X

APRIL & NOVEMBER 2017 ELEPHANT SIGN TRANSECT SURVEYS

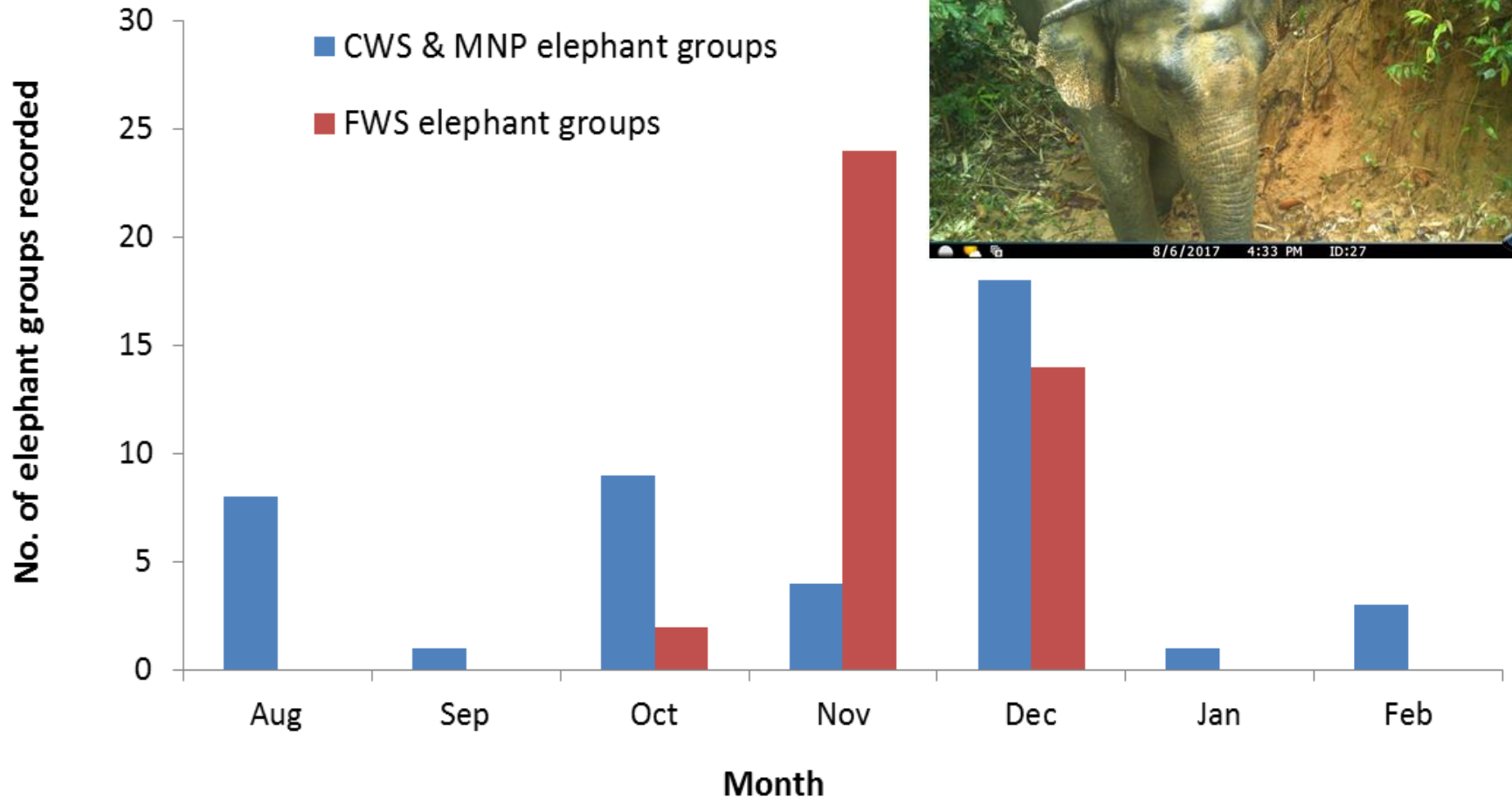
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27+200	CWS	2	2-5		X	4	>10		X
27+300	CWS		2-5	X			2-5	X	
28+300	CWS		2-5		X				X
28+400	CWS								X
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29+200	CWS		2-5	X		2	2-5	X	
55+100	FWS					5	2-5		X
55+520	FWS						10	X	
55+550	FWS						10	X	
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56+400	FWS	3	2-5	X			5	X	
56+500	FWS						5	X	
59+200	FWS						1		
64+800	MNP	3	2.5		X	3	2-5		X

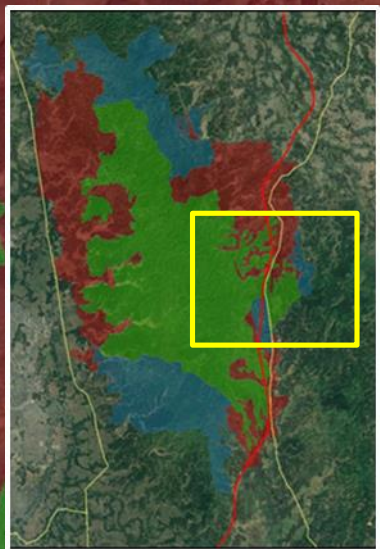
Most CWS sites tied to trails/corridors – Consistent use between seasons

Most FWS sites tied to crop raiding – Inconsistent seasonal use (fall)

ELEPHANT CAMERA TRAPPING – GROUPS BY MONTH

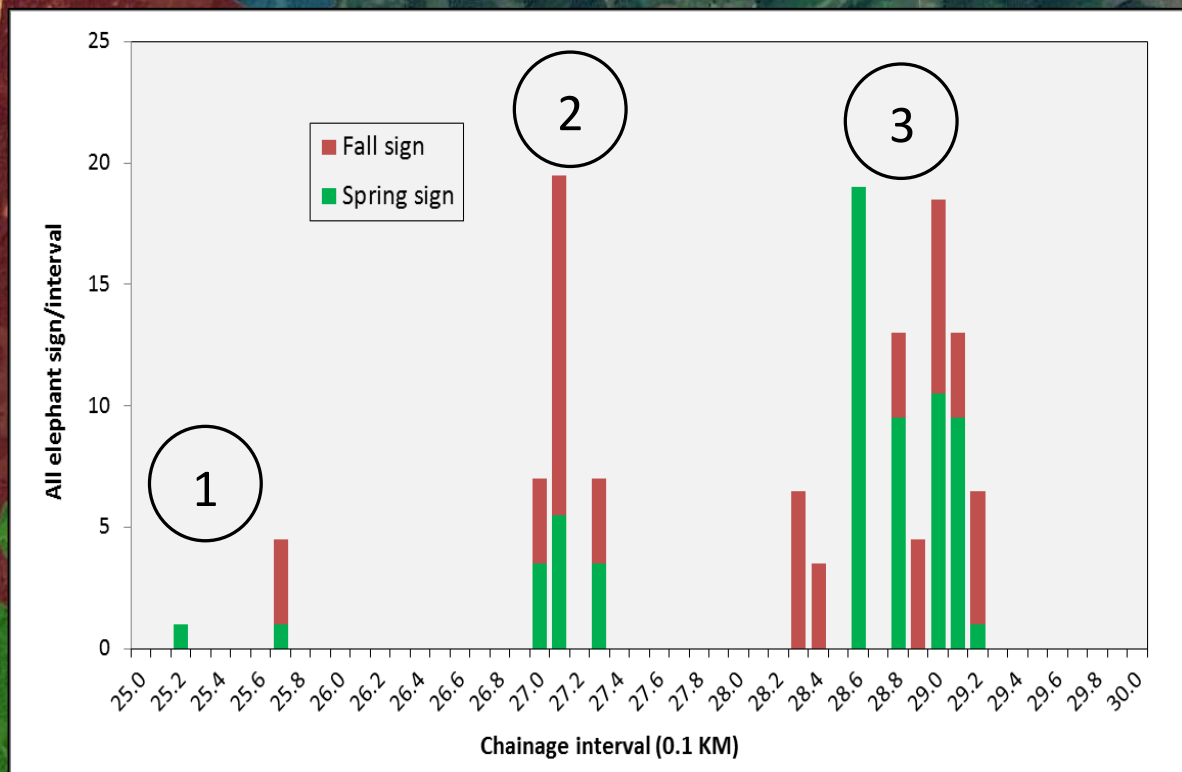
(July 2017 – February 2018)





CHUNATI WS KEY TO SIGN LOCATIONS

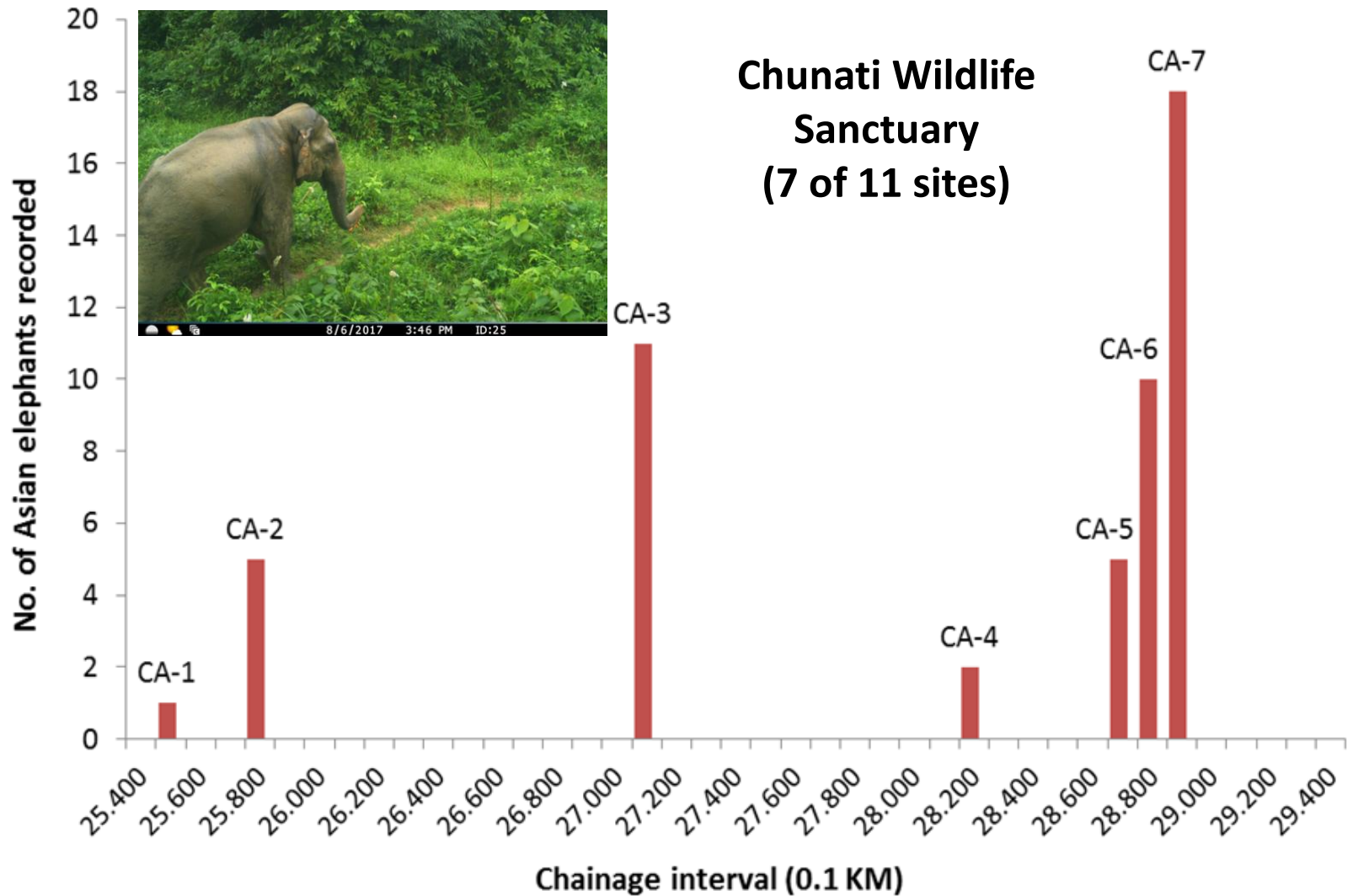
- ◊ Fall and Spring sign
- ◊ Fall sign only
- ◊ Spring sign only

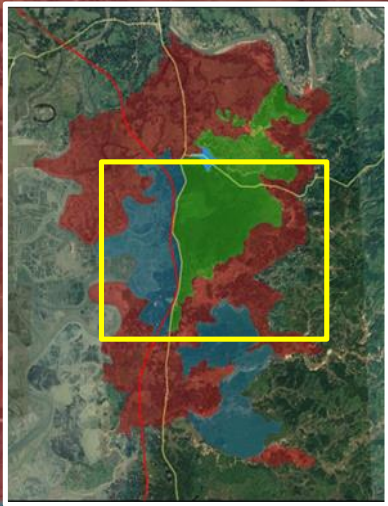


Confirmed all 3 IUCN (2014) Active Crossings

ELEPHANT CAMERA TRAPPING

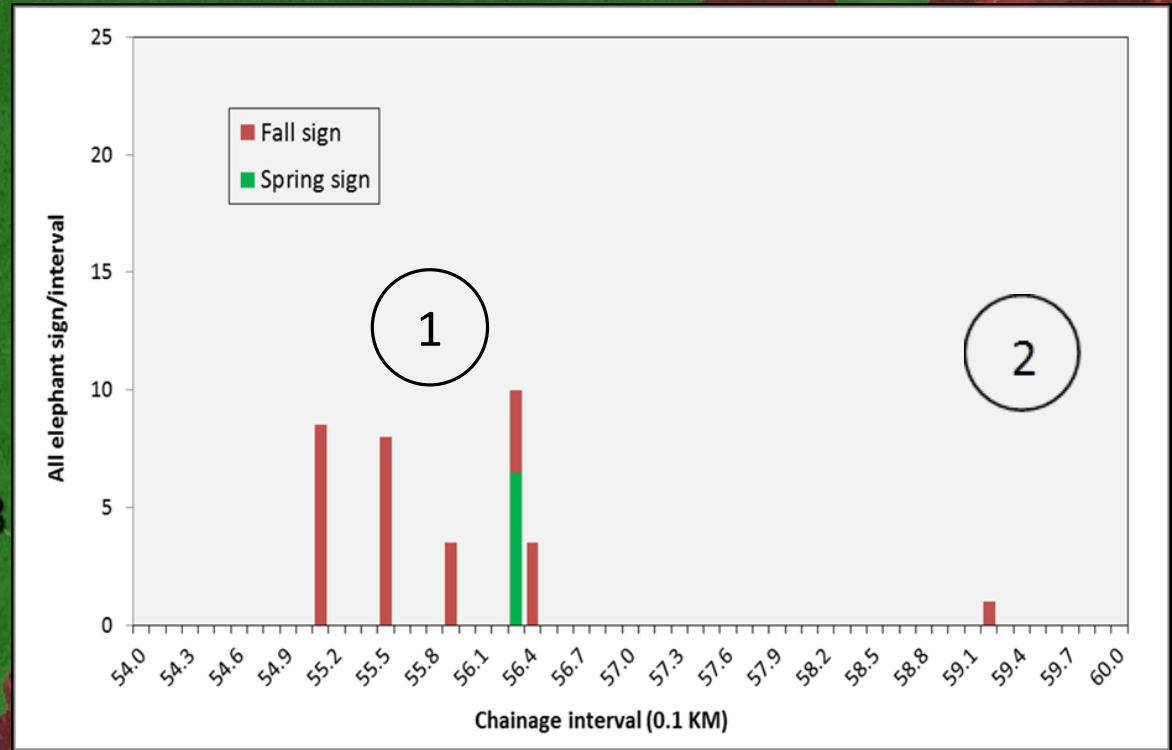
(July 2017 – March 2018)





FASAIKHALI WS **KEY TO SIGN LOCATIONS**

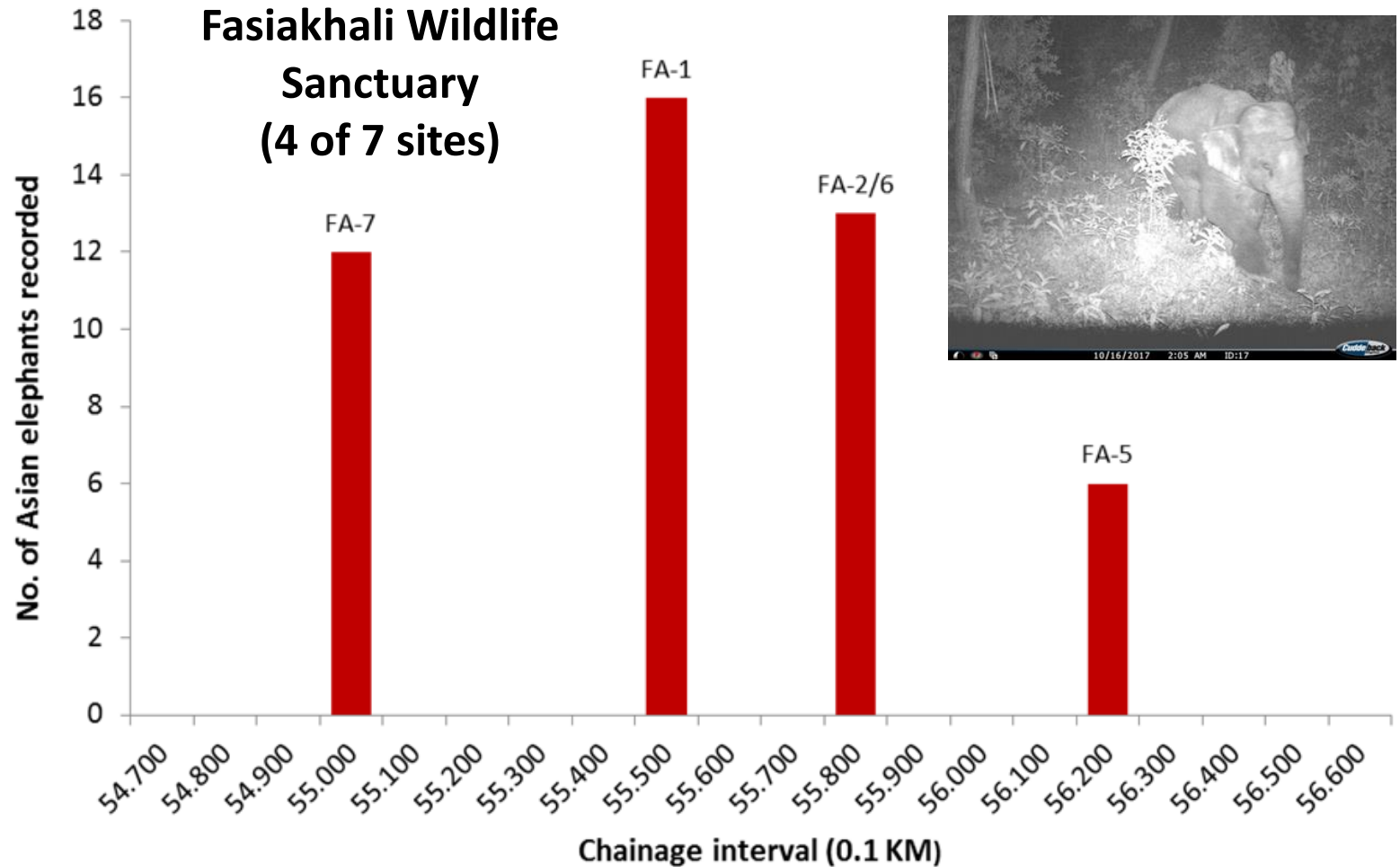
-  Fall and Spring sign
-  Fall sign only
-  Spring sign only



Confirmed both IUCN (2014) Active Crossings

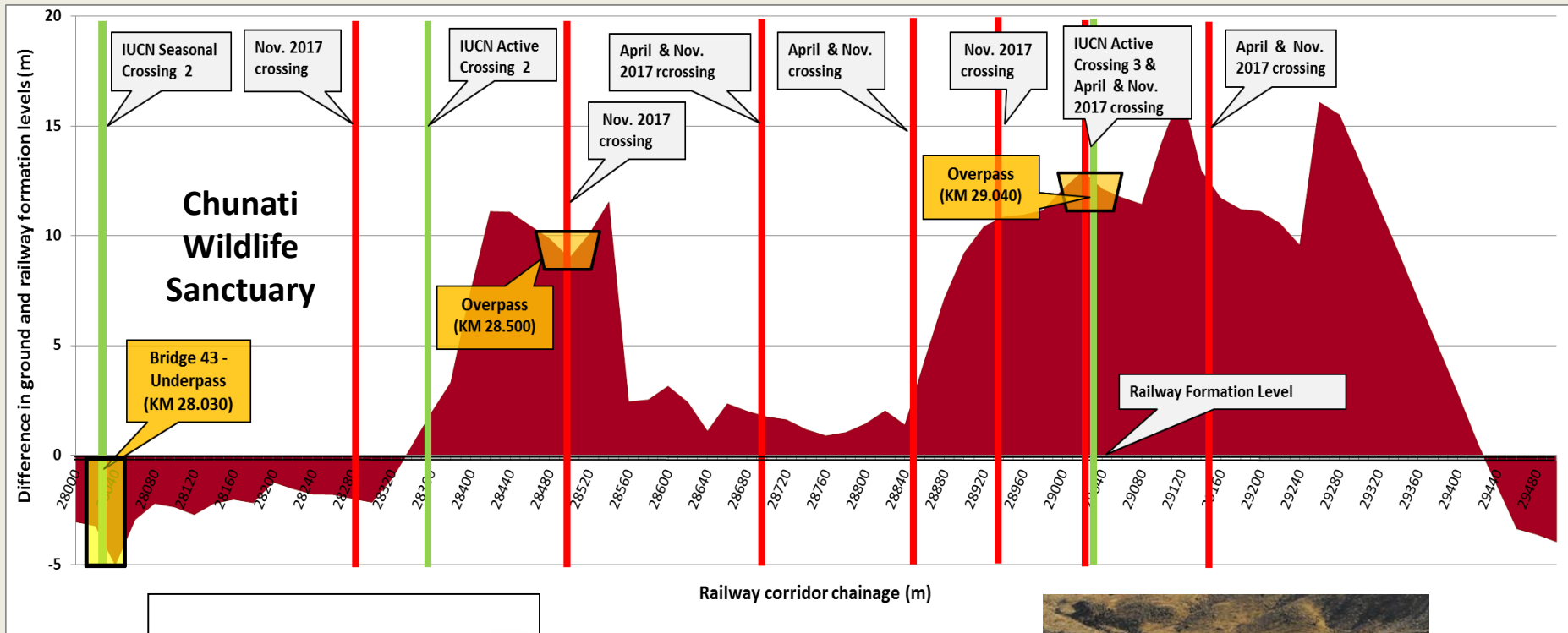
ELEPHANT CAMERA TRAPPING

(July 2017 – March 2018)

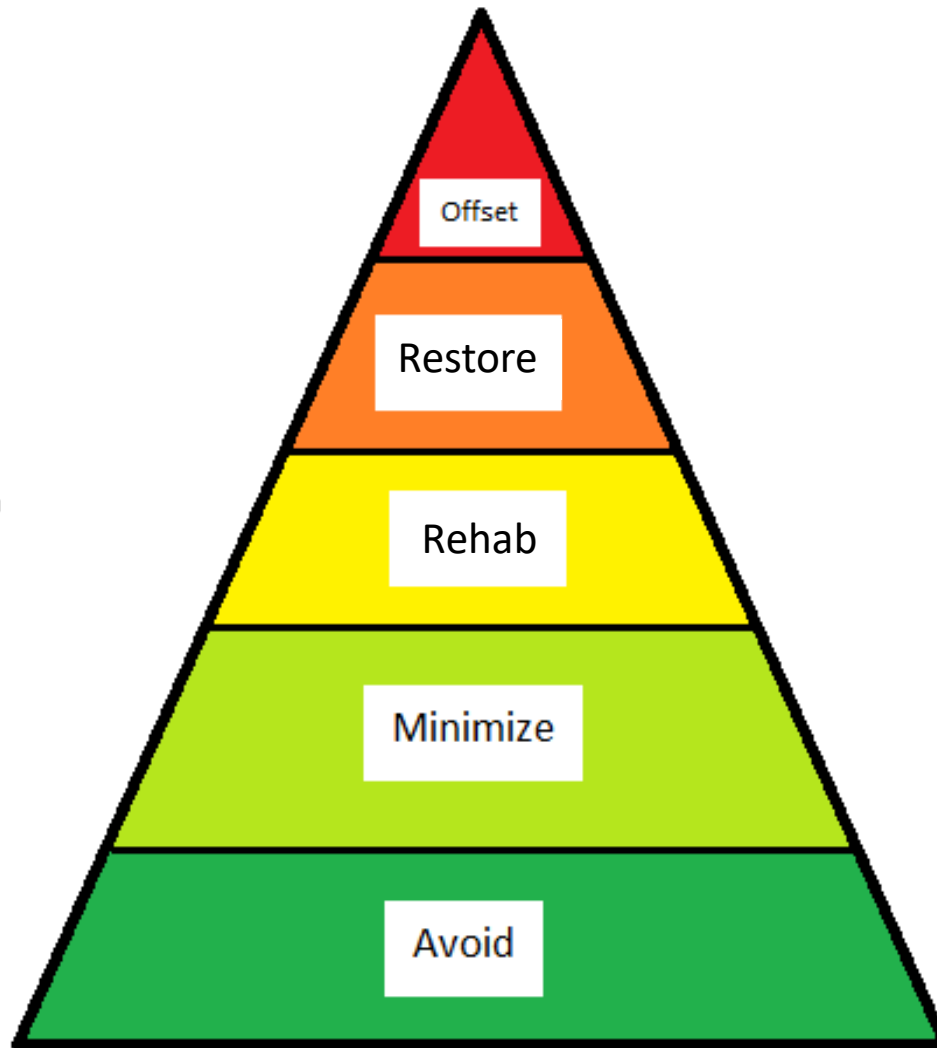


WHERE BIOLOGY MEETS ENGINEERING

- Integration of the elephant crossing information with cut-fill profiles and drainage culvert suitability information to identify passage structure needs and potential sites

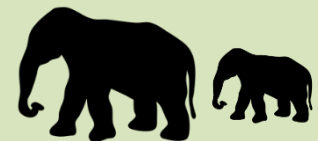


Decreasing preference



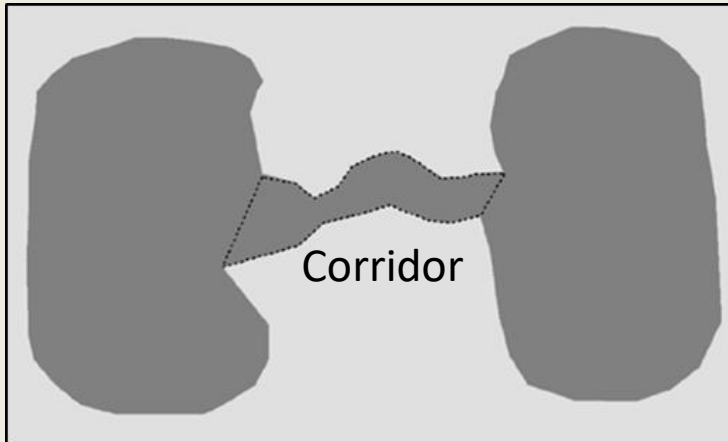
MITIGATION HIERARCHY

CONFERENCE ON ROAD ECOLOGY:
Transportation Infrastructure and Wildlife Conservation

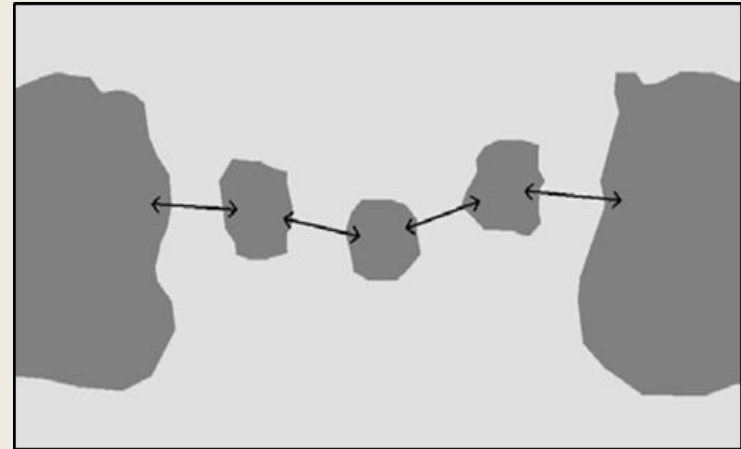


ELEPHANT CORRIDOR FORMS

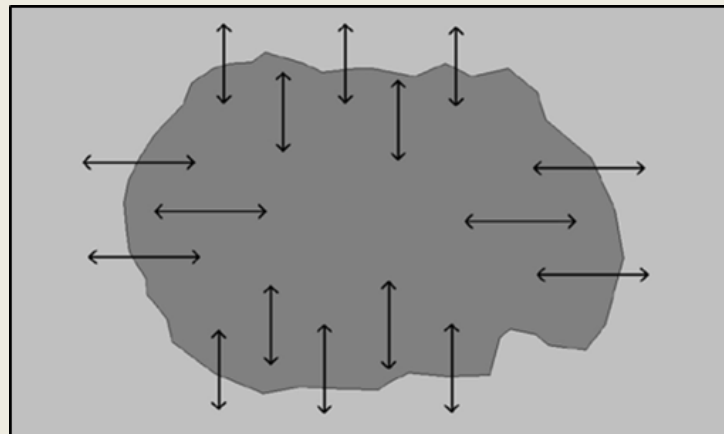
(from Venkataraman et al. 2017)



TYPICAL CORRIDOR LINKING BLOCKS



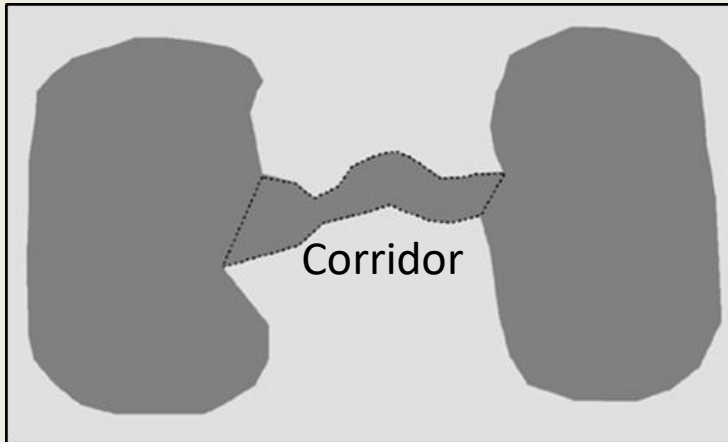
STEPPING-STONE CORRIDOR



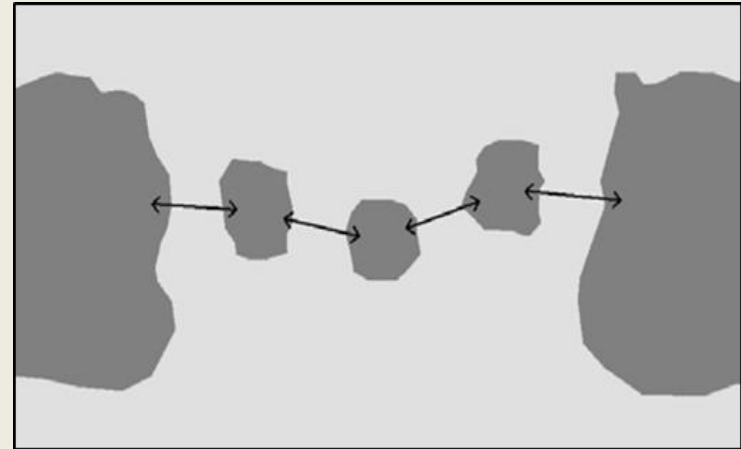
MOVEMENTS ASSOCIATED WITH CROP RAIDING

ELEPHANT CORRIDOR FORMS

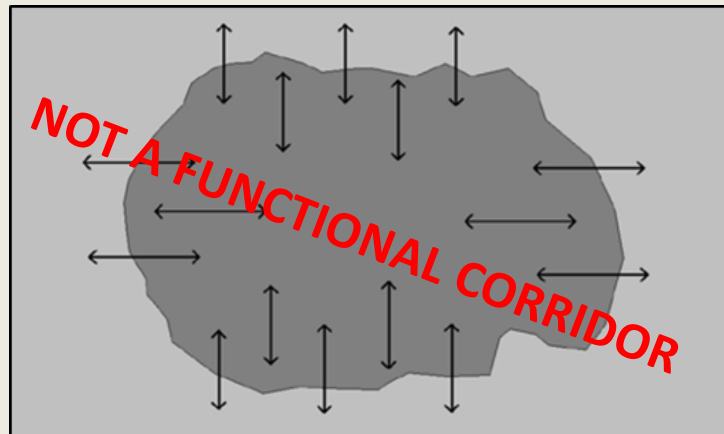
(from Venkataraman et al. 2017)



TYPICAL CORRIDOR LINKING BLOCKS



STEPPING-STONE CORRIDOR



MOVEMENTS ASSOCIATED WITH CROP RAIDING

RAILWAY CONSTRUCTION MITIGATION and CONSERVATION STRATEGY GOALS

Railway Construction Mitigation and Conservation Strategy Goals	Primary and secondary goals by PA		
	CWS	FWS	MNP
Preserve Asian elephant landscape connectivity and minimize habitat fragmentation	Primary	N/A	N/A
Prevent Asian elephant and other wildlife mortality from train-wildlife collisions	Secondary	Secondary	Primary
Provide passage for other wildlife species and protect high biodiversity areas	Secondary	Secondary	Secondary
Resolve human elephant conflicts	Secondary	Primary	Secondary
Implement habitat enhancements to mitigate construction impact and promote elephant recovery	Secondary	Secondary	Secondary

RAILWAY CONSTRUCTION MITIGATION and CONSERVATION STRATEGY GOALS

Railway Construction Mitigation and Conservation Strategy Goals	Primary and secondary goals by PA		
	CWS	FWS	MNP
Preserve Asian elephant landscape connectivity and			

Assigning different primary Goals among the Protected Areas based on their prevailing biological (and social) conditions reflects “context-sensitive” mitigation

Provide passage for other wildlife species and protect high biodiversity areas	Secondary	Secondary	Secondary
Resolve human elephant conflicts	Secondary	Primary	Secondary
Implement habitat enhancements to mitigate construction impact and promote elephant recovery	Secondary	Secondary	Secondary

RAILWAY CONSTRUCTION MITIGATION and CONSERVATION STRATEGY GOALS

Railway Construction Mitigation and Conservation Strategy Goals	Primary and secondary goals by PA		
	CWS	FWS	MNP
Preserve Asian elephant landscape connectivity and minimize habitat fragmentation	Primary	N/A	N/A
Prevent Asian elephant and other wildlife mortality from train-wildlife collisions	Secondary	Secondary	Primary
Provide passage for other wildlife species and protect high biodiversity areas	Secondary	Secondary	Secondary
Resolve human elephant conflicts	Secondary	Primary	Secondary
Implement habitat enhancements to mitigate construction impact and promote elephant recovery	Secondary	Secondary	Secondary

CHUNATI MITIGATION STRATEGY

Preserve elephant corridors with:

- 2 underpasses 
- 2 overpasses 
- 3.9 km wildlife funnel fence
- 3 at-grade crossings with sensor technology

KEY Chunati Wildlife Sanctuary

Railway alignment 

Elephant travel/
landscape corridors 

Management Zones:

Core Zone 

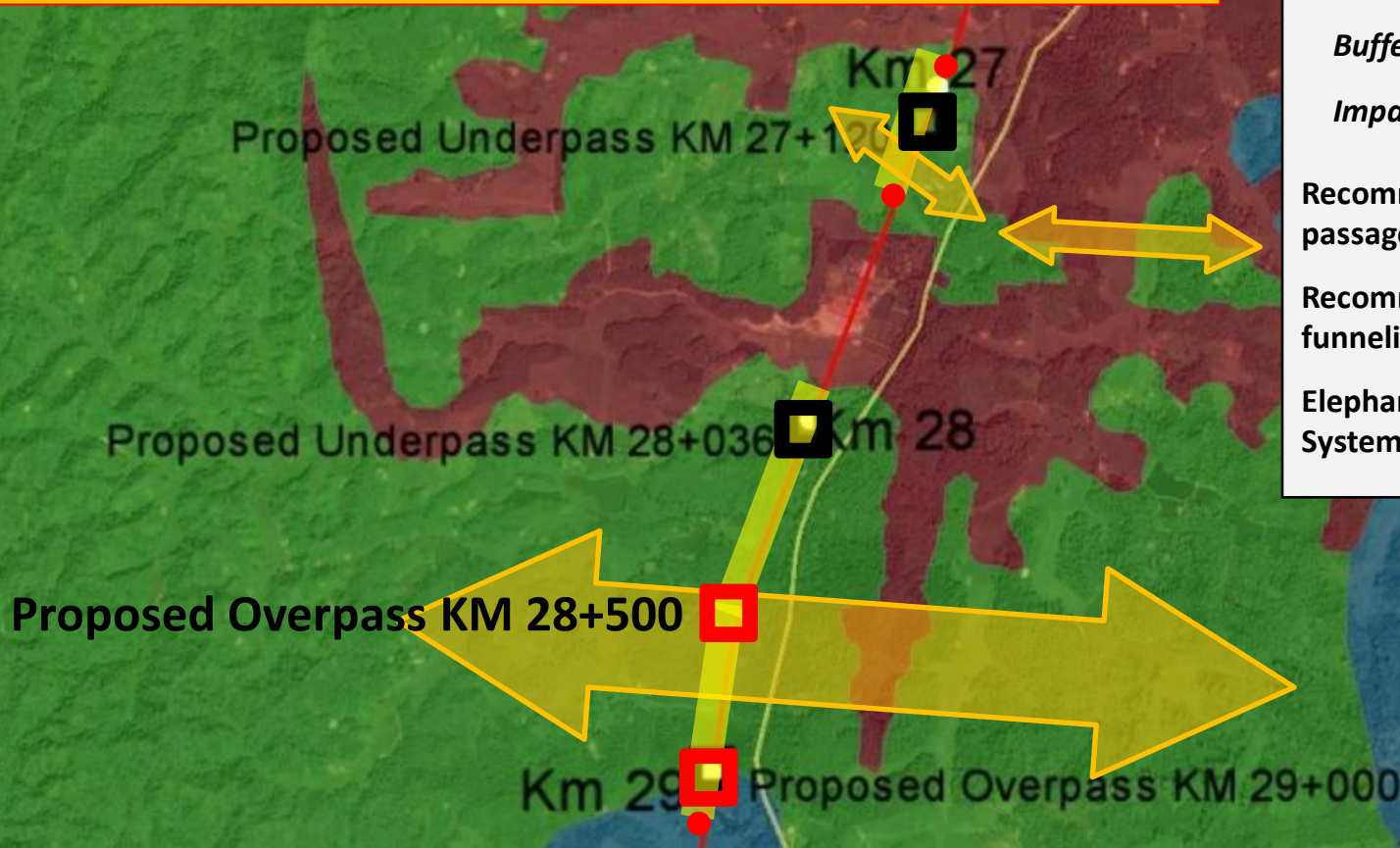
Buffer Zone 

Impact Zone 

Recommended
passage structures 

Recommended
funneling treatment 

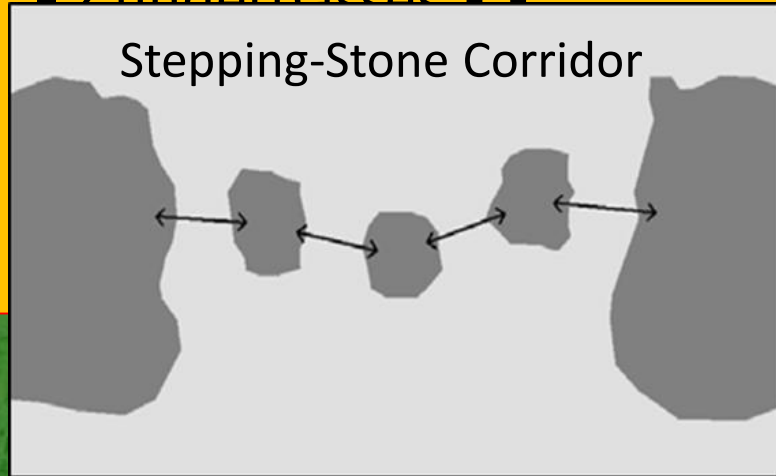
Elephant detection
Systems 



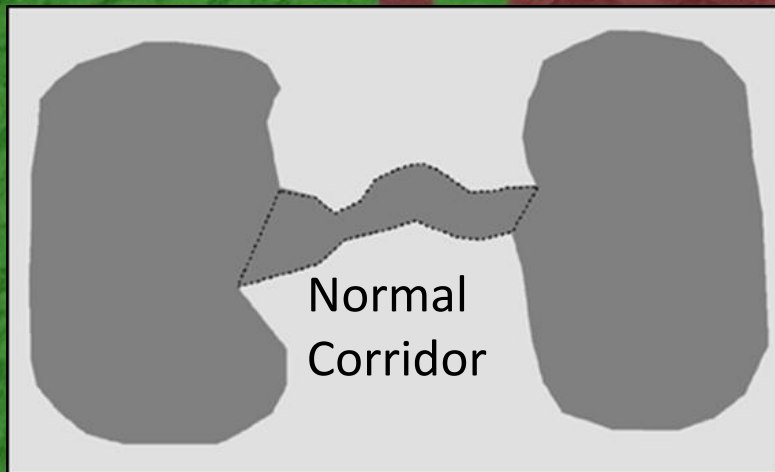
CHUNATI MITIGATION STRATEGY

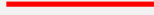
Preserve elephant corridors with:

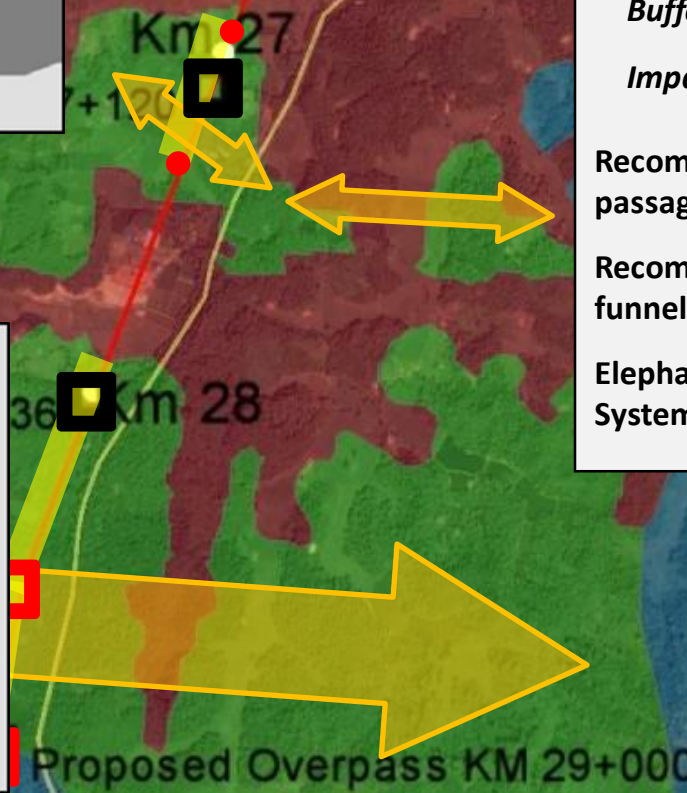
2 underpasses



sensor technology



KEY	
Chunati Wildlife Sanctuary	
Railway alignment	
Elephant travel/landscape corridors	
Management Zones:	
Core Zone	
Buffer Zone	
Impact Zone	
Recommended passage structures	
Recommended funneling treatment	
Elephant detection Systems	



Overpasses at
established travel
routes on ridges
(with **8 – 13 m**
excavation cuts
needed for
railway alignment)



Proposed Underpass KM 2

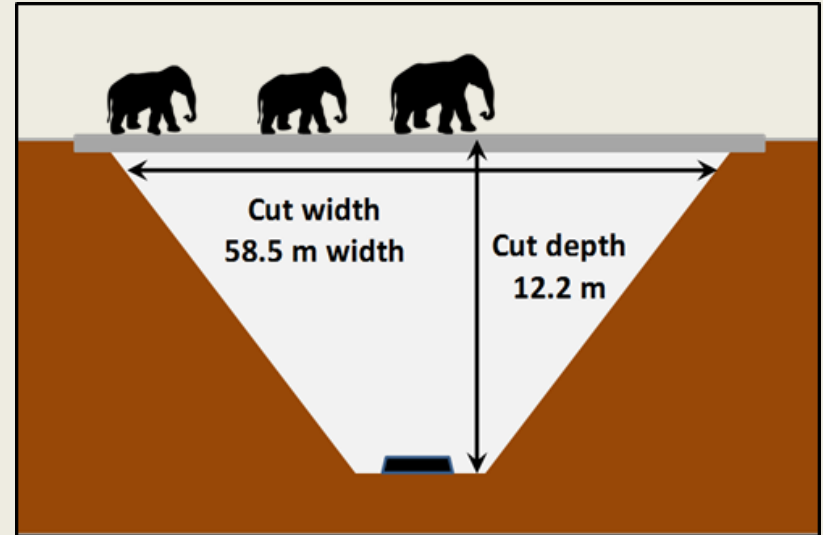
Proposed Overpass KM 28+50



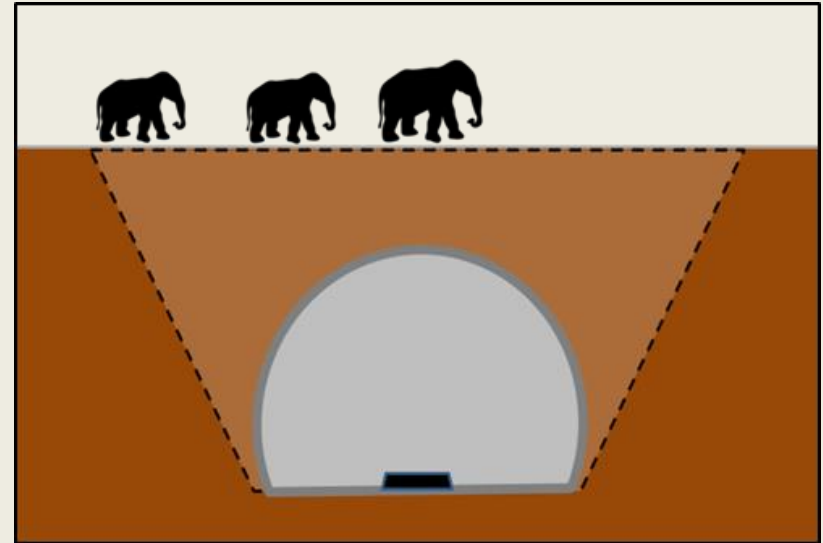
Km 2



OVERPASS DESIGN OPTIONS



Bridge between cut slopes – length dependent on steepness of slopes



Backfilled arched tunnel at railway formation level through which trains pass

CHUNATI MITIGATION STRATEGY

Preserve elephant corridors with:

- 2 underpasses 
- 2 overpasses 
- 3.9 km wildlife funnel fence
- 3 at-grade crossings with sensor technology

KEY Chunati Wildlife Sanctuary

Railway alignment 

Elephant travel/
landscape corridors 

Management Zones:

Core Zone 

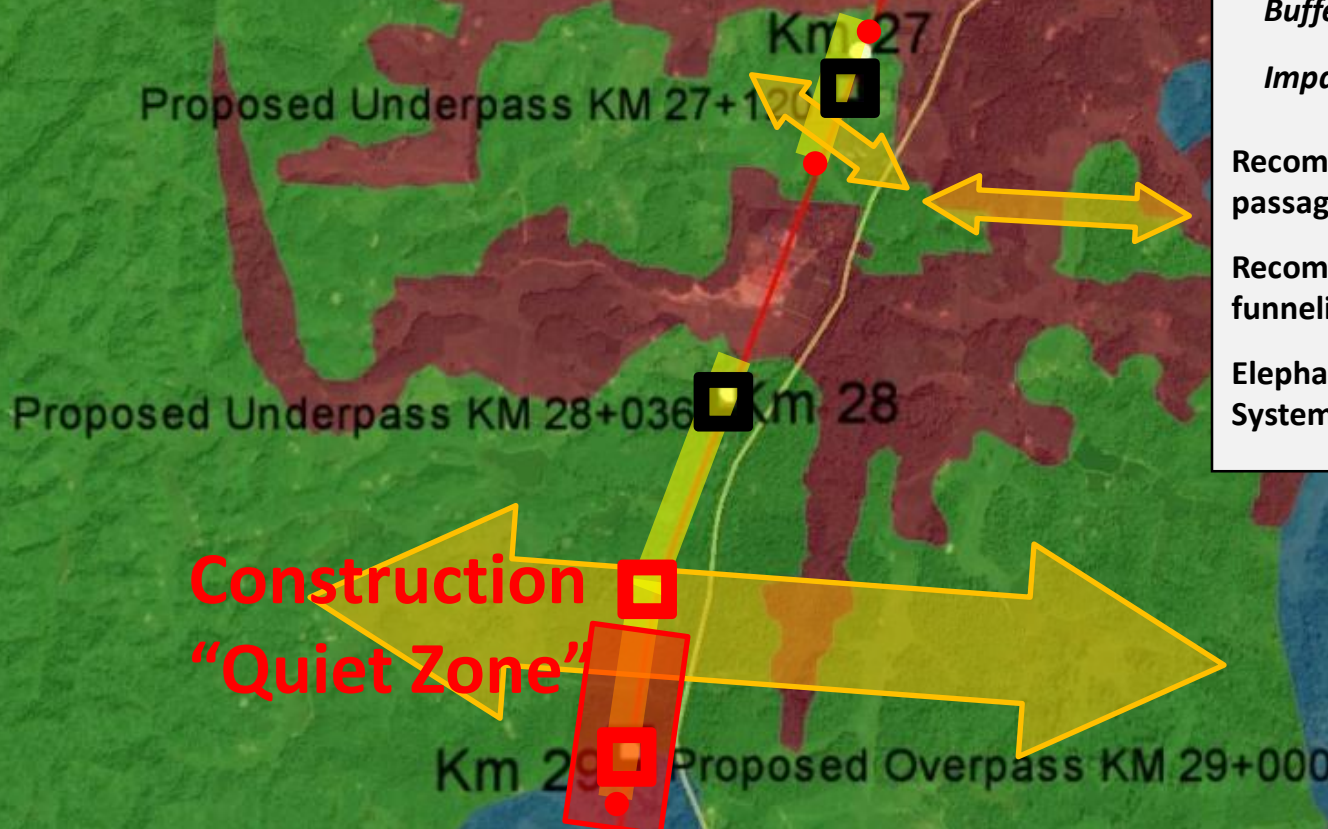
Buffer Zone 

Impact Zone 

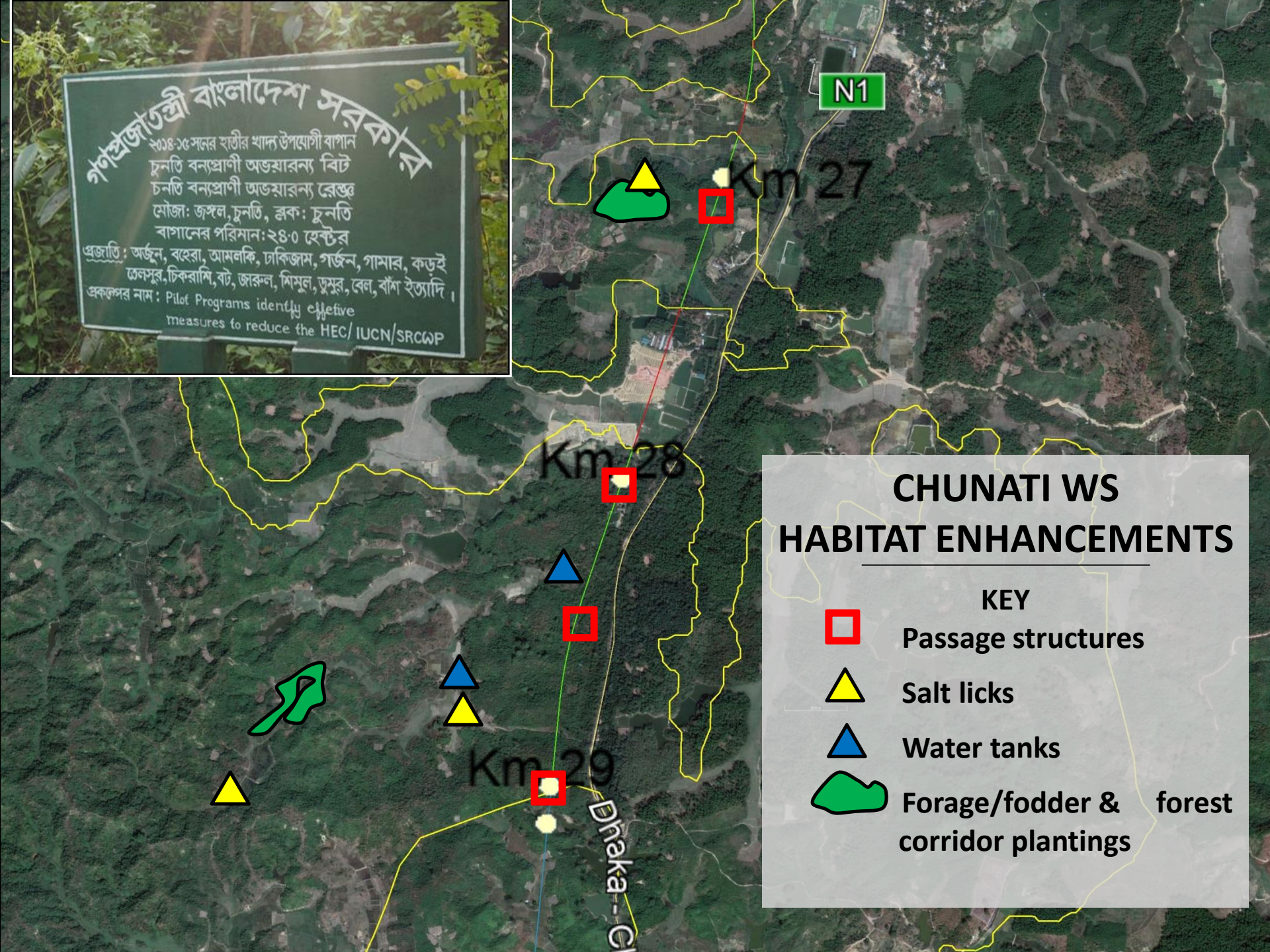
Recommended
passage structures 

Recommended
funneling treatment 

Elephant detection
Systems 



গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
 ২০১৪-১৫ সনের হাতীর খাদ্য উপযোগী বাগান
 চুনতি বন্যপ্রাণী অভয়ারণ্য বিট
 চুনতি বন্যপ্রাণী অভয়ারণ্য রেস্ট্রিক্ট
 মৌজা: জঙ্গল, চুনতি, ব্লক: চুনতি
 বাগানের পরিমাণ: ২৪০ হেক্টর
 প্রজাতি: অর্জুন, বহেরা, আমলকি, ঢাকিজাম, গর্জন, গামার, কড়ই
 তেলপুর, চিকরাশি, বট, জারুল, শিমুল, তুমুর, বেল, বাঁশ ইত্যাদি।
 প্রকল্পের নাম: Pilot Programs identify effective
 measures to reduce the HEC/ IUCN/ SRCWP



CHUNATI WS HABITAT ENHANCEMENTS

KEY

-  Passage structures
-  Salt licks
-  Water tanks
-  Forage/fodder & forest corridor plantings

RAILWAY CONSTRUCTION MITIGATION and CONSERVATION STRATEGY GOALS Fasiakhali Wildlife Sanctuary

Railway Construction Mitigation and Conservation Strategy Goals	Primary and secondary goals by PA		
	CWS	FWS	MNP
Preserve Asian elephant landscape connectivity and minimize habitat fragmentation	Primary	N/A	N/A
Prevent Asian elephant and other wildlife mortality from train-wildlife collisions	Secondary	Secondary	Primary
Provide passage for other wildlife species and protect high biodiversity areas	Secondary	Secondary	Secondary
Resolve human elephant conflicts	Secondary	Primary	Secondary
Implement habitat enhancements to mitigate construction impact and promote elephant recovery	Secondary	Secondary	Secondary

RAILWAY CONSERVATION

MITIGATION

GOALS uary

Railway Conserv
Preserve and minim
Prevent As mortality fr
Provide pass protect high
Resolve huma
Implement hab construction im recovery



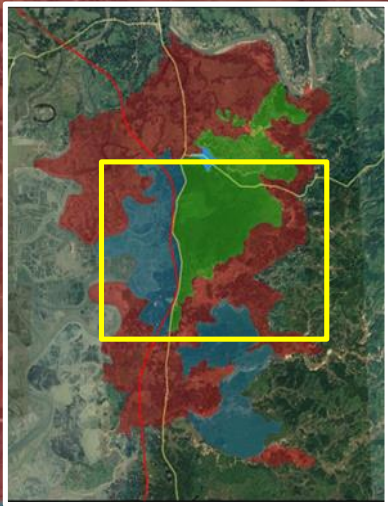
Government of Bangladesh
Ministry of Environment and Forests
Bangladesh Forest Department



Management Plan For Fasiakhali Wildlife Sanctuary

Bangladesh Forest Department
January 2015

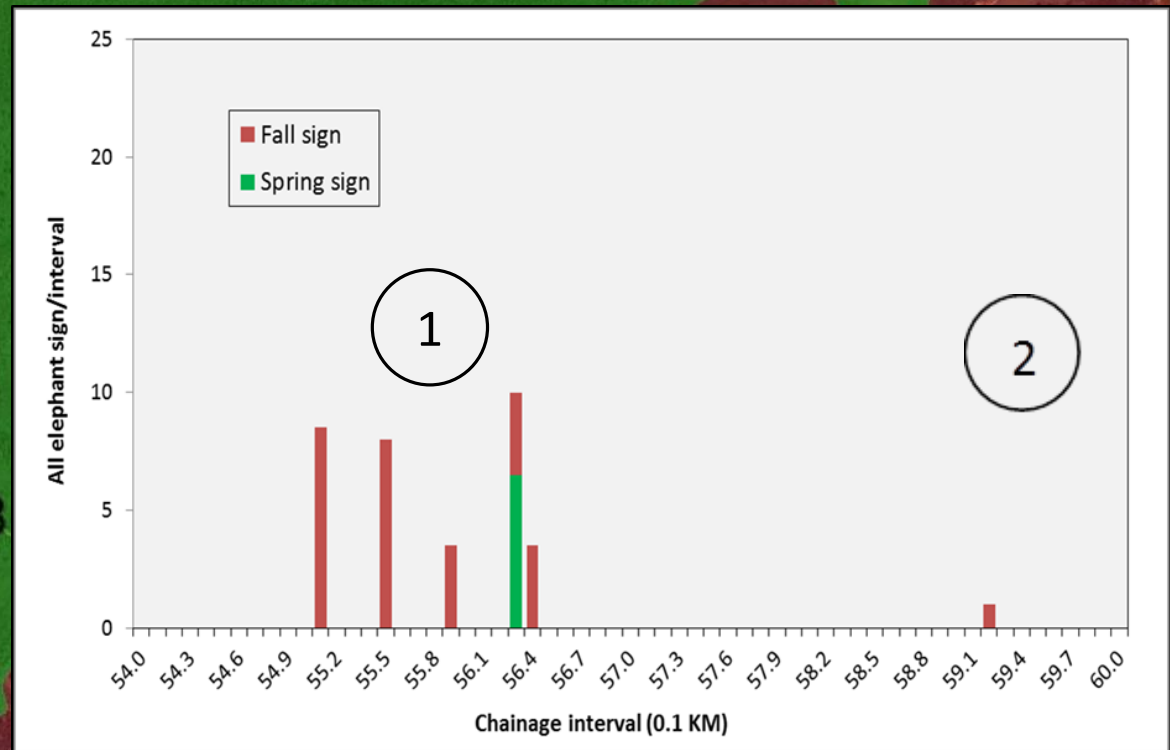
and secondary goals by PA	
FWS	MNP
N/A	N/A
Secondary	Primary
Secondary	Secondary
Primary	Secondary
Secondary	Secondary

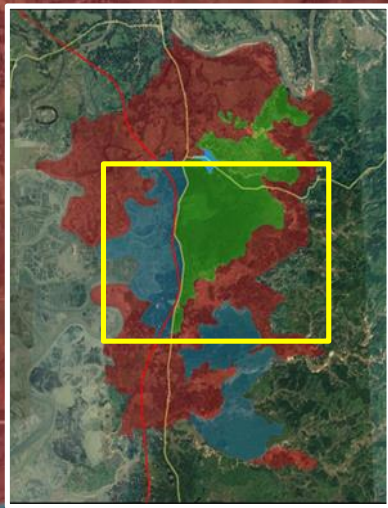


FASAIKHALI WS KEY TO SIGN LOCATIONS

-  Fall and Spring sign
-  Fall sign only
-  Spring sign only

ELEPHANT SIGN SURVEY





Km 55
Km 56
Km 57

FASAIKHALI WS KEY TO SIGN LOCATIONS

-  Fall and Spring sign
-  Fall sign only
-  Spring sign only

ELEPHANT SIGN SURVEY

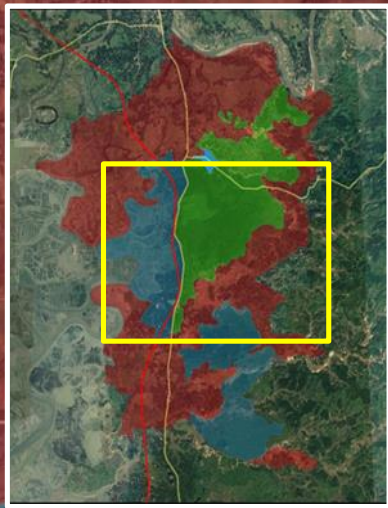
PRELIMINARY FASIAKHALI MITIGATION STRATEGY

Promote elephant passage across alignment:

- 2 underpasses 
- 1 overpass 
- ≈1.5 km wildlife funnel fence

Km 59

2



**FASAIKHALI WS
KEY TO SIGN LOCATIONS**

-  Fall and Spring sign
-  Fall sign only
-  Spring sign only

**PRELIMINARY
MITIGATION
STRATEGY**

**But was this the “context sensitive” thing to do
or just doing what transportation ecologists do?**

Km 55

Km 56

Km 57

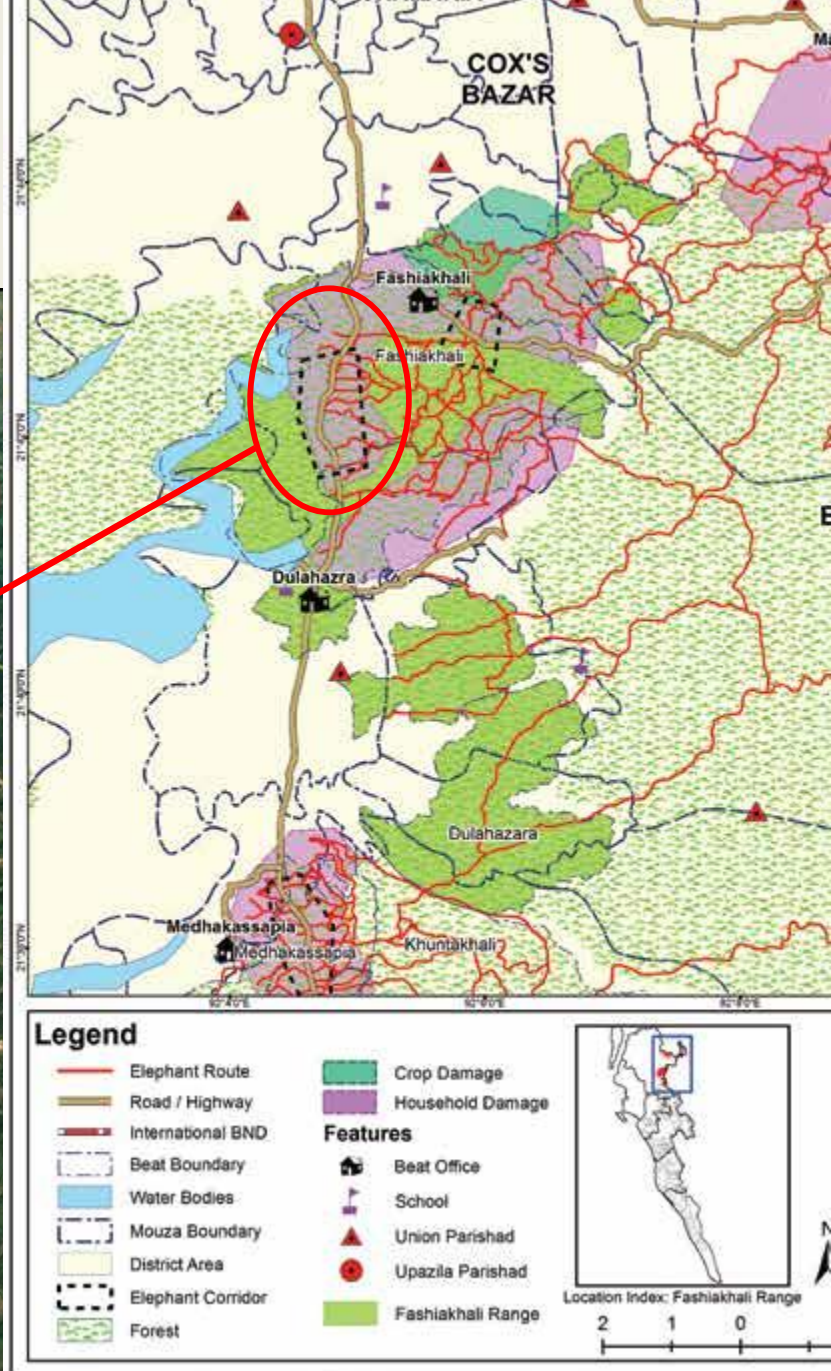
Km 58

Km 59

FASIAKHALI WILDLIFE SANCTUARY STRATEGY

Why build passage structures that would link no corridors and only perpetuate Human –Elephant Conflict beyond the new rail way?!

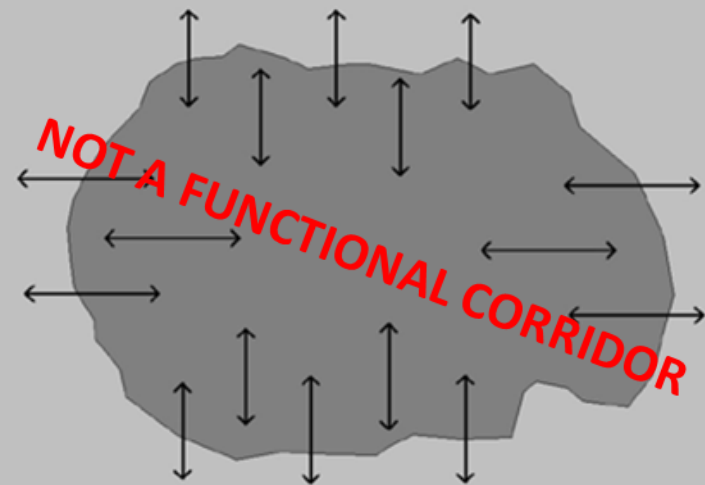
Rice paddy crop raiding



FASIAKHALI WILDLIFE SANCTUARY STRATEGY

Why build passage structures
that would link no corridors and
perpetuate Human –Elephant
Conflict?!

Rice paddy crop raiding



Legend

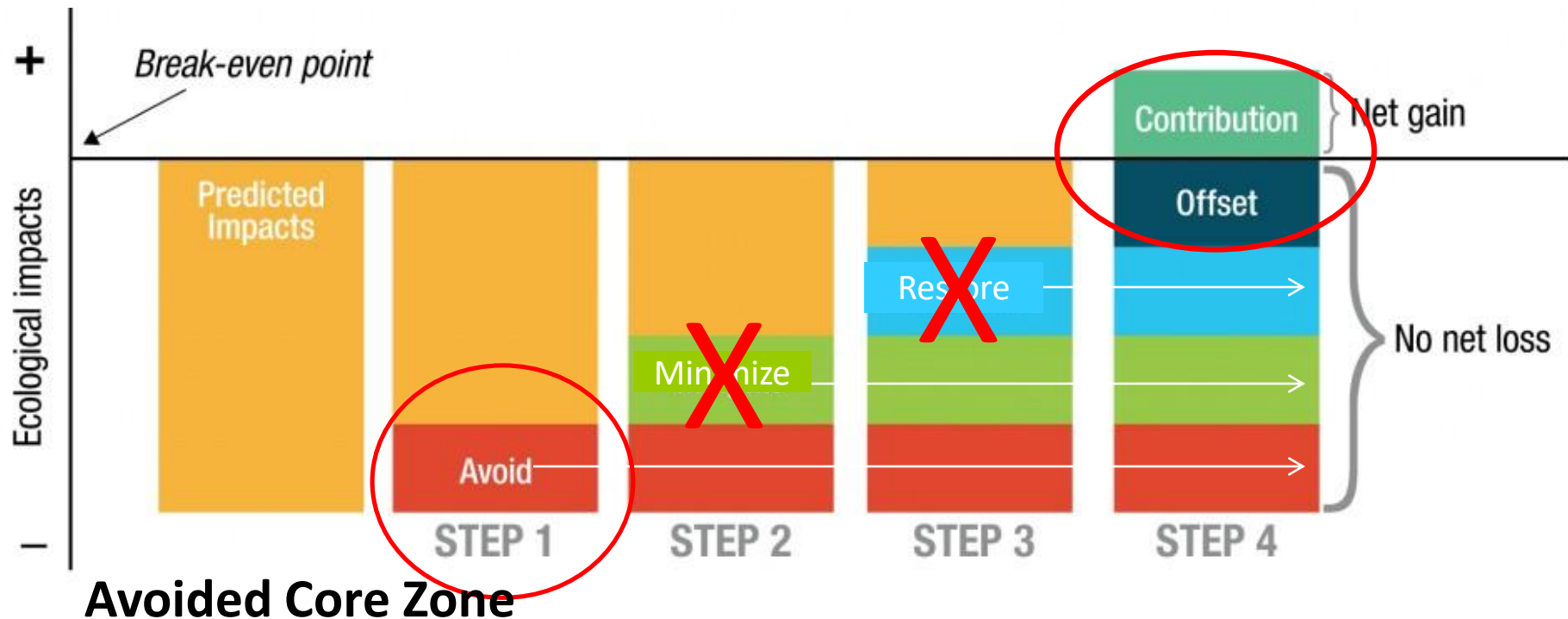
- | | |
|-------------------|-------------------|
| Elephant Route | Crop Damage |
| Road / Highway | Household Damage |
| International BND | Features |
| Beat Boundary | Beat Office |
| Water Bodies | School |
| Mouza Boundary | Union Parishad |
| District Area | Upazila Parishad |
| Elephant Corridor | Fashiakhali Range |
| Forest | |



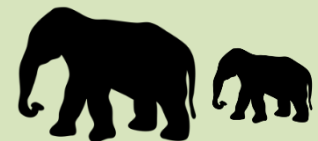
Location Index: Fashiakhali Range



MITIGATION HIERARCHY APPLICATION



Buffer Zone (Modified) habitats with railway alignment constitute **“CRITICAL HABITAT”** still needing to be fully mitigated – but how?

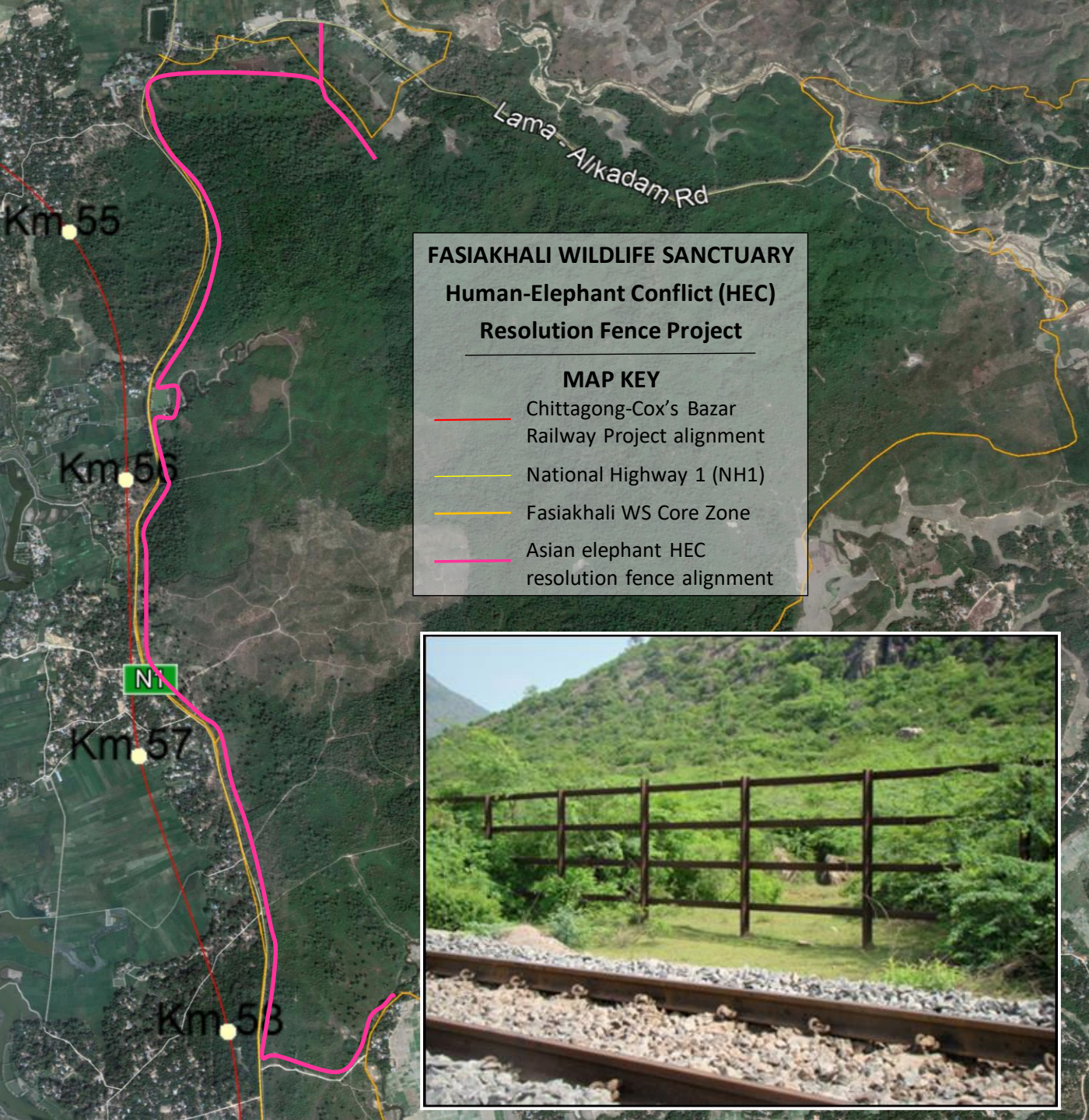


FASIAKHALI WILDLIFE SANCTUARY

HUMAN- ELEPHANT CONFLICT (HEC) RESOLUTION STRATEGY

Elephant Barrier Fence (≈5 km)

In lieu of passage
structures to
“nowhere” that
would have
perpetuated
HEC



FASIAKHALI WILDLIFE SANCTUARY

HUMAN-ELEPHANT CONFLICT (HEC) RESOLUTION STRATEGY

CORE ZONE HABITAT ENHANCEMENT

Enhance habitat and forage quality to address lost access to rice crops (>150 ha)



FASIAKHALI WILDLIFE SANCTUARY HABITAT ENHANCEMENTS

KEY

-  Salt licks
-  Water tank development
-  Forage/fodder & corridor enhancement plantings



RAILWAY CONSTRUCTION MITIGATION and CONSERVATION STRATEGY GOALS Medhkachapia National Park

Railway Construction Mitigation and Conservation Strategy Goals	Primary and secondary goals by PA		
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Resolve human elephant conflicts	Secondary	Primary	Secondary
Implement habitat enhancements to mitigate construction impact and promote elephant recovery	Secondary	Secondary	Secondary

ORIGINAL MITIGATION STRATEGY



KEY Medhkachapia National Park

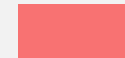
Railway alignment 

Management Zones:

Forest



Forest/Shrub



Agriculture



Settlement



Recommended
funneling treatment 

Overpass 

Km 65

ORIGINAL MITIGATION STRATEGY



Elephants
seeking
salt

Km 65

KEY Medhkachapia National Park

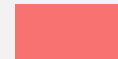
Railway alignment 

Management Zones:

Forest



Forest/Shrub



Agriculture



Settlement



Recommended
funneling treatment 

Overpass 

CONTEXT-SENSITIVE MITIGATION STRATEGY



KEY Medhkachapia National Park

Railway alignment ———

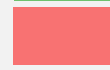
Elephant travel corridors 

Management Zones:

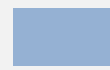
Forest



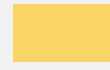
Forest/Shrub



Agriculture



Settlement



Recommended
funneling treatment



Elephant detection
Systems



Artificial
Salt Lick



Km 65

ASSESSMENT OF PROJECT IMPACTS

Potential Direct Mortality to Asian Elephants

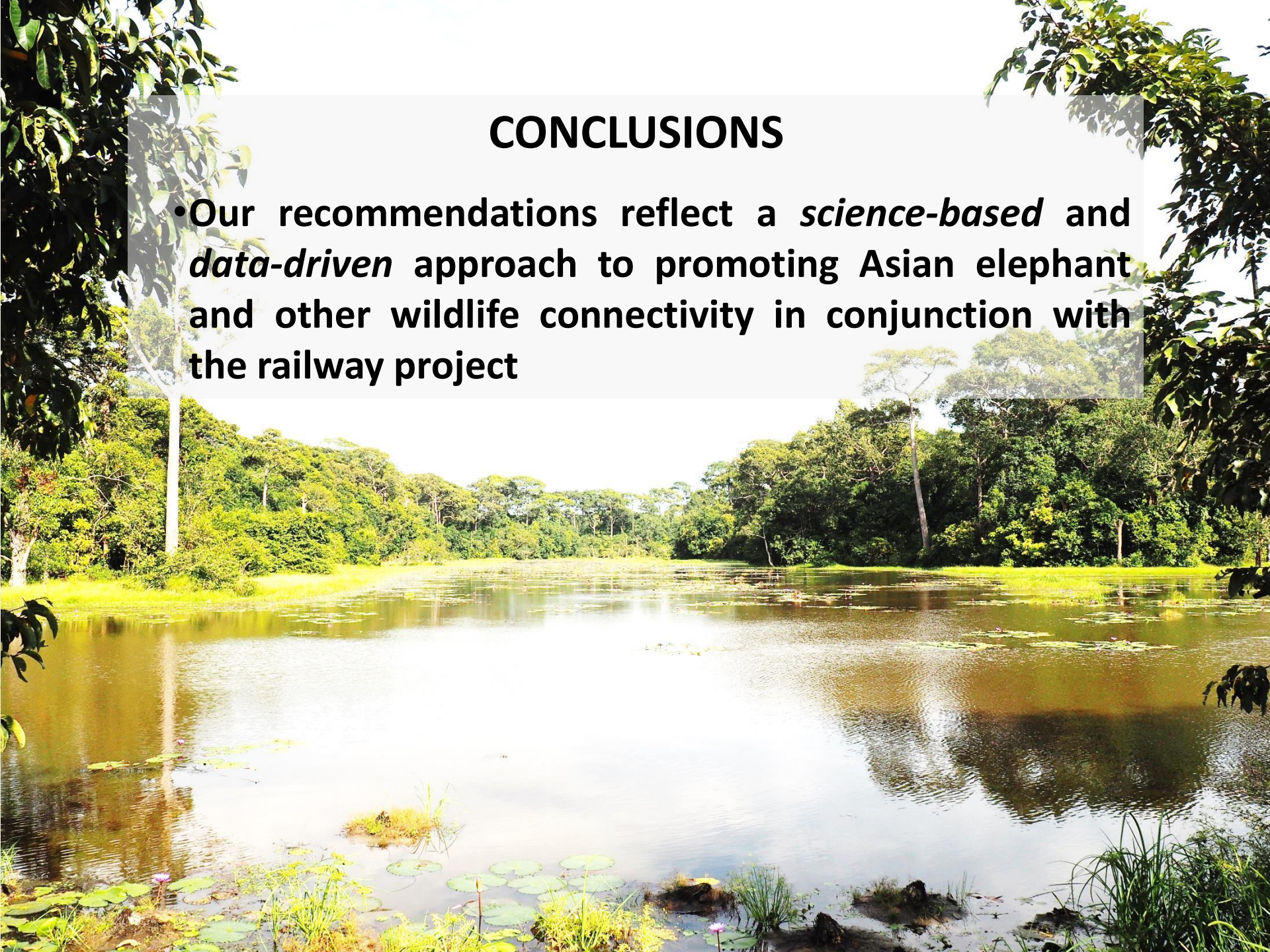
Greatest potential for Asian elephant mortality from trains - length and depth of cut slope areas where animals become trapped and vulnerable to collisions – **mitigate by fencing with at-grade crossings at ends (and sensor technology to alert trains)**

Protected area	Linear distance of cut slopes by depth to railway formation				Length (%) to be fenced
	<2 m deep cuts	2–8 m deep cuts	>8 m deep cuts	PA total (% of total slopes)	
CWS	570 m	500 m	900 m	1,970 m (69.1%)	1,170m 60%
FWS	160 m	240 m	0	400 m (14.0%)	400 m (100%)
MNP	60 m	260 m	160 m	480 m (16.8%)	500 m (100%)
All	790 m	1,000 m	1,600 m	2,850 m	1,670 m (73%)



CONCLUSIONS

- Our recommendations reflect a *science-based* and *data-driven* approach to promoting Asian elephant and other wildlife connectivity in conjunction with the railway project



CONCLUSIONS

Our recommendations reflect a *science-based* and *data-driven* approach to promoting Asian elephant and other wildlife connectivity in conjunction with the railway project

- These recommendations constitute a balanced and *cost-effective* ($\approx 0.7\%$ of total project cost) approach to preserving Asian elephant connectivity and biodiversity

CONCLUSIONS

- Our recommendations reflect a *science-based* and *data-driven* approach to promoting Asian elephant and other wildlife connectivity in conjunction with the railway project
- These recommendations constitute a balanced and *cost-effective* approach to preserving Asian elephant connectivity and biodiversity
- This is our *best opportunity* to implement a comprehensive, context-sensitive approach to preserving biodiversity and resolving HEC that will yield long-term benefit

MANY THANKS FOR SUPPORT FROM:

- **Bangladesh Railway**
- **Bangladesh Forest Department**
- **Co-Management Committees & Community Protection Groups**
- **Wildlife Institute of India**

QUESTIONS?

THE END

21/01/2015 20:33

SUMMARY OF PROJECT PROGRESS

Goal 3. Provide recommendations for locations and design of elephant passage structures to promote passage and landscape connectivity.

Passage structure locations determined from:

Biological Factors

- ✓ Elephant crossings in the IUCN Elephant Route Study (2014)
- ✓ Elephant crossings and corridor distribution from 2017 assessment
- ✓ Spacing of potential passage structures to promote passage

Engineering Factors

- ✓ Sites suitable for cost-effective underpasses based on modification of *planned* drainage culverts and bridges
- ✓ Suitability of terrain for overpasses relative to existing ground levels versus planned railway formation levels (using *cut-fill profiles*)

ROLE OF FUNNELING TREATMENTS

- Funneling treatments (fencing & alternatives) to guide elephants to passage structures are critical to successful use and to prevent at-grade crossings and collisions along ***highest elephant use*** stretches
- Especially warranted with multiple, close passage structures
- Recommended funneling treatments (*minimum*):
 - ≈**3.0 km** in Chunati WS – 2.0 km linking recommended underpass and overpass (KM 27.500 – 29.500) & 1.0-km stretch linking crossing trail at KM 25.860 to underpass at KM 26.270 – 13% of corridor
 - ≈**1.8-km stretch** of Fasiakhali WS linking 2 recommended underpasses (KM 55.000 – 56.800) – 16% of corridor
- Assumes elephant-detection technology is used to prevent collisions elsewhere
- Future monitoring may identify other areas needing treatment



SUITABLE VS. RECOMMENDED ELEPHANT PASSAGE STRUCTURES

Protected area	Elephant Passage Structures			
	Overpasses		Underpasses	
	Suitable sites	Minimum recommended	Suitable sites	Minimum recommended
Chutani WS	5	1-2	6 (2 bridges)	2-3 (1 bridge)
Fasiakhali WS	1	0	3	2
Medhkachapia NP	0	0	2	1
TOTAL	6	1-2	11	5-6

FASIAKHALI WILDLIFE SANCTUARY

SIGN SURVEY ELEPHANT CROSSINGS

- While Chunati
 - ✓ 1 *trail* crossing in forested habitat
 - ✓ 4 *crop raiding* crossings
 - ✓ 2 crossings (40%) confirmed in **both** April & November surveys (inconsistency)
- Confirmed use of IUCN study crossings:
 - ✓ 1 of 2 “Active” crossings
 - ✓ 0 of 1 “Seasonal” crossings
- Crossings within one zone (**KM 55.450 – 56.280**) occur in a sheet fashion where the railway corridor abuts the Core Zone (where nearly all documented crop damage occurred <150 m from highway)

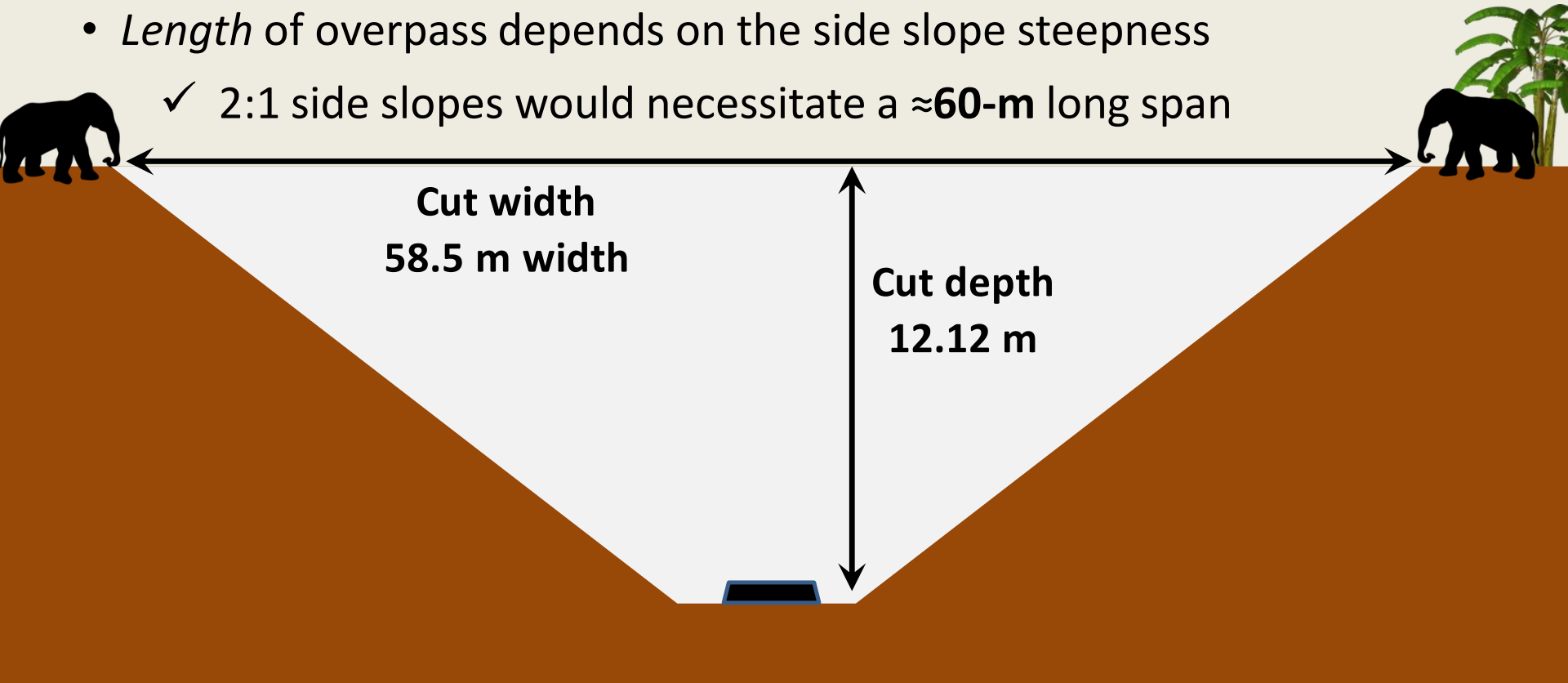


DESIGN CONSIDERATIONS FOR RECOMMENDED ELEPHANT UNDERPASSES

Protected area	Culvert or Bridge ID	Structure dimensions			Recommended modifications as an effective underpass
		Height (m)	Width (m)	No. cells/spans	
Chutani WS	Culvert 39	3.5	10	2 cells	Widen to at least 15 m (marginal height)
Chutani WS	Culvert 41	4.1	3	1 cell	Widen to at least 15 m with metal plate arch or bridge
Chutani WS	Bridge 43	7.4	30	1 span	Accommodate elephant passage aside stream course
Fasiakhali WS	Culvert 66	5.0	10	2 cells	Widen to at least 15 m with metal plate arch or bridge
Fasiakhali WS	Culvert 68	4.8	15	3 cells	Use metal plate arch or bridge
Fasiakhali WS	Culvert 69	4.3	15	3 cells	Use metal place arch or bridge
Medhkachapia NP	Culvert 85	4.5	10	2 cells	Widen to at least 15 m with metal plate arch or bridge

DESIGN CONSIDERATIONS FOR RECOMMENDED ELEPHANT OVERPASS

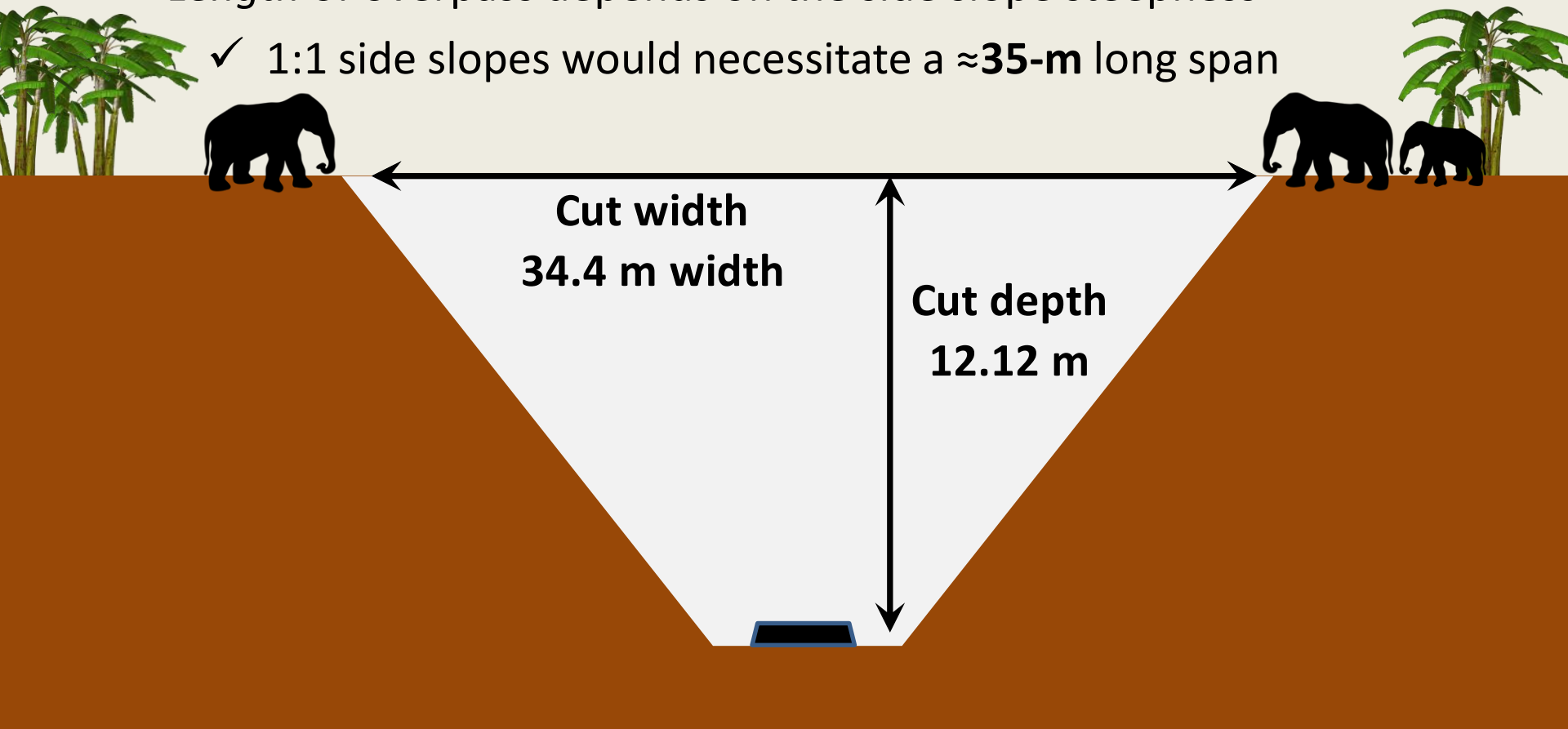
- Minimum recommended *width* for Asian elephant overpasses is 40 m but can be “hourglass” shaped
- *Length* of overpass depends on the side slope steepness
 - ✓ 2:1 side slopes would necessitate a **≈60-m** long span



WITH 2:1 SIDE SLOPES

DESIGN CONSIDERATIONS FOR RECOMMENDED ELEPHANT OVERPASS

- Minimum recommended *width* for Asian elephant overpasses is 40 m but can be “hourglass” shaped
- *Length* of overpass depends on the side slope steepness
 - ✓ 1:1 side slopes would necessitate a **≈35-m** long span



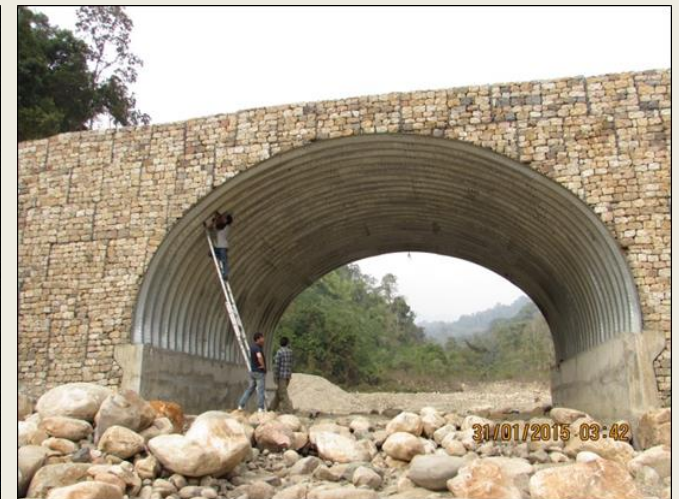
WITH 1:1 SIDE SLOPES

BUT WILL AN OVERPASS FOR ELEPHANTS WORK HERE?

- No elephant overpasses yet constructed anywhere in Asia or Africa – a first for the World! And no wildlife overpasses have been constructed anywhere in Asia
- However, when passage structures are designed to meet the needs of the target species, they invariably are successful (though sometimes requiring a “learning curve” period)
- *Underpasses* have been readily used by Asian elephants in China and Bhutan (below), especially where they are located along established corridors/trails (as is being done here). Where structures have **not** been successful in India and Nepal, they were not suitable - India's “underpass” was a **tunnel** (5 m wide × 5 m high × 111 m long).



V_00017 Elephants x 5 Samrang.M4V



BUT WILL AN OVERPASS FOR ELEPHANTS WORK HERE?

- Elephants in India have been documented using bridges (Joshi and Singh 2009) – there's absolutely **no** reason they won't readily use a well-designed and implemented overpass in Bangladesh!



BUT WILL AN OVERPASS FOR ELEPHANTS WORK HERE?

BIGGER CONCERNS:

- *Timing* of overpass construction at a crucial elephant movement corridor, and short- and long-term impact due to protracted railway construction activities
- Impact of slope excavation and creation of a deep barrier to movement before an overpass would normally be constructed – elephants could abandon use of that portion of Chunati Wildlife Sanctuary

POSSIBLE SOLUTION:

- Construct the overpass **before** any other construction takes place in the sanctuary, including before excavation occurs
- Establish elephant use of the overpass before any other construction occurs – may require habitat enhancements and/or erection of funneling treatments (e.g., fencing or alternative)
- Once use established, excavation under the constructed overpass can commence, during a restricted construction window (daytime hours)
- Would be a burden and make construction challenging, but is warranted

CHITTAGONG-COX'S Bazar RAIL PROJECT

Biodiversity Assessment Goals

Goal 1. Conduct a year of biodiversity assessment.

Goal 2. Assess spatial distribution of Asian elephants and compare to IUCN Elephant Route Study.

We will defer this goal until elephant passage structure recommendations are evaluated and the biodiversity assessment is completed.

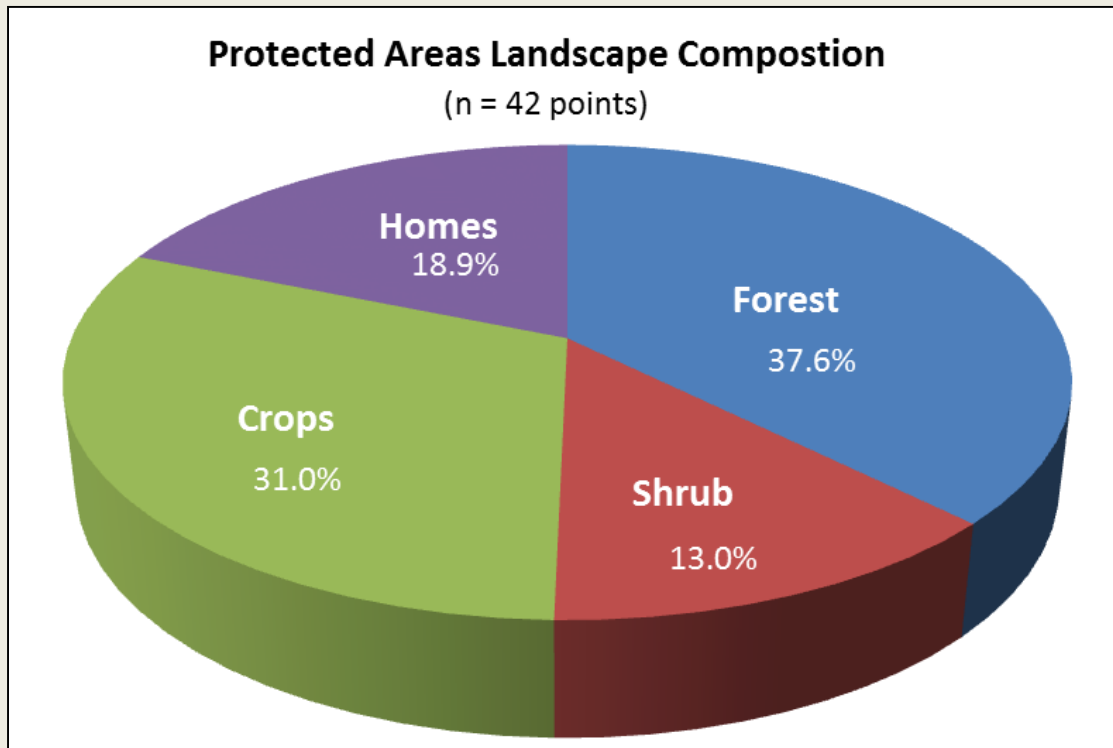
This information will be integrated into an elephant management strategy this spring, with a workshop to be held in March or April 2018.

DESIGN CONSIDERATIONS FOR RECOMMENDED ELEPHANT UNDERPASSES



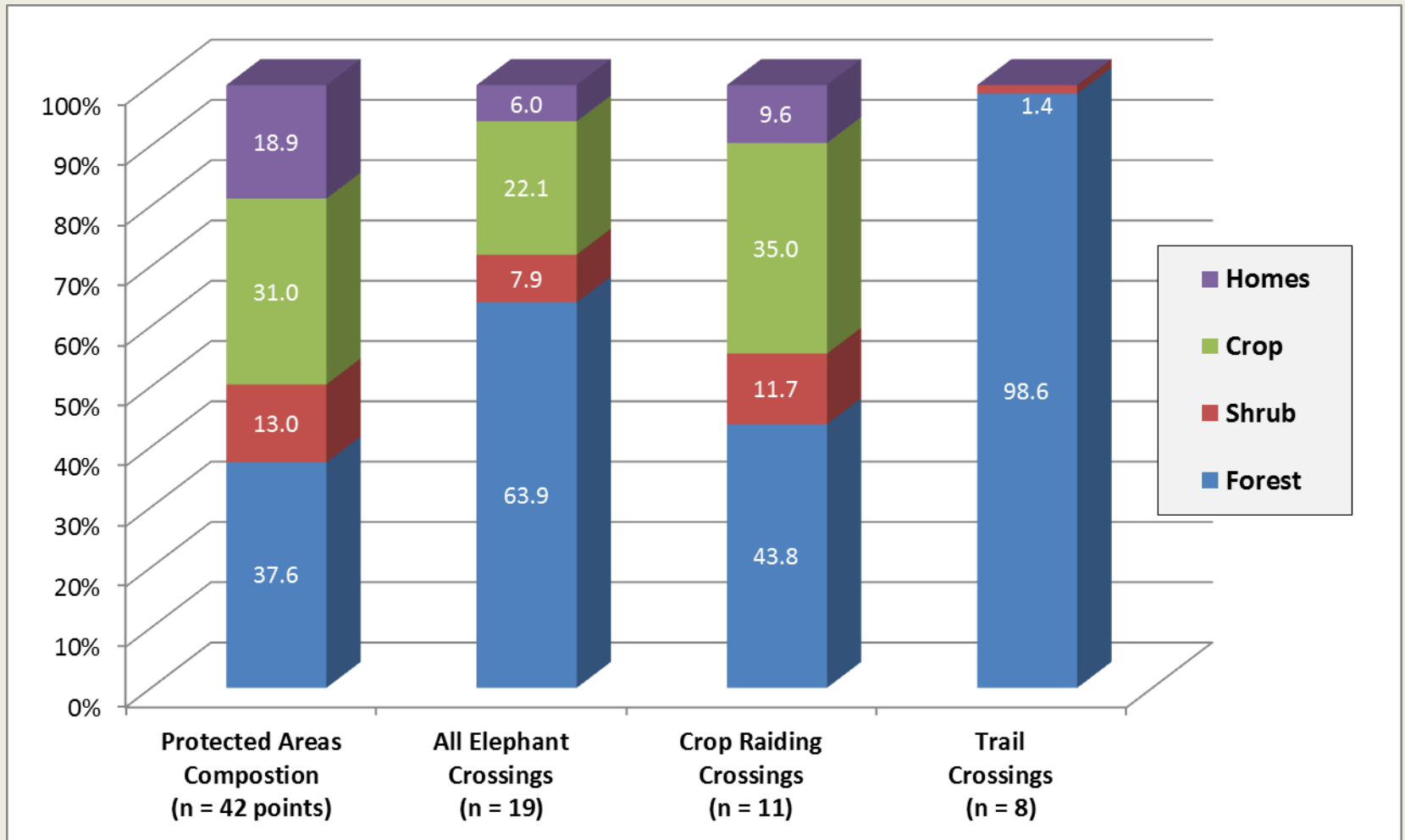
NOVEMBER 2017 HABITAT ASSESSMENT

- Assessed landscape habitat composition (within 4 categories) every 0.5 km along survey transects to:
 - ✓ Prioritize sites for overstory tree and understory inventory (next week)
 - ✓ Quantify elephant corridors
 - ✓ Compare to elephant crossing locations and assess habitat preferences

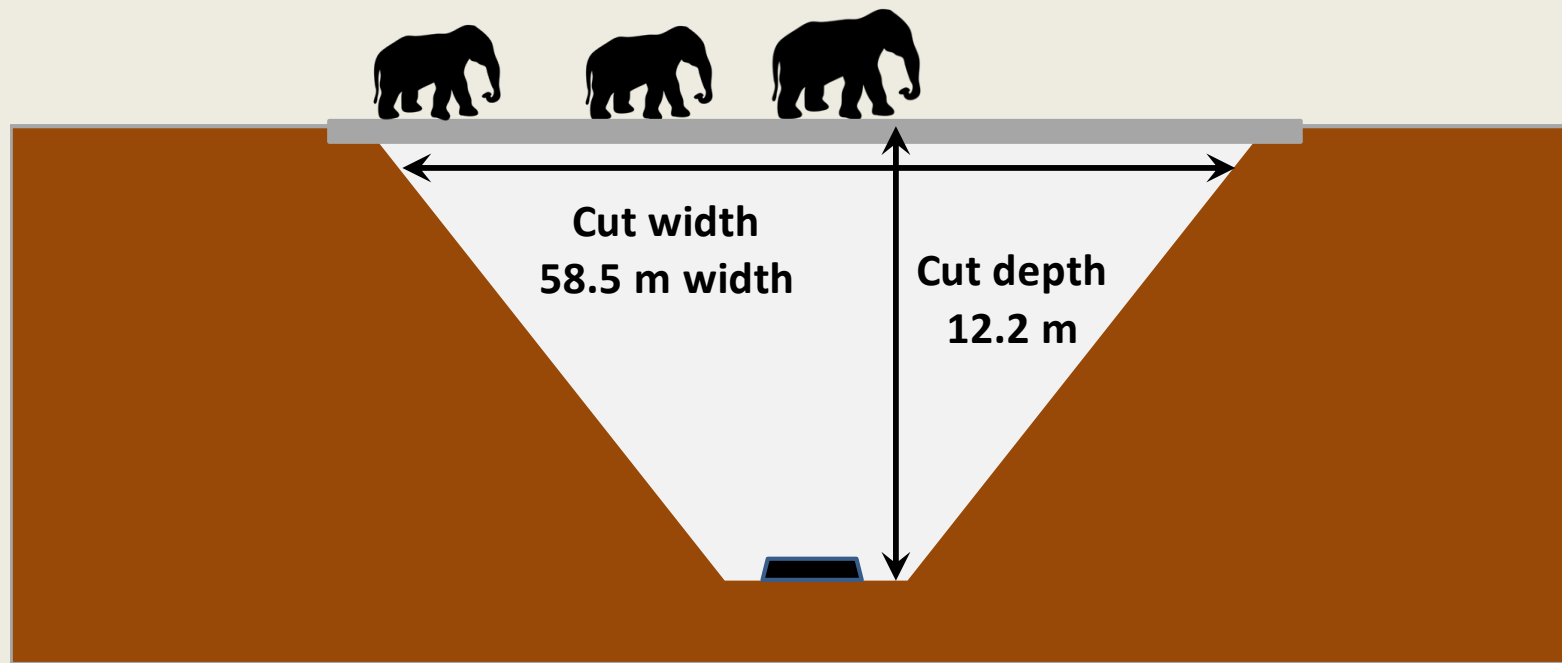


LANDSCAPE HABITAT COMPOSITION

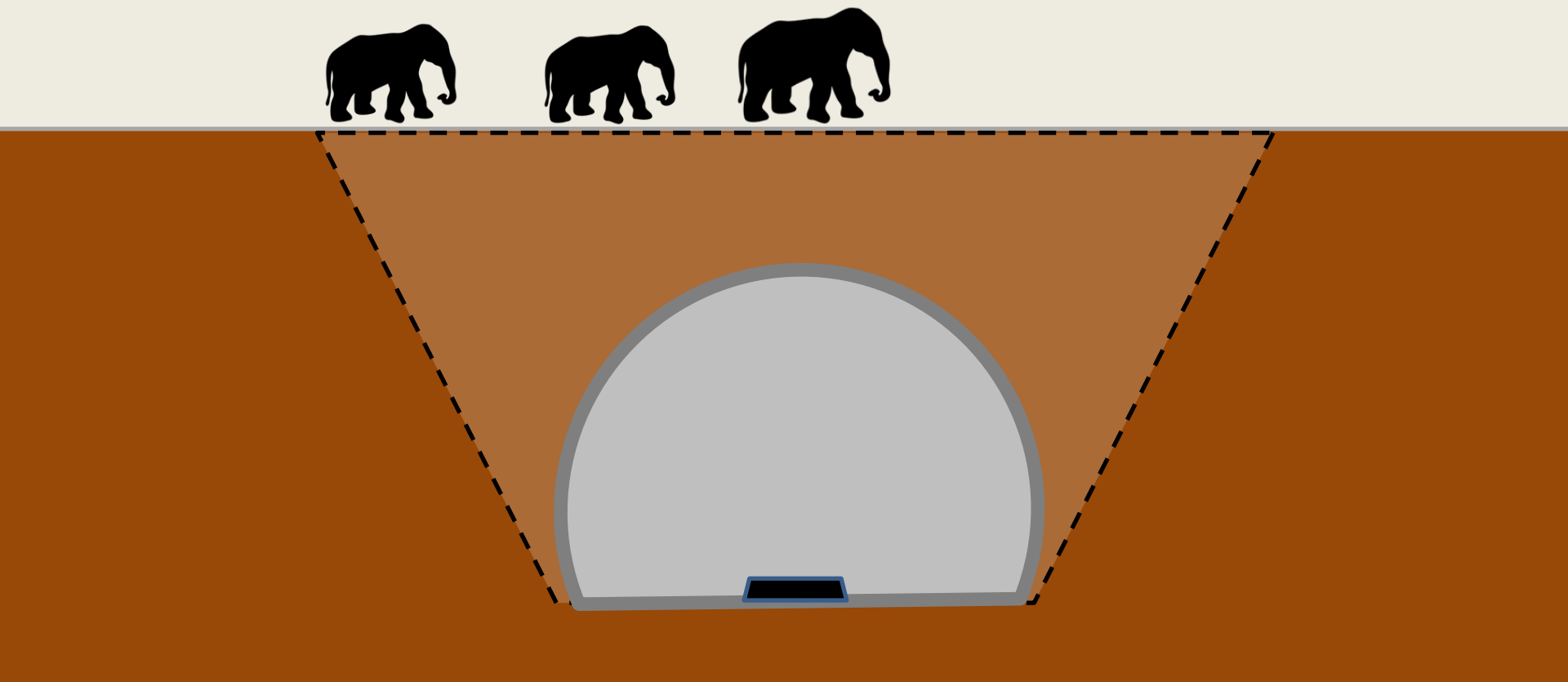
Comparison of Protected Areas To Elephant Crossings



- Elephant use of trail/corridor crossings – strong preference for forests
- Crop raiding sites – similar to overall protected area composition



WITH 2:1 SIDE SLOPES



WITH 2:1 SIDE SLOPES