Practical road assessment: iRAP/EuroRAP training

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10-11 November 2016, Devin

EuroRAP
EUROPEAN ROAD ASSESSMENT PROGRAMME

The team

- **Liljana Çela,** Information Resources Manger and Coordinator Road Safety Working Group, South East Europe Transport Observatory (SEETO)

- **Olivera Djordjevic,** RADAR Programme Director, EuroRAP and iRAP Strategic Projects

- **Nikola Galovic**, Director, Road Safety Department, AMSS-CMV

- **Steve Lawson**, Regional Director, EuroRAP and iRAP

About us

Liljana Çela, Information Resources Manger and Coordinator Road Safety Working Group, SEETO (South East Europe Transport Observatory for Albania, Bosnia & Herzegovina, FYROM, Montenegro, Serbia, Kosovo*)

Project manager, IT specialist and computer scientist, traffic safety manager and researcher.

Olivera Djordjevic, RADAR Programme Director, iRAP Strategic Projects

SENSoR project in South East Europe including Bulgaria

International project specialist

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About us

Nikola Galovic, Director, Road Safety Department, AMSS-CMV. Research and applications for government and for motoring organisation. EuroRAP and iRAP inspections in Egypt, Moldova, Netherlands, Russia, Serbia and Ukraine.

Steve Lawson, Regional Director for EuroRAP and iRAP
Road safety with road authorities, universities, motoring organisation and EuroRAP since 1979
Projects in Europe, Africa and the Middle East.

Questions to you…

- From Bulgaria?
- From Sofia?
- From Plovdiv?
- From the Devin area?
- From elsewhere in Europe?

Questions to you.
Experience now or in the past of...

- Road safety engineering and road safety auditing?
- Accident investigation, crash cluster analysis?
- Road engineering or highway design?
- Traffic/transport policy?
- Road equipment industry?
- Other?

Questions to you

- Which of these best describes you…
  - I know **a bit** about EuroRAP/iRAP?
  - I know **a lot** about EuroRAP/iRAP?
  - I know **nothing** about EuroRAP/iRAP?
- **?**

Questions to you

- Which of these best describes you…
  - I know **a bit** about EuroRAP/iRAP?
  - I know **a lot** about EuroRAP/iRAP?
  - I know **nothing** about EuroRAP/iRAP?
- **?Who was at the BBARS April conference in Hissarya?**

Thank you

- To BBARS for its work in the region
- For this invitation and opportunity

- To the road authorities, ministries and police in Bulgaria who we are working with

Road safety people in Bulgaria?

- Busy people!!
- Heavy workloads – technical issues, people management, political relationships, policy formulation
- Allocation of scarce resources
- Competing demands – poor infrastructure, trade routes, goods-to-market, traffic congestion, tourism, environmental sustainability, balancing budgets

Road safety people in Bulgaria?

- Busy people!!
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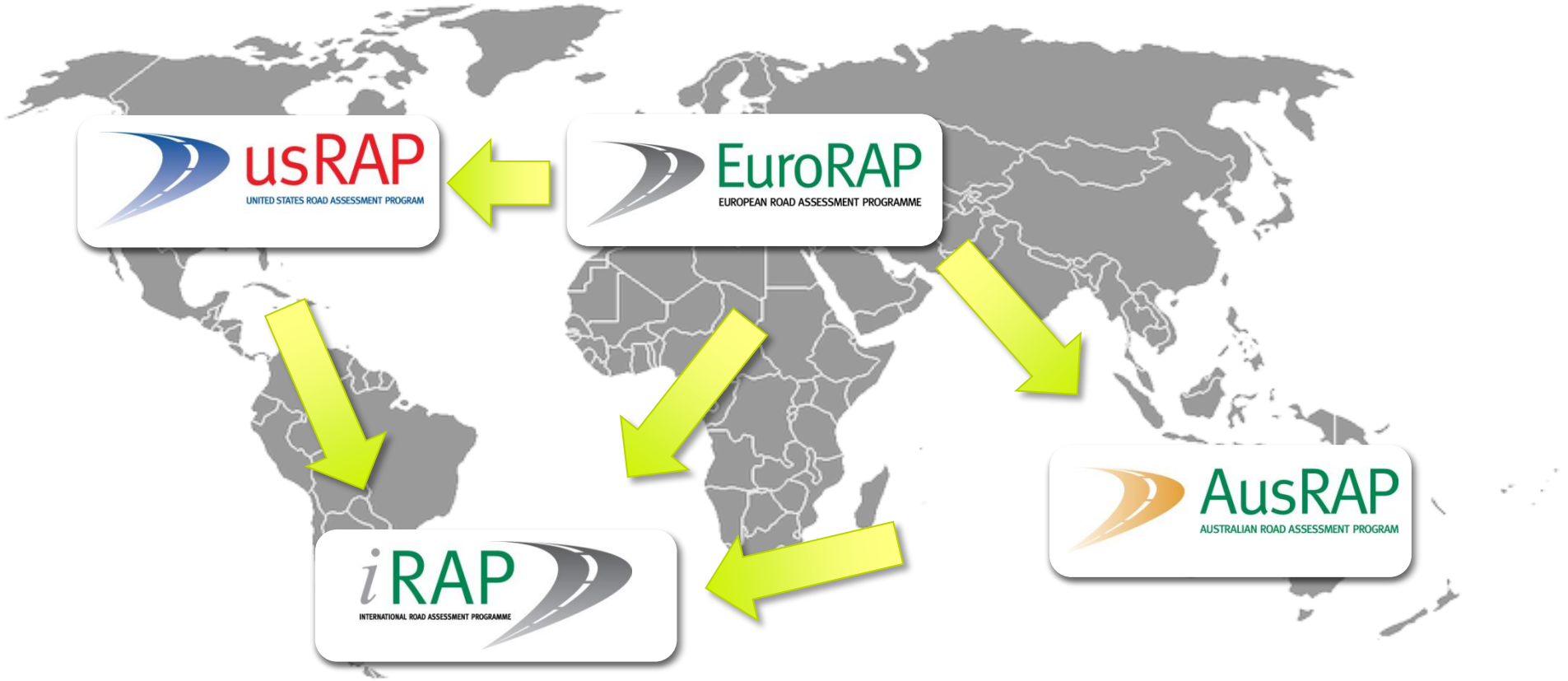
…and road safety!!

Financial appraisal

- Not much **new** money for roads
- Must spend **existing** funds wisely
- **Where to** spend, **what to** spend, **how to** spend?

Early historic development



RAP – History

- **RAP – Road Assessment Programme**

- **EuroRAP AISBL**
  - 2002 – Registered in Brussels as an international **not-for-profit** organisation, building on work since 1999

- **International Road Assessment Programme (iRAP)**
  - Established in 2006
  - Registered as **UK charity** in 2010

- Now active in about **80+ countries**

Some things to think about today and tomorrow

- Benefits – how it sits **alongside other work** that you are doing now
- Benefits – how this work will help **what you do now**
- Benefits – **technical value**
- Benefits – **communication value**

Results – EuroRAP's core activity

Spatial description of risk, and development of infrastructure-related investment packages.

- **Where and how** are people killed?
- How do we match **countermeasures to needs?**
- What are the **costs and benefits?**

iRAP – a tool in a spectrum of crash analysis

- **Not** "hot spot", "crash cluster" or "black spots"
- iRAP models safety from drive-through assessment of 52 factors every 100m

single site – safety audit – area wide – mass action – route action – route quality

1979

eg: Trunk road upgrades 1990s

Case study 1

“Before” – late 1970s

“After” -- changed in early 1980s

The Safe System

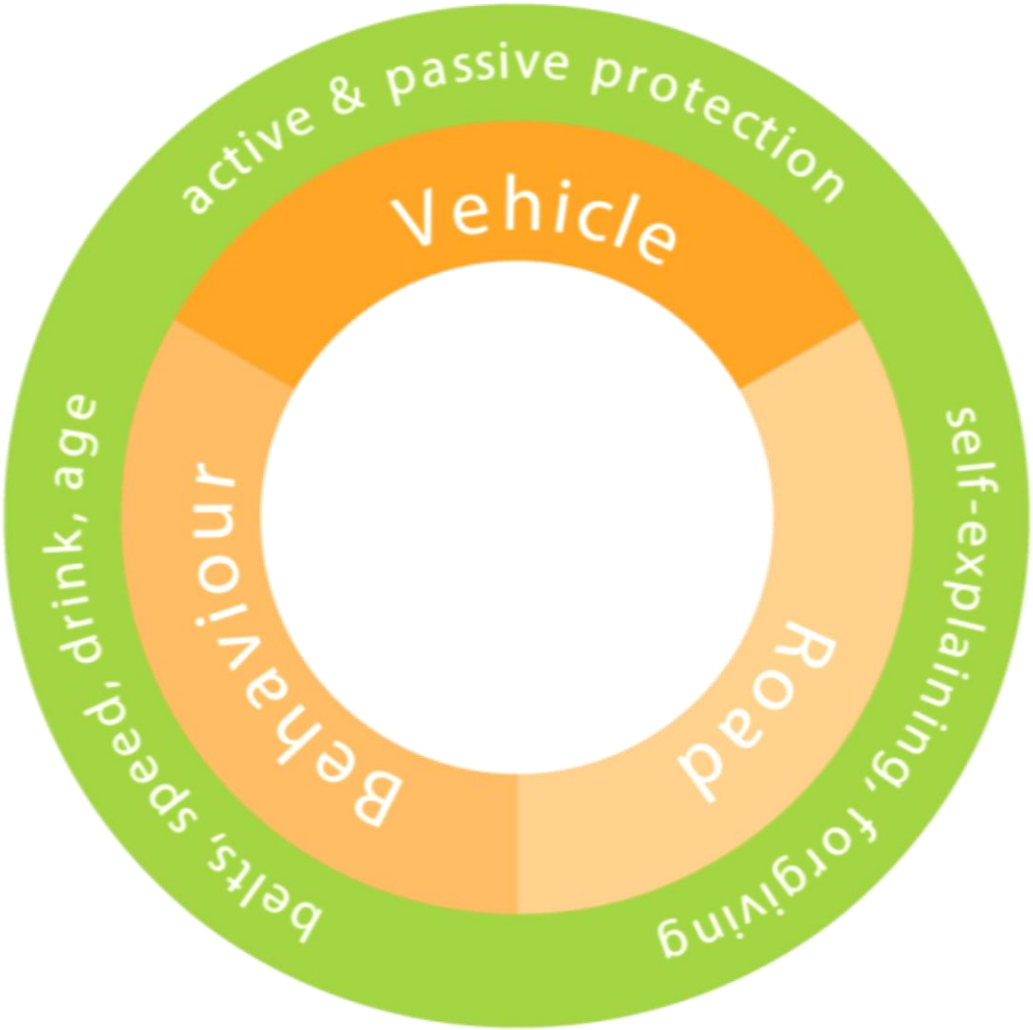
Complementary Actions on Roads, Vehicles and Behaviour

The Safe System

Complementary Actions on Roads, Vehicles and Behaviour

The Safe System

Complementary Actions on Roads, Vehicles and Behaviour



The Safe System – in Operation

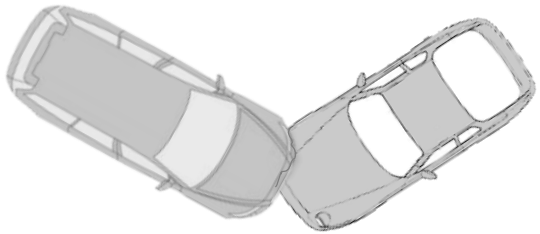
Education reduces stupid mistakes

Enforcement reduces deliberate errors

Infrastructure reduces risk of collision and the impact in the event of collision

Vehicle reduces impact in the event of collision

Safe speeds reduce the severity of an impact



Case study 2

Vehicle, behaviour and road

“Before” (1982)

- 4 young men – 17, 19, 20, 21
- Late night at the weekend

How to survive your crash

- **Have a long, slow crash – minimise deceleration**

- **Wear a seat belt in a vehicle**

- Stay in the vehicle – avoid partial or complete ejection
- Avoid crush of your vehicle's passenger compartment
- Speed: ≤ 50km/h in head-on, ≤ 30km/h in side impact
- Pedestrian/cyclist – reduce speeds, increase separation

"After"

How do we Star Rate roads for safety?

Star Rating the safety of roads

- Based upon video records

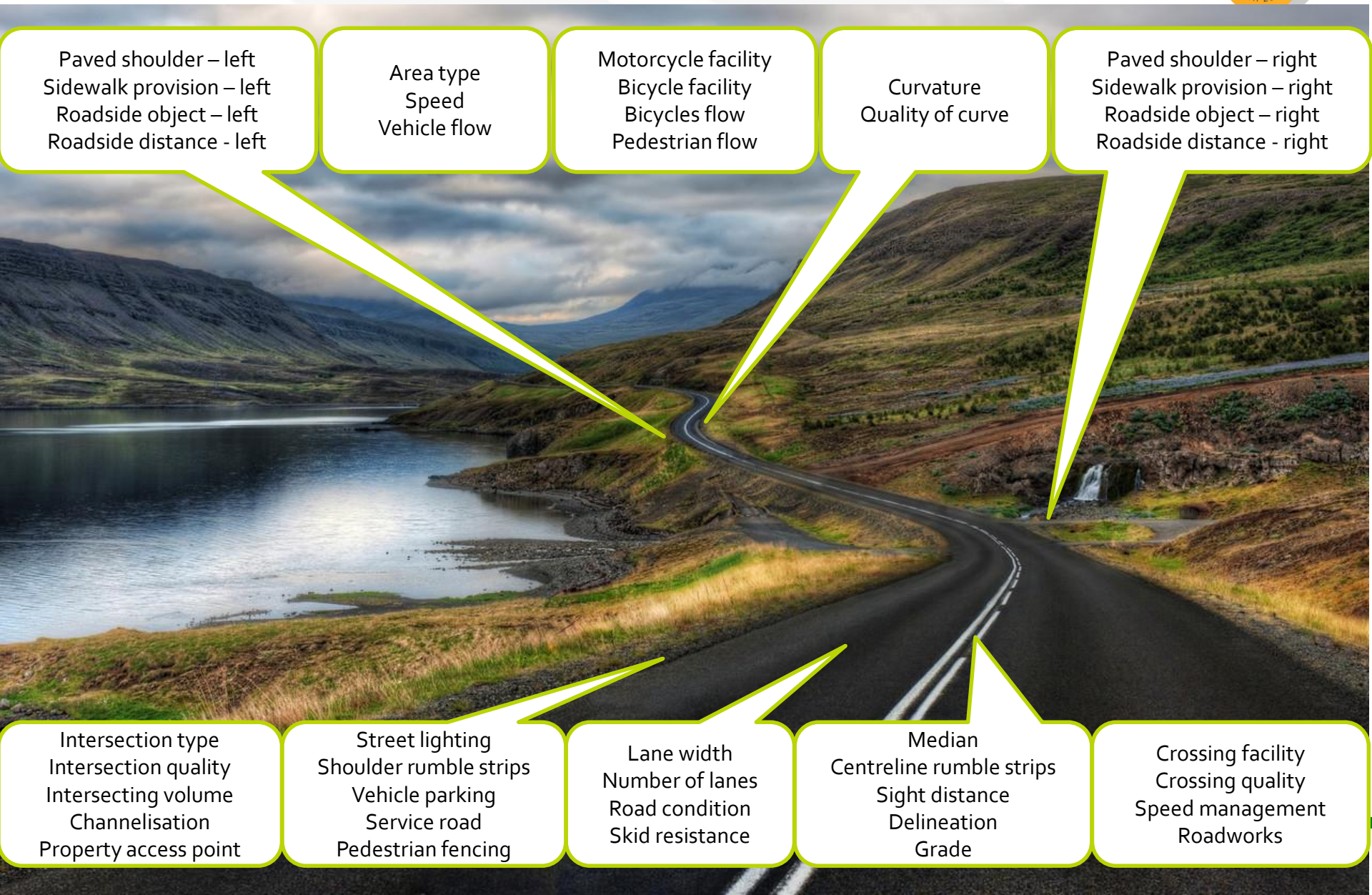
- Road features – 52 features known to affect likelihood and severity of injury collected every 100 metres

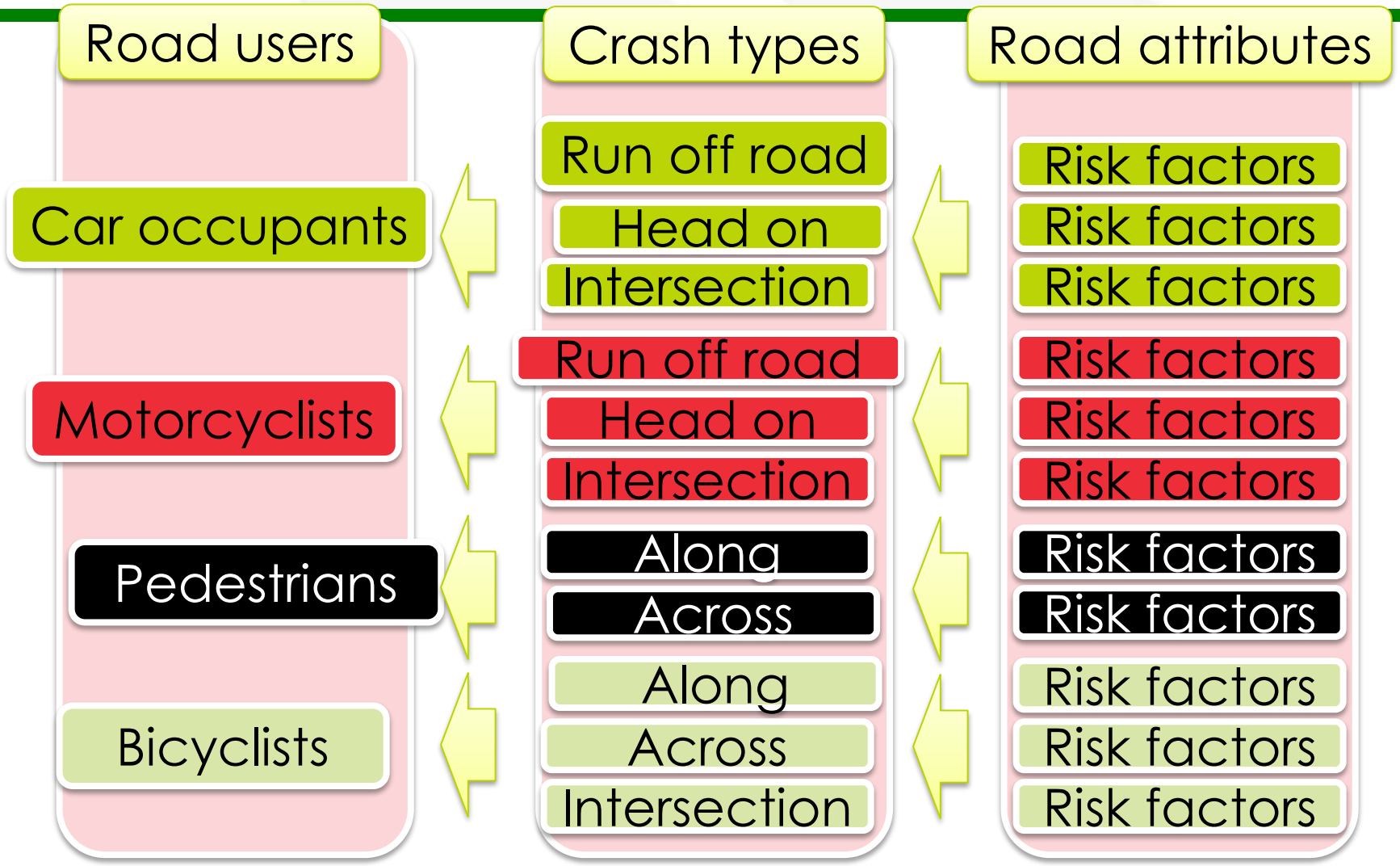
- Car occupants, motorcyclists, pedestrians, bicyclists
- Major crash types including head-on, run-off, intersection crashes

A few of the 52 attributes…

Posted Speed Limit, Operating speed, Traffic volumes
Lane width, Paved shoulder
Curvature, Curvature quality
Delineation, Shoulder rumble strip, Shoulder sealing
Road condition, skid resistance
Roadside object to be struck
Roadside severity (distance from carriageway)
Intersection type and quality
Intersecting road volume, minor access point density
Pedestrian facilities and activity
Land-use, area type, etc etc etc…

Some of the 52 attributes…




Road users
Crash types
Road attributes
Car occupants
Motorcyclists
Pedestrians
Bicyclists
Run off road
Head on
Intersection
Run off road
Head on
Intersection
Along
Across
Along
Across
Intersection
Risk factors
Risk factors
Risk factors
Risk factors
Risk factors
Risk factors
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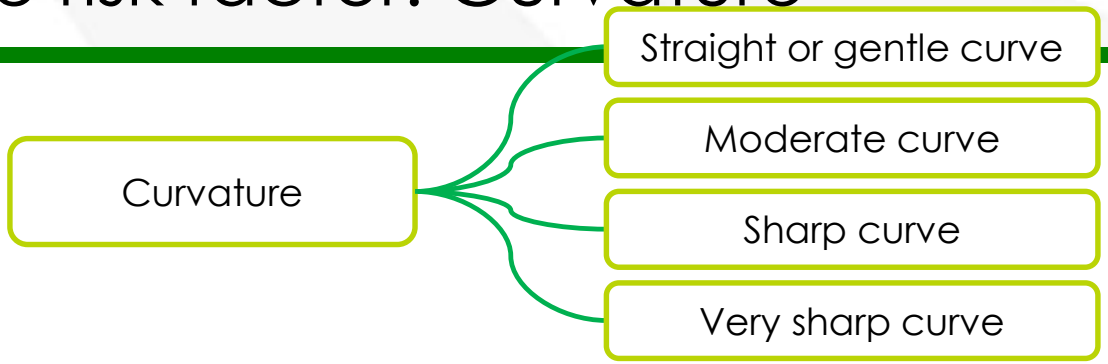
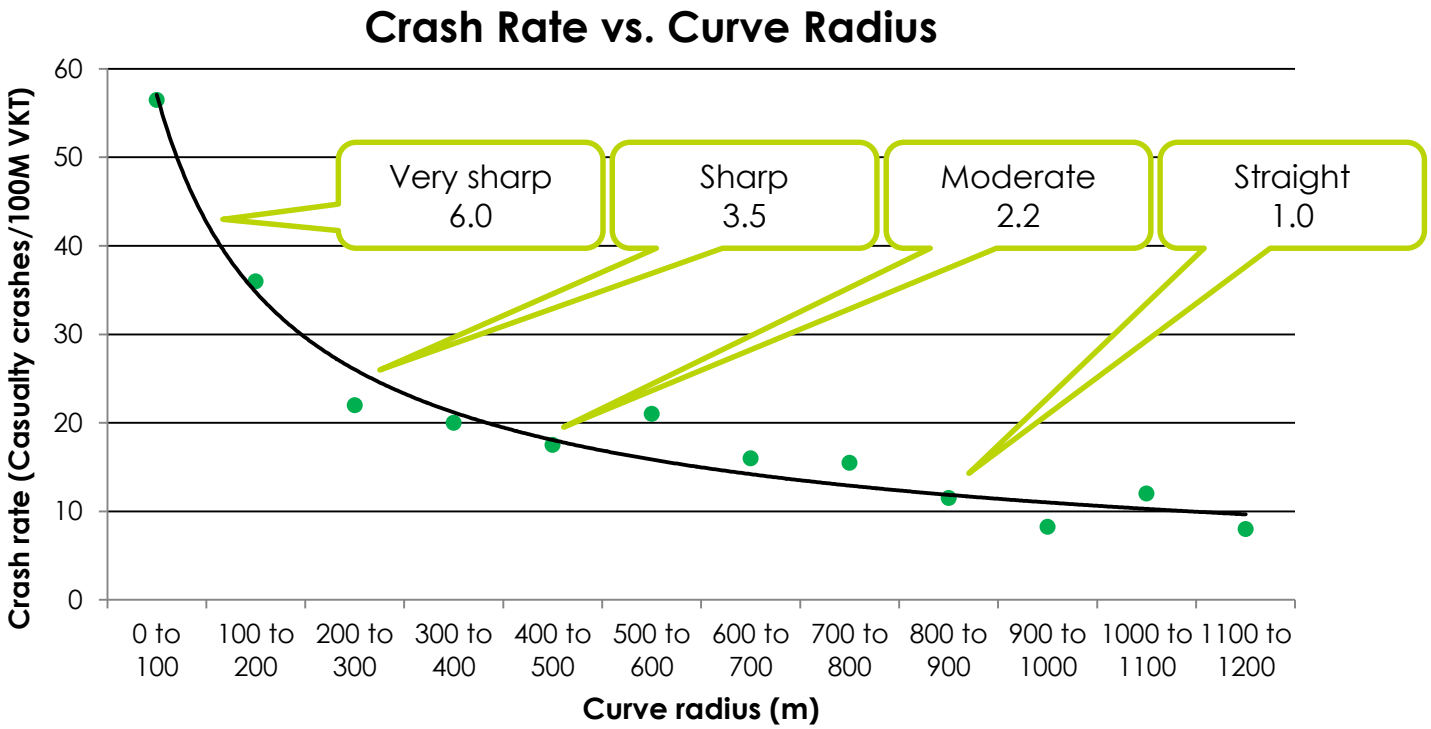
Risk factors
Risk factors

Example risk factor: Curvature





“How we score what we score”

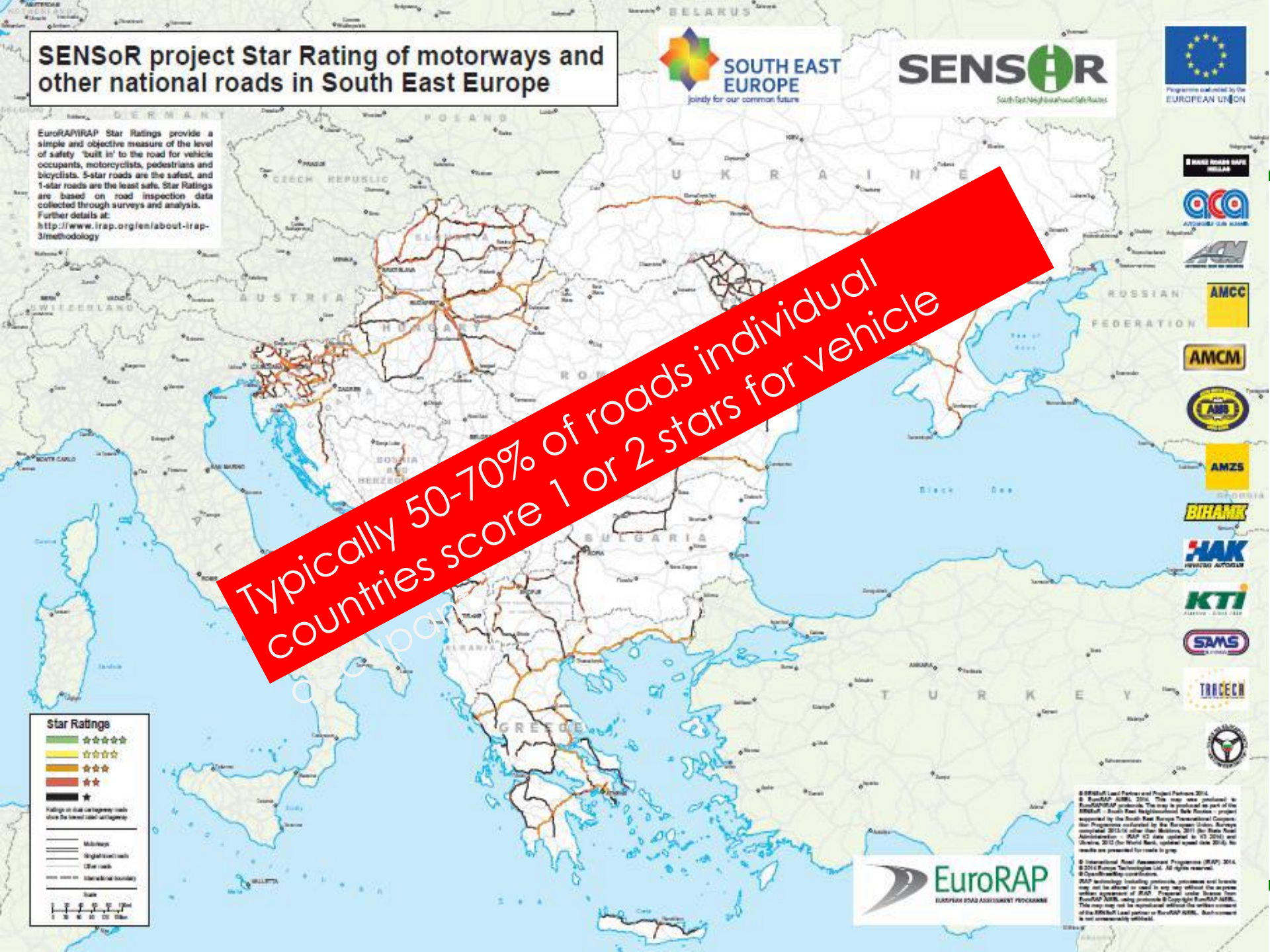
http://www.irap.org/en/about-irap-3/methodology

Maps for 4 road-user groups

- Vehicle occupants……
- Motorcyclists
- Pedestrians
- Bicyclists

Bulgaria – 3 in 4 curves have hazards

76% of curves where traffic flows at 80km/h or more have hazardous roadsides


SENSoR project Star Rating of motorways and other national roads in South East Europe
SOUTH EAST EUROPE
jointly for our common future
SENSOR
EUROPEAN UNION
EuroRAP/iRAP Star Ratings provide a simple and objective measure of the level of safety 'built in' to the road for vehicle occupants, motorcyclists, pedestrians and bicyclists. 5-star roads are the safest, and 1-star roads are the least safe. Star Ratings are based on road inspection data collected through surveys and analysis.
Further details at:
http://www.irap.org/en/about-irap-3/methodology
Typically 50-70% of roads individual countries score 1 or 2 stars for vehicle
Star Ratings
EuroRAP

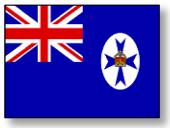
A 3-star minimum – not just England

(Netherlands) No 1- or 2-star national roads by 2020

(Sweden) 75% of travel on 3-star or better by 2020 and approaching 100% by 2025

(England) 90% of travel on 3-star or better roads by 2020

(New Zealand) Roads of National Significance (RONS) to be 4-star



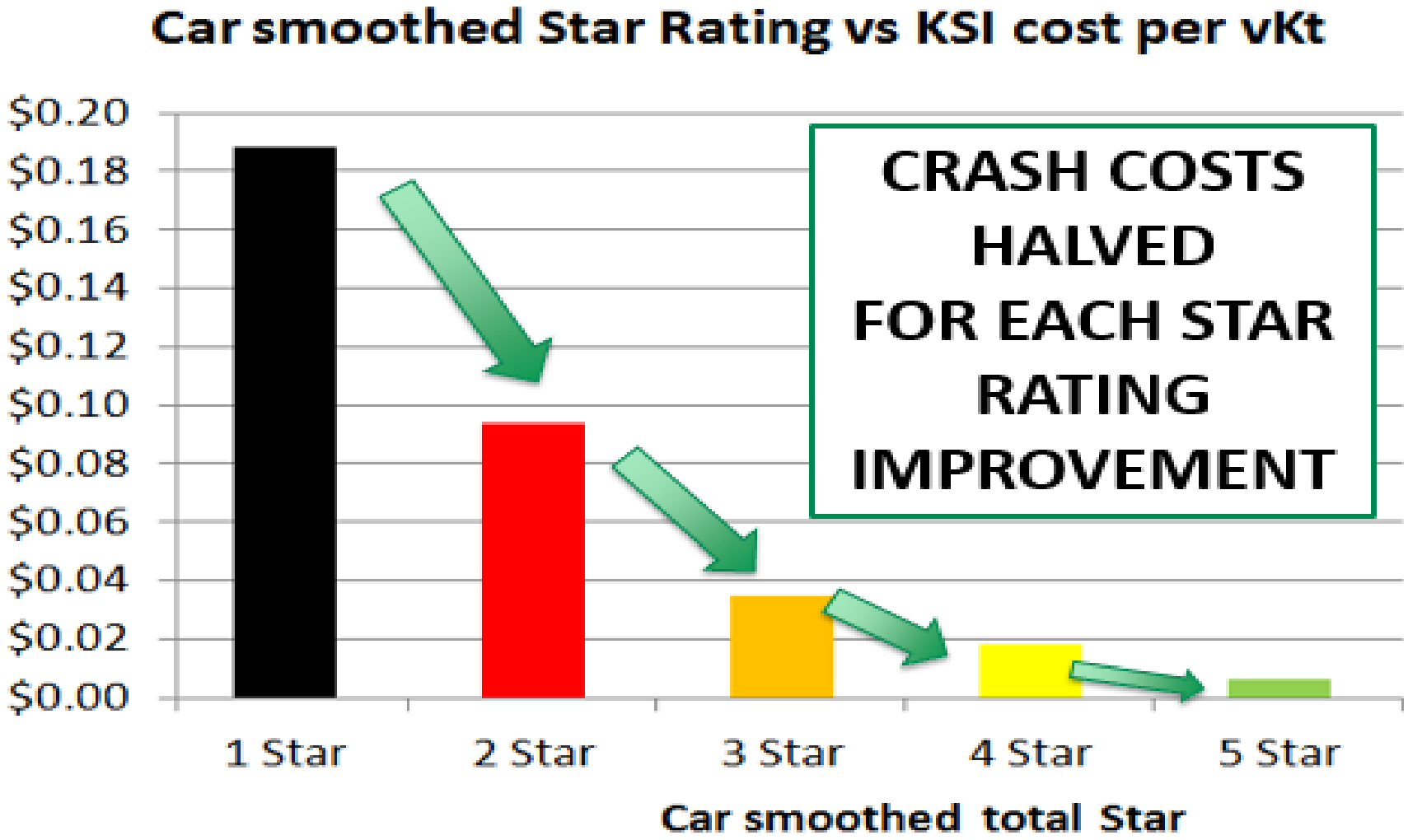
} Minimum 3-star related targets national highways: Tasmania; and Queensland

}

(Australia) All new roads 4-star and no road user group less than 3-star

(Malaysia) 3-star or better by 2020 for 75% of travel on high volume networks

Star Rating vs crash costs or crash rates



What are the important variables in a crash?

- What can you collect in a drive-through survey?
- What things are difficult to collect in a drive-through survey?
- Perfect day
- Coding form
- Practical exercise using the Demonstrator

- Star Rating data collection – Nikola Galovic
- Accessing Star Rating results in ViDA – Olivera Djordjevic
- Safer Road Investment Plans in ViDA – Steve Lawson and others

EuroRAP data for every 100m

- 52 attributes
- 691km in Bulgaria
- RADAR project will collect more data in 2017-2019

SRIP (Safer Roads Investment Plans)

Compares:

- **Risk at every 100m section**
- Crash costs – costs of life, injuries and damage

Suggests:

- **Infrastructure crash countermeasures for every 100m**
- Looks at costs of infrastructure improvements
- Compares **costs** and **benefits**

Identifying potential location of countermeasures by software zoom

Bulgaria measures:

- Median and roadside barriers, road widening, shoulder rumble strips and sealing, white lining, re-surfacing, footpath provision for pedestrians

Safer Road Investment Plan (SRIP) Bulgaria

Safer Roads Investment Plan

Currency: лв BGN - Analysis Period: 20 years

Total FSIs Saved	Total PV of Safety Benefits	Estimated Cost	Cost per FSI saved	Program BCR
15,085	1,418,962,164	501,281,170	[illegible]	3

Location for barriers

Countermeasure	Length / Sites	FSIs saved	PV of safety benefit	Estimated Cost	Cost per FSI saved	Program BCR
Duplication with median barrier	143.70 km	2,881	271,050,183	176,234,000	61,161	2
Roadside barriers - driver side	390.90 km	2,273	213,794,376	78,180,000	34,398	3
Additional lane (2 + 1 road with barrier)	334.50 km	1,831	172,247,591	50,983,000	27,842	3
Roadside barriers - passenger side	308.80 km	1,285	120,922,224	61,760,000	48,044	2
Shoulder rumble strips	507.10 km	971	91,307,056	6,584,505	6,784	14
Improve Delineation	348.30 km	932	87,648,859	9,284,815	9,965	9
Road surface rehabilitation	257.80 km	909	85,470,845	10,298,172	11,334	8
Footpath provision passenger side (adjacent to road)	281.70 km	876	82,403,099	24,215,000	27,642	3
Footpath provision driver side (adjacent to road)	281.40 km	870	81,876,081	24,143,000	27,738	3
Shoulder sealing driver side (>1m)	548.40 km	793	74,560,948	10,025,800	12,649	7

Roadside barriers - passenger side | More info

- What did we learn yesterday? – Olivera Djordjevic

- Evolution of the model and improvements to the model. Understanding the Star Rating V3 model – Steve Lawson

- Comparing an iRAP assessment with Road Safety Audit and Inspection: what does each offer? – Steve Lawson and others with Rossitsa Spasova, Mott MacDonald, Bulgaria

Case study 5

Safer roadsides – barriers

“After”


M53
All Docks
Birkenhead 5
Wallasey 7
Liverpool 11


M53
All Docks
Birkenhead 5
Wallasey 7
Liverpool 11

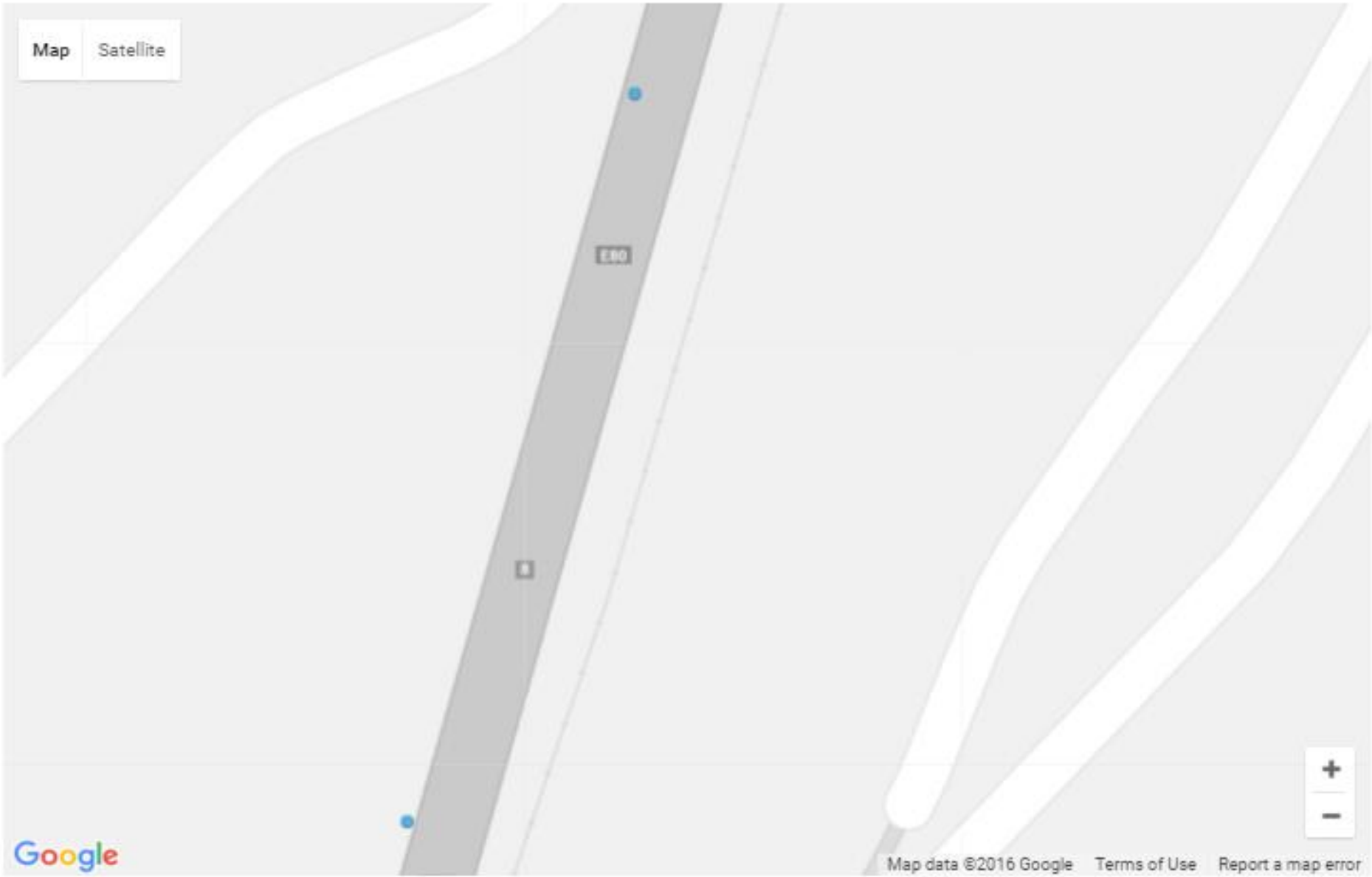
“Before” (late 1970s)

Roadside barriers - passenger side | More info

Roadside barriers - passenger side | More info

Roadside barriers - passenger side | More info

Roadside barriers - passenger side | More info



Roadside barriers - passenger side | More info

Next steps

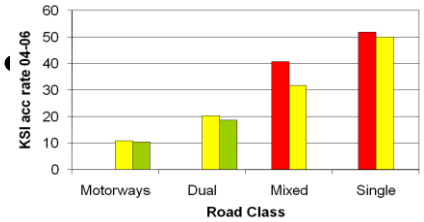
- Survey more roads in Bulgaria 2017-2019

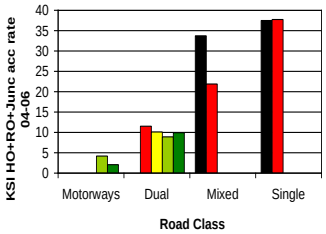
- Encourage implementation of countermeasures

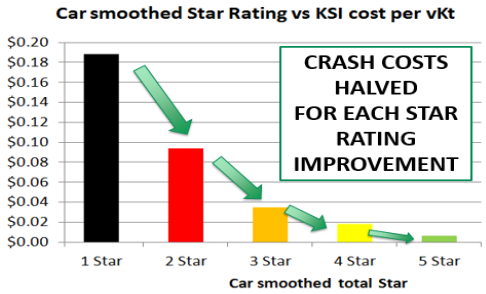
- Save lives by improved design!

Why innovate? How best to?

- Provide a better **explanation of risk**
- v1.0 v1.5







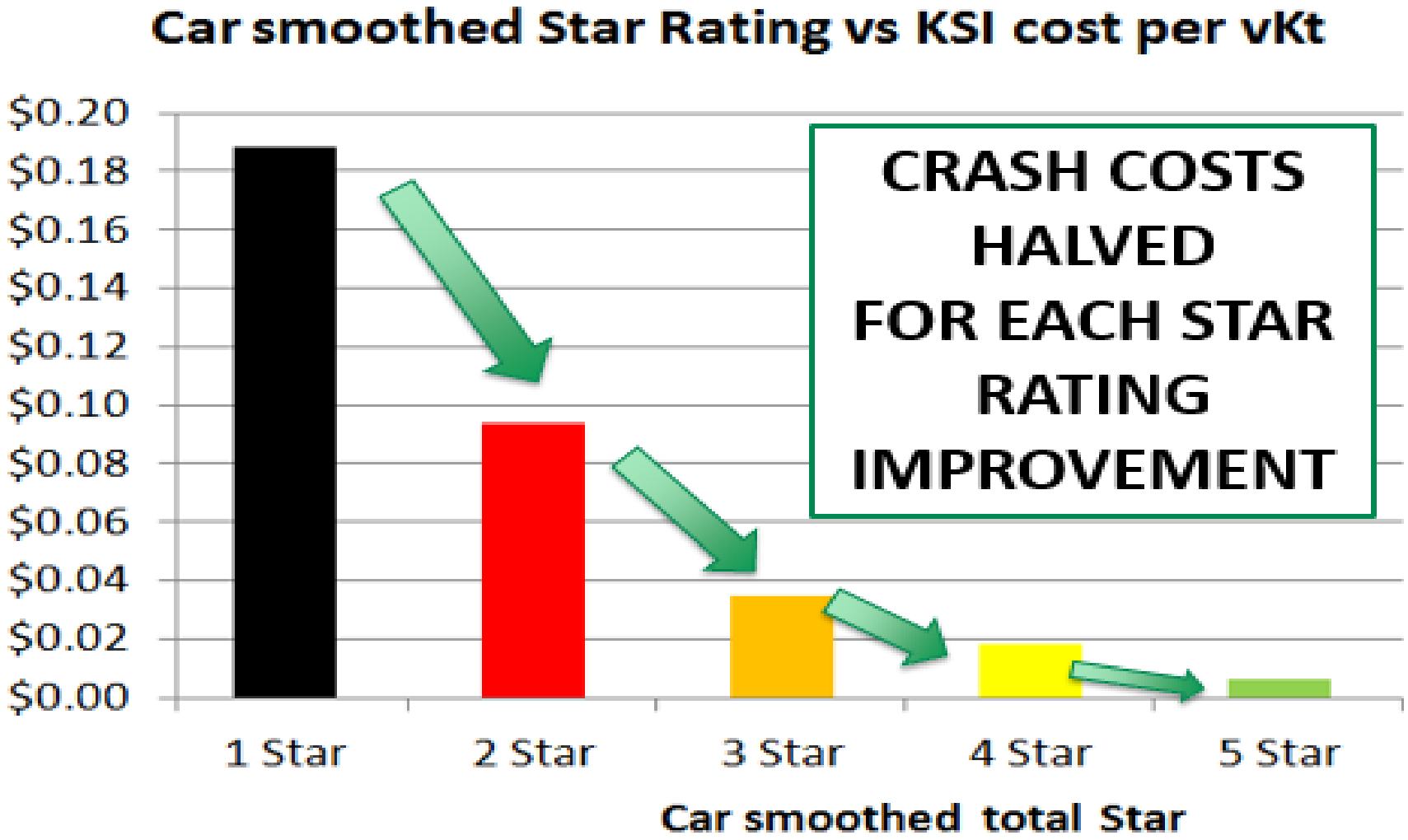
From Martin et al (2009)

Key: 1-star 2-star 3-star 4-star

- To answer "**So what?**" ("How can we use this Star Rating information?")

eg – Safer Roads Investment Plans

Star Rating vs crash costs or crash rates



Continuous improvement in **iRAP Star Rating**

- Initially devised to help "explain" the risk maps (SHOW)

- **Version 1 (original UK work)** only crash protection – "the **extent to which the road protects the vehicle occupant** in the event of a crash" (2004) – akin to NCAP car tests

- **Version 2** – incorporated crash **likelihood** (2006)

- **Version 3** – protection and likelihood, 52 features recorded every 100m; **+ 4 road-users**; more **crash types** (2013)

The principal iRAP protocols

- 1 Risk Mapping

Each year since **2002** for British roads

Fatal and serious crashes per billion vehicle kilometres (with international reporting corrections)

- 2 Star Rating

Pilot published in 2007. Update published in 2010

What we are here to discuss

Five main model development areas

Version 1.0 – 2004-2006	Version 3.02 – from 2013
(1) Only crash protection	**Crash protection and likelihood**
(2) About 30 attributes	**50+ attributes, structure changed**
(3) 4-point scale	**5-point scale & different thresholds**
(4) Risk – posted speed limit	**Risk – 85%ile operating speed**
(5) Only for car occupants	**Vehicles, peds, cyclists, m/cyclists**

(1) Adding crash likelihood elements

V1.0 Crash Protection	Version 3.02 Crash Protection & Likelihood
Barrier, median type, slope, distance to object, point object? continuous object? shoulder, roundabout or not? …only for vehicle occupants	**<= All of these, but in more detail (about 20 more attributes having a substantial effect on risk); model structure changes**
	plus crash likelihood of
	head-on crashes – median design
	intersection likelihood – layout
	run-off crash and injury likelihood – distance curvature, nature of object
	Pedestrian provision
	Cyclist and **motorcyclist** provision

iRAP – a tool in a spectrum of crash analysis

- **Not** "hot spot", "crash cluster" or "black spots"
- iRAP models safety from drive-through assessment of 52 factors every 100m

single site – safety audit – area wide – mass action – route action – route quality

1979

eg: Trunk road upgrades 1990s

Road Safety Audit alongside iRAP

Topic	**Road Safety Audit** → **Qualitative**	**iRAP** → **Quantitative**
Method of data collection	On-site visits / design plans	Survey to collect mages at 10m to 20m intervals / design plans
Assessment	Checklist Covers broad number of issues	Coding of fixed list of attributes at 100m intervals Application of risk factors
Reporting of risk	Checklist	Star Rating Scores, Star Ratings, estimates of deaths and serious injuries, estimate of economic cost
Recommendations	List of countermeasures and further work	List of countermeasures at 100m intervals, deaths and serious injuries that could be prevented, economic savings

Star Rating of Design Plans

Case study 4

"Before" characteristics of M2

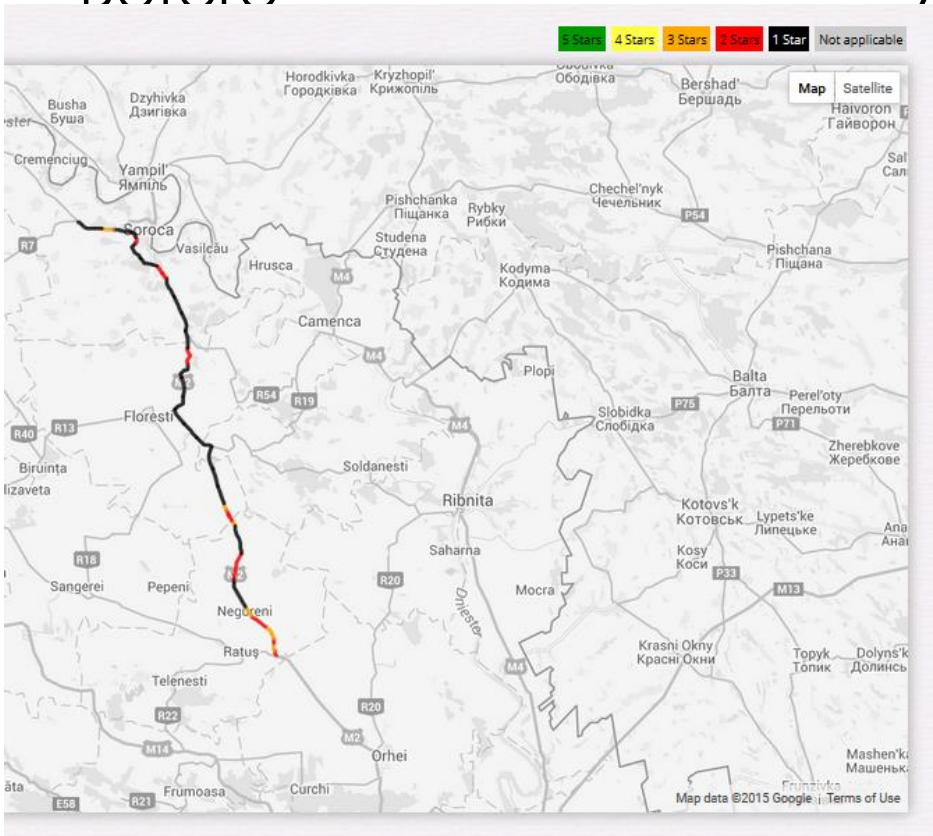
1. Poor quality single carriageway, markings and signs, *very* poor pavement in parts. Mixed traffic.

2. Lack of run-off protection generally. Existing safety fencing poor; many roadside hazards. Aggressive bridge parapet-ends. Junctions poor.

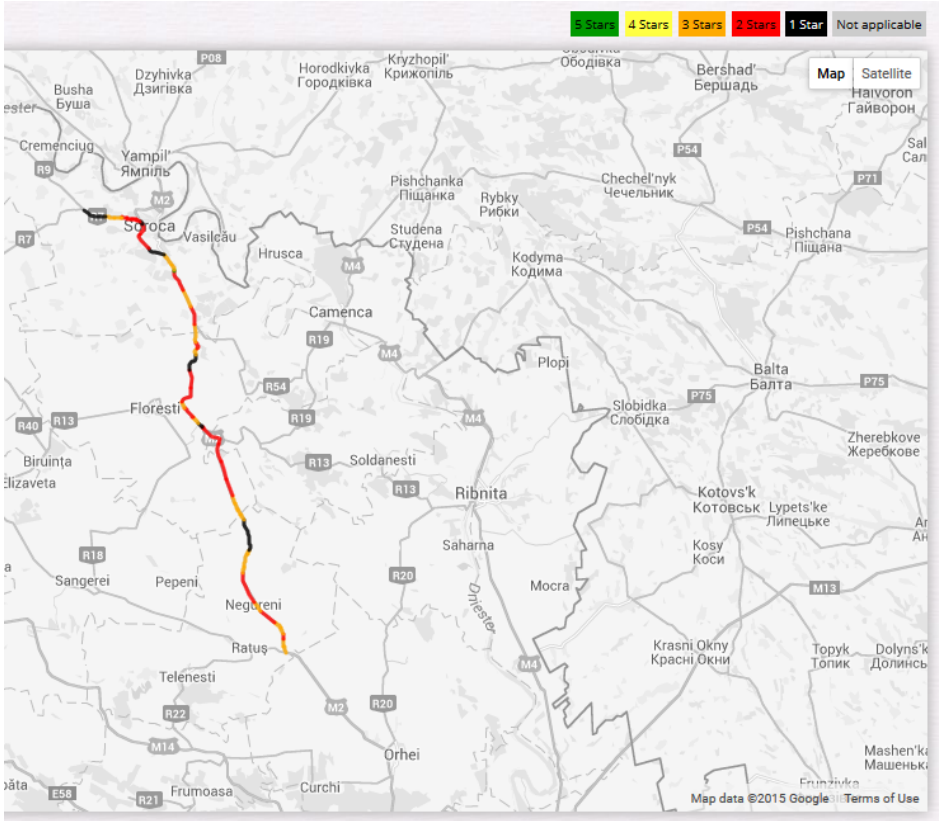
3. Villages – no speed reduction measures. Pedestrian footways poor quality. Few pedestrian crossings.

93km, M2 Moldova – from 17% to 37% 3-star or more

Before



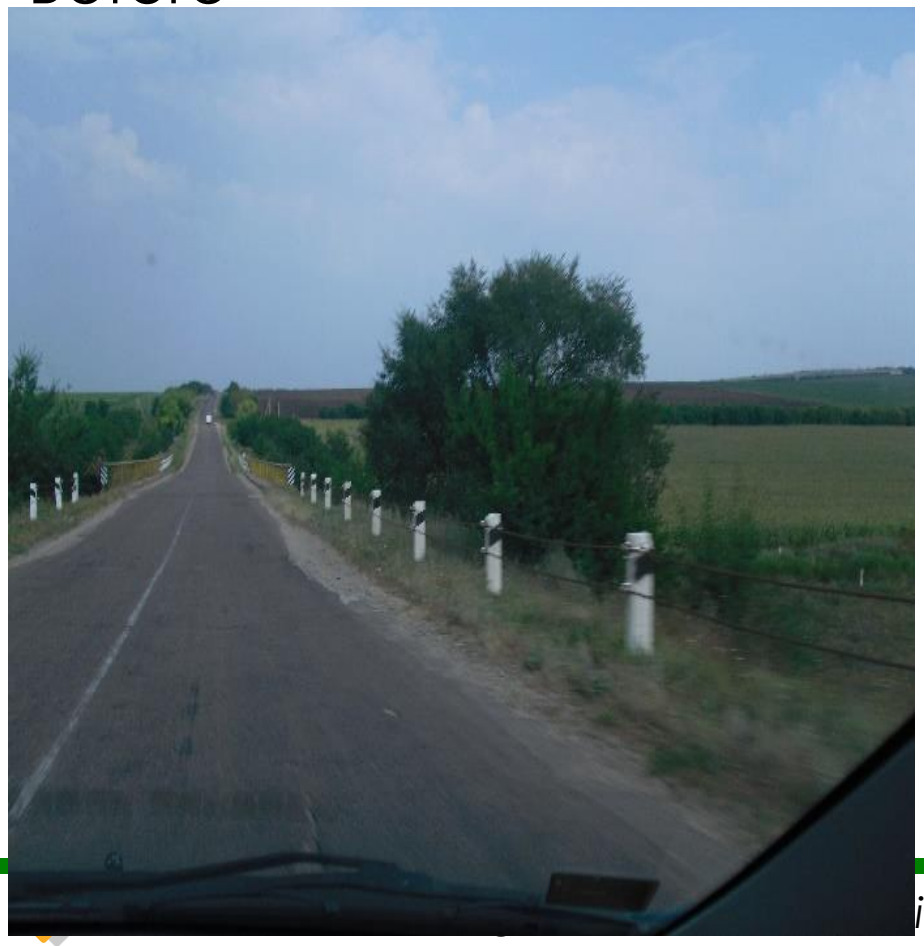
After



Safe Roadsides – run-off crashes

walnut trees – 8,394m guardrail/barriers

Before



After

Safe Intersections – lines of sight; slow vehicles or protect them:

13 major intersections

MILLENNIUM CHALLENGE CORPORATION
UNITED STATES OF AMERICA

EuroRAP
EUROPEAN ROAD ASSESSMENT PROGRAMME

Safe Villages – concerns for pedestrians – footpaths, 51 pedestrian crossings; speed in villages

Investment in the M2 in Moldova, 2010

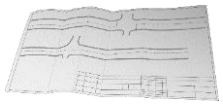
- **Benefit Cost Ratio (BCR) > 5**

Cost **Benefit**

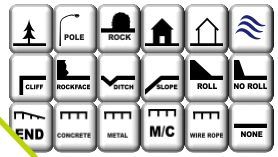
Process

Road Survey

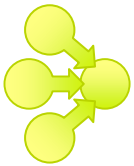
Road Design



Road coding

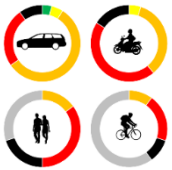


Data preparation



Processing

Star Ratings



Investment plan

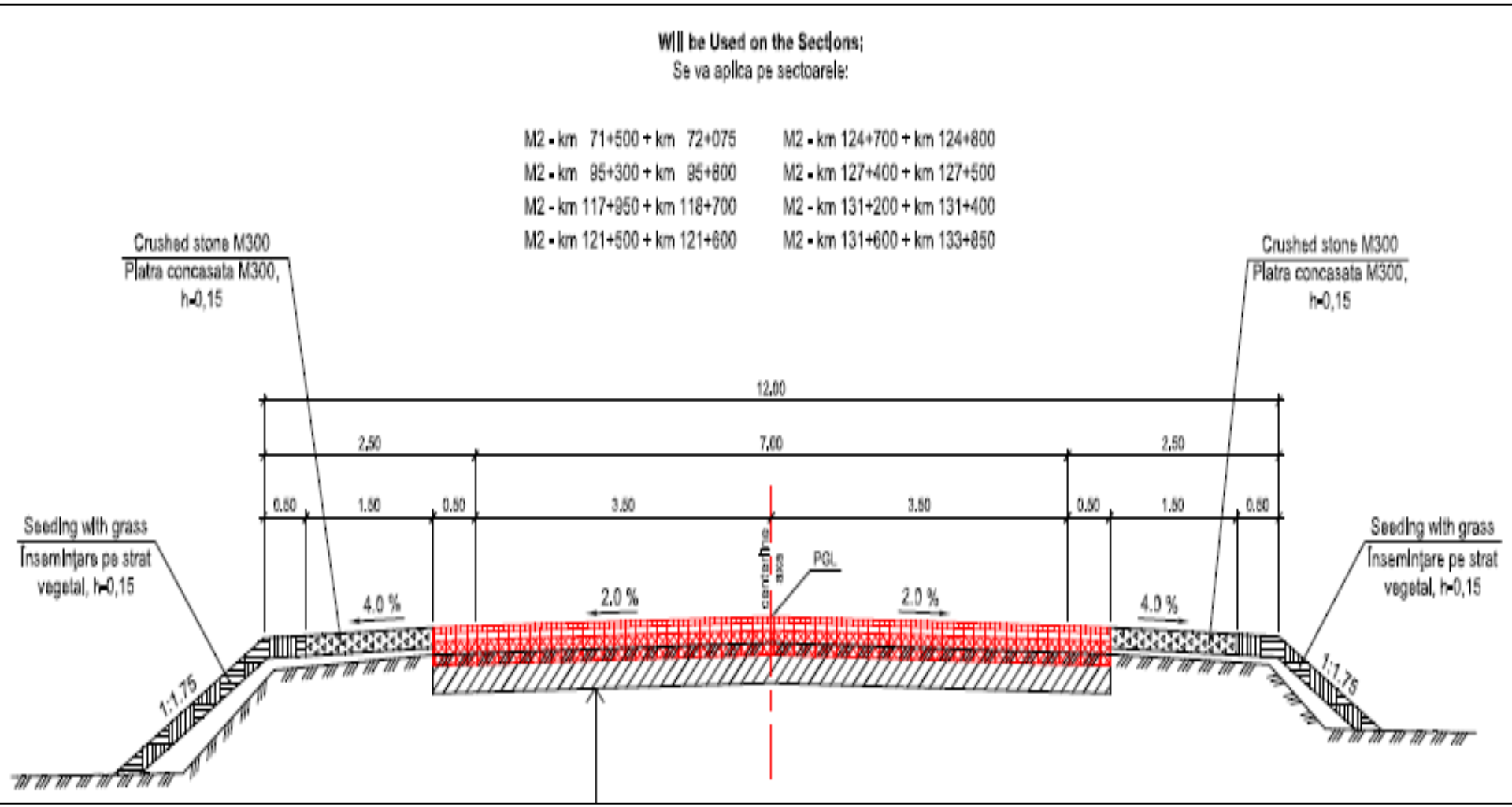
Target: optimise star ratings, reduce deaths and serious injuries

Local designers develop and update designs

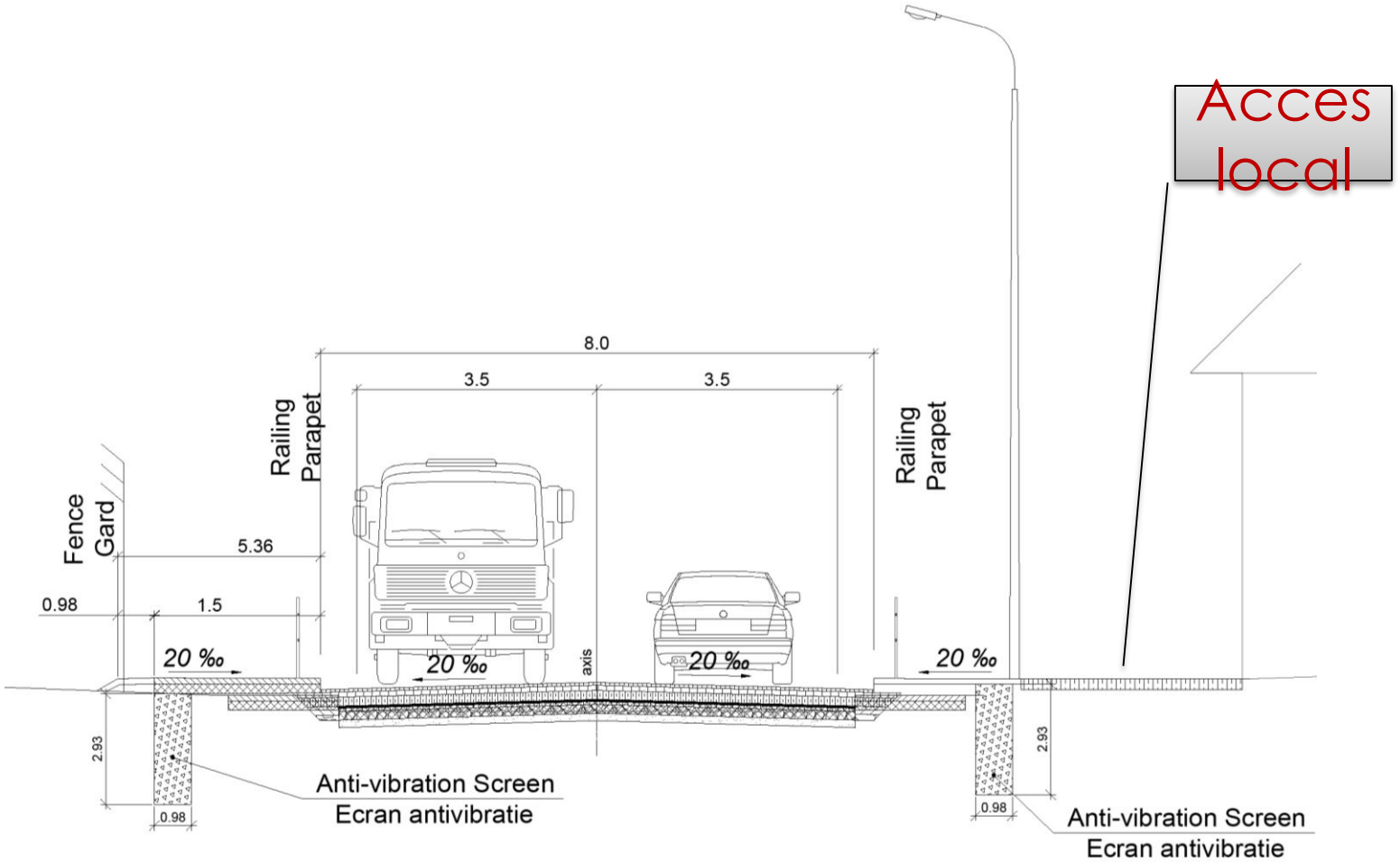
What do design plans show?

1. **Road profiles** – locations and lengths

Road profile



Typical cross section in the village / Profil transversal in localități

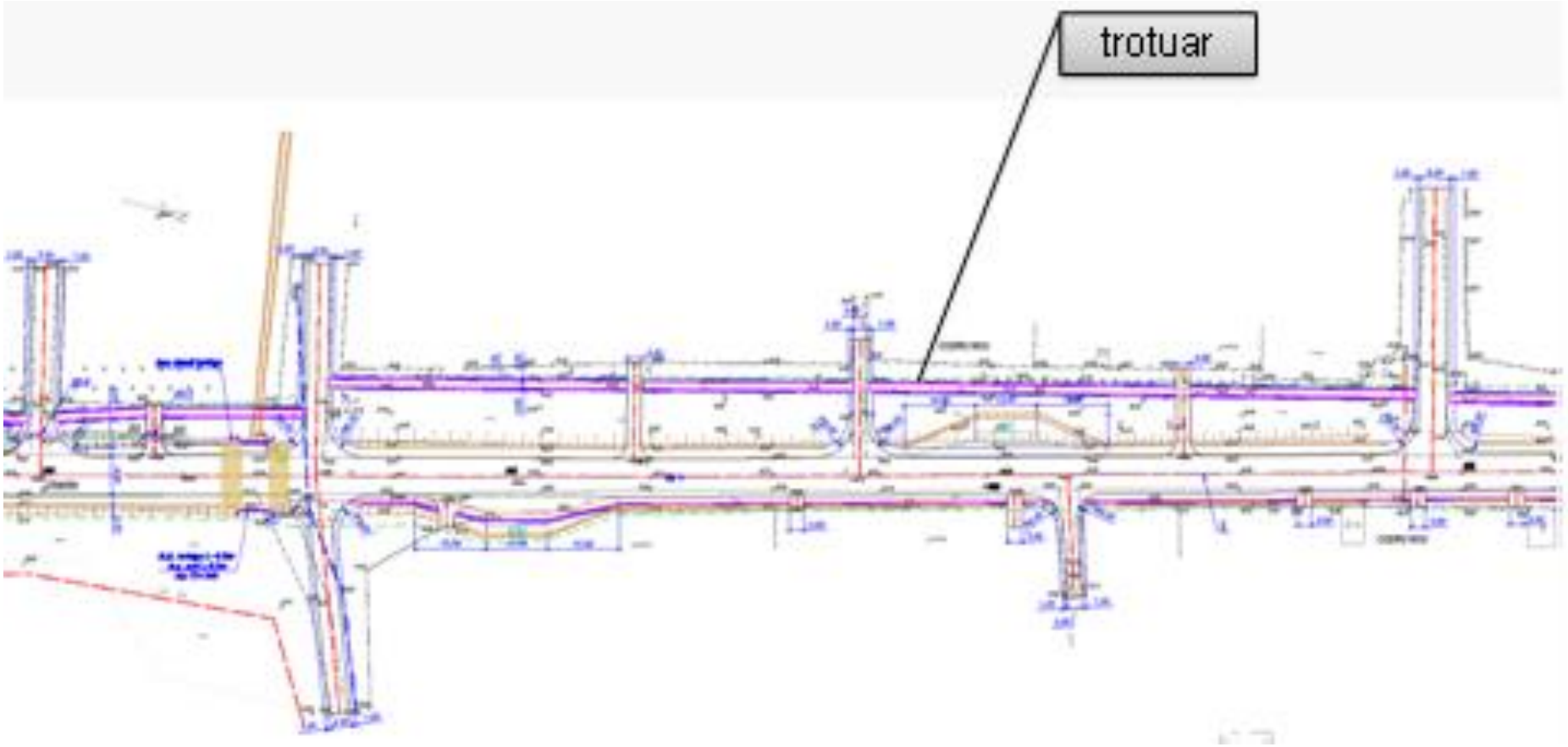


What do design plans show?

1. **Road profiles** – locations and lengths

2. **Road plan** – location of footways, frequency and layout of junctions

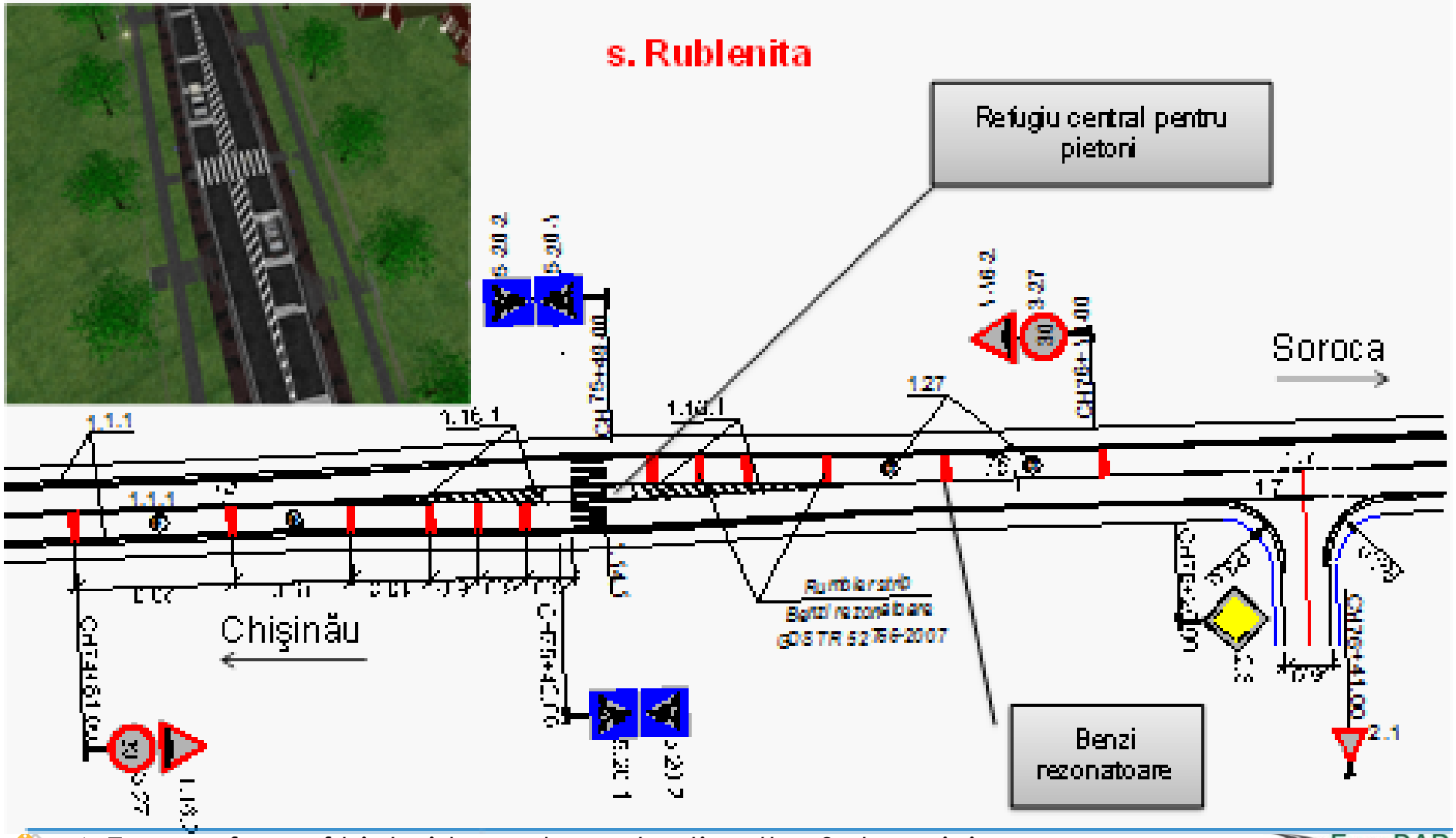
Road plan – eg footway layout



What do design plans show?

- **Road profiles – locations and lengths**
- **Road plan – location of footways, frequency and layout of junctions**
- **Road markings plan** – detail of signing, road markings, supplementary measures such as rumble strips

Road markings – signs and lines



M2 Star Rating (car occupants) of existing road and from design plans

M2 Saratenii-Soroca-Drochia Junction 93km

Results – increase in Star Rating

	Existing road	Design plans
Vehicle occupant – 3-star or more	**15%**	**38%**
Pedestrian – 4-star or more*	**9%**	**84%**
***where pedestrians present**		

Reduction in fatal and serious injuries

	Existing road	Design plans
Model-predicted number estimated killed or seriously injured per year	**46**	**27**

Star Rating Policy & Project Targets

- 4-star roads of national significance (NZ Transport Agency)
- 75% of travel on 3-star or better by 2020 (Malaysia MoT)
- Minimum 3-star Midlands Highway; 85% of travel on 3-star or better roads by 2020 (Australian Authorities)
- 4-star roads for pedestrians in linear settlements and all roads with 50,000 vehicles or more (ADB)
- Minimum 3-star for new roads (MCC)
- Minimum 3-star roads for projects in India (World Bank)

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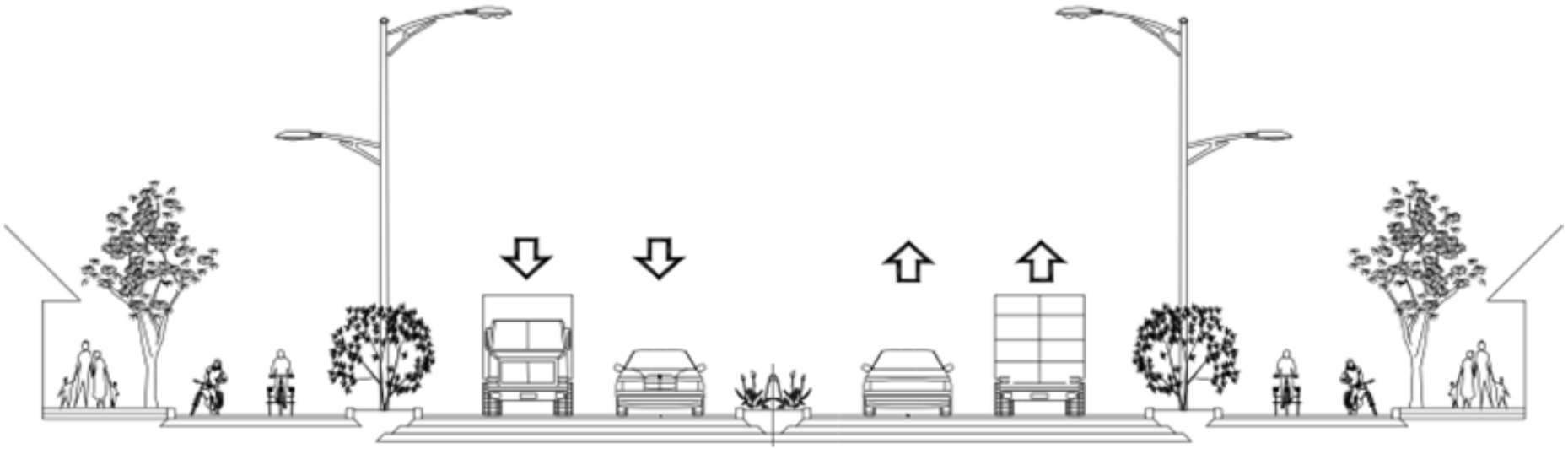

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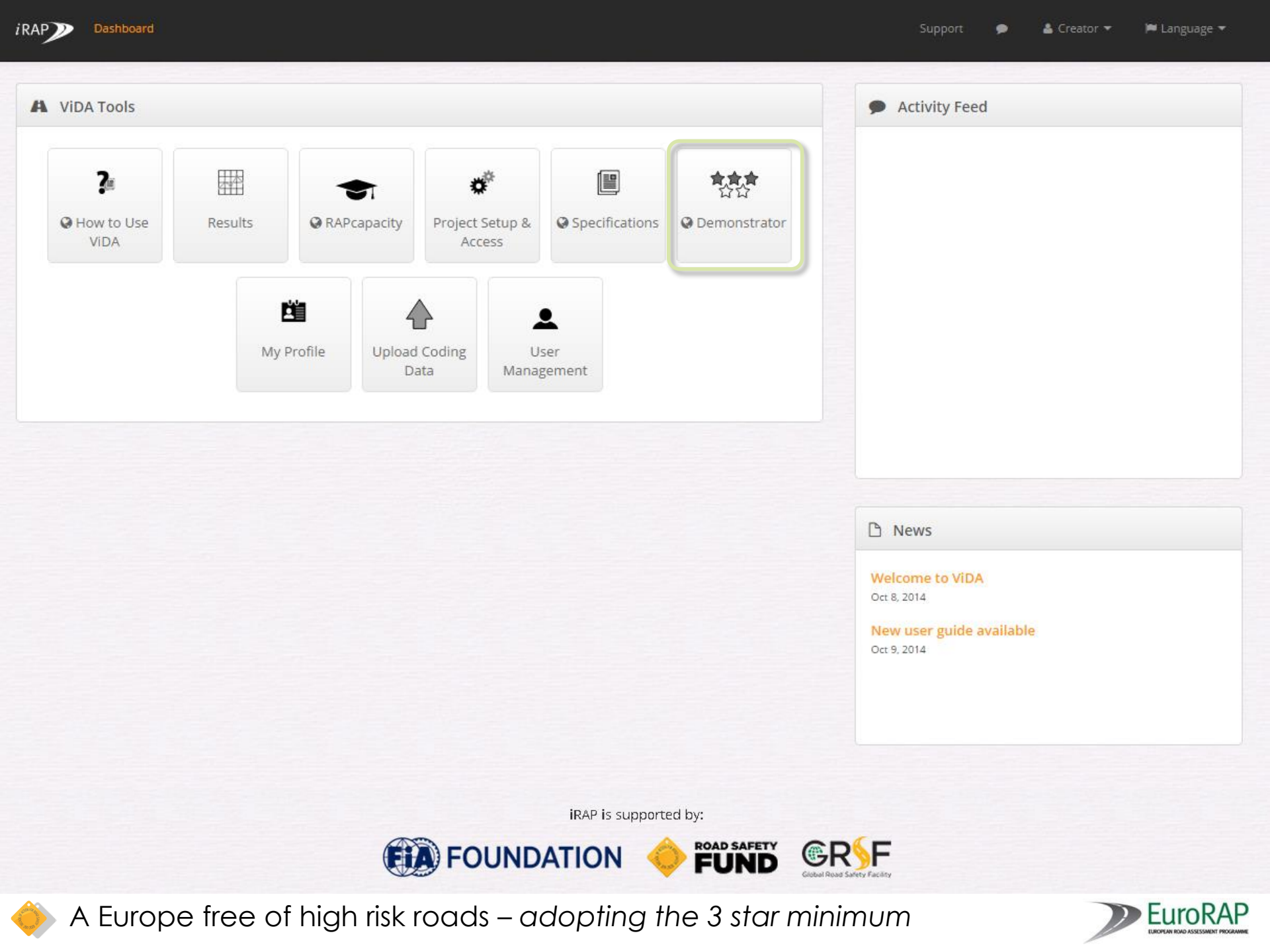
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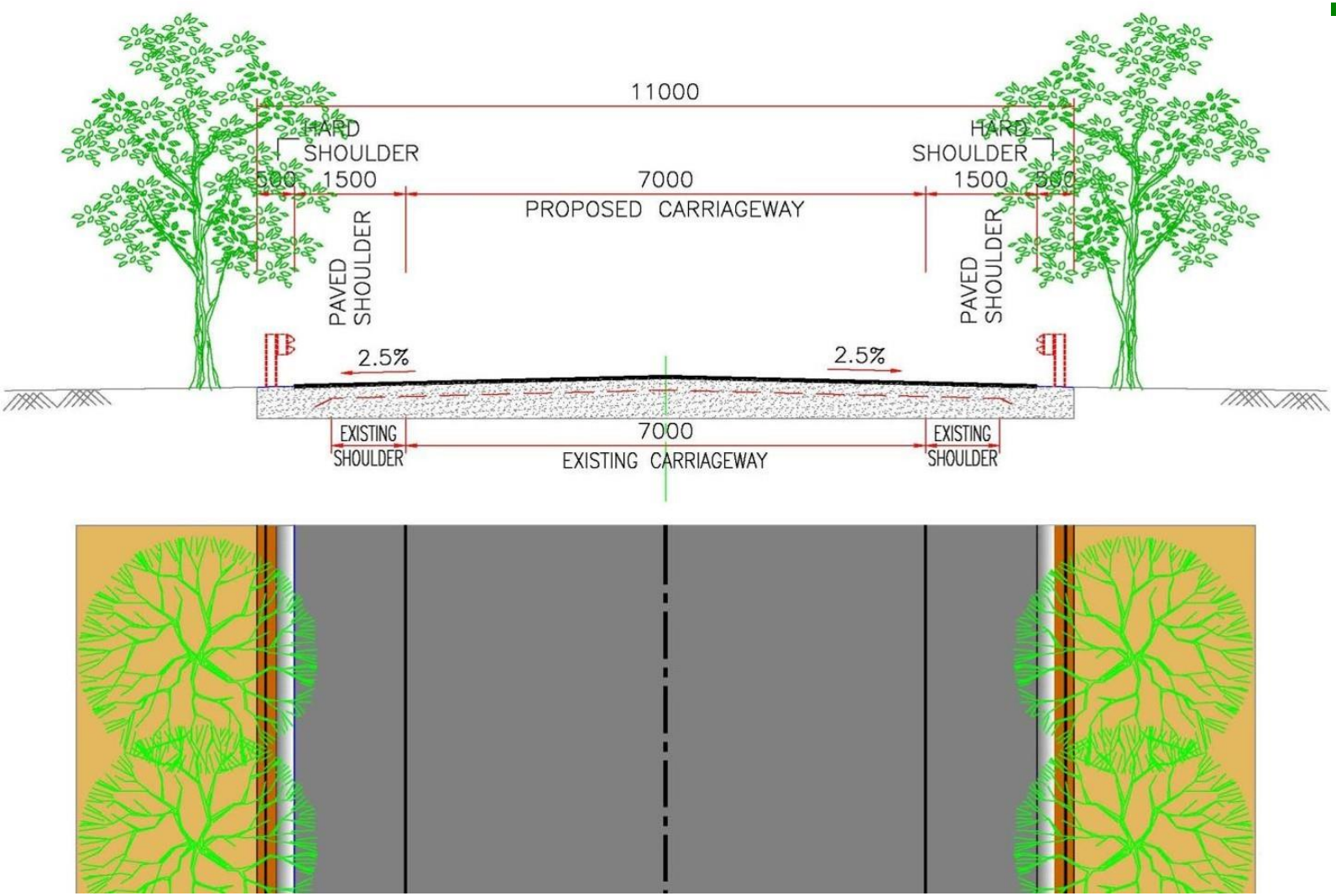
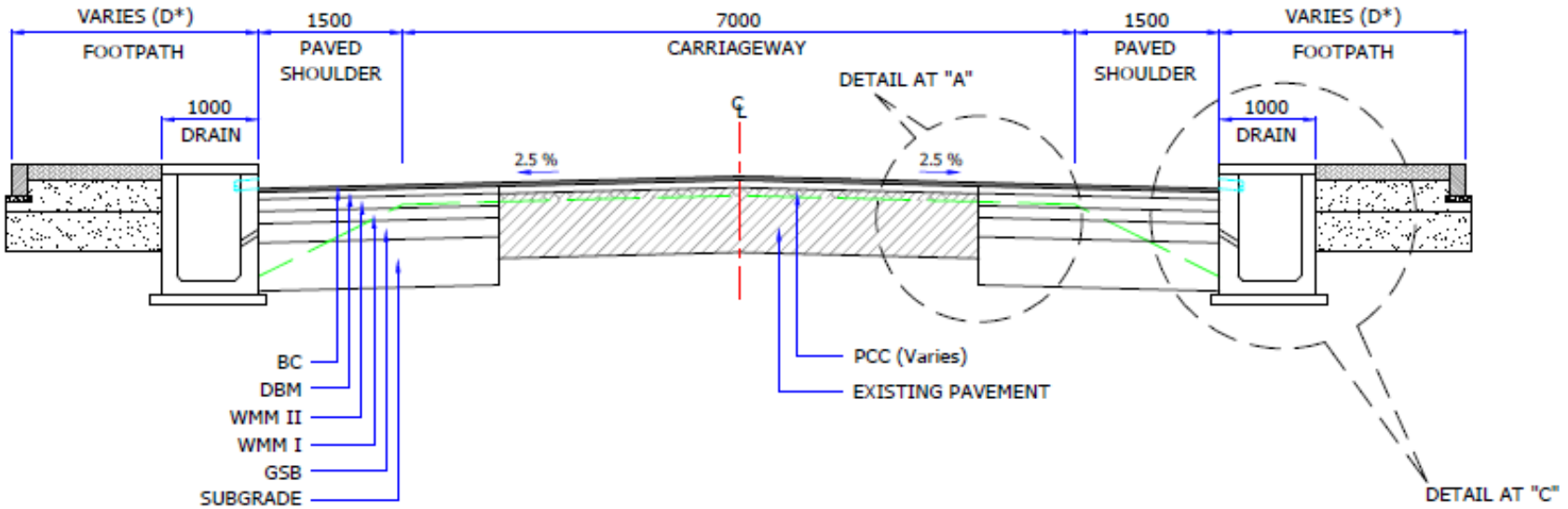
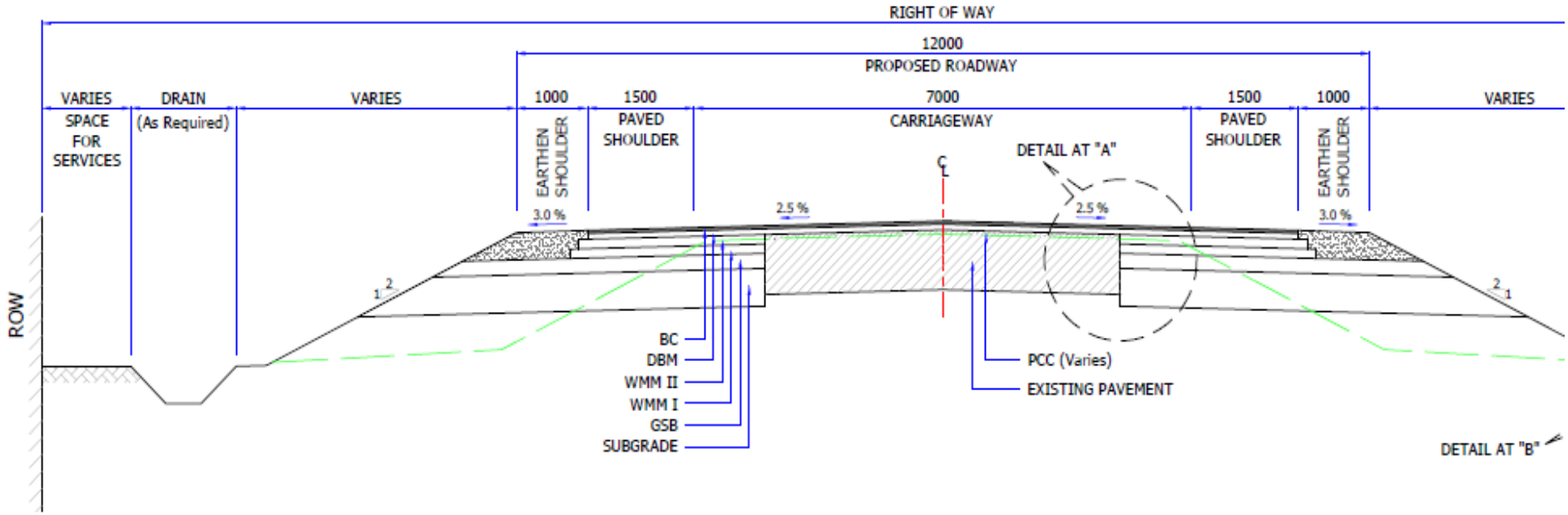


Design B – urban widening



TCS-2A - WIDENING IN URBAN AREA (OVERLAY SECTION)

Design C – rural village



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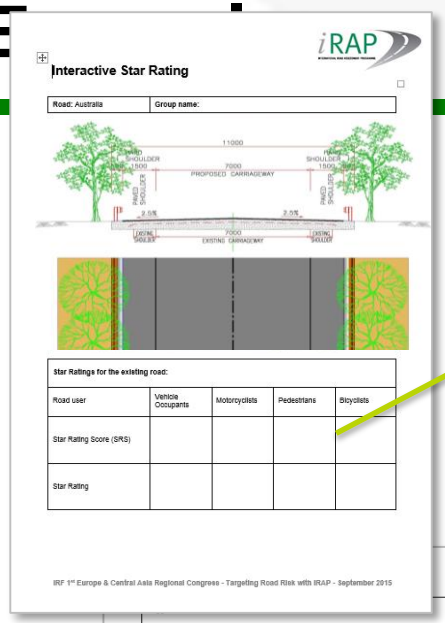

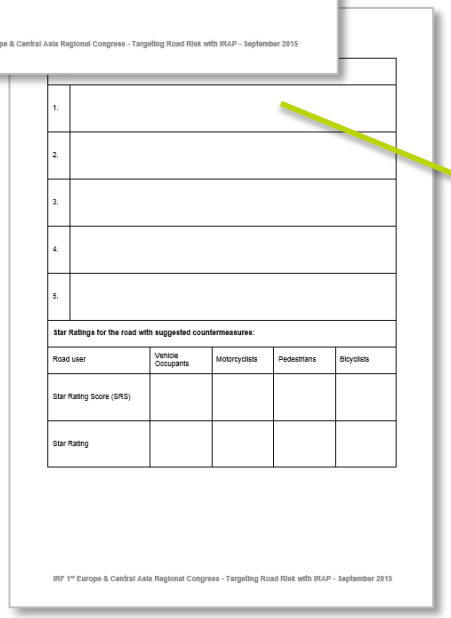

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Advantages and disadvantages of iRAP and other methodologies

- Discussion led by Steve and Olivera

THANK YOU

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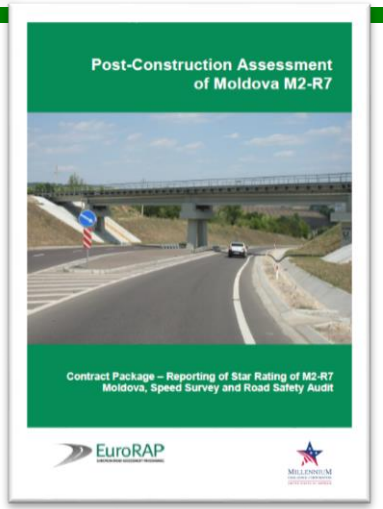
Moldova and Ukraine case studies

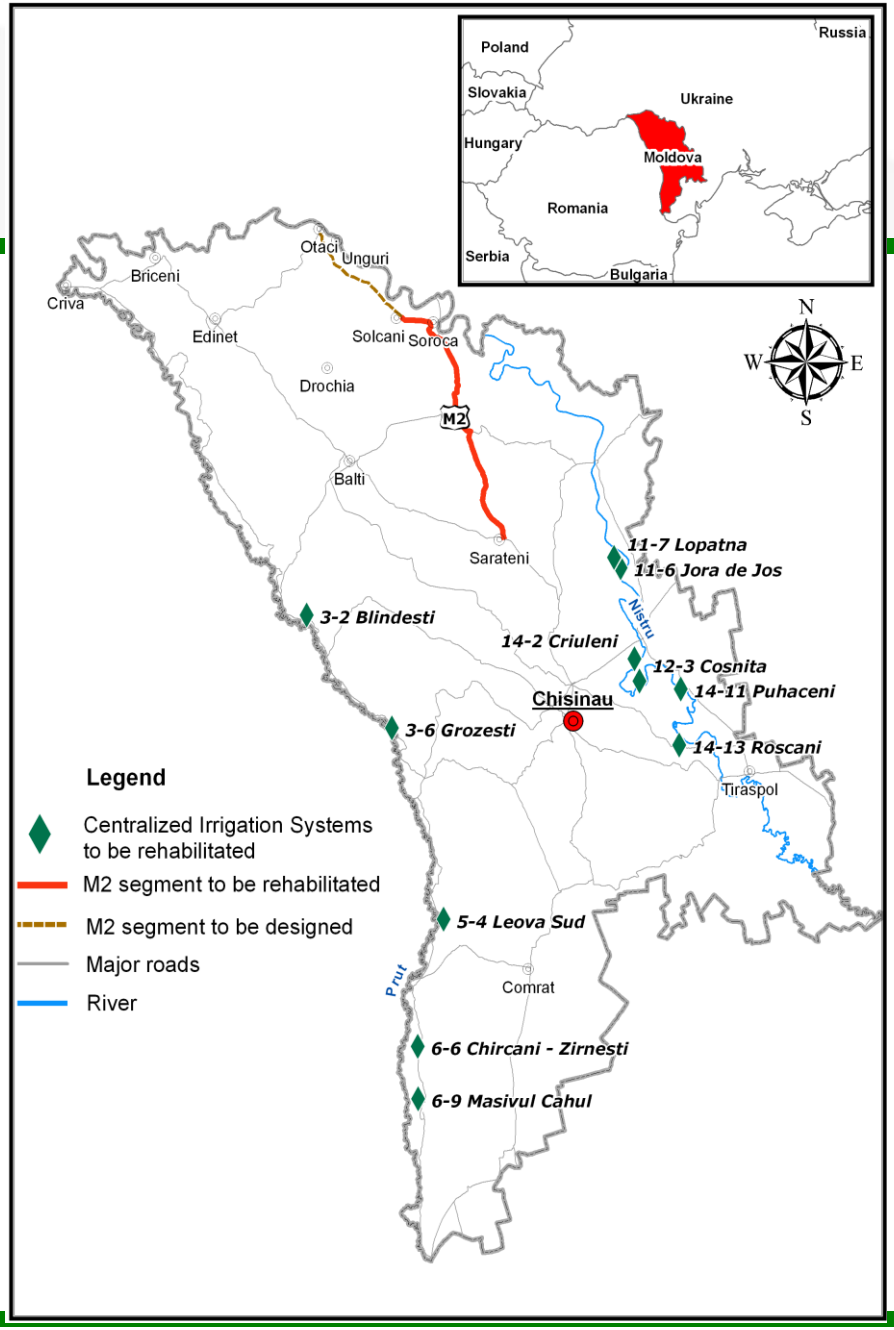
- Moldova 2011 and 2015 -- "Before and after"

- http://www.irap.org/en/about-irap-3/assessment-reports?download=282:m2-r7-moldova



- Ukraine 2012 and 2016 – roads rated and sections selected for upgrade

http://www.irap.org/en/about-irap-3/assessment-reports?download=285:m12-corridor-ukraine-assessment-report


Poland
Russia
Slovakia
Ukraine
Hungary
Moldova
Romania
Serbia
Bulgaria
N
W
E
S
Otaci
Unguri
Briceni
Criva
Edinet
Solcani
Soroca
Drochia
M2
Balti
Sarateni
11-7 Lopatna
11-6 Jora de Jos
3-2 Blindesti
14-2 Criuleni
Nistru
12-3 Cosnita
14-11 Puhaceni
Chisinau
3-6 Grozesti
14-13 Roscani
Tiraspol
Legend
Centralized Irrigation Systems to be rehabilitated
M2 segment to be rehabilitated
M2 segment to be designed
Major roads
River
5-4 Leova Sud
Prut
Comrat
6-6 Chircani - Zirnesti
6-9 Masivul Cahul

M2-R7 iRAP Star Rating "Before"

M2 Saratenii-Soroca-Drochia Junction
93km

Priorities for the M2 in 2010

1. **Safe Intersections** – lines of sight; slow vehicles or protect them – **13 major intersections**

2. **Safe Villages** – concerns for pedestrians – footpaths, **51 pedestrian crossings**; speed in villages

3. **Safe Roadsides – run-off crashes; walnut trees – 8,394m guardrail/barriers**

- **Benefit Cost Rating (BCR) > 5 from Safer Roads Investment Plans – shoulder sealing, signing & lining, road surfacing, refuge islands**

Before and after


90


STRABAG

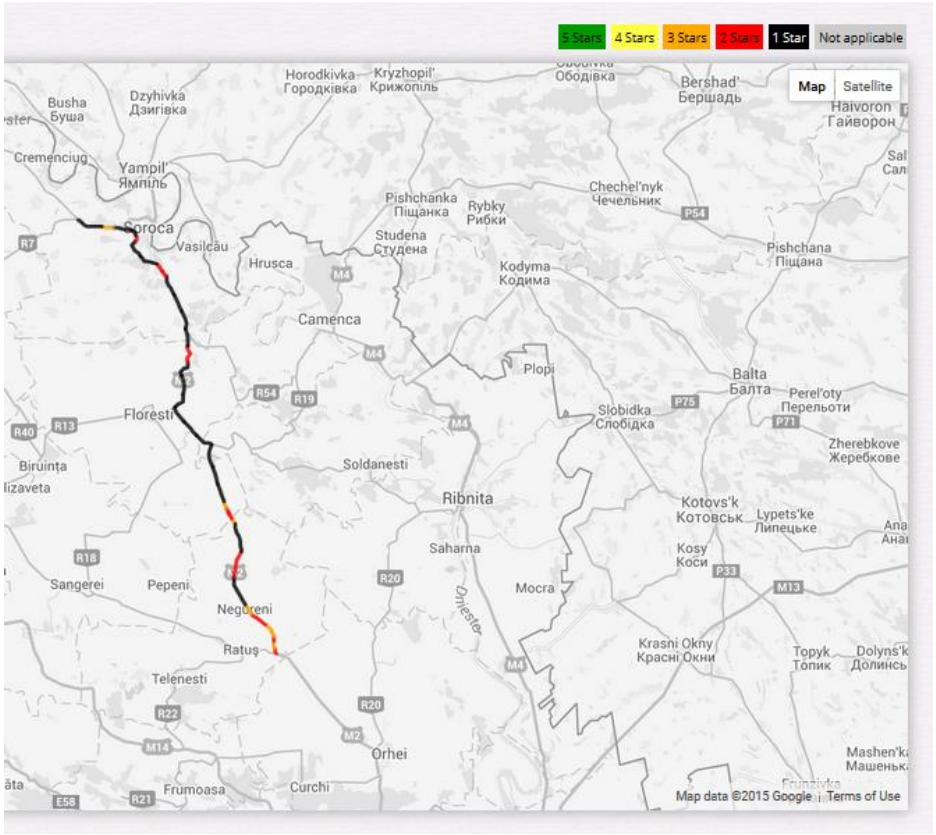

OTACI 42
OCNIȚA 69
DROCHIA 31

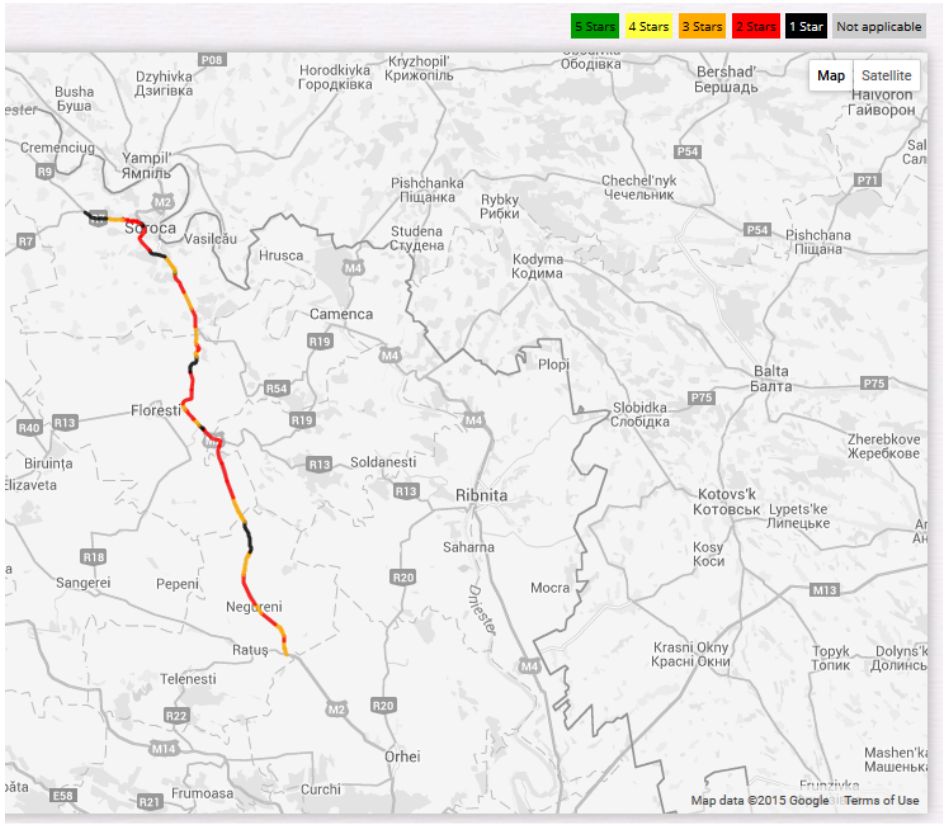

50
50


RÎBNIȚA 55
ORHEI 65
CHIȘINĂU 110


30

Vehicle occupant safety





Priorities for the M2

- **32%** of the M2-R7 is **now** 3-star or better for car occupants.

- The percentage of road rated 3-stars or better for pedestrians in villages increased from **67% to 72%** (with a notable increase in 4-star and 5-star provision (from none to 27% in total))

- How **do we increase** that?

Moldova further opportunities

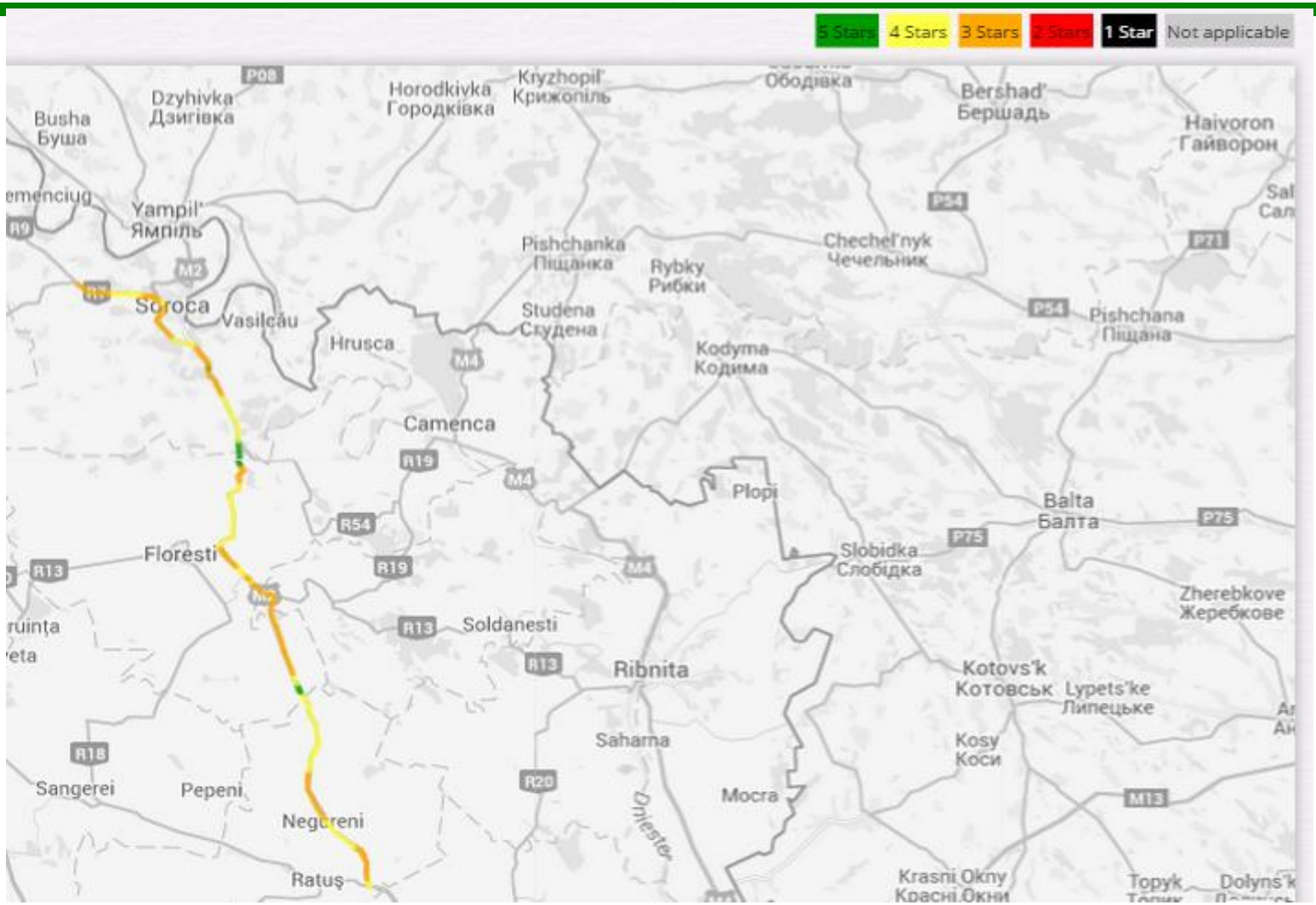
- Roadside barriers
- Shoulder rumble strips
- Central hatching
- Clear roadside hazards
- Shoulder sealing
- Intersections
- etc, etc

SAFE ROADSIDES


PETROTYL

SAFE VILLAGES

Vehicle Star Rating if all measures implemented



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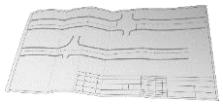
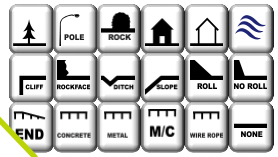
Process

Road Survey

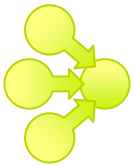
Road Design



Road coding

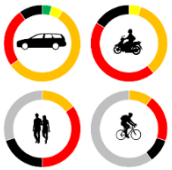


Data preparation



Processing

Star Ratings



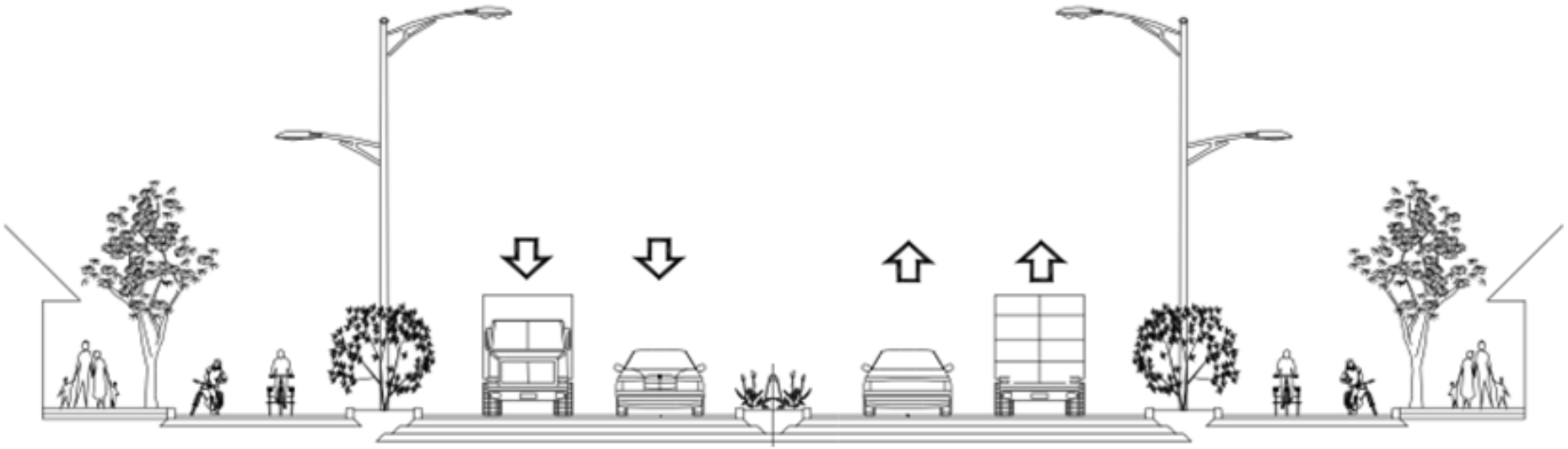
Investment plan

Target: optimise star ratings, reduce deaths and serious injuries

Local designers develop and update designs

Proven safety countermeasures

iRAP assessments: quantitative



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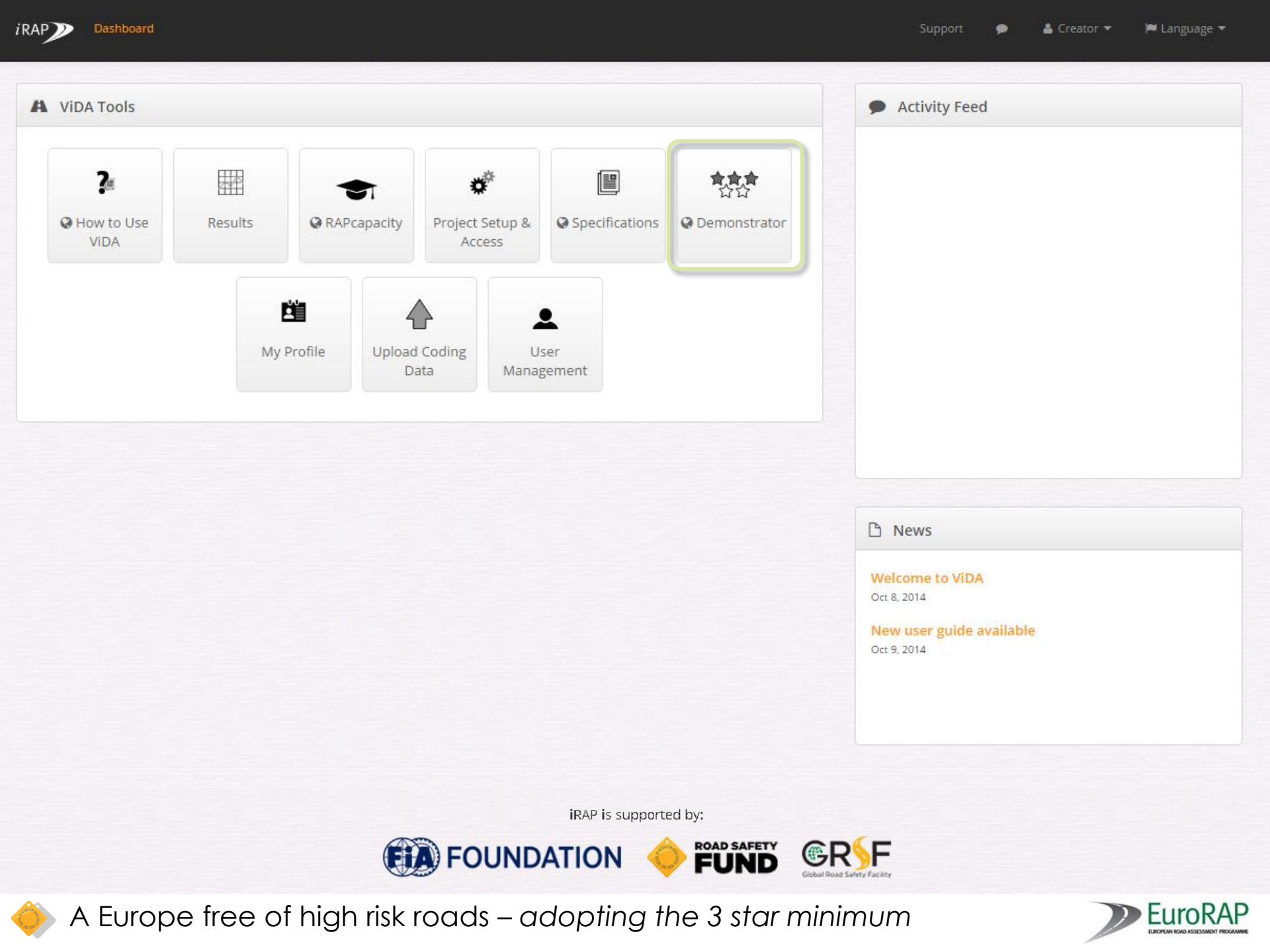
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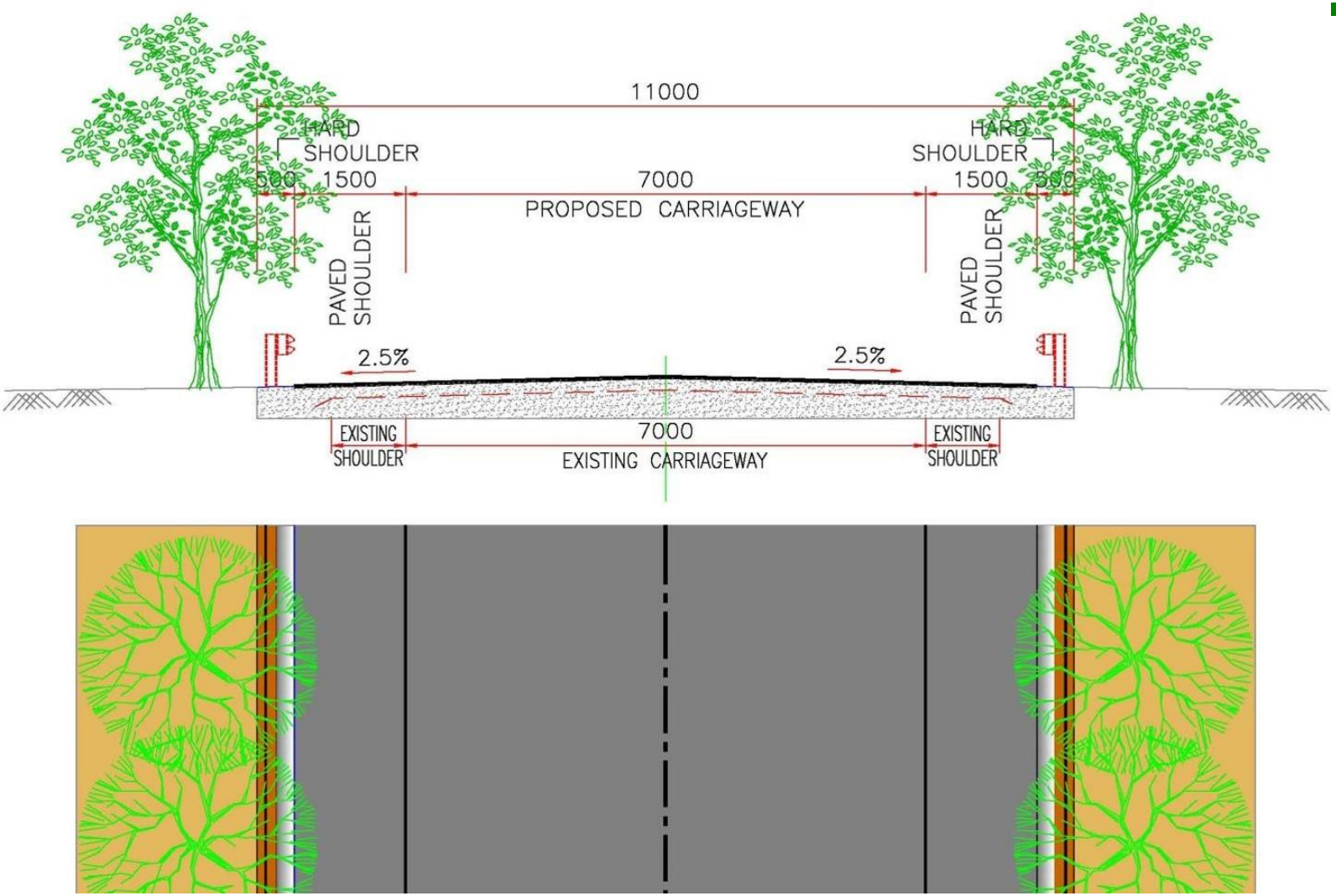

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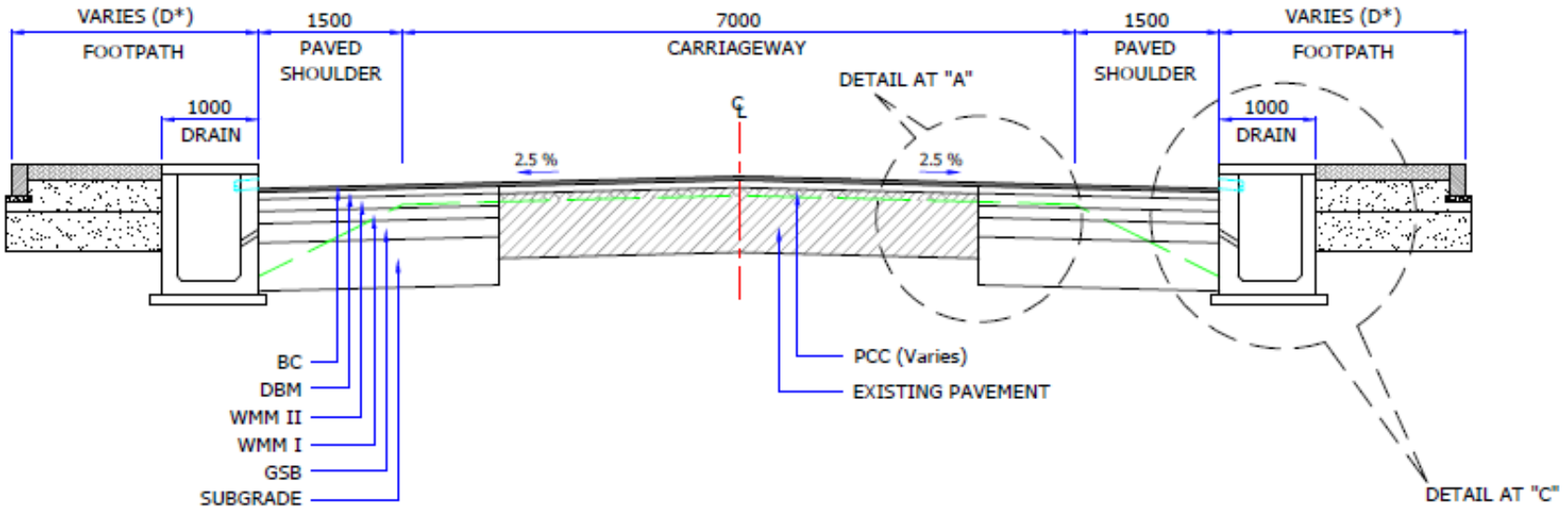

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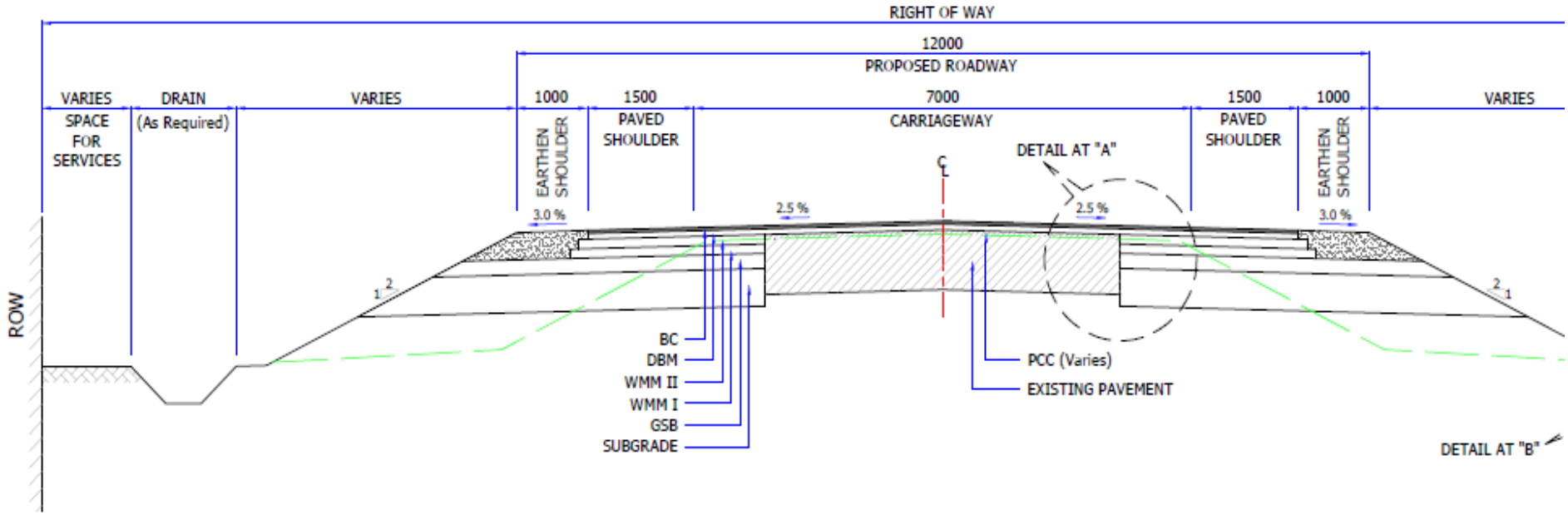

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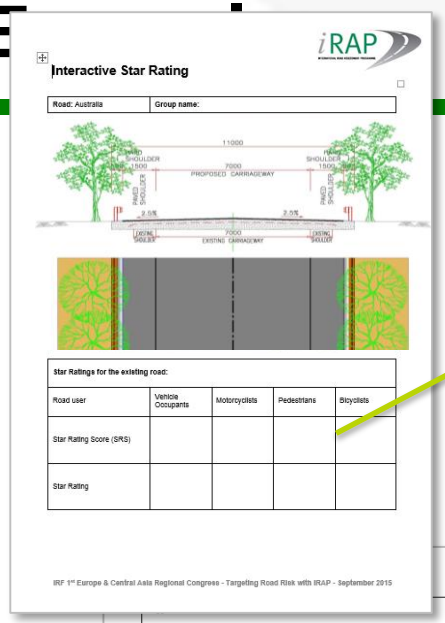

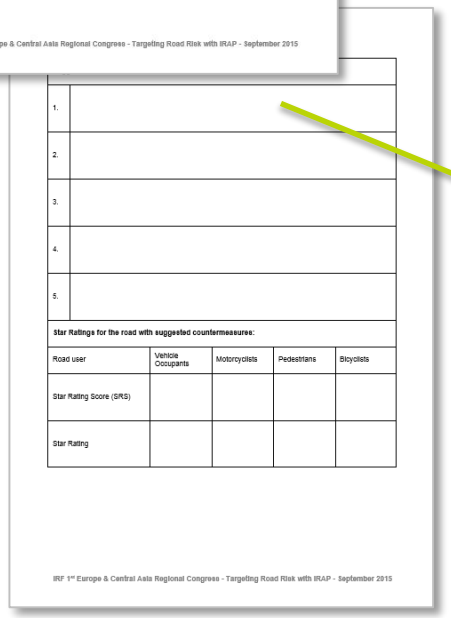

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