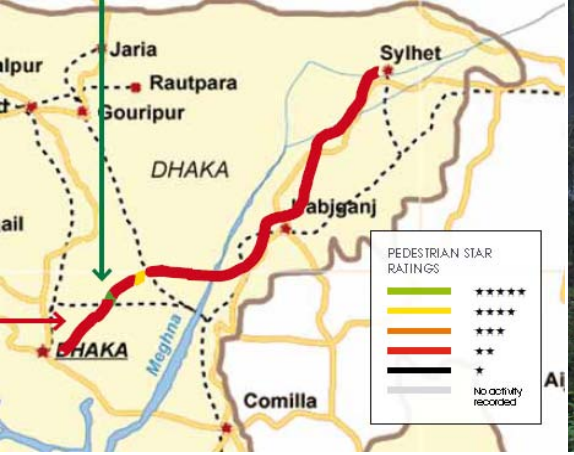

Risk Mapping Based on Structured Data

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Advisor IRF (India Ch)

IRF

INDIA CHAPTER

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Structure of Presentation

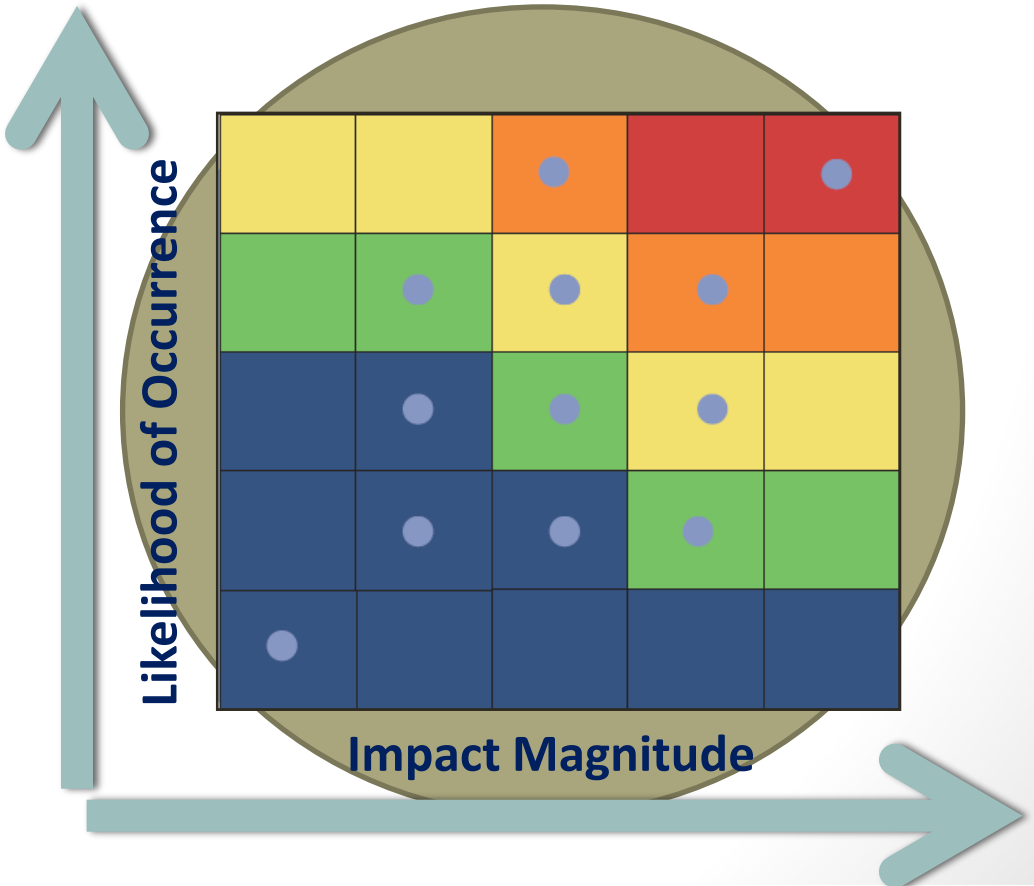
1. Background
2. Traditional approach of risk mapping based on historic crash data
3. Limitations of traditional approach
4. Relating the risk with infrastructure – where crashes are likely to occur
5. Crash data in developing countries
6. RADaR for comprehensive crash database

What is risk mapping?

- Risks are unanticipated events that may cause loss of property or life.
- Risk mapping is the process of identifying, quantifying and prioritising the risks that may interfere with the achievement of objectives of any organization.
- Its aim is to arrive at a clear set of action plans that improve risk management controls, in areas where these are necessary and help the management of resources.

Road Safety and Risk Mapping

- Risk mapping depicts where road users are likely to be killed or seriously injured on a road network and where their crash risk is more



Methods of Risk Mapping

1. Traditional approach of risk mapping based on historic crash data (A Reactive Approach)
2. Relating the risk with infrastructure – where crashes are likely to occur (A Proactive/Predictive Approach)
   - Road Safety Audit/Assessment – manual method
   - Road Assessment Programs – automatic method

RISK MAPPING BASED ON HISTORIC CRASH DATA

Crash Data

1. Minimum Data
   I. Crash identification (a unique number-based system)
   II. Time (the date, hour, minute, day of week)
   III. Location (to create GIS enabled database)
   IV. Crash type
   V. Vehicles involved (number, type)
   VI. Crash consequences (fatalities within 24 hours/30days, injuries, material damage)
2. Road and Traffic Data
3. Additional Data

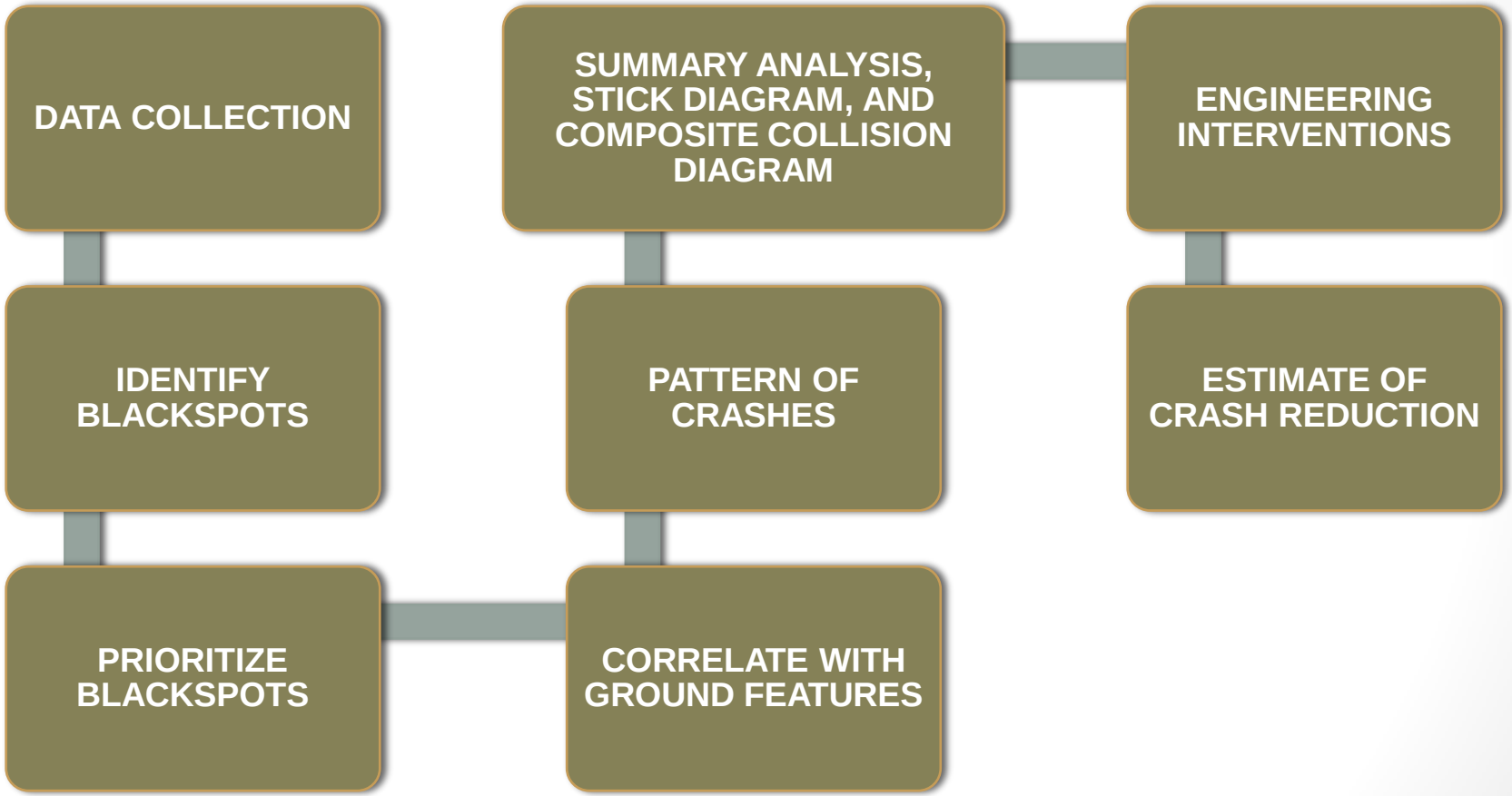
Crash Data

1. Minimum Data
2. Road and Traffic Data – to relate crashes with the site condition
   - Geometric details of crash site
   - Specific places/objects – pedestrian crossing, rail crossing, bridge, tunnel, bus/tram stop, parking place, etc.
   - Road surface condition
   - Delineation at the site
   - Roadside hazards
   - Visibility conditions
   - Weather conditions
   - Traffic control
   - Position of crash – travel direction, location - traffic lane, shoulder, roadside, etc.
   - Main causes of crash – speeding, overtaking, right of way, etc.
3. Additional Data

Crash Data

1. Minimum Data
2. Road and Traffic Data
3. Additional Data
   - Driver details
   - Impairment of the driver
   - Use of restraint devices
   - Condition and behavior of the pedestrian involved in crash
   - Vehicle license plate number
   - Brand make of vehicle
   - Vehicle operator (private, commercial, public transport…)
   - Emergency service involvement

Risk Mapping based on Historic Crash Data



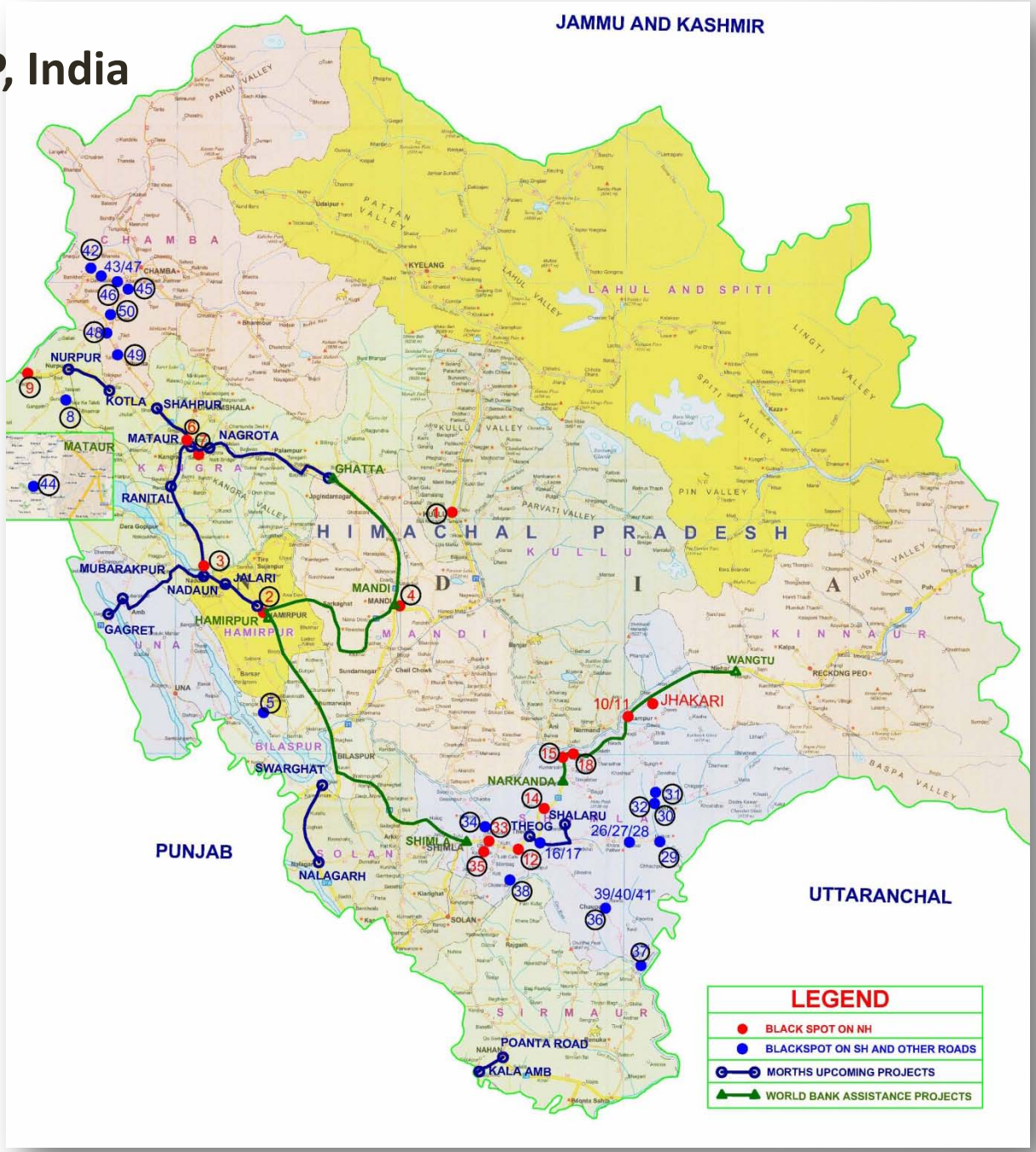
Risk Mapping based on Historic Crash Data

- Detailed crash data for minimum past 3-years
- Identification of sites with frequent crashes
- Prioritization of such sites based on some well defined criteria
- Crash data analysis including identification of crash pattern, preparation of collision type and collision diagram, etc.
- Recommend engineering interventions

Case study – Blackspot improvement for HP, India

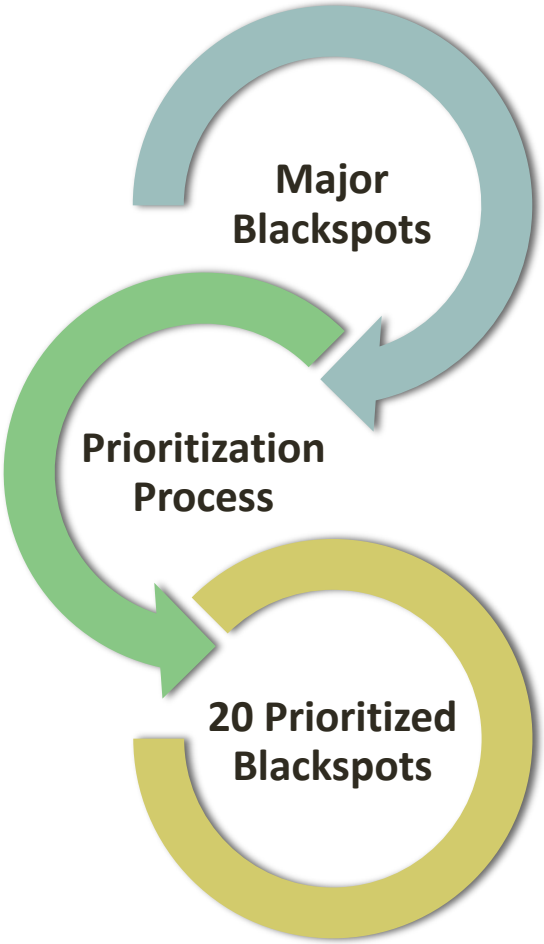
- Screening of 500+ frequent crash sites based on severity index
  - Fatal crash – 10 points
  - Grievous injury crash – 6 points
  - Minor injury crash – 3 points
- Each site is assigned points based on the above criteria and top 50 sites are chosen for further prioritization

50 blackspots in HP, India

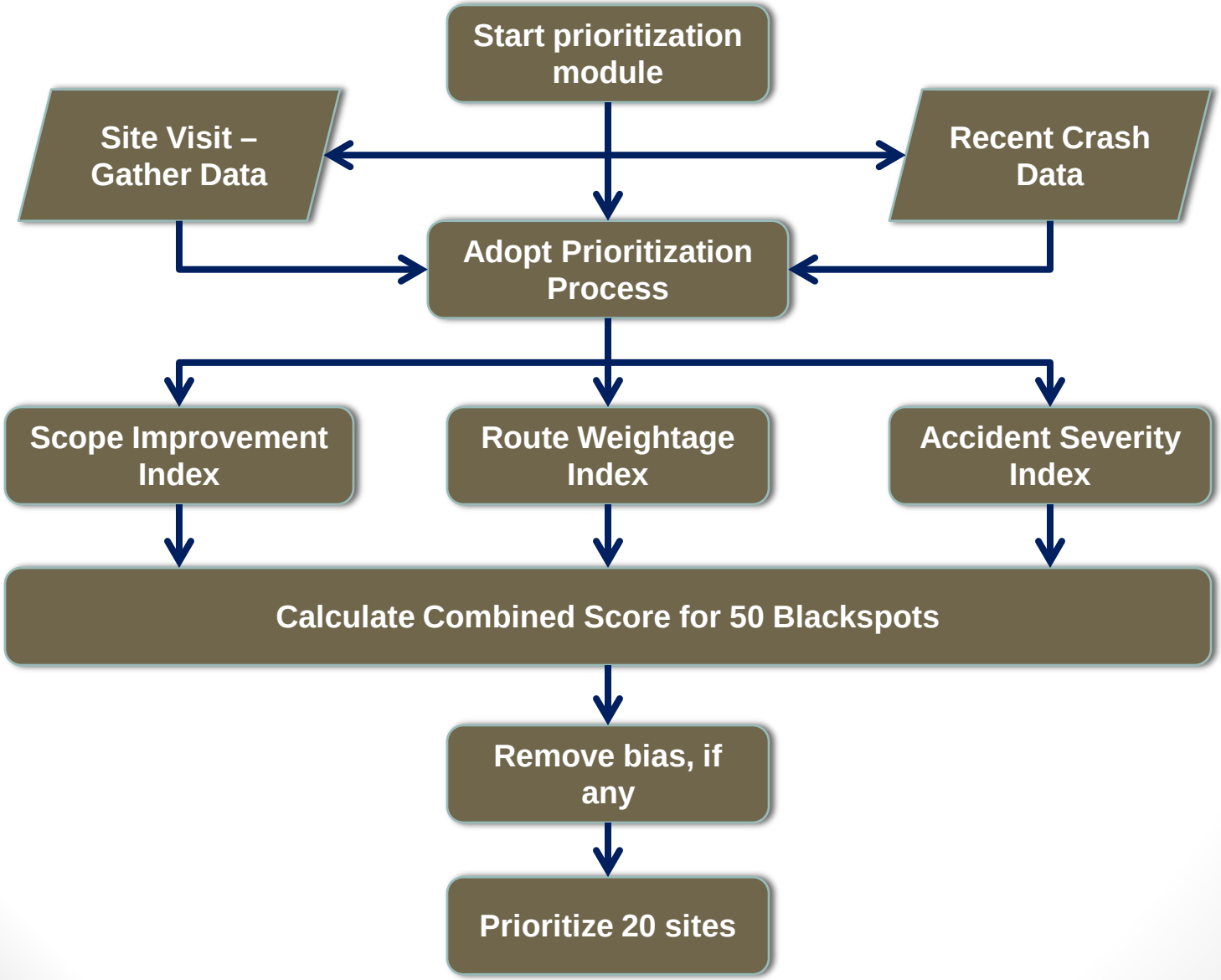


Prioritization of blackspots

- A quantitative framework for prioritization based on indices with a scale of score, in order to perform the prioritization in a structured manner



Process of Blackspot Prioritization



Indices for Quantitative Assessment

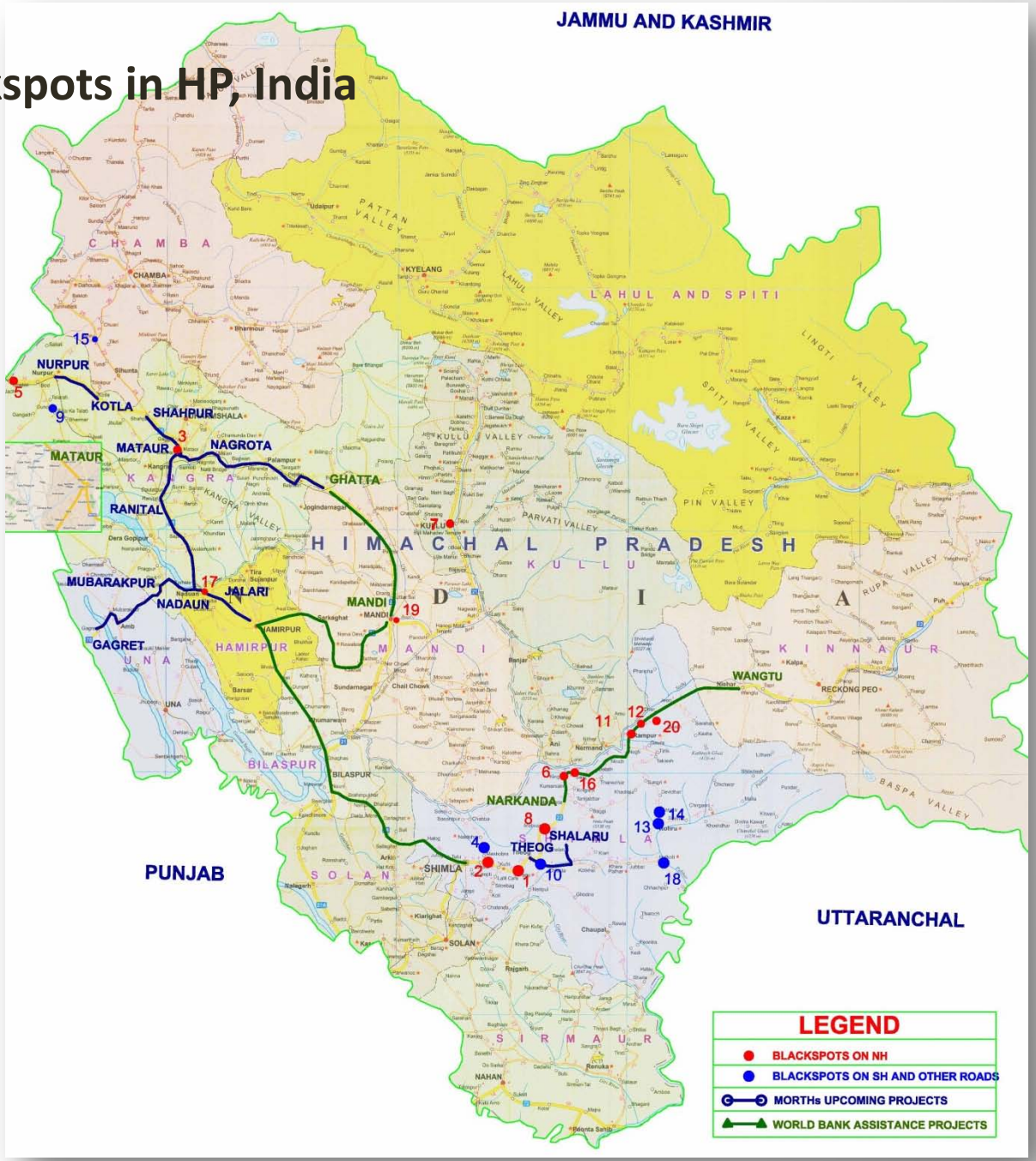
1. Scope of Improvement Index
   - Based on road geometry, condition, and perceived danger
2. Route Weightage Index
   - Based on the strategic importance of the route
3. Severity Index
   - Based on severity of crash casualty

Scope of Improvements	Score
High	30
Medium	20
Low	10
Nil	0

Road classification	Score
NH	20
SH	15
MDR	10
VR	5

Crash classification	Score
Fatal crash	10
Grievous injury crash	6
Minor injury crash	3
Crash classification	Score

20 Prioritized blackspots in HP, India



Limitations of Risk Mapping based on Crash Data

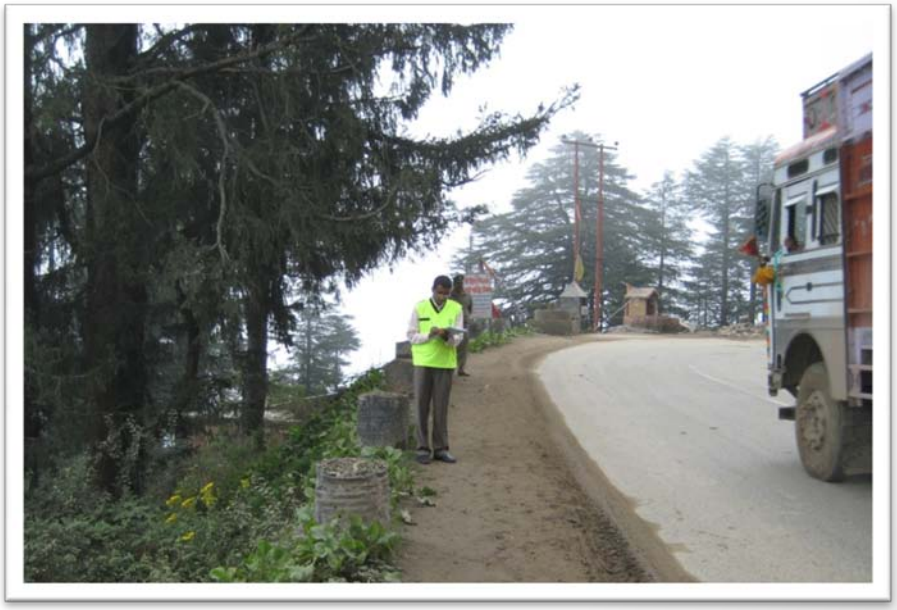
- Lack of adequate crash data (In Australia only 2/3rd of serious injury crashes are recorded in the crash database)*
- Even developed nations may not have comprehensive crash data (New Zealand crash data revealed that more than half of fatal crashes occurred at locations where no other crashes had occurred in the previous five years)*
- If attention is focused only on frequent crash sites, the opportunity to prevent a large proportion of crashes might be missed !

* **Source:** *"Why do we need to take a risk assessment based approach in road safety?",* Philip Roper and Blair Turner, ARRB Group, Australia

RISK MAPPING BASED ON AUDIT/ ASSESSMENT OF INFRASTRUCTURE

Road Safety Audit (RSA)

- RSA is formal examination of an existing or a new road or a traffic project
- An independent RSA team reports on the crash potential and safety performance
- It can be an important input to design process

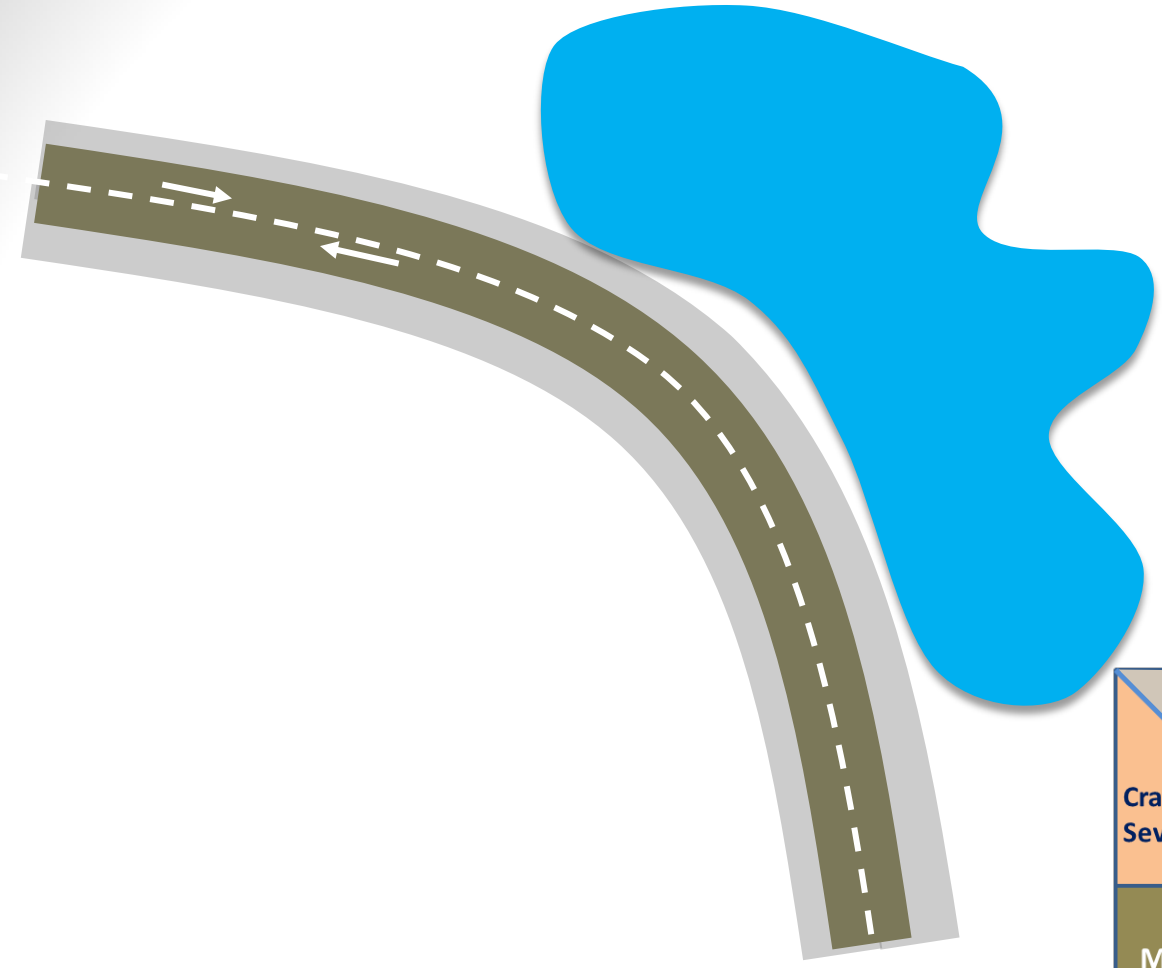


Road Safety Audit

- Audit of road infrastructure parameters by visual inspection
  - Geometric Design
  - Road Surface Characteristics
  - Road Markings and Delineation
  - Road Signs, Street Furniture and Appurtenances
  - Provision for VRUs
  - Traffic Management
  - Road Works and Maintenance
- Identification of critical sites/stretches where crash risk is high

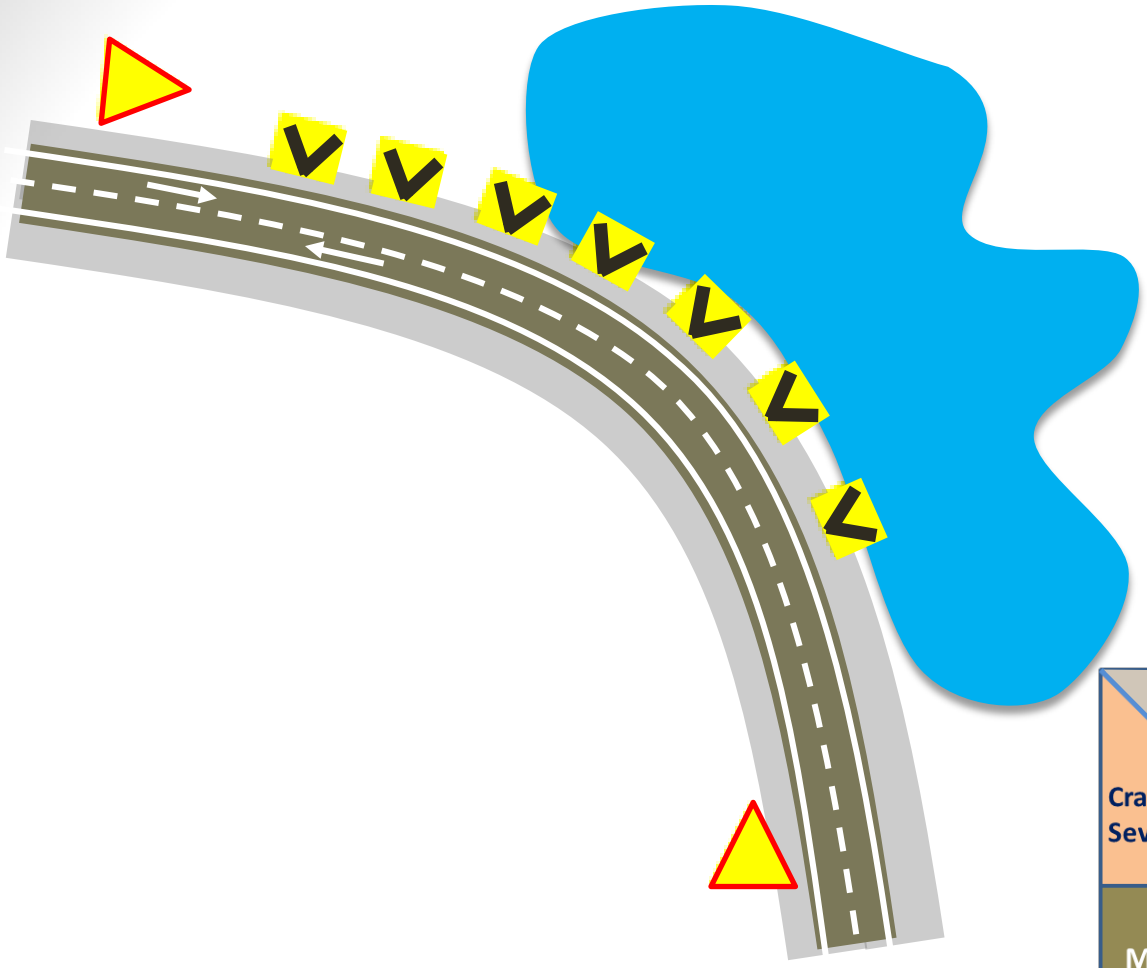
What is Risk?

Frequency / Severity	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low



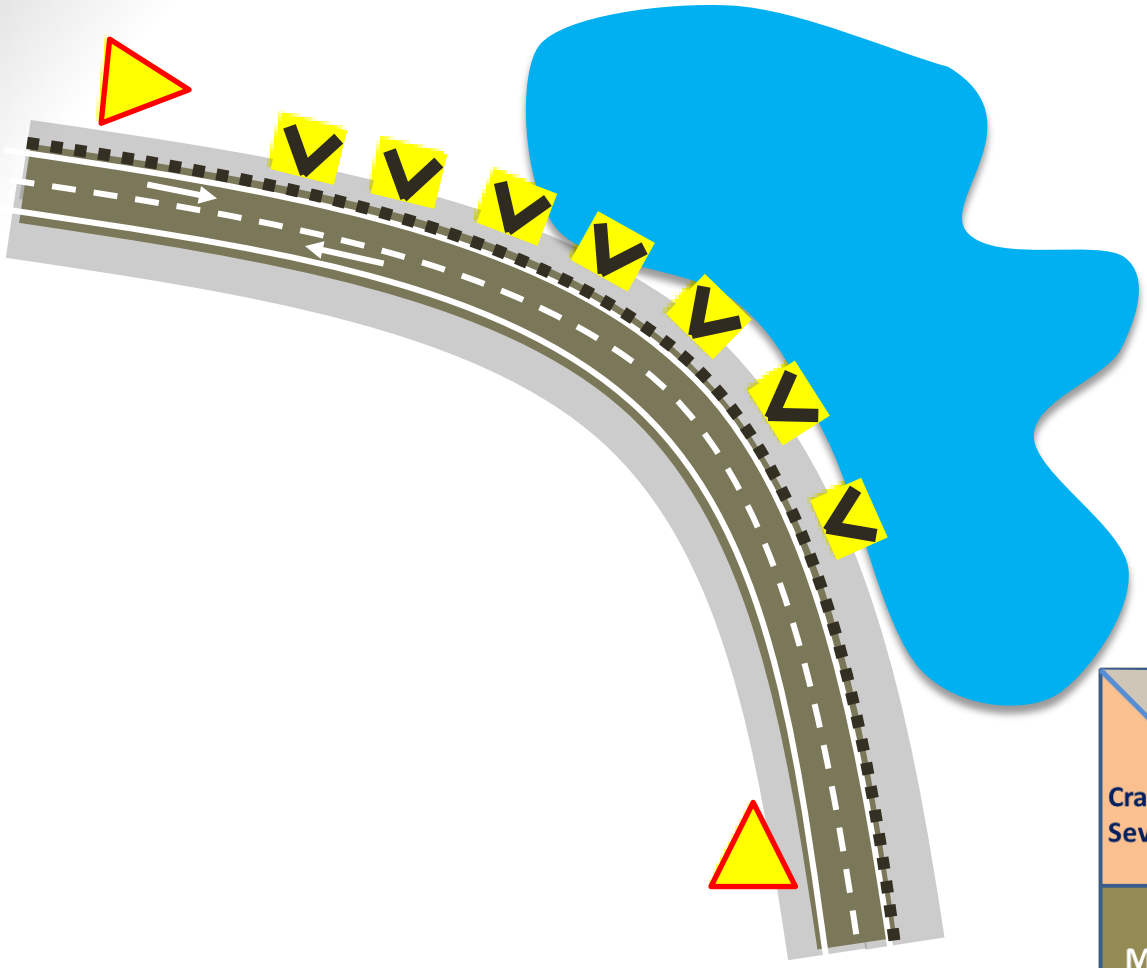
Crash Severity \ Frequency	Low	Medium	High
Minor Injury			
Major Injury			
Fatal			●

1. Sharp curvature on high embankment
2. Pond on outer edge
3. No delineation and warning signage
4. No edge protection



Crash Severity \ Frequency	Low	Medium	High
Minor Injury			
Major Injury			
Fatal		●	

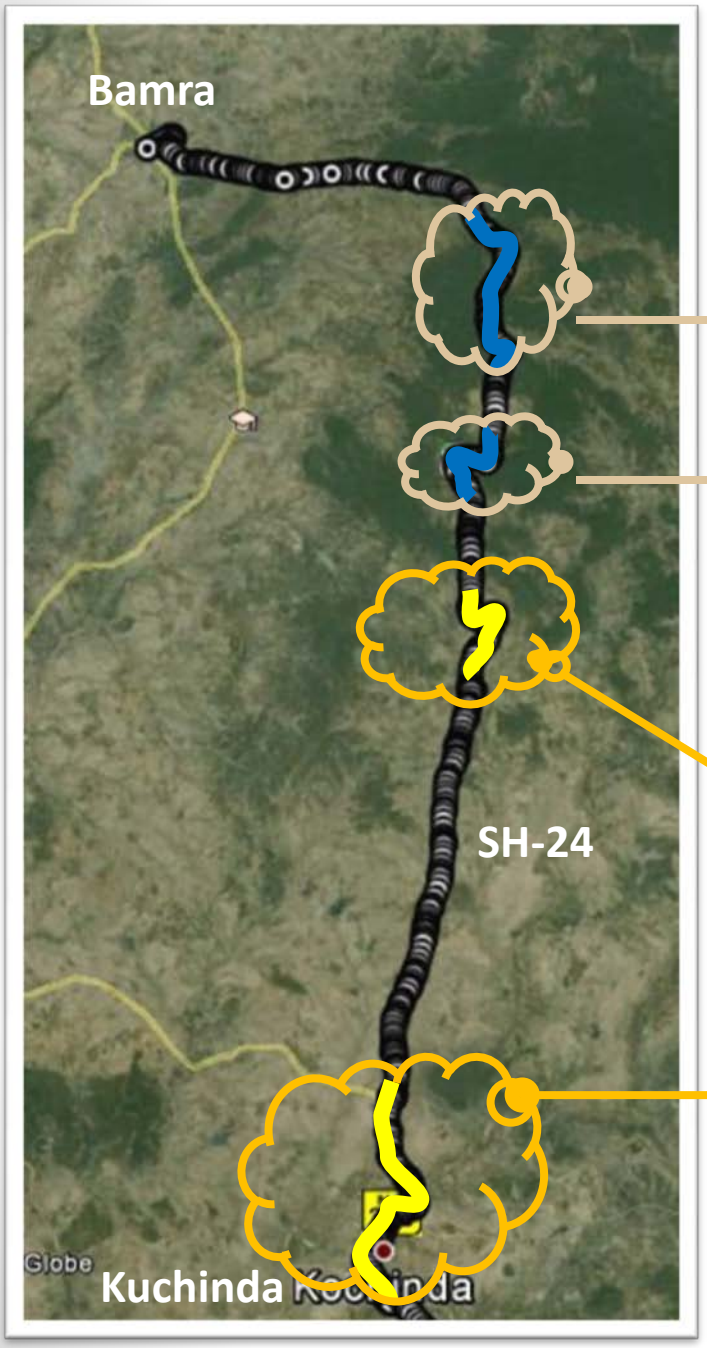
1. Sharp curvature on high embankment
2. Pond on outer edge
3. **Delineation (edge lines), warning sign, and chevrons**
4. No edge protection



Crash Severity \ Frequency	Low	Medium	High
Minor Injury		●	
Major Injury		●	
Fatal			

1. Sharp curvature on high embankment
2. Pond on outer edge
3. **Delineation (edge lines), warning sign, and chevrons**
4. **Crash barrier on the outer edge**

Road Safety Audit of SH-24 Odisha, India

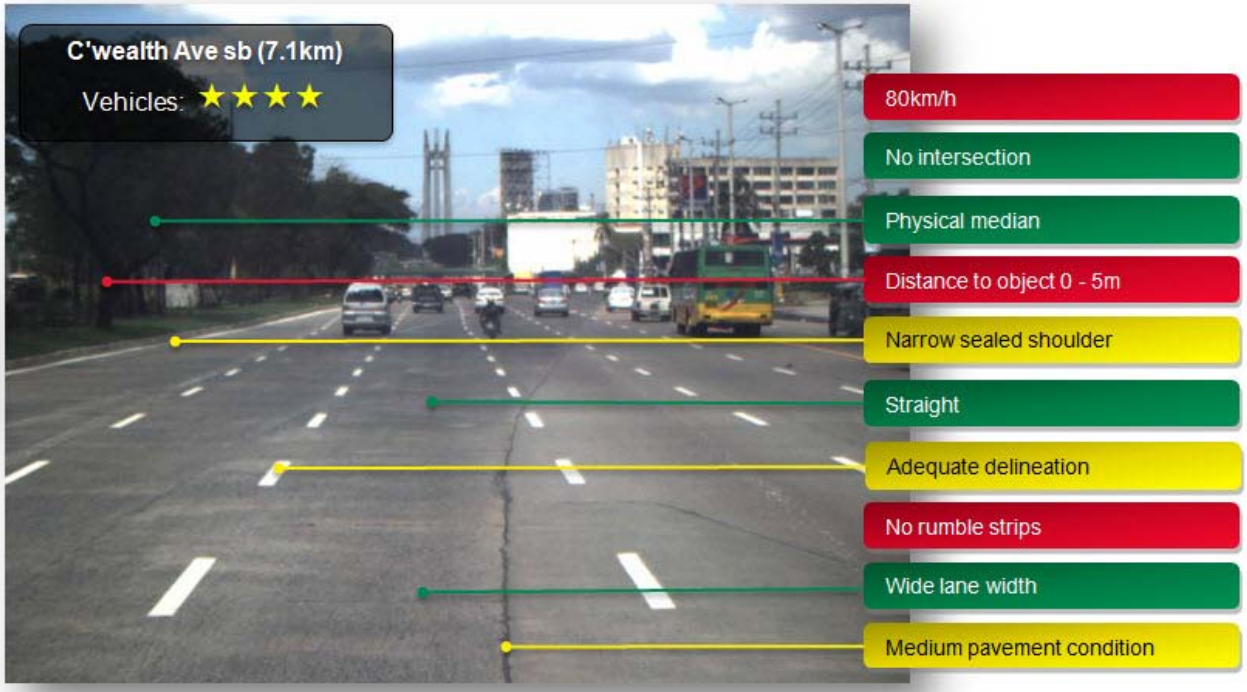


- **Hill road in forest area**
- **Series of sharp horizontal curves and bends**
  - No delineation and edge protection
  - Risk of fatal and major injury to vehicle occupants high
  - Delineation, but no edge protection
  - Risk of fatal and major injury to vehicle occupants medium

- **Built-up Area**
  - No Facilities for VRU
  - High speed Traffic, no traffic calming measures
  - Risk of fatal and major injury to pedestrian and bicycles high
  - Footpaths, but no crossing facility for pedestrian
  - Medium speed traffic, traffic calming measures at few places
  - Risk of fatal and major injury to pedestrian and bicycles medium

Quantifying the Risk of Crash

- Road Assessment Program (RAP) works on Star Rating of roads
- iRAP does star rating of roads in middle and low income courtiers
- More than 50 road attributes like, traffic speeds, number of lanes, sealed shoulder, footpath, pedestrian crossings, delineation, etc. are recorded for each 100m section of road



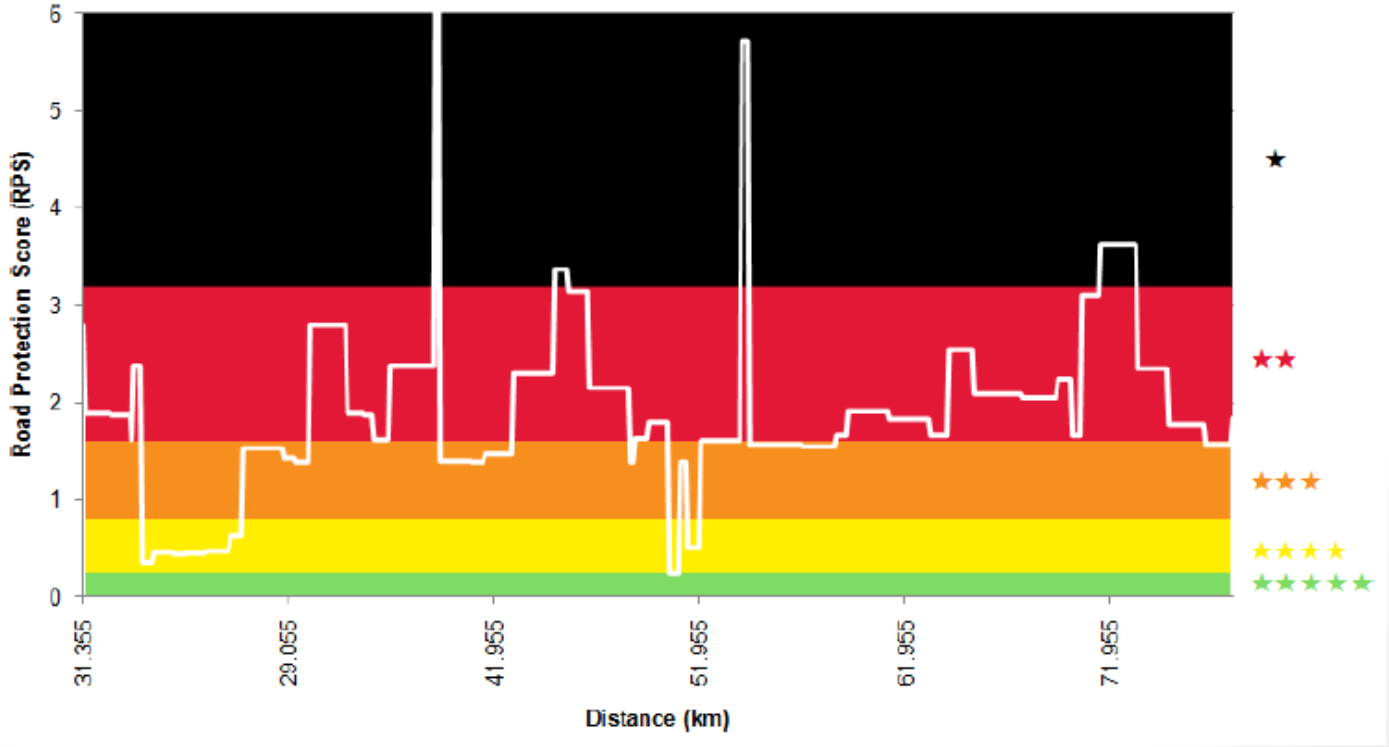
Star Rating of Roads

- Infrastructure Safety Score is calculated for each 100 metre section of road using iRAP model (online)
- It is an objective measure of likelihood of a crash occurring and its severity
- Separate score is produced for,

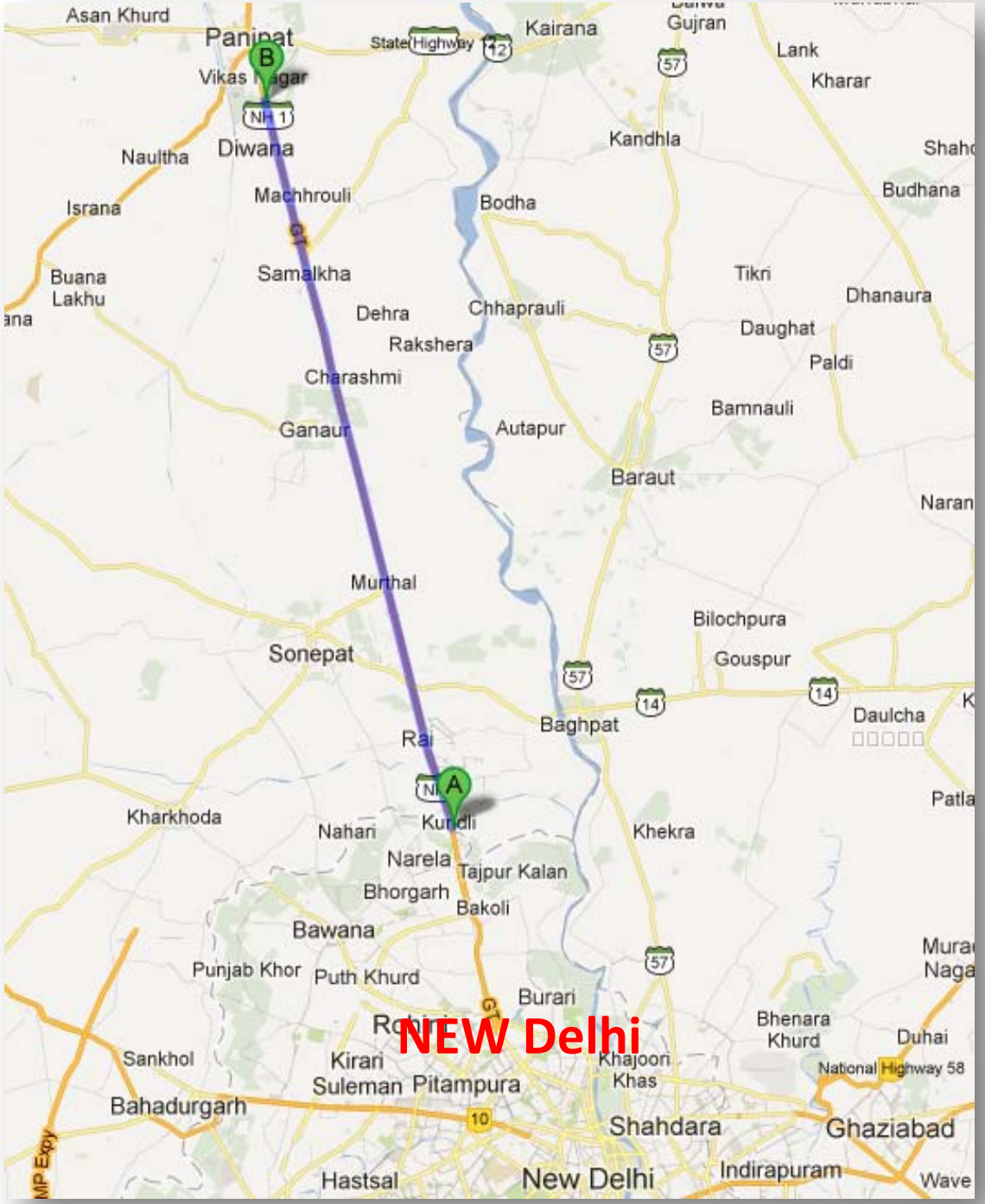
  (i) vehicle occupants, (ii) motorcyclists, (iii) bicyclists, and (iv) pedestrians

Star Rating of Roads

- Each segment is allocated to one of five Star Rating bands.
- The system reflects typical international practice of recognizing the best performing category as 5-star and the worst as 1-star.
- When plotted on a map the color coded star rating of road depicts the infrastructure related risk and likelihood of crash.



NH-1:
Delhi Border to Panipat

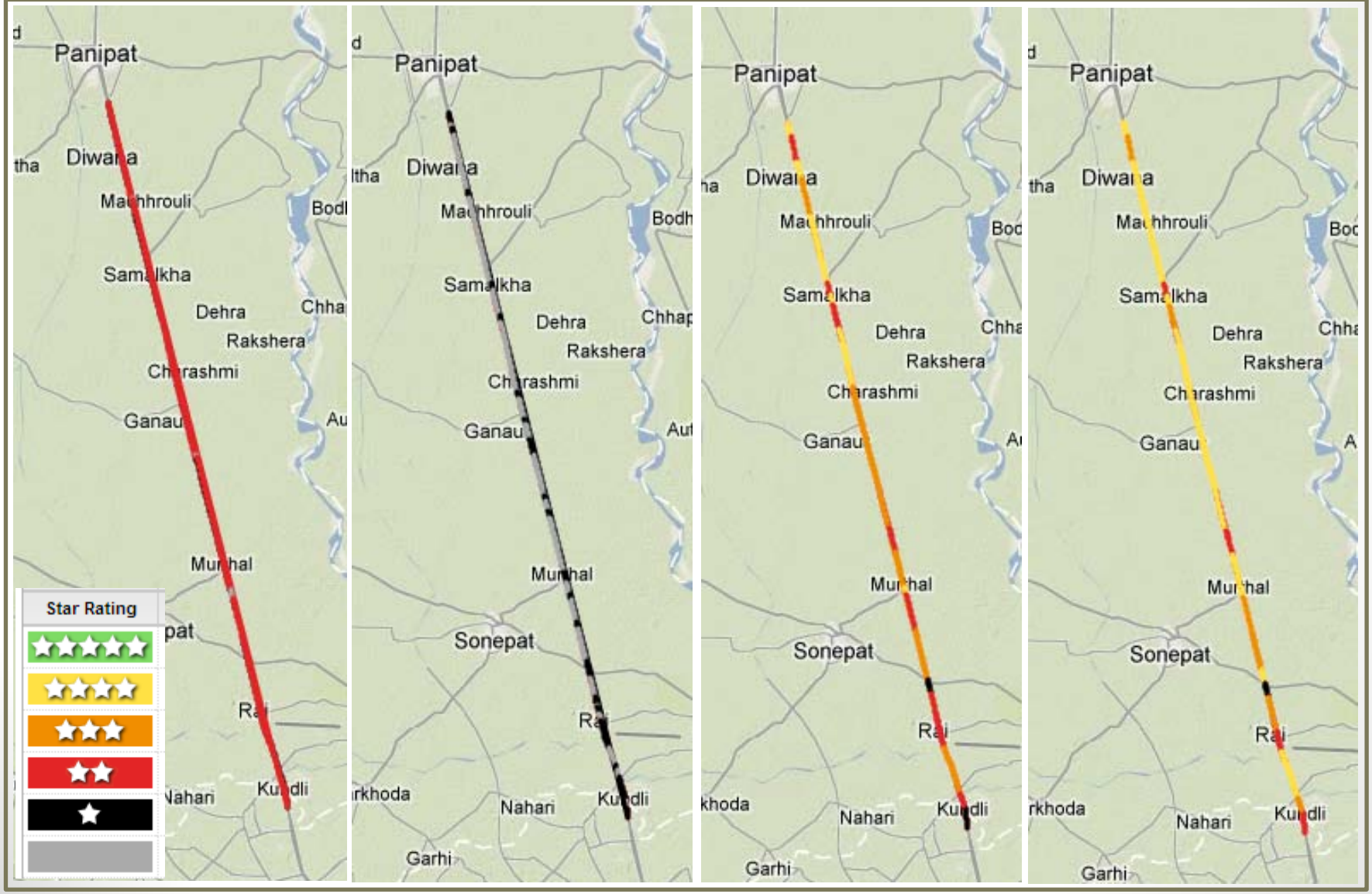


NH-1 Information on Safety …

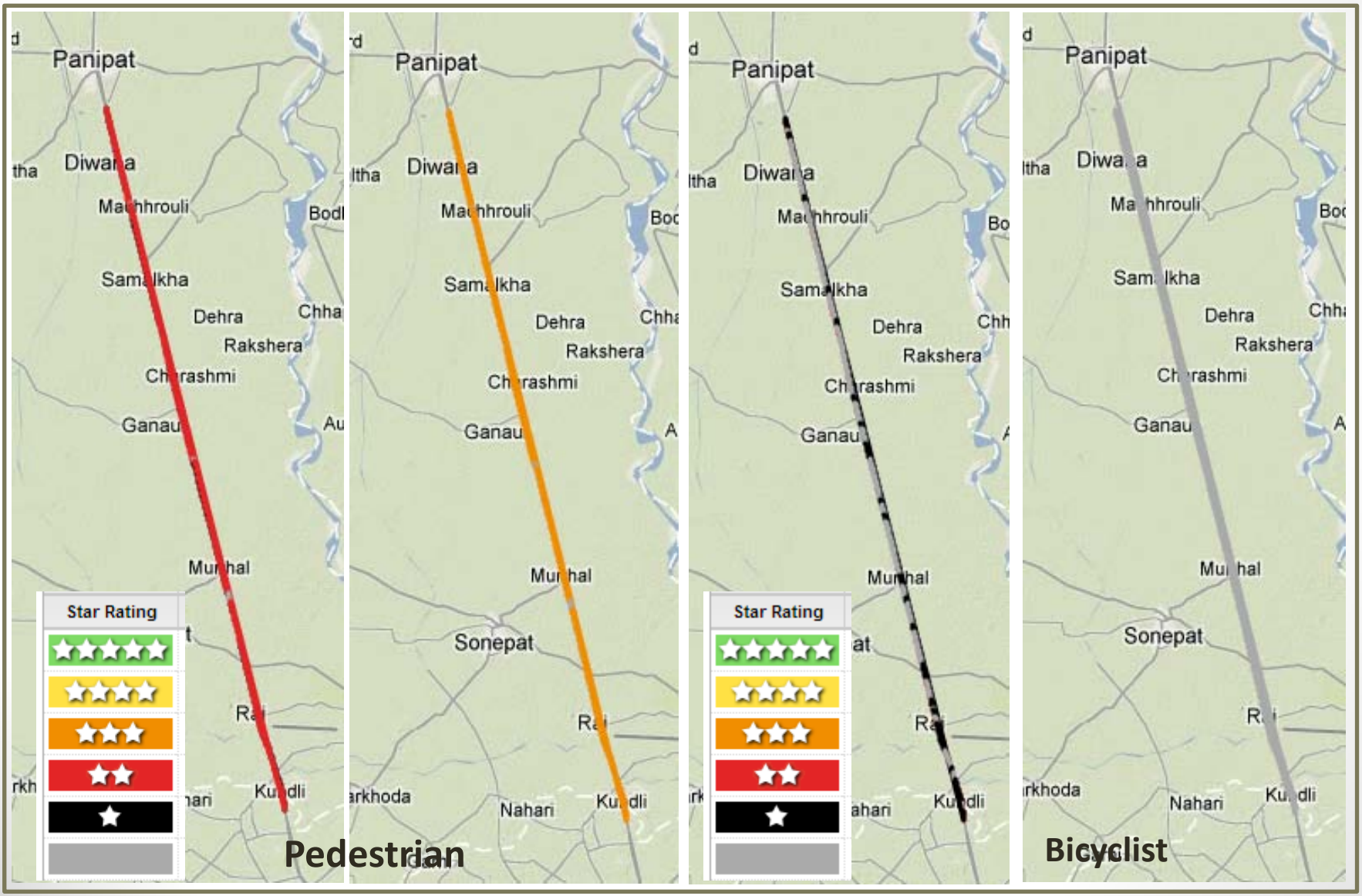
- Length = 56 km; Road is 6-lane divided; without access control
- Fatality – 217per year and 649 in 3 years (2009-2011) - Almost 4 deaths per km per year
- Serious injury – 122per year and 364 in 3 years –*seems to be under reported*
- Mixed Traffic - Pedestrians , Bicycles, Mot. 2-wheelers, Mot. 3-wheelers, Cars, and Trucks
- Carries 48,000 to 67,000 vehicles per day. No. of cars 23,000 to 35,000 per day.

Star Rating of NH-1, India

Pedestrian **Bicyclist** **Motorcycle rider** **Vehicle Occupant**

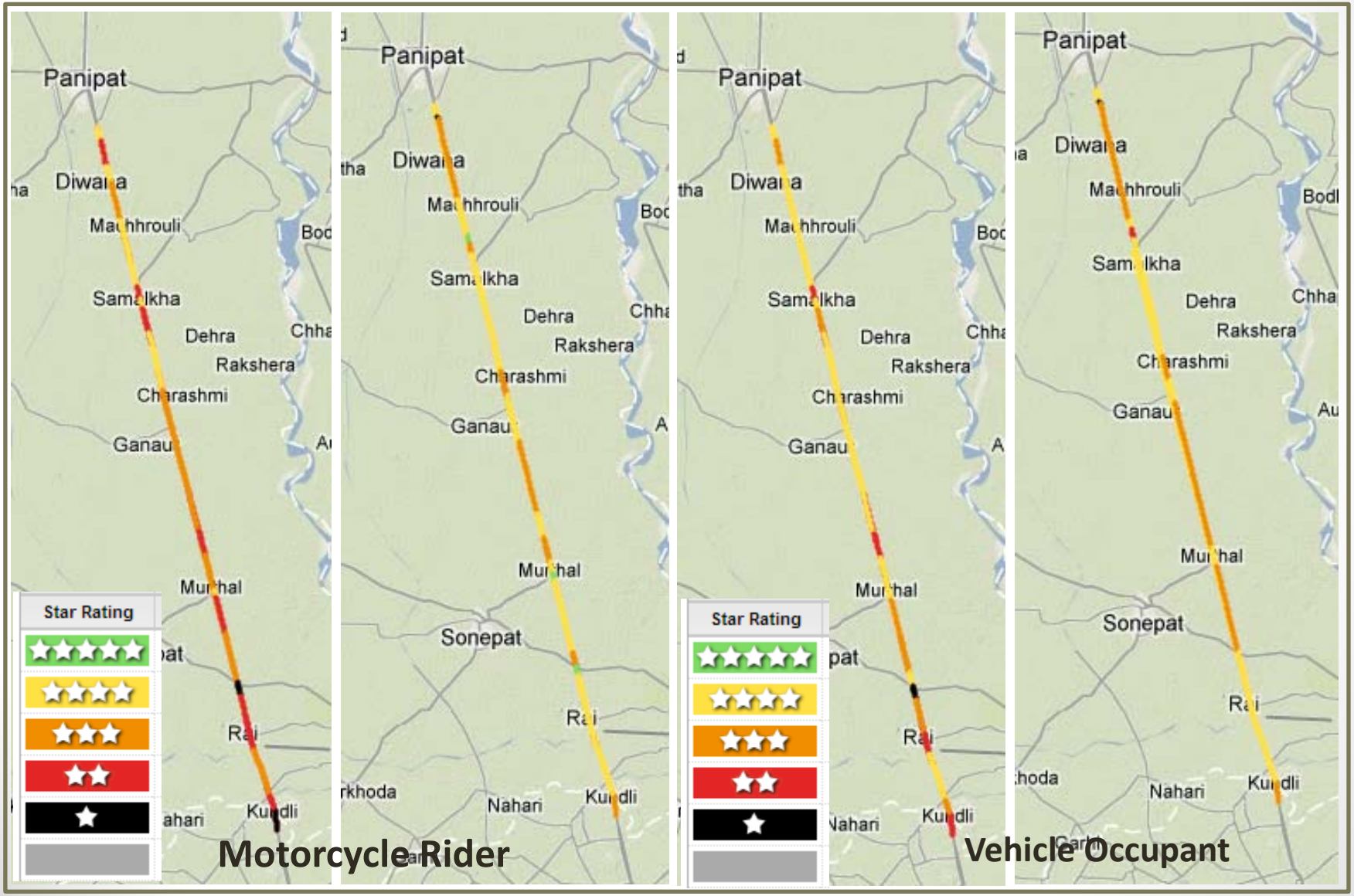


Star Rating of NH-1, India



Star Rating of NH-1, India

Existing Road **Design** **Existing Road** **Design**



Motorcycle Rider **Vehicle Occupant**

Star Rating of NH-1

Proportion of Length at Improved Star Rating After Design

	BASE (Benchmark)				Design			
Star Rating	Car Occupants	Motorcyclists	Bicyclists	Pedestrians	Car Occupants	Motorcyclists	Bicyclists	Pedestrians
5 Star	0%	0%	0%	0%	1%	3%	0%	0%
4 Star	60%	23%	0%	0%	71%	75%	0%	0%
3 Star	24%	49%	0%	0%	27%	22%	0%	63%
2 Star	15%	25%	14%	49%	1%	0%	0%	0%
1 Star	2%	3%	14%	44%	0%	0%	0%	0%
NA	0%	0%	72%	7%	0%	0%	100%	37%

CRASH DATA IN DEVELOPING COUNTRIES

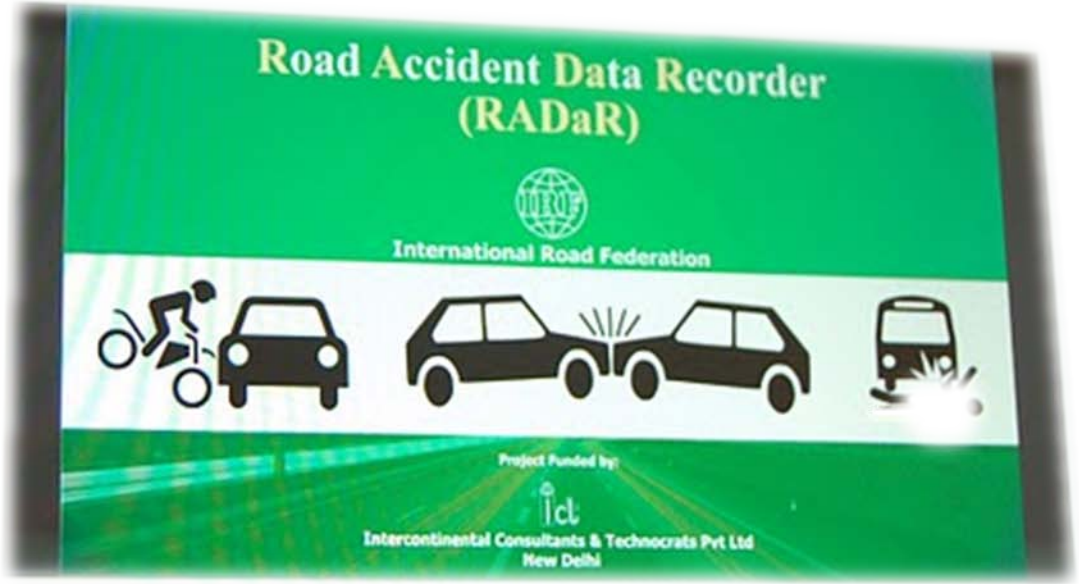
Crash Data in Developing Countries

….. Crash data is required for validation of risk mapping

- Collected by Police officers
- Incomplete data collection for any scientific investigation
- Cause of crash is attributed to mostly the driver behavior
- Insufficient details such as exact location and road condition
- It is an adjudication record, not for correction in design/operation
- No mechanism to share data with other Stakeholders

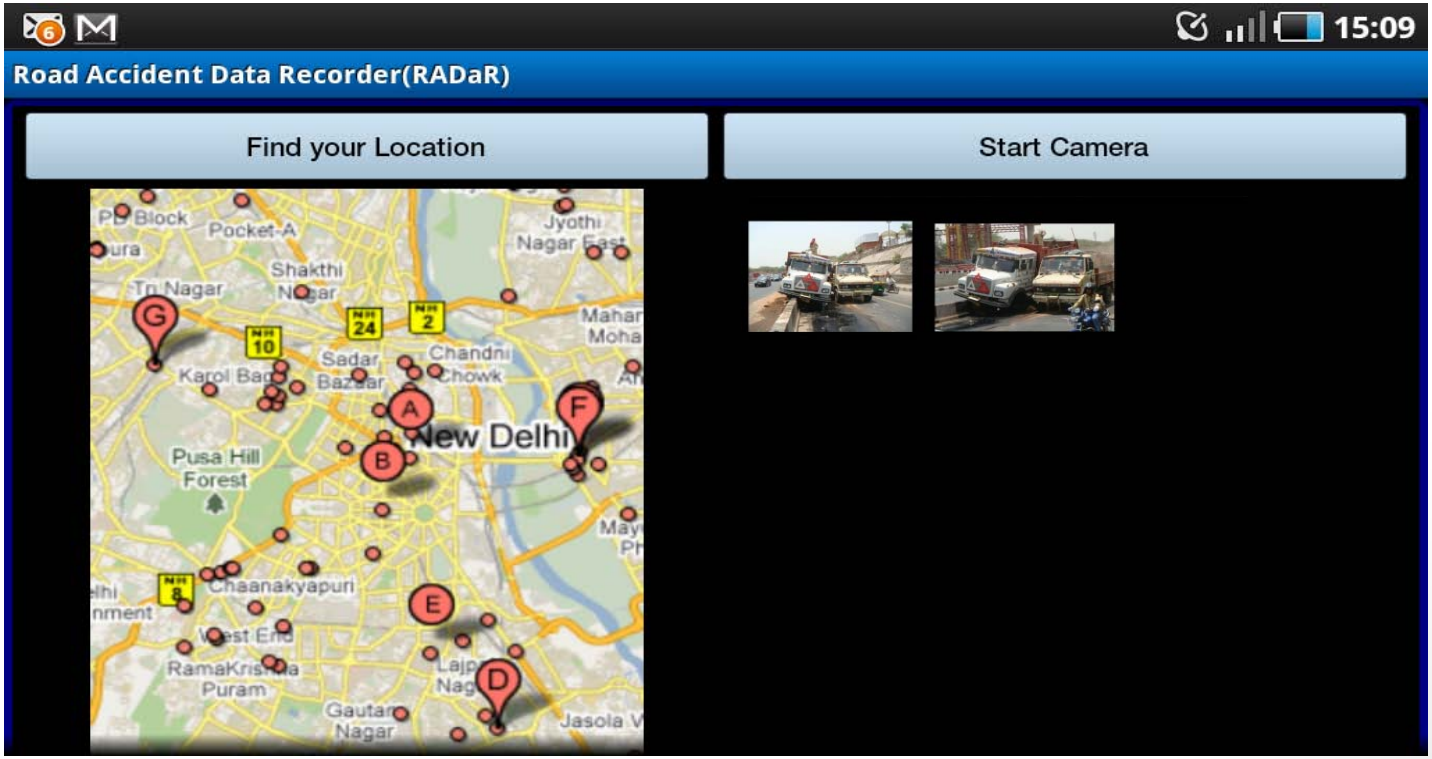
Comprehensive Crash Data

- Comprehensive and location based crash data is must to relate the infrastructure related risk with crash
- RADaR is a tool developed by IRF to record comprehensive crash data including the GPS coordinates of crash location



Features of RADaR

- Quick and easy automated tool to collect comprehensive road crash data
- User friendly software application loaded on to tablet computer working on ANDROID operating system
- GPS/GPRS facility to record exact crash location in global coordinate system and to transmit data to central server



To Summarize…

- Risk mapping based on crash data gives an opportunity to identify blackspots and spot remedial measures to avert more crashes (a reactive method)
- Mapping of infrastructure related risk gives an opportunity to identify sites where crashes are likely to occur (proactive way)
- Due to lack of comprehensive or location based crash data it is not possible to relate or validate the iRAP risk assessment model in developing countries
- With help of RADaR the comprehensive crash database will surely open an era of road crash research in developing countries (to validate manual and automated risk mapping)

thank you

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