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TA2 VRUS – CZECH REPUBLIC

RADAR – Risk Assessment on Danube Area Roads

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5.	04 October 2021	Final revision	Roman Turza, UAMK

Abbreviation list

AADT	Annual Average Daily Traffic
EIA	Environmental Impact Assessment
RADAR	Risk Assessment on Danube Area Roads (DTP project)
SR4S	Star Rating for Schools
SRIP	Safer Road Investment Plan
SRS	Star Rating Score
SUMP	Sustainable Urban Transport Plan
VRUs	Vulnerable Road Users

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1. Executive summary

The following report aims at providing an English executive summary of the RADAR WP5 Pilot study carried out by UAMK in the Czech Republic. The study focused on a detailed comprehensive analysis of the provisions for Vulnerable Road Users (VRUs) in road traffic, particularly in urban environment.

The study consisted of 2 major exercises:

- analysis and surveys conducted by an external subcontractor (AFRY CZ);
- survey, assessment and finalization of the study carried out by UAMK.

The objective of the study was to identify state-of-the-art traffic engineering practices incl. legislative framework, technical conditions, persisting shortcomings in practical implementations, as well as best practice examples, which can be observed in Czech municipalities of various sizes. In addition, the provisions for road safety of VRUs have been examined in a survey along the primary north – south class I road connections between the capital of Prague and CZ/A borders. A special focus was given to the assessment of conditions for VRUs in a problematic and publicly well-known case of the town of Olbramovice – the municipality located on a heavily loaded class I road I/3, which is presently substituting the missing D3 motorway link.

Even though the thematic area of VRUs has been more and more accented within both national and municipal infrastructure development in the Czech Republic, many aspects still rather remain in the form of strategies and lack practical implementation. The pilot study not only analyses present legal and technical conditions framing the development of provisions for VRUs but brings a valuable insight on how different measures are being put to practice in different urban and semi-urban environments. There has never been a study of such an extent produced on safety of VRUs in road traffic in the Czech Republic.

iRAP methodology was used to present star rating for cars and pedestrian at the approach to the Olbramovice village at the junction and access to the bus-stop on a 1st class road, used by children for school buses, and at the through road section through the Olbramovice. At the next step, suitable countermeasures were proposed and new star rating after implementation of safety treatment was calculated by ViDA calculator.

Based on the countermeasures proposed, schematic design layouts for both sections were prepared as a proposal for implementation.

2. Study structure

The pilot study consists of several key parts, which are in brief presented below.

2.1. Definition of VRUs and their mobility needs

The study begins with a proper definition of all VRU groups and specification of their individual needs in transport/mobility. It does not only concern pedestrians and cyclists, but specifically users of scooters, e-bikes, motorcycles, wheelchairs, in-line skates and other people movers like Segway. Special focus is given to the safety of children.

2.2. Conditions and provisions for VRUs in theory

The chapter is dedicated to the evaluation of present conditions for implementing infrastructure provisions for VRUs in compliance with valid national legislation and technical conditions. It includes the recherche of normative requirements, template solutions and technical regulations with respect to provisions for pedestrians and cyclists, considering properly the needs of people with decreased orientation ability or children.

The research of all relevant legislative and technical conditions together with professional methodologies has been carried out in order to identify all sources relevant to non-motorised traffic.

2.3. Non-motorized traffic demand

The section analyses a real demand for pedestrian and bicycle traffic among different origins and destinations within, as well as among settlements of various sizes. The scope of the analysis includes reasons and purposes for using non-motorized transport (e.g. regular, unique, touristic journeys) and typical origins/destinations.

The analysis takes into account demographic structure of population, area characteristics (size and distance of settlement, terrain, public facilities, public transport accessibility) with the aim of defining generally valid mobility behaviour patterns and modal split.

Many different data sources were used, analysed and complemented with own professional expertise and experience, including available Sustainable Urban Mobility Plans (SUMPs) of several Czech cities. The analysis concludes with a comprehensive assessment of the demand, possibilities, and ways of using pedestrian and cycle transport.

2.4. Conditions and provisions for VRUs in practice

A significant part of the pilot study was dedicated to the survey of practical solutions implemented for VRUs and their safety. The examination was carried out in carefully selected Czech cities, as well as smaller municipalities, with respect to their urban structure and primary road networks.

The chapter describes and evaluates real conditions for non-motorized traffic within individual settlements, as well as among them. Partial results of the VRUs provisions assessment and further professional experience of the project expert team have been summarized and generalized as the state-of-the-art condition of road infrastructure provisions for VRUs in the Czech Republic.

2.5. Catalogue of solutions

Based on the desk research and analysis of legal framework, technical conditions and standards, road safety experts of UAMK and AFRY created a catalogue of measures and template solutions for effective protection of VRUs in road traffic. Those include transections and cross sections on both rural and urban roads, incl. accesses to public transport and other facilities. Normative solutions are therefore examined in terms of their real benefits, based on professional experience of authors with implementation of road infrastructure provisions for non-motorized traffic. Its purpose is to revise the available practices with special focus on their benefits to safe movement of VRUs in traffic and elimination of risk.

2.6. Practical surveys and assessments

A significant part of the pilot study is dedicated to site examination of VRUs provisions in various urban settlements, as well as in rural areas with specific VRU activities. There were 2 major exercises carried out – surveys in 9 carefully selected Czech municipalities of different sizes and a drive-through road survey of VRU provisions along the class I road connection Prague – CZ/A borders (towards Linz) with a special dedication to a problematic case of the town of Olbramovice.

3. Provisions for VRUs in Czech municipalities

The settlements targeted for the surveys were carefully selected using the methodology and the matrix considering the number of inhabitants, road infrastructure, social infrastructure (schools, hospitals, theatres), job opportunity, public transport availability, distance to the regional centre and to the motorway. From the longlisted cities, shortlisted ones were investigated in detail to collect and describe the typical level of provisions for VRUs.

The following settlements (number of inhabitants indicated) were used to cover requested categories:

- Ústí nad Labem (92 716)
- Kutná Hora (20 600)
- Beroun (19 600)
- Český Brod (7 000)
- Líbeznice (2 900)
- Babice (1 300)
- Točník (230)

3.1. Example of the analysis performed – the town of Líbeznice

Basic information

- population: 2 900
- average age: 35,8
- status: municipality
- area: 6 km2
- altitude: 195-280 above sea level
- terrain type: flat

Origins and destinations

There are no other destinations apart from those of public amenities named below.

Road transport

A trunk road network consists of road I/9, which forms a western bypass, and roads II/243 and II/244, which are connected to I/9. This network is complemented with class III roads leading to neighbouring municipalities and the urban road network. The road carrying highest volumes (except for the bypass) is road II/243 in direction of Bořanovice, which is daily used by 11 300 vehicles (AADT working day).

Long-distance transit in west-east direction does not go through the municipality due to the vicinity of the Vltava River and the absence of any bridges across. The closest long-distance transit routes are the Prague City Ring Road and road I/16. Long-distance transit in north-south direction is channelled along the near-by motorways D8 and D10 and partially road I/9 (western bypass of the town). Therefore, only short-distance regional transit runs through the municipality, from neighbouring settlements (Měšice, Bašť) to Prague and back.

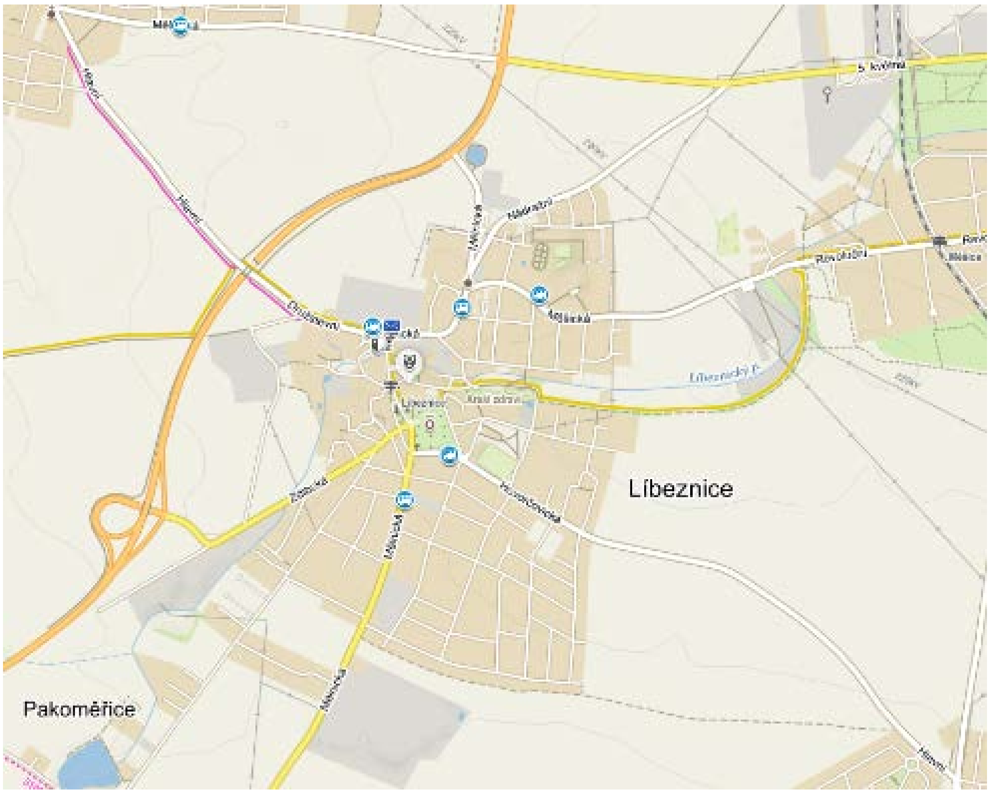

Figure 1 – Touristic map of Líbeznice (source: Mapy.cz)

Public transport

Public transport supply is covered by suburban bus routes. Alternatively, one can also use suburban train lines from the stop of Měšice u Prahy, which is located closely beyond the municipal administrative border. All public transport lines are integrated in the Prague integrated transport system.

Public amenities

The municipality offers grocery store, kindergarten, elementary school, skatepark and theatre.

Commuting

- 524 outbound and 226 inbound for work,
- 164 outbound a 129 inbound for education (pupils, students, apprentices).

Altogether there are 41 % of employed inhabitants leaving the municipality for work, vast majority heading to Prague, the same applies for commuting to educational institutions. Inbound employees arrive mostly from Prague and Neratovice, inbound pupils mainly Měšice and Bašť.

Conditions for non-motorized transport

A touristic route passes through the municipality, heading toward the near-by settlement of Mratín, while a cycle path crossing road I/9 on a bridge can be used to get to Bašť. Road I/9 forms the already mentioned bypass. There are suburban bus stops located in the town centre.

In-site examination was performed on the trunk road network, the cycle path, and the vicinity of the town centre.

Cycle path

The path leaves the municipality in the Družstevní street. It runs segregated from the road on interlocking pavers. At the crossing of road I/9, the path is channelled onto the crossing road and separated with white flexible posts (those were installed recently, no separation from motorised traffic had been in place before).

Figure 2 – Pedestrian and cycle path along the road and on the bridge across I/9

Town centre

There are numerous traffic calming facilities installed in the centre of Líbeznice (zone 40, elevated crossings, etc.), as well as protective features in high-risk locations.

Figure 3 – Public transport stop area with elevated crossing / barrier separating a narrowed sidewalk from busy road

There is a newly reconstructed sidewalk in the whole municipality, with high number of tactual features for visually impaired persons.

Figure 4 – Tactual features at pedestrian crossings

In certain locations, sidewalks are clearly expected to be used by cars, as well.

Figure 5 – Connections of sidewalk surface with road surface

Elementary school vicinity


Figure 6 – Treatments of space in front of the school

At some locations, parking is allowed on sidewalks perpendicularly to the road even in front of residential entrances, which creates a safety risk to pedestrians.

Figure 7 – Inappropriate parking obstructing pedestrian movement on sidewalk

3.2. Partial conclusions

Based on the conducted examination, it is possible to state that the safety of VRUs and conditions for their mobility **are sufficiently ensured,** even for the people with lower ability of movement and orientation. As it is visible from the above figures, pedestrian facilities have been properly reconstructed in the whole municipality, including tactual features for people with sight disabilities. That significantly increases safety, even though some minor shortcomings were observed in terms of installation of concrete features.

4. Pilot survey of VRU provisions along class I roads

Apart from the urban area's investigation, special attention was given to the VRUs safety along some strategical arteries (class I roads of international importance no. I/3 and I/4) and to the conditions in the recreational areas, where walking and cycling activities are high.

The exercise was carried out by UAMK road safety experts as a drive-through survey, in order to investigate the quality of provisions for VRUs along the two important international road links from Prague to southern borders.

Very poor conditions for pedestrian and cyclist using such high-volume roads with very narrow or no hard shoulder were identified, compared to the secondary roads going through recreational area Lipno, developed to provide cyclist and pedestrian with parallel mixed paths.

The investigation was focussed on the walking and cycling along busy roads, mostly without the hard shoulder. VRUs often are in serious danger, when they need to walk from village to village in darkness.

Specific deficit was found at accesses to bus stops, which are on main roads passing the villages. Specifically, for children, the access to/from bus stops close to intersections, without any provision for crossing and access to stops was found serious and regular.

The findings of the video surveys were incorporated into final conclusions and recommendations of the pilot study. The following figures illustrate only an exemplary selection of the features observed during the survey. A separate assessment has been done for the town of Olbramovice, one of the most critical locations along the I/3 long-distance international road link.

Figure 8 – Recreation area survey, road II/163, through road of Vyssi Brod

Figure 9 – Recreation area survey, road II/163, parallel mixed-use path and pedestrian crossing

Figure 10 – Recreation area survey, road II/163, parallel mixed-use path along the Lipno water reservoir

Figure 11 – Recreation area survey, road II/163, parallel mixed-use path along the Lipno water reservoir

Figure 12 – Recreation area survey, road II/163, parallel mixed-use path along the Lipno water reservoir, interfered with the access to a camp site

Figure 13 – Recreation area survey, road I/3, accesses to public transport stop Bystřice, Tožice

5. Pilot case 1: Accessibility and safety upgrades at rural bus stop

In order to demonstrate, how iRAP methodology can be used to identify and assess risks for VRUs on rural road sections, the RADAR team has made use of the case of class I road I/3 in the vicinity of Olbramovice and a typical bus stop located on it.

5.1. Location description

VRU accessibility of bus stops located along busy class I roads (and particularly those situated close to junctions with access roads to settlements off the main route) represent a typical problem, which has been identified at numerous locations. There is frequently lack any equipment for safe access to boarding platforms. Accessibility gets even more risky together with lower visibility and high traffic volumes.

For the project pilot case, a bus stop located northwards of Olbramovice was selected. It is named "**Olbramovice, rozcestí Zahradnice"** and is formed of 2 stops opposing each other in the vicinity of the crossroad of I/3 and class III road no. 1116.

The stop is served with 2 bus lines (500 and 554), which generate the load of 37 buses in both directions. The gradient area of the bus stop covers near-by villages of Božkovice and Zahradnice (westwards), as well as Dvůr Semtín and Tomice II (eastwards). These settlements have no civil facilities and altogether account for the population of ca. 250 people.

Since the peak frequencies of buses appear very early morning and late afternoon, the lack of provisions for safe movement of pedestrians represents a significant risk especially in winter months, when almost no visibility is ensured in dark hours.

There are no cycling or touristic routes signed in the subject area. The main road I/3 is straight in the length of 1730 m and the bus stops are situated on the horizon of a convexly curved route. There are no pedestrian provisions for crossing the main road at the bus stops, while the crossing distance is 15 m. The following pictures illustrate the setting in more details.

Figure 14 – Situation of I/3 – III/1116 crossroad and closest settlements

Figure 15 – Aerial view of I/3 – III/1116 crossroad and closest settlements

Figure 16 – Detailed aerial view on the subject crossroad and location of opposite bus stops

Figure 17 – Crossroad view from north

Figure 18 – Crossroad view from south

Figure 19 – Crossroad view from west, bus stop obstructed by parked heavy vehicle

Figure 20 – Crossroad view from east

5.1.1. Traffic volumes

The relevant information on traffic volumes can be obtained from the figures of the national traffic counting carried out in 2016. Results of a newer counting of 2020 are not available yet and will certainly be significantly affected and degraded by mobility restrictions applied within the state of emergency declared to mitigate the Covid-19 pandemics.

While the full Czech report brings a complete detailed accident data record, the summarized statistics shows the following:

- AADT of 18 767 vehicles (of which 3 901 are HGVs, 112 motorcyclists and 25 cyclists);
- working day AADT of 20 308 vehicles;
- 3 040 vehicles in peak hour.

These figures clearly support the need to revise the road scheme at the location and introduce suitable measures to increase safety of pedestrians and improve accessibility to both bus stops, especially during periods of lower visibility.

5.1.2. Accident record

The national web portal of "Dopravní nehody v ČR" (available at nehody.cdv.cz) was consulted to find out detailed information on traffic accidents in the location. Similar to traffic volumes, only cumulative figures are provided in the summary, while a more detailed breakdown is part of the full pilot study.

After selecting the whole period of data collection (2006 – 2020), the accident record of the location includes the total of 21 accidents, of which 12 resulted in injuries of 17 people. Luckily no person has been killed there yet.

Looking at specific VRU accidents, one can find out that there were 2 collisions with pedestrians crossing the main road in last 3 years:

1. Accident from October 8, 2018 – heavy injury of a person hit while crossing the main road, 11-year-old female crossing behind a vehicle standing in the bus stop bay;

2. Accident from September 9, 2019 – light injury of a pedestrian hit at the bus stop, 38-year-old male, bad visibility conditions, rain, influence of alcohol

Figure 21 – Localization of accidents Case 1 (green/orange/red – no/light/serious injury)

injuries	no. of accidents	no. of persons
fatal	0	0
serious	3	3
light	9	14
no injury	9	
TOTAL	**21**	

Figure 22 – Case 1 accident summary

accident type	no. of accidents	killed	serious injury	light injury
collision with moving vehicle	16	0	2	12
collision with pedestrian	2	0	1	1
breakdown	1	0	0	0
collision with animal	1	0	0	0
collision with solid obstacle	1	0	0	1

Figure 23 – Case 1 types of accidents

Additional specific blackspot information

While pilot case 1 is dedicated to the above description bus stop location and related VRUs mobility, there is one more critical blackspot located close to Olbramovice. It is not a subject of the report but is worth mentioning, since it demonstrates how wrong and mis-leading road design can seriously impact safety with severe consequences for many years.

This most critical blackspot in terms of casualties is located just ahead of Olbramovice when coming from Prague – at the location, where the planned bypass shall begin. The present road lay-out creates a very problematic chicane at the place of temporary provisional end of the by-pass, which frequently becomes an accident site, especially for those, who do not know the place and do not expect such an alignment. Even though road marking and signs can be assessed as sufficient now, the spot has been a nightmare for years. The map below clearly illustrates the problematic lay-out and related accident records. The following figures give evidence to the above statements, indicating both the present and future (dotted) road alignment, together with the number of accidents in different severity categories. There were already 5 people killed and further 21 injured (3 seriously) between 2007 and 2020, compared to the town centre, where larger number of accidents were recorded, but with much lower severity.

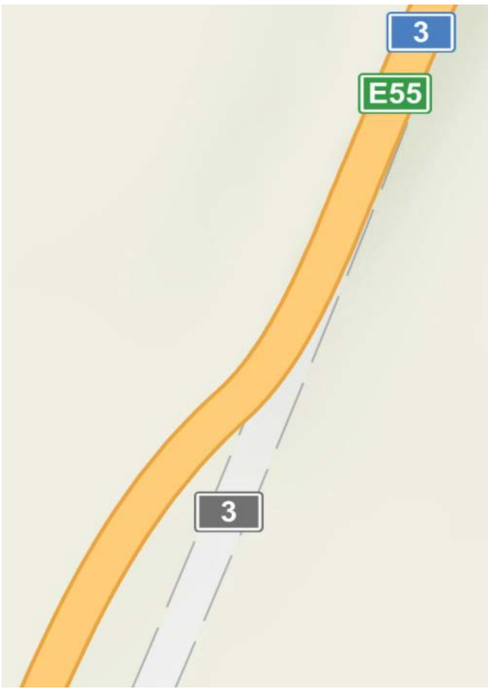

Figure 24 – Blackspot at the beginning of the future bypass

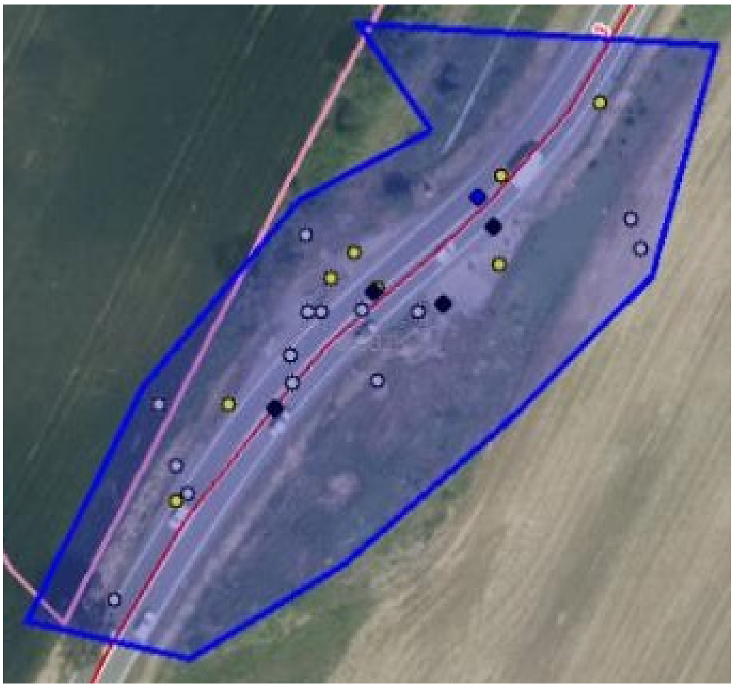

Figure 25 – Accidents at the beginning of the future bypass (light blue/yellow/blue/black – no/light/serious/fatal injury)

Since this critical black spot is going to be eliminated completely by the new design and does not relate to any specific VRUs issue, is has not been further analysed in the Pilot study.

5.2. iRAP road safety assessment

In order to demonstrate the process of assessing the level of safety with iRAP Star rating protocol and its ViDA tool, a section of ca. 800 metres (symmetrical to both sides of the crossroad, including both bus stops) was coded and assessed, both for existing situation and modified layout taking into consideration proposed countermeasures.

The following graphical outputs of Star Rating have been watermarked as "DRAFT". It does not mean they are not complete or final, but only refer to the fact that the exercise has been performed for demonstration purposes of the RADAR pilot project and has not fulfilled all process steps needed for official Star Rating publication.

5.2.1. Inputs and ViDA setting

iRAP methodology and ViDA tool were used to assess both the present layout and the proposed (upgraded) model layout with all countermeasures applied. In practice, a modification of the present state coding is modified according to the new features.

- Axis depicted in ViDA
- Length ca 800 m (8 x 100m section)
- Present layout:
    - coding based on Google Street View
    - ViDA:
        - Programmes: Sandbox

- Region: AF-CITYPLAN
- Project: CR I_3
- Datasets: extravilan

- Proposed layout:
  - Modification of present layout – countermeasures coded
  - ViDA:
    - Programmes: Sandbox
    - Region: AF-CITYPLAN
    - Project: CR I_3
    - Datasets: extravilan upgrade
- Supporting data – since a Safe Roads Investment Plan (SRIP) was not required for this pilot demonstration, supporting data were not set exactly but easily accessible public sources were used:
  - iRAP default values used in many cases
  - Global Status Report on Road Safety 2018 (WHO) – fatality underreporting factor
  - national traffic counting 2016 – AADT
  - accidents statistics (nehody.cdv.cz) – number of deaths
  - accidents statistics (Police of the Czech Republic) – serious injury to fatality ratio
  - countermeasure cost = iRAP default defined in RAP-SR-3-3_Upload_file_specification.xlsx, converted from EUR to CZK

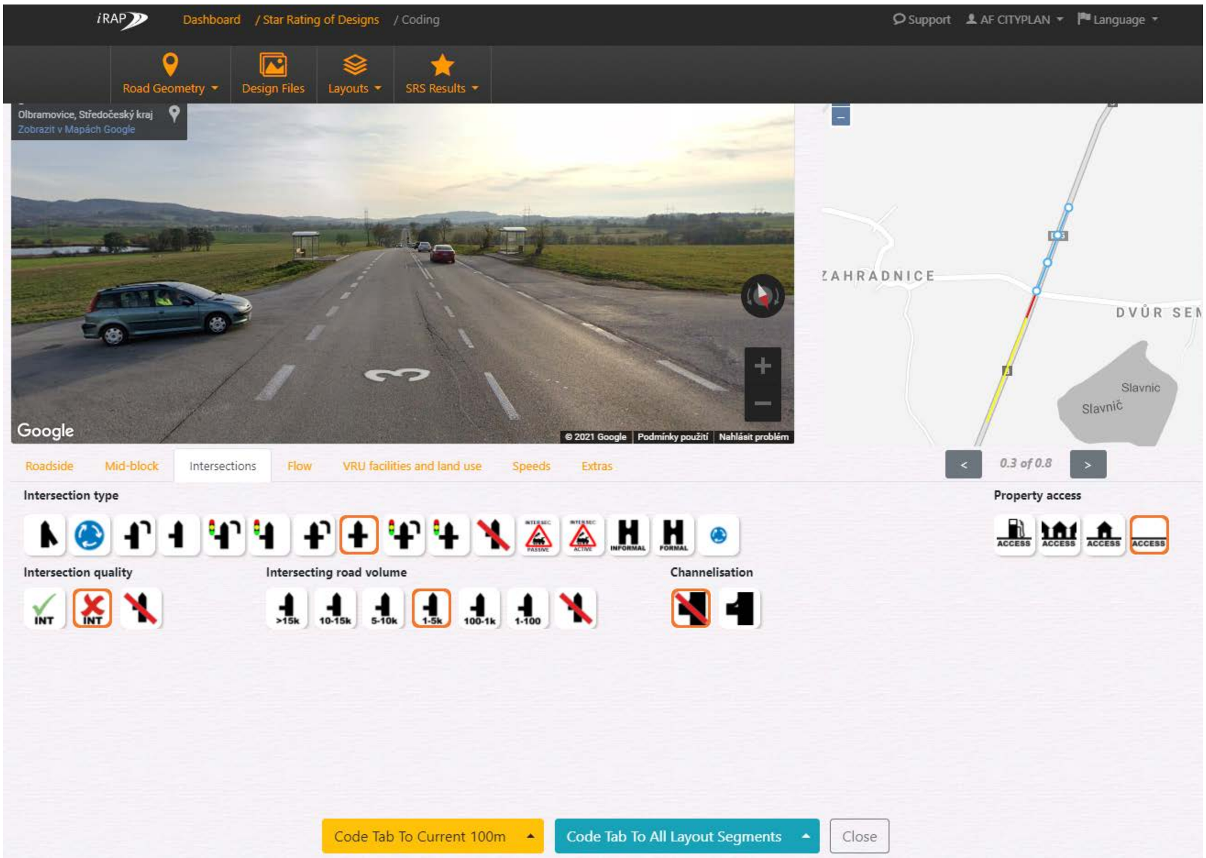

Figure 26 – Case 1 example of coding in ViDA (Star Rating for Design, SR4D)

5.2.2. Identified safety risks

The key risk factors identified in the existing layout of the bus stop site, which affected the final scoring, include the following:

- unsatisfactory 4-leg intersection with poor road marking (no marking on side roads);
- unsatisfactory conditions for pedestrian movements at the bus stop;
- high traffic volumes;
- high actual speeds;
- occurrence of solid obstacles – trees (almost along the whole length of the road section assessed).

The risks are clearly illustrated in the existing layout scheme attached below.

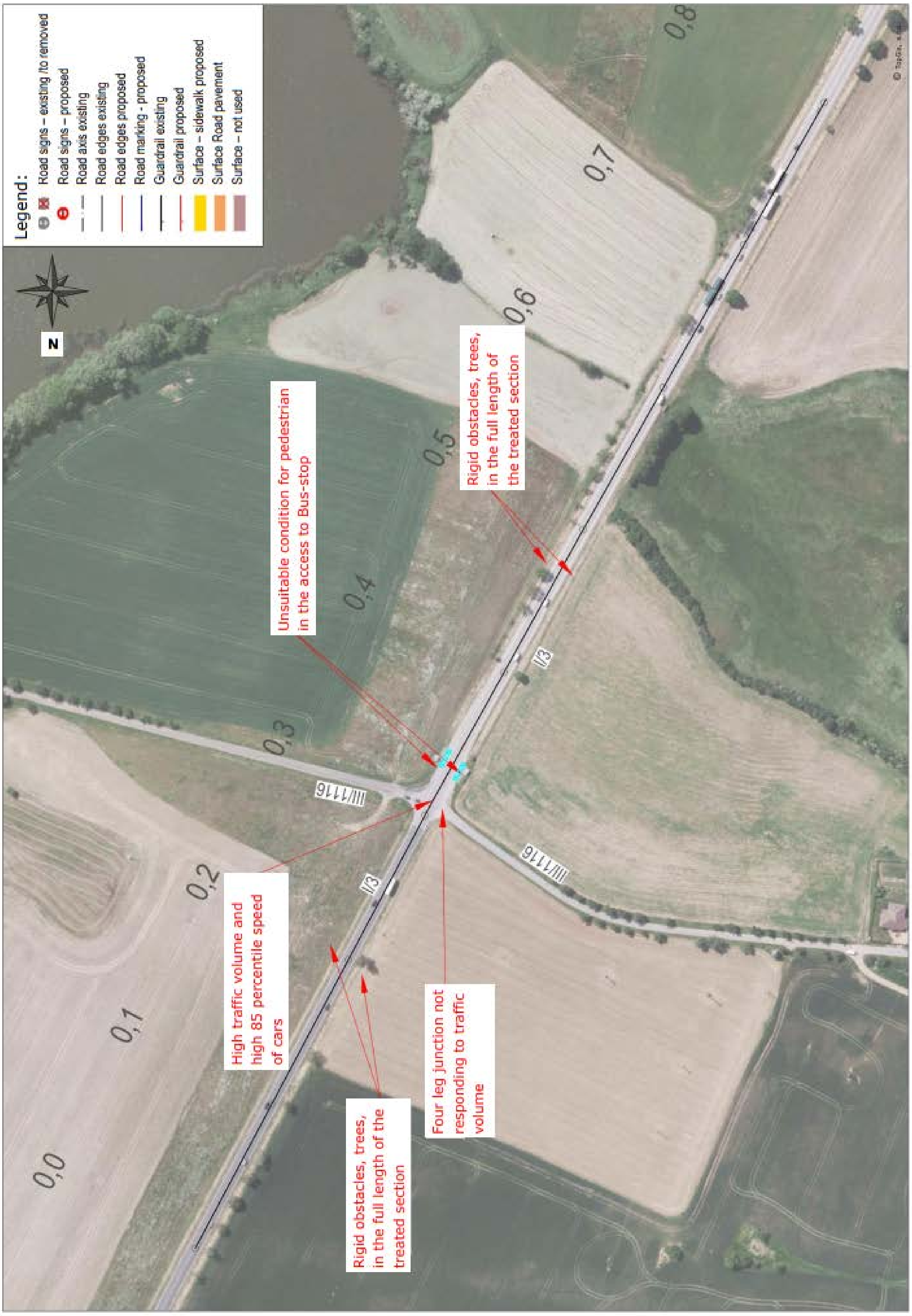

Figure 27– Case 1 existing layout scheme

5.2.3. Star rating of existing layout

As the following figures indicate, **the star rating exercise of the existing provisions identified numerous safety deficits at the location, which resulted in the poorest, 1-star verdict.** Star ratings are shown for vehicles, motorcyclists, as well as pedestrians separately.

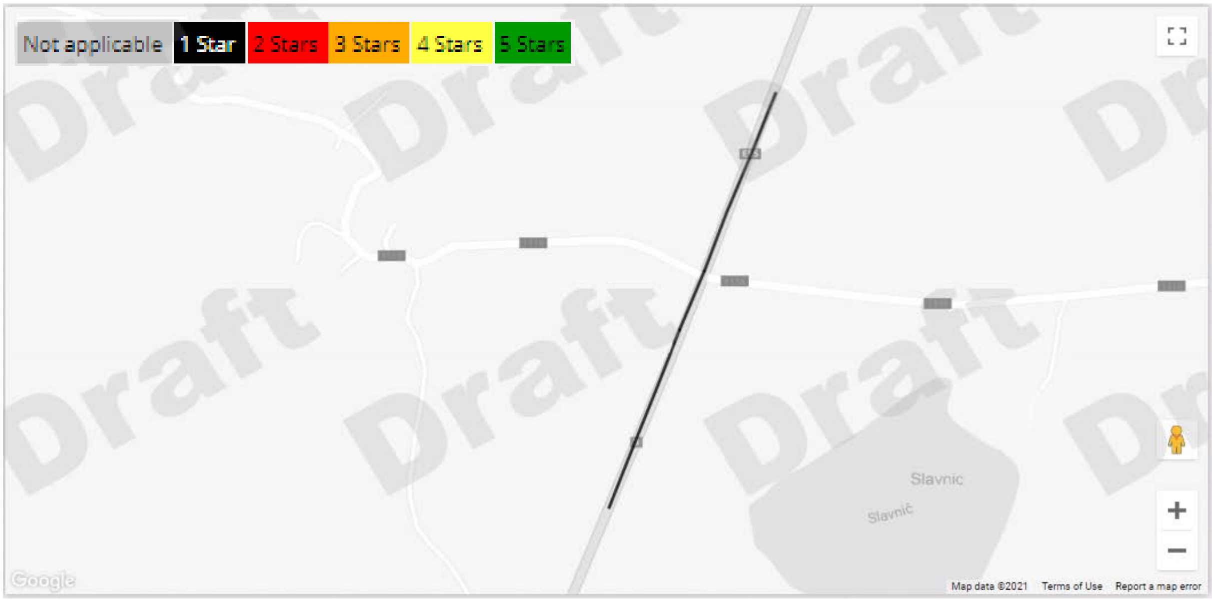

Figure 28 – Star rating vehicle occupants + motorcyclists – existing layout, star rating for both groups is the same

Star rating score for vehicle occupants = 31,6 (smoothed)

Figure 29 – Risk worm vehicle occupants (raw)

Star rating score for motorcyclists = 37,2 (smoothed)

Figure 30 – Risk worm motorcyclists (raw)

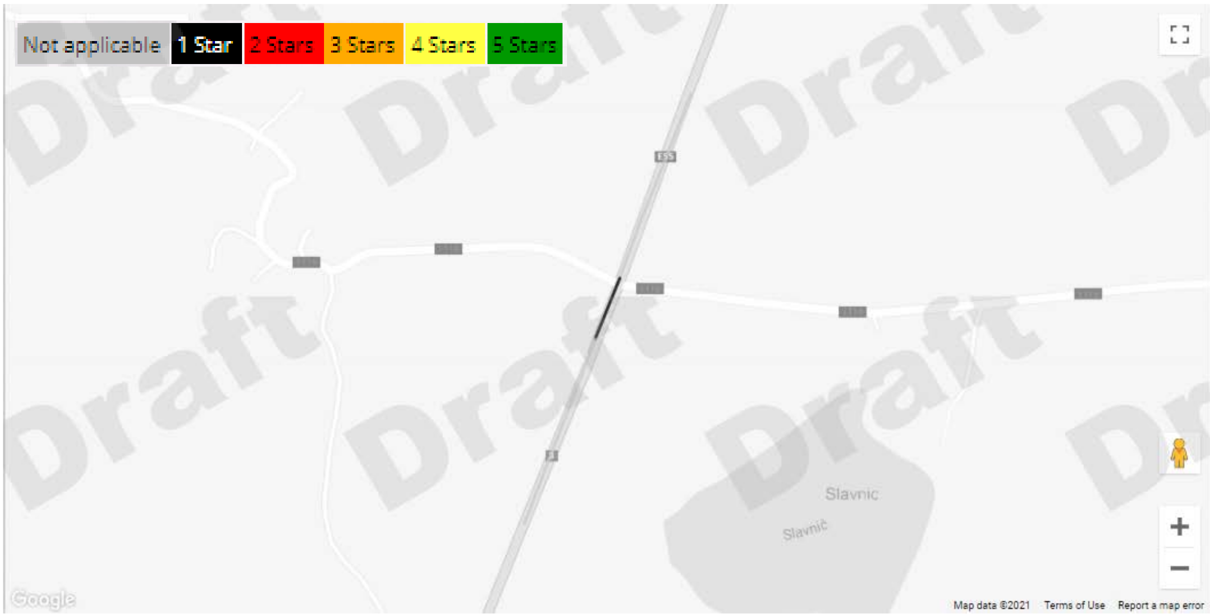

Figure 31 – Star rating pedestrians – existing layout

Star rating score for pedestrian = 620,1 (raw)

Figure 32 – Risk worm pedestrians (raw) – no background colours generated by ViDA

5.2.4. Proposed safety upgrading countermeasures

In order to increase road safety at the location (level crossroad and two-way bus stop), the following countermeasures were considered:

- Installation of roundabout instead of cross roads
- reduction of general speed limit of 90 km/h, which often tends to be broken due to road type and its delineation (long-distance traffic trunk road, straight);
- restriction of overtaking in the section of bus stops;
- construction of access sidewalks to both bus stops from both legs of the intersecting road III/1116;
- physical measures to reduce speed;
- refuge islands to make crossing for pedestrians safer;
- additional lighting installed at the crossing and both bus stops;
- higher visual differentiation of individual traffic space segments;
- bus stops properly road-marked;
- installation of suitable traffic management elements (warning signs, button-activated traffic signals;
- road marking on intersecting road.

For the iRAP assessment demonstration purposes, several risk-eliminating measures were proposed in compliance with common traffic engineering practices used in the Czech Republic. The proposal is quite generous and comfortable in order to illustrate maximized safety benefits of the countermeasures.

The proposed safety upgrades cover:

- section 0,3-0,4 km:
    - big roundabout with adequate quality (instead of low-quality intersection);
    - pedestrian crossing with refuge island;
    - sidewalks on both sides continuing from both bus stop platforms to the pedestrian crossing and further to link the intersecting road III/1116;
    - lighting installation (pedestrian crossing and sidewalks);
    - a pole in the middle of the roundabout;
    - speed limit reduction from 90 km/h to 50 km/h;
    - announce the roundabout by a **"Roundabout"** sign at a reasonable distance (not shown);
    - **"Give way" signs** at the entry arms of the roundabout (not shown);
- sections 0,2-0,3 km; 0,4-0,5 km:
    - speed limit reduction from 90 km/h to 70 km/h in continuing sections from both sides of the roundabout;
    - traffic calming countermeasures before and beyond the roundabout – optical speed-reducing brake;
- sections 0,4-0,8 km:
    - extension of roadside safety to eliminate existing solid obstacles (trees);
- elimination of solid obstacles (cutting down trees) not proposed.

The figure below depicts the proposed countermeasures in the vicinity of the newly modified intersection (roundabout), while the completely new layout scheme is attached below.

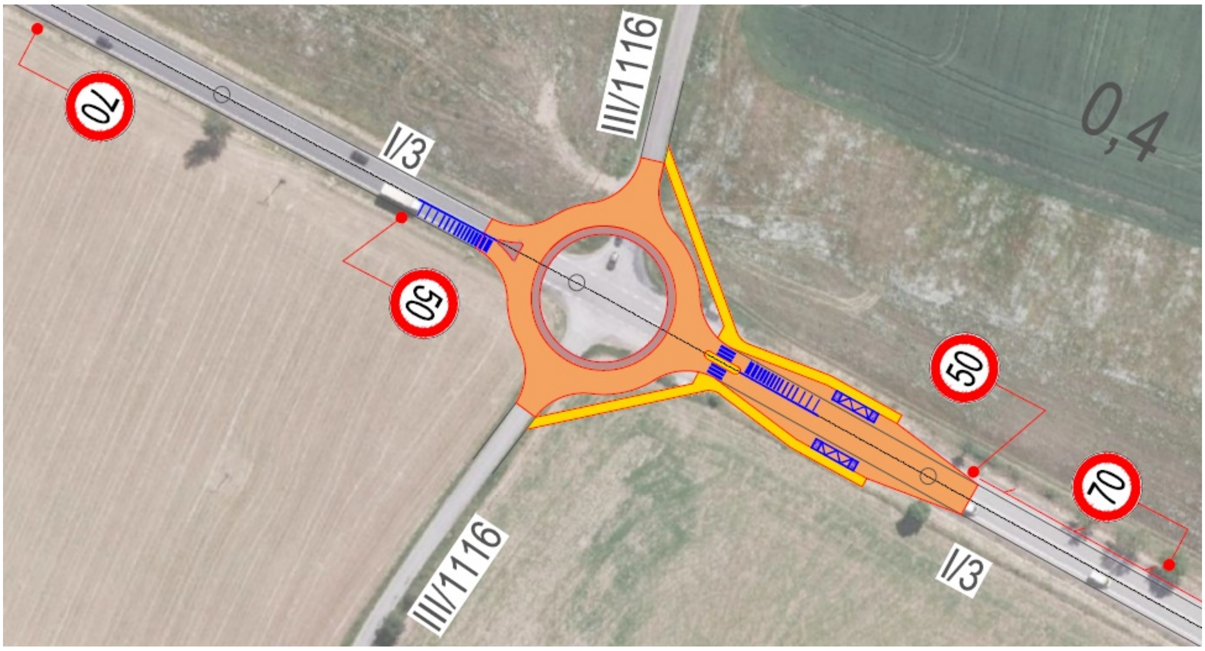

Figure 33 – Proposed safety upgrading countermeasures

Figure 34 – Signs mandatory, not included in the relevant scheme

Figure 35 - Signs mandatory, not included in the relevant scheme

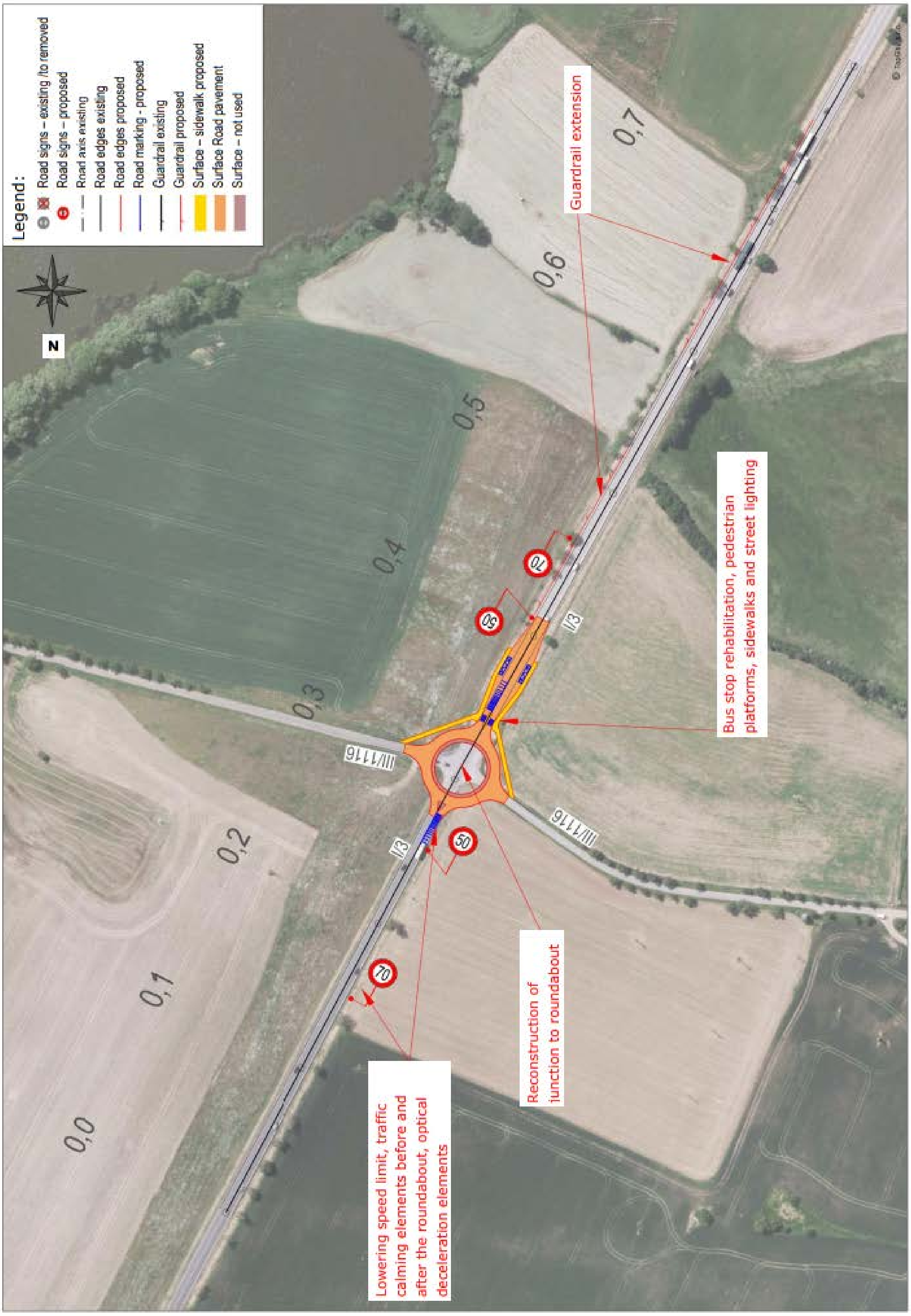

Figure 36– New layout scheme (mandatory signs are not shown)

5.2.5. Star rating of upgraded layout

After conducting Star rating assessment of the new layout with proposed countermeasures, the results show significant improvement. On the other hand, it can be observed that – despite much better rating values – the countermeasures were not sufficient enough to increase the number of stars for pedestrians. The drop from 620,1 to 118,2 is a major improvement of pedestrian safety at the location but it still remains in the worst, 1-star black category. For vehicle occupants and motorcyclists, the score was increased to 2 stars.

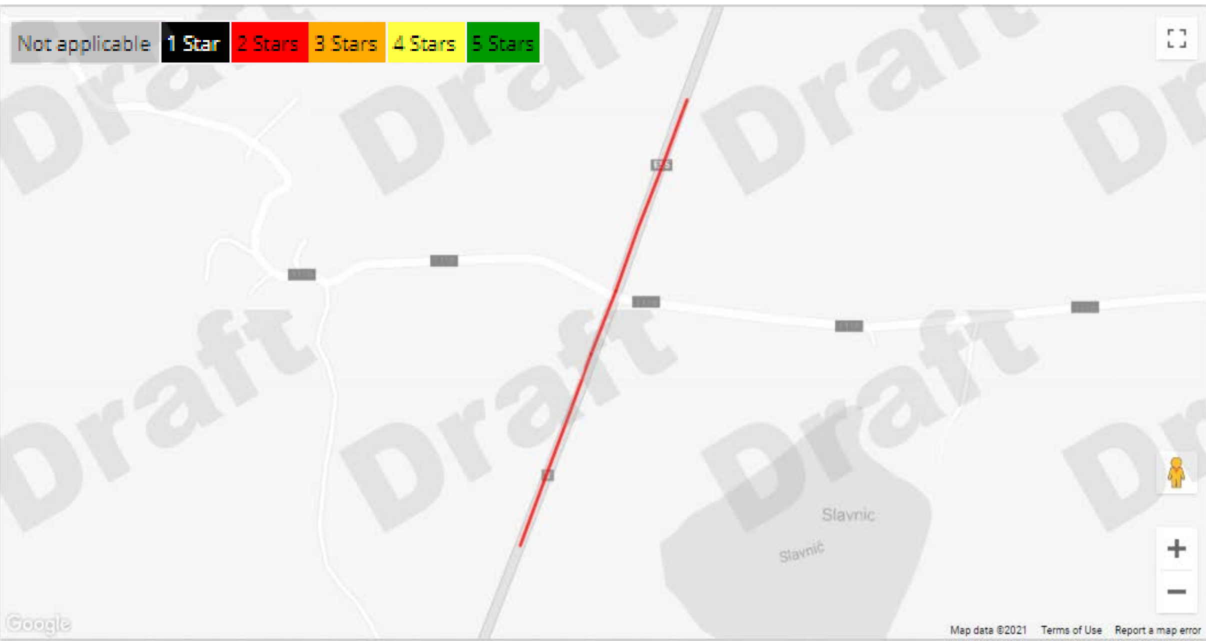

Figure 37 – Star rating vehicle occupants + motorcyclists – upgraded layout

Star rating score for vehicle occupants = 14,8 (smoothed)

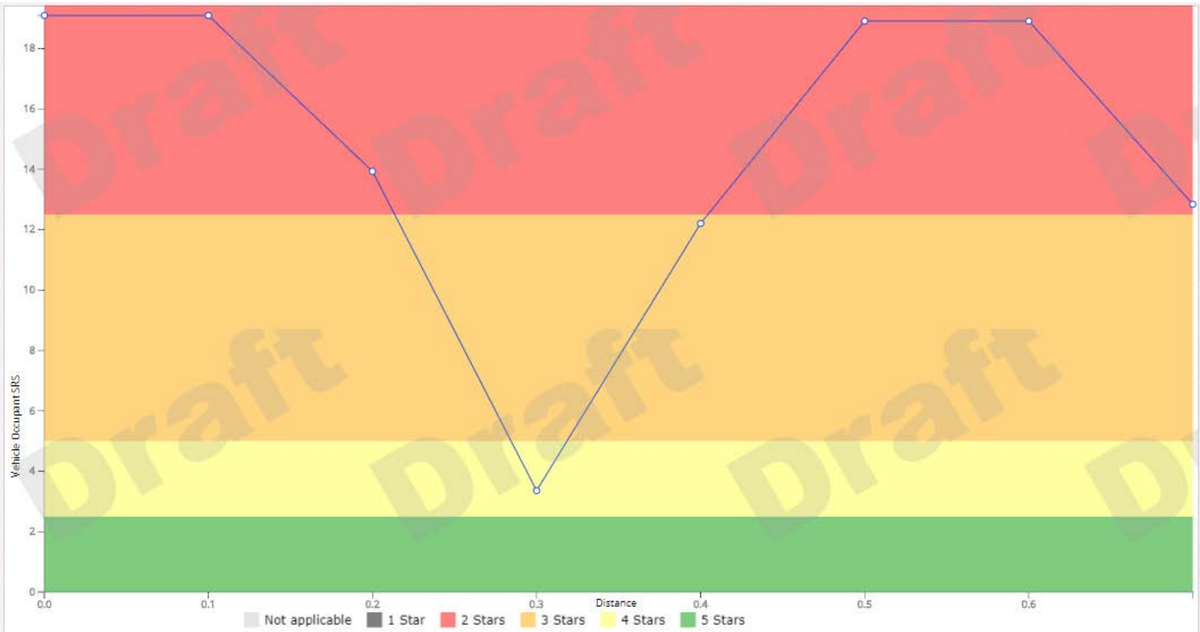

Figure 38 – Risk worm vehicle occupants (raw)

Star rating score for motorcyclists = 19,75 (smoothed)

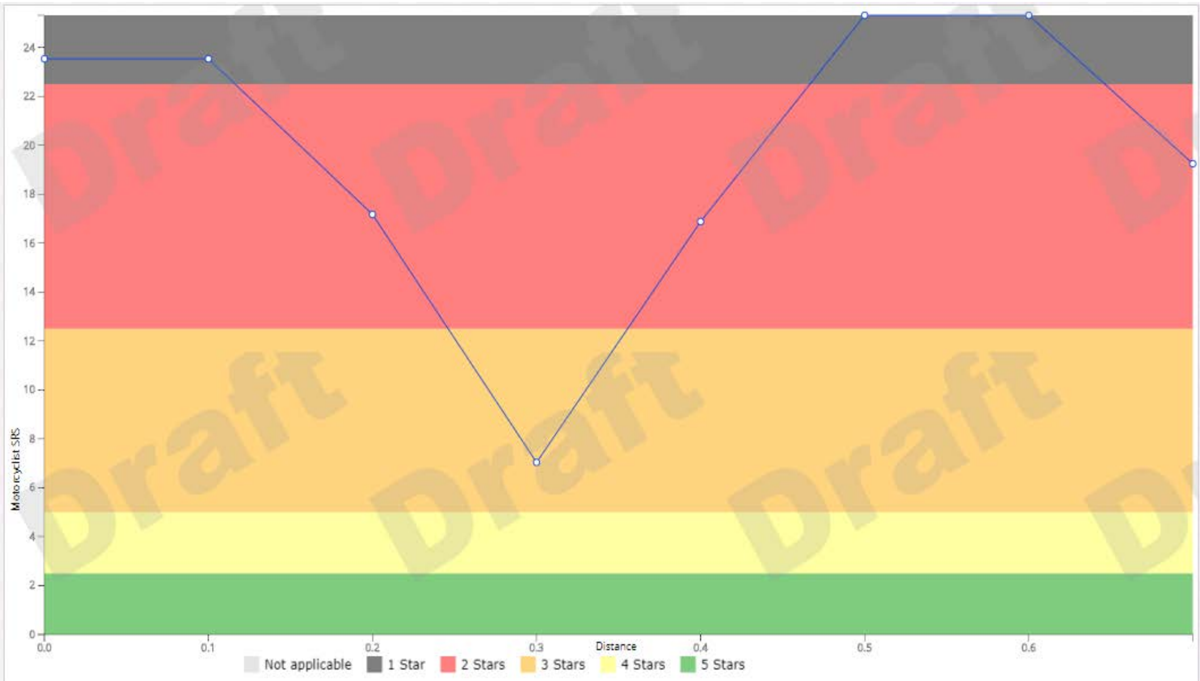

Figure 39 – Risk worm motorcyclists (raw)

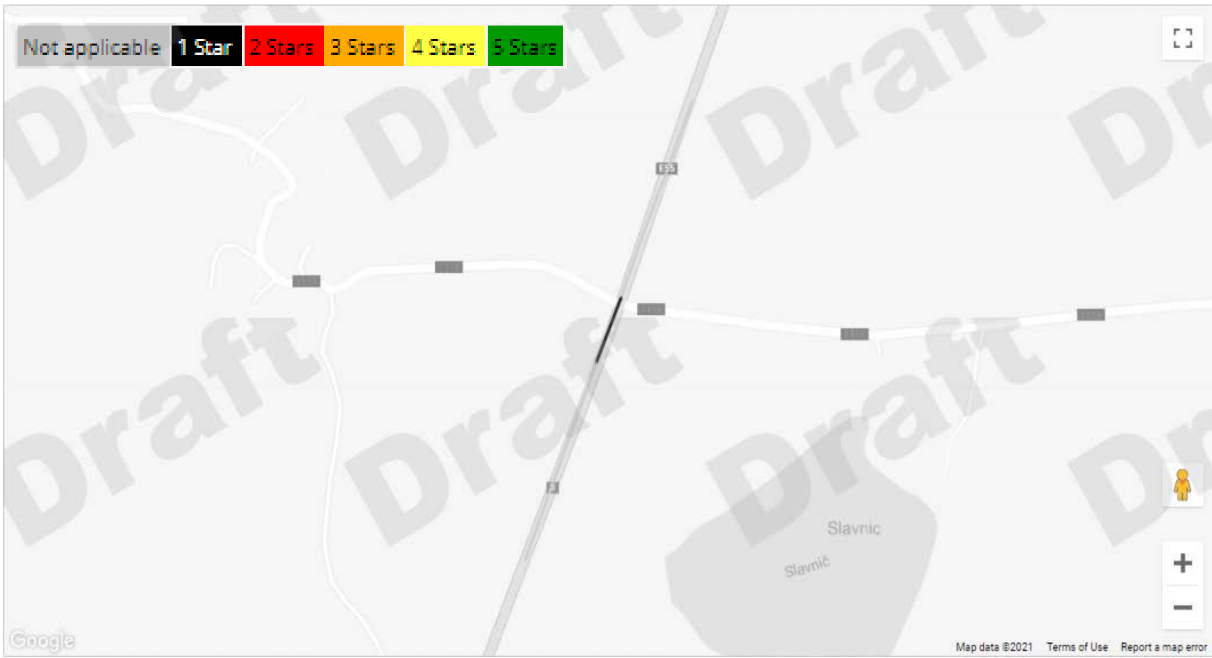

Figure 40 – Star rating pedestrians – upgraded layout

Star rating score for pedestrians = 118,2

Figure 41 – Risk worm pedestrians (raw) Note: ViDA is not generating coloured bacground

5.2.6. **Assessment summary**

The existing layout contains numerous serious shortcomings and risk factors – no solutions for pedestrian movement around the bus stops and numerous solid obstacles along the main road. Even though the proposal for countermeasures to eliminate the existing risks with the iRAP methodology was quite generous, it still was not sufficient to achieve the shift from 1-star to 2-star safety standard for pedestrians. One of the key factors impacting the final score is traffic volumes and since the trunk road I/3 carries AADT of 19 000 vehicles, it is methodologically rather difficult to place and integrate bus stops onto the road of such volumes in a properly safe way.

6. Pilot case 2: Risk reduction for pedestrians along urban class I through-road

The second demonstration pilot focuses on implementing iRAP methodology in urban environment and – again – takes the example of Olbramovice, the municipality suffering from high traffic volumes with high shares of heavy traffic. Up to now (and for some more years to come), class I road I/3 have represented the only possible transit connection from Prague southwards to Austria (Linz), as no continual motorway link in this direction has been finished yet.

Even though plans for the Olbramovice bypass were prepared decades ago, the project preparation has faced enormous delays due to administrative and legal obstructions, causing major problems to people living in the municipality.

6.1. Location description

Road no. I/3 is an important part of Czech primary road network, running from the Mirosovice junction with D1motorway towards Czech-Austrian border crossing of Dolni Dvoriste. The road runs through numerous municipalities, incl. Olbramovice, which is practically split into 2 separate parts. The situation has major negative environmental and social impacts on people´s daily lives and produces a lot of traffic complications with safety risks to pedestrians, particularly in peak hours. On the other hand, interfering intra-urban pedestrian (as well as agricultural) traffic obviously negatively affects traffic flow fluency and increases risk of accidents, which tend to be quite frequent. Passing through Olbramovice has thus become a burden for both inhabitants and drivers.

Partial relocations of I/3 have been systematically planned and step-by-step implemented in past 2 decades, the one of Olbramovice was prepared in late 80´s together with sections of Tomice and Votice. While the 2 are for long in operation, Olbramovice suffered from many procedural delays. The EIA documentation for the 3420m long relocation was elaborated in 1998, followed by the documentation for building permit in 2005. Due to numerous appeals of the approval process participants, investment preparation has been enormously delayed and things began to start moving not earlier than 2020, when the project finally reached the implementation phase. A building contract was signed in March 2021and the schedule expects the bypass to be put in operation in 2022, i.e. 24 years after the EIA assessment.

Road I/3 divides Olbramovice and its public facilities and services in 2 parts, which generates quite significant pedestrian volumes crossing the road. There is municipal office, post office and school on one side, while kindergarten, library, train station and majority of residential housing on the other. In addition, there are much more local services, which generate intra-urban traffic demand, such as restaurants, petrol station, charging station, church with cemetery and 2 general stores. Particularly the locations of school and kindergarten are problematic issues – being only 430 m away from each other but on the opposite sides of the through-road. There also is a "blue" touristic route crossing the road in the municipality and a cycle route going along the through-road.

Speaking not only about the inner area of Olbramovice, the municipality covers additional 15 near-by settlements and provides all necessary civil services for their inhabitants. Those do not have particularly good and safe connection for VRUs and users are basically dependent on using local roads with no dedicated equipment.

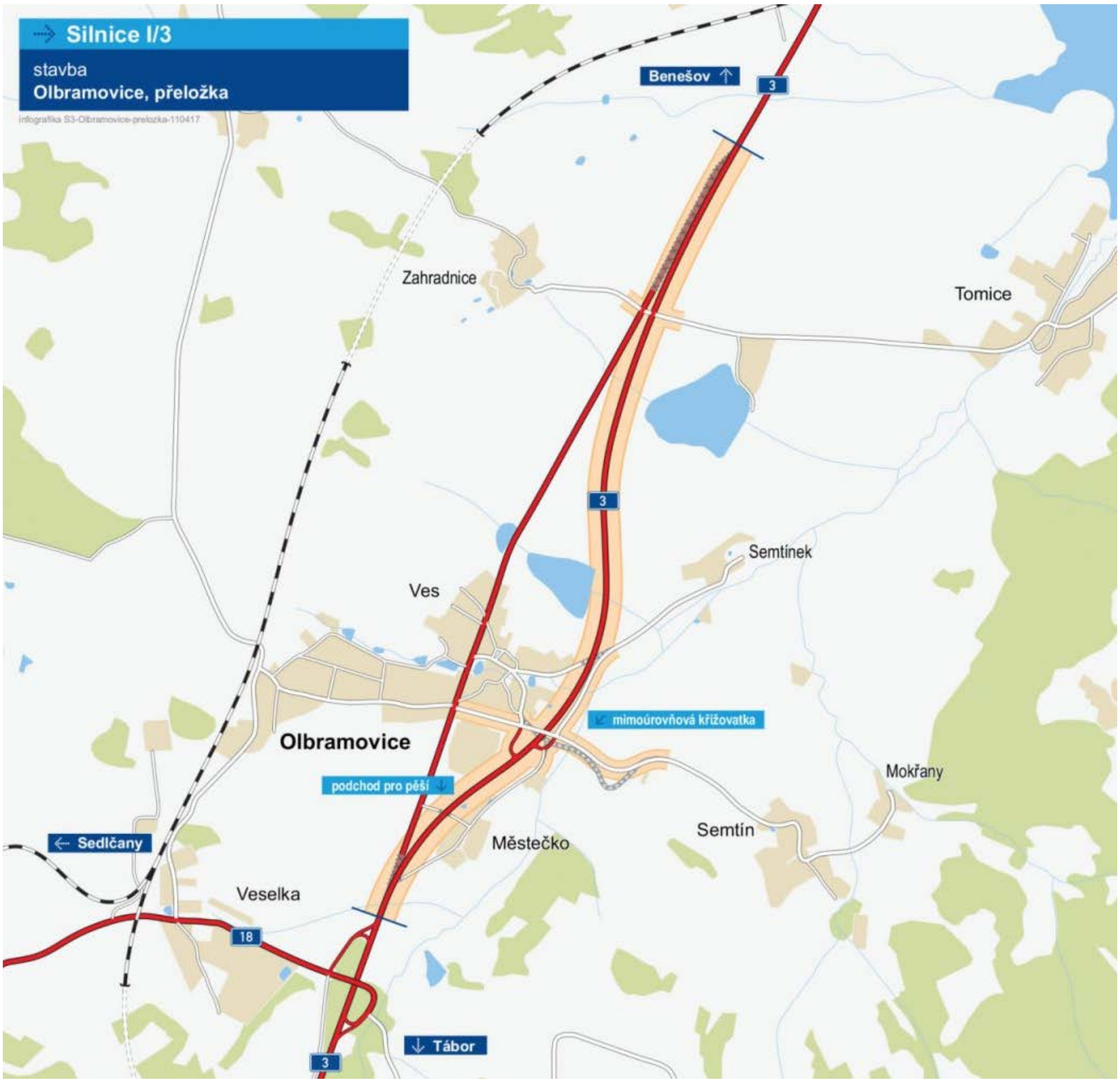

Figure 42 – Scheme of the new Olbramovice bypass routing (source: RSD CR)

6.1.1. Traffic volumes

Since there is no other official piece of evidence on traffic volumes than the 2016 national traffic counting, which was used for the Pilot case 1 analysis, the same figures source was applied in the second case.

There are almost 15 000 cars and more than 3 500 heavy vehicles passing through the town centre on a daily basis, which makes living in Olbramovice very difficult and risky. Even though there were several protest actions organized by local people, no proper infrastructure safety upgrades have been implemented so far, justified not only by the plans for a bypass but – ironically – by a rather small number of serious accidents on the through road, which can easily be explained by quite low speeds of congested traffic and quite high awareness of local people, having been "trained" for decades.

6.1.2. Accident record

When analysing the accidents that happened in Olbramovice, it becomes obvious that local urban traffic conditions imply to certain extend the character, as well as severity of accidents occurring on the through-road.

Olbramovice, due to numerous junctions, access points and pedestrian crossings, mainly suffers from traffic congestion, environmental pollution, noise and – particularly – significant barrier effect. All these features impact the fluency and speed of traffic, making the number and particularly severity of accidents lower. And as such, public pressure on different authorities has not been successful so far, typically neglected with an argument of future improvement and traffic calming thanks to the bypass in place.

The figures below present the accident statistics 2006 – 2020, supporting the presumption stated above.

Figure 43 – Localization of accidents Case 2 (light blue/yellow/blue/black – no/light/serious/fatal injury)

injuries	no. of accidents	no. of persons
fatal	1	1
serious	1	1
light	47	61
no injury	115	
TOTAL	**164**	

Figure 44 – Case 2 accident summary

Looking at what the most frequent causes of the 164 accidents are, one can find that 99 of them were caused by "not keeping a safe distance behind a vehicle", while 18 relate to "not paying proper attention to driving", which quite well comply with the presumption of rather non-fluent, slow and frequently obstructed traffic flow. In terms of VRUs, only 2 accidents involved pedestrians and resulted in their light injuries. However, the aim of the pilot study is to propose infrastructure safety upgrades for VRUs so that the risk of any potential collisions with traffic is reduced.

6.1.3. Photo documentation of the existing through-road safety deficits

Figure 45 – I/3 through road in Olbramovice – section with sidewalks on both sides, but levelled wit road surface due to numerous surface treatments

Figure 46 – I/3 through road in Olbramovice – disputable highlighting of a crossing with a concrete barrier, sidewalks at the same level as road surface

Figure 47 – I/3 through road in Olbramovice – walking possible on one side only

Figure 48 – I/3 through road in Olbramovice – walking possible on one side only

Figure 49 – I/3 through road in Olbramovice – poorly equipped pedestrian crossing, pedestrian provisions not continuous

Figure 50 – I/3 through road in Olbramovice – pedestrian crossing highlighted by coloured road surface but pedestrian facilities levelled with road surface

Figure 51 – I/3 through road in Olbramovice – detail of a sidewalk condition – bad surface, levelled with road surface

Figure 52 – I/3 through road in Olbramovice – another example of sidewalks condition on a road of international importance

Figure 53 – North entrance to Olbramovice – no physical entry measures, 12 "safe distance" road marks

Figure 54 – South entrance to Olbramovice – no physical entry measures, speed limit signs 90-80-60-50 km/h, 13 "safe distance" road marks

6.2. *iRAP road safety assessment*

Similarly to Case 1, safety provisions for VRUs and other road safety risks along the I/3 through-road in Olbramovice were assessed with iRAP Star rating protocol and ViDA tool, using the Star Rating for Design module. Case 2 analysis involved a 1km long urban section, which was star-rated both for existing situation and proposed layout with countermeasures applied.

Again, Star rating outputs bear a watermark "DRAFT", since the analysis has been performed for demonstration purposes of the RADAR pilot project and has not fulfilled all process steps needed for official Star Rating publication.

6.2.1. Inputs and ViDA setting

iRAP methodology and ViDA tool were used to assess both the present layout and the proposed (upgraded) model layout with all countermeasures applied. In practice, a modification of the present state coding is modified according to the new features.

- Axis depicted in ViDA
- Length ca 1000 m (10 x 100m section)
- Present layout:
  - coding based on Google Street View
  - ViDA:
    - Programmes: Sandbox
    - Region: AF-CITYPLAN
    - Project: CR I_3
    - Datasets: intravilan
- Proposed layout:
  - Modification of present layout – countermeasures coded
  - ViDA:
    - Programmes: Sandbox
    - Region: AF-CITYPLAN
    - Project: CR I_3
    - Datasets: intravilan upgrade
- Supporting data – since a Safe Roads Investment Plan (SRIP) was not required for this pilot demonstration, supporting data were not set exactly but easily accessible public sources were used:
  - iRAP default values used in many cases
  - Global Status Report on Road Safety 2018 (WHO) – fatality under reporting factor
  - national traffic counting 2016 – AADT
  - accidents statistics (nehody.cdv.cz) – number of deaths
  - accidents statistics (Police of the Czech Republic) – serious injury to fatality ratio
  - countermeasure cost = iRAP default defined in RAP-SR-3-3_Upload_file_specification.xlsx, conversed from EUR to CZK

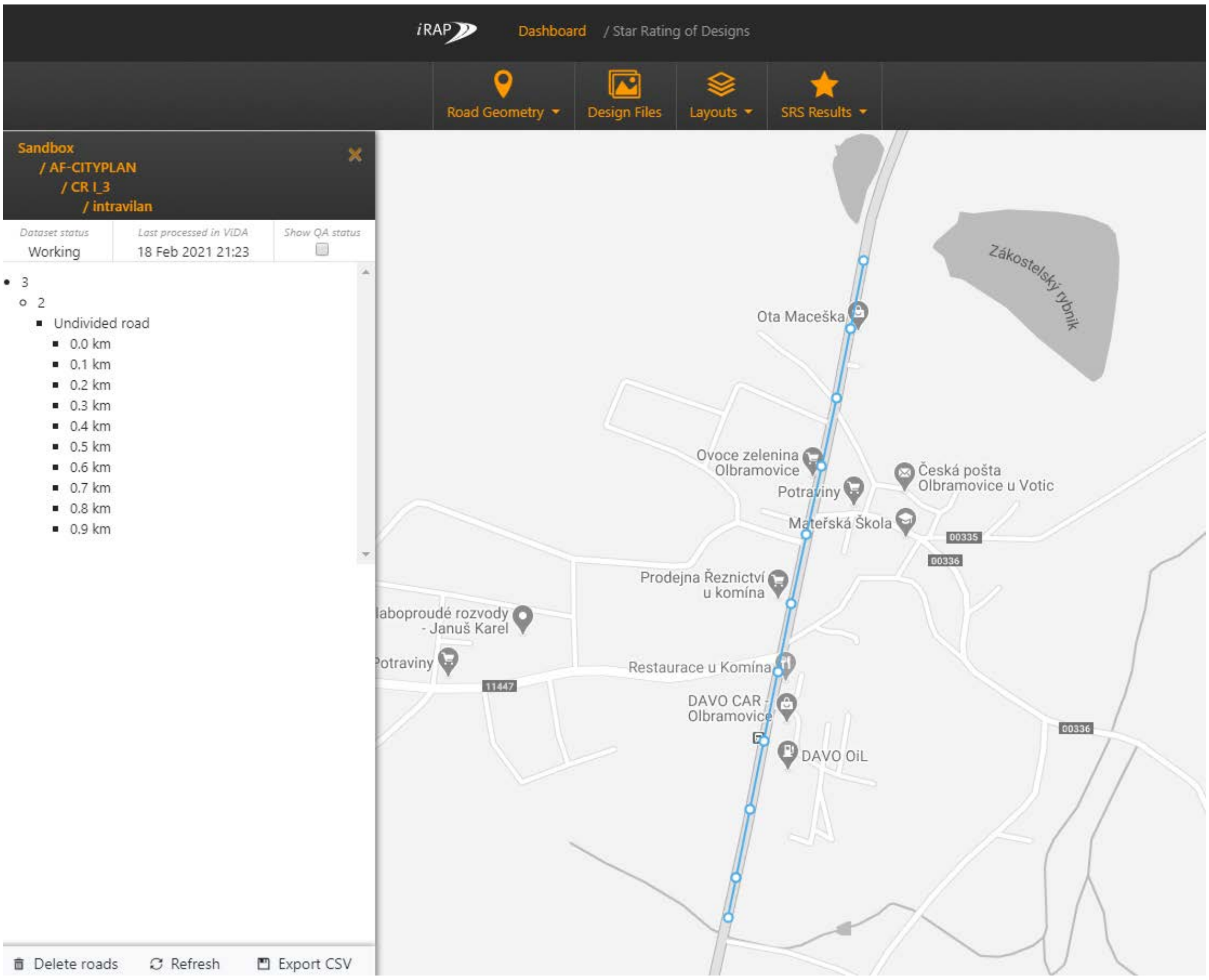

Figure 55 – Case 2 example of coding in ViDA (Star Rating for Design, SR4D)

6.2.2. Identified safety risks

The key risk factors identified on the Olbramovice through-road, which affected the final scoring, include the following:

- missing traffic calming measures at the rural – urban interfaces on both entries;
- strong barrier effect in the municipality;
- unsatisfactory conditions for pedestrians:
  - discontinuous sidewalks
  - sidewalks with no raised edges
  - insufficient safety level of pedestrian crossings;
- high traffic volumes;
- missing continuous road marking.

The risks and safety deficits are clearly illustrated in the existing layout scheme shown below.

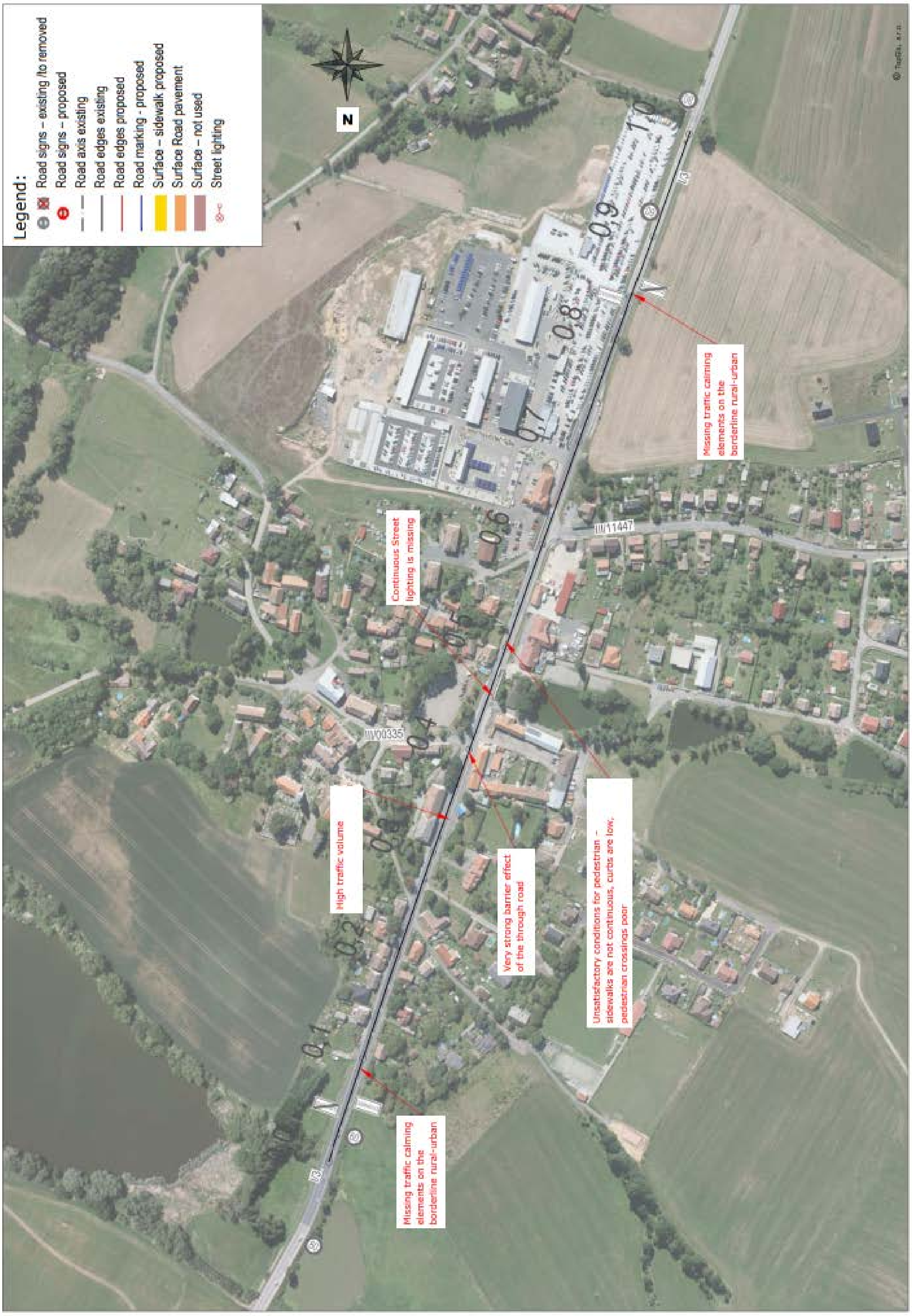

Figure 56 – Case 2 general layout of existing safety deficits

6.2.3. Star rating of existing layout

Figures below present Star rating of the existing situation. In terms of motorized traffic, the results are quite satisfactory, **the through road achieved 3 stars for both cars and motorcycles. And as expected, results for pedestrians are much worse, only 1 star.**

Coding note:

- In this demonstration exercise the presence of "along" and "across" pedestrian traffic has been coded in the whole length of the coding section to quantify road´s barrier effect.
- Average speed and speed v_{85} set by professional estimation

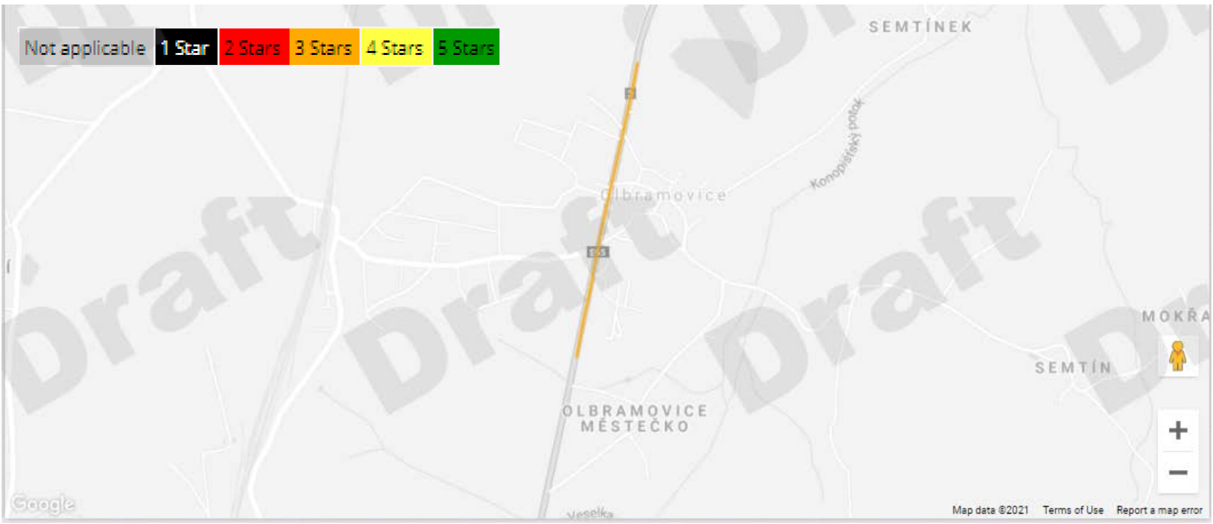

Figure 57 – Star rating vehicle occupants – existing layout

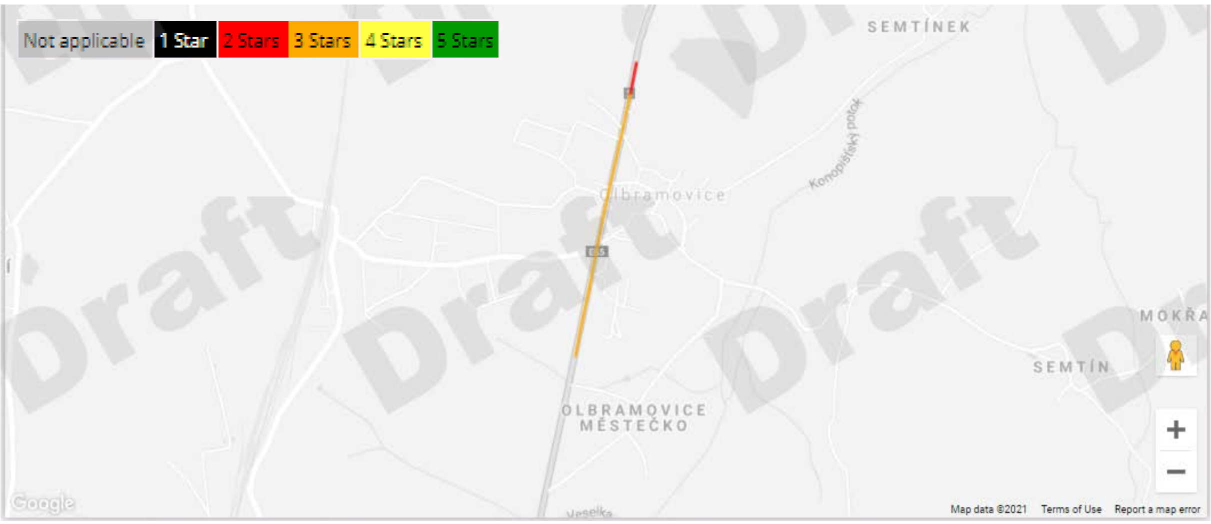

Figure 58 – Star rating motorcyclists – existing layout

Star rating score for vehicle occupants = 9,4 – 11,7 (smoothed)

Figure 59 – Risk worm vehicle occupants (raw)

Star rating score for motorcyclists = 12,1 – 15,5 (smoothed)

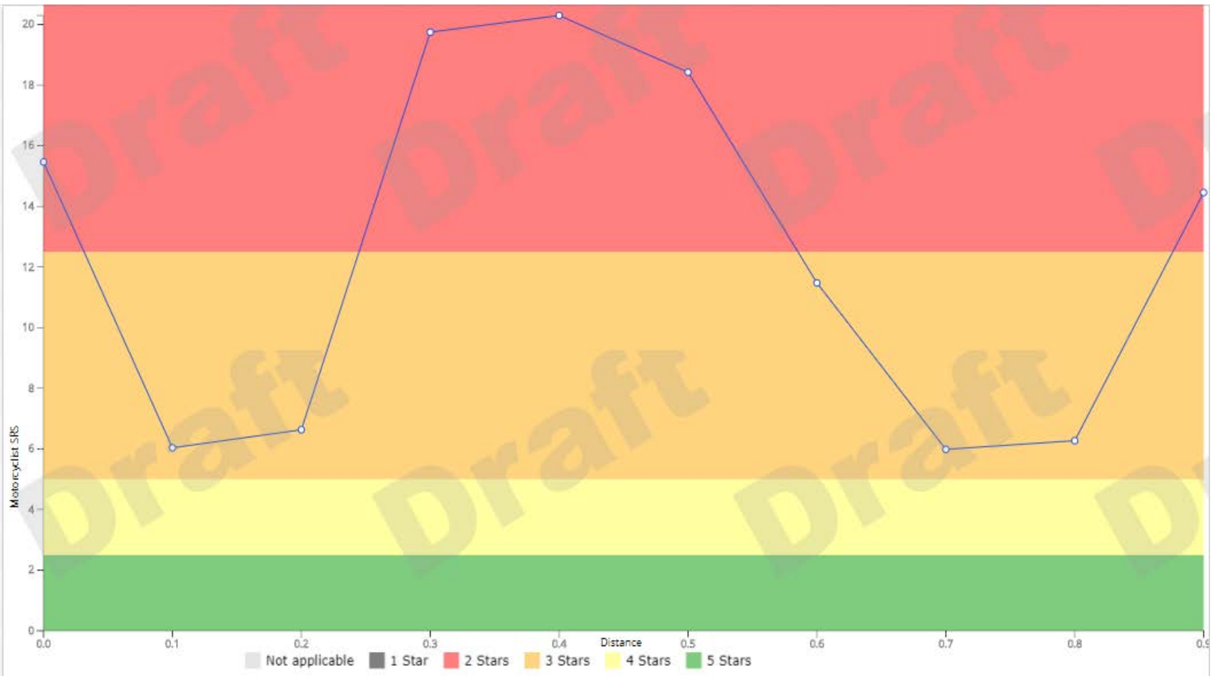

Figure 60 – Risk worm motorcyclists (raw)

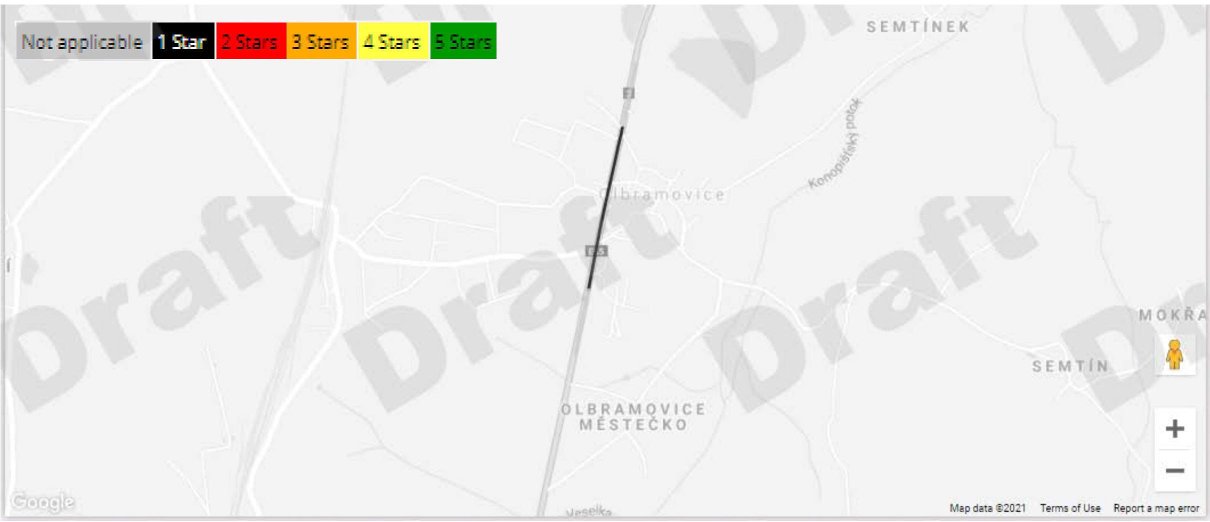

Figure 61 – Star rating pedestrians – existing layout

Star rating score for pedestrians = 52,9 (smoothed)

Figure 62 – Risk worm pedestrians (raw) (Note: ViDA is not generating background colours)

6.2.4. Proposed safety upgrading countermeasures

Proposals for effective measures to reduce risk for VRUs (particularly pedestrians) have been prepared in compliance with common engineering practices applied for humanization of through-roads in the Czech Republic. Partial schemes below illustrate individual measures, while the complete new layout scheme is attached to the report.

The proposed safety upgrades cover:

- entries to the municipality:
  - o traffic calming measure – entry islands; (speed limit 50 is given by traffic law by sign "Village name")

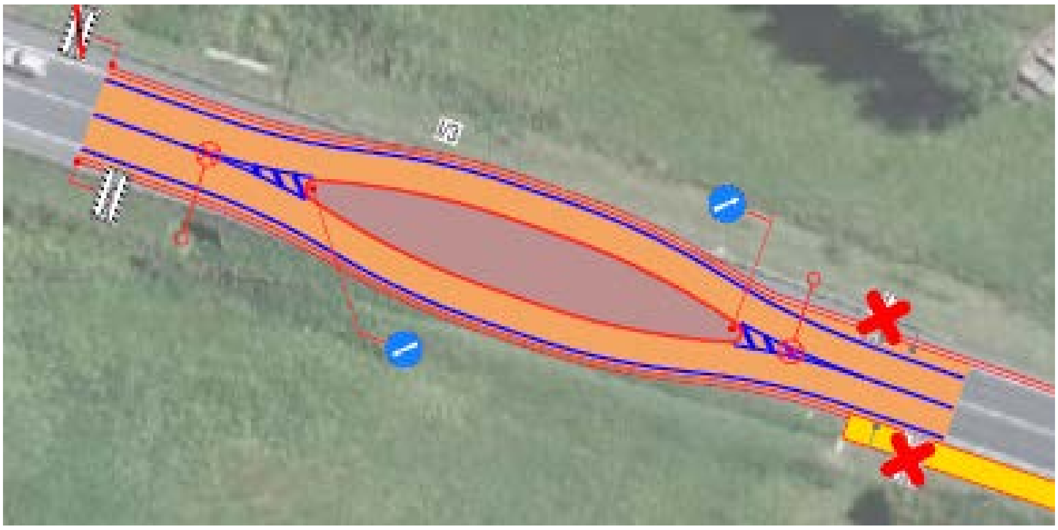

Figure 63 – Proposed safety upgrading countermeasures – entry islands

- section 0,2-0,3 km:
  - o new pedestrian crossing (no refuge island);

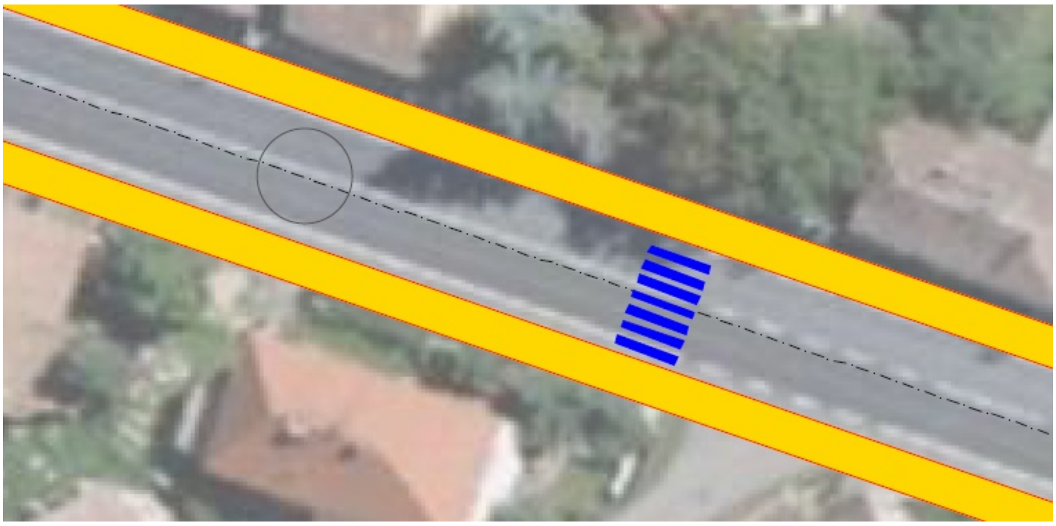

Figure 64 – Proposed safety upgrading countermeasures – new pedestrian crossing (standard mandatory signs are not shown)

- section 0,3-0,4 km:
    - modification of existing pedestrian crossing – new refuge island and traffic signals + active warning on occurrence of pedestrians;
    - new pedestrian crossing on side road III/00335;

Figure 65 – Proposed safety upgrading countermeasures – signalized crossing with refugee island

Figure 66 – Signs at the refuge islands

- section 0,5-0,6 km
    - modification of existing pedestrian – new refuge island;
    - new pedestrian crossing on side road III/11447;
- section 0,6-0,7 km
    - cross-road modification + new pedestrian crossing on side road;

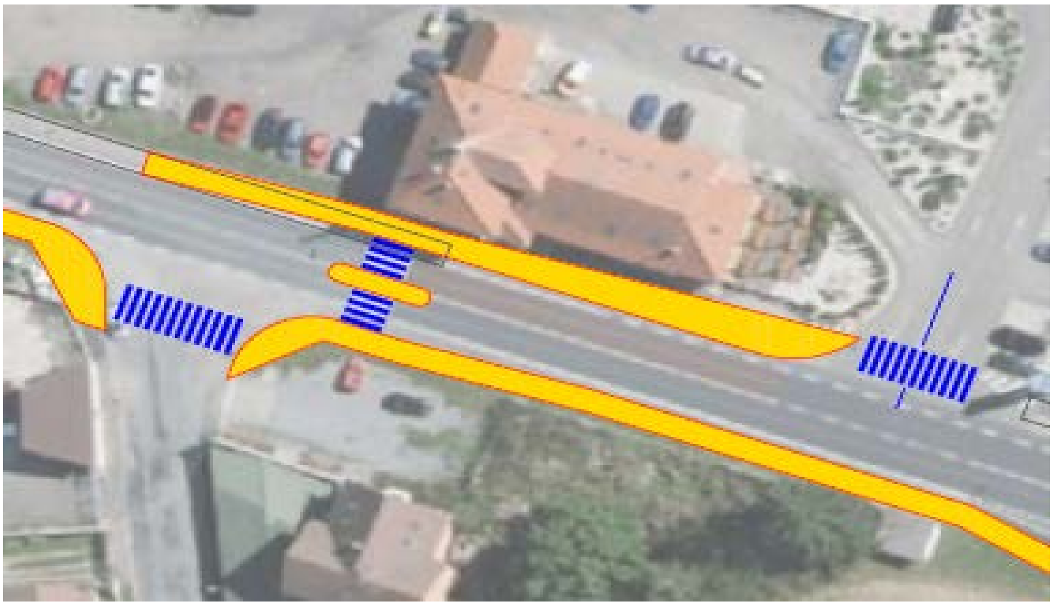

Figure 67 – Proposed safety upgrading countermeasures – crossing upgrade (refuge island, new crossings on sides)

- along the whole scheme:
    - o continuous road marking added (completed);
    - o continuous sidewalks on both sides added;
    - o traffic calming measures to reduce actual speeds (road marking “50” and “ATTENTION CHILDREN”, entry radars).
    - o All standard traffic signs with the yellow frame (not shown);

Figure 68 - Signs at the pedestrian crossings

Figure 69 – Proposed safety upgrading countermeasures – road marking and sidewalks

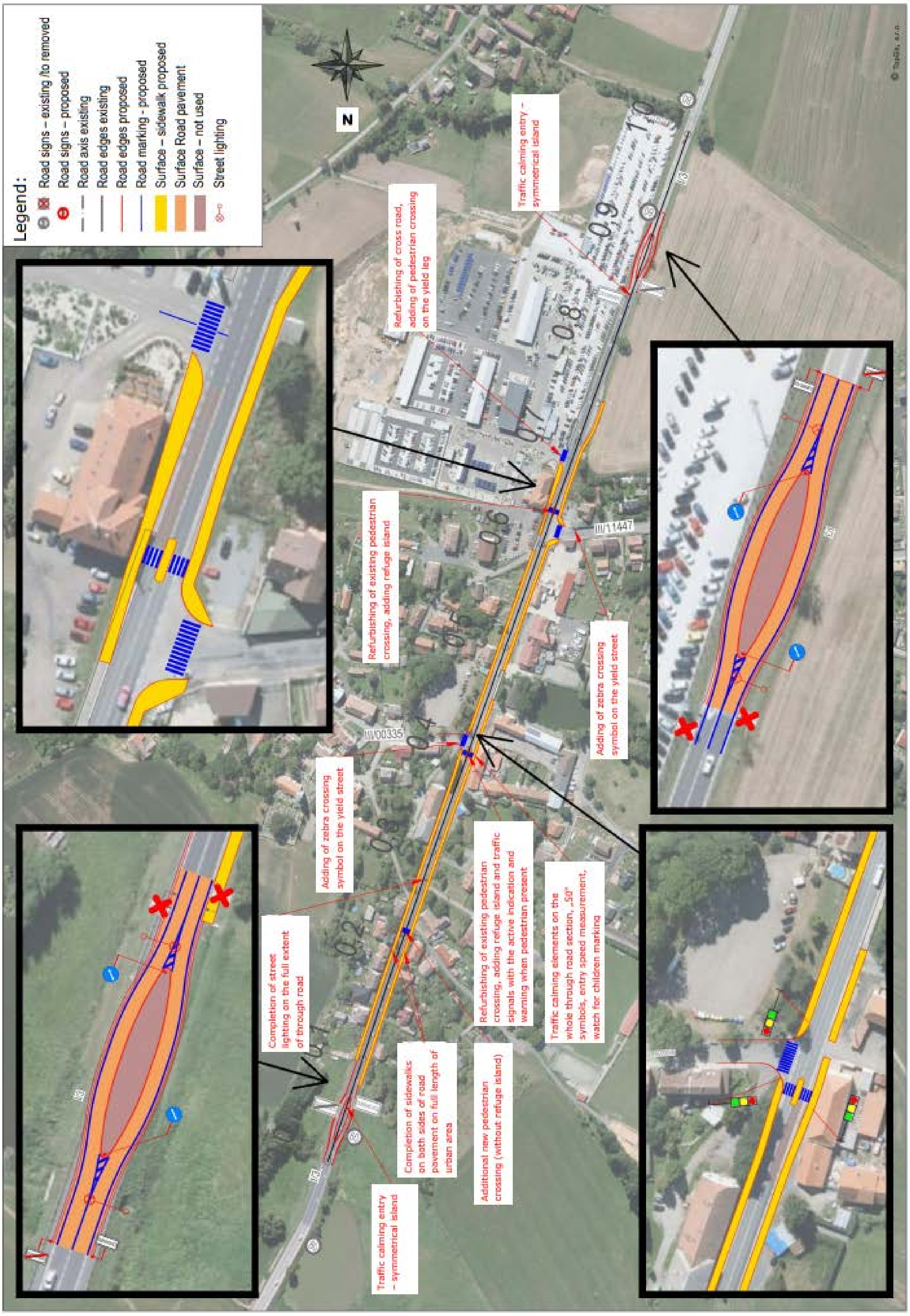

Figure 70 – Full extend of through road section. Proposed safety upgrading countermeasures – road marking and sidewalks (standard mandatory signs are not shown)

6.2.5. Star rating of upgraded layout

After examining and scoring the new layout with proposed countermeasures, the safety level of the through-road improved significantly. **3-star level for vehicle occupants have been kept (even with lower Star rating score) and a decent improvement occurred with motorcyclists, where the whole section assessed is newly 3-star (first 100m segment of the existing layout was 2 stars. Important and satisfactory improvement can be observed with scoring for pedestrians, where the safety level went from 1 star to 3 stars.**

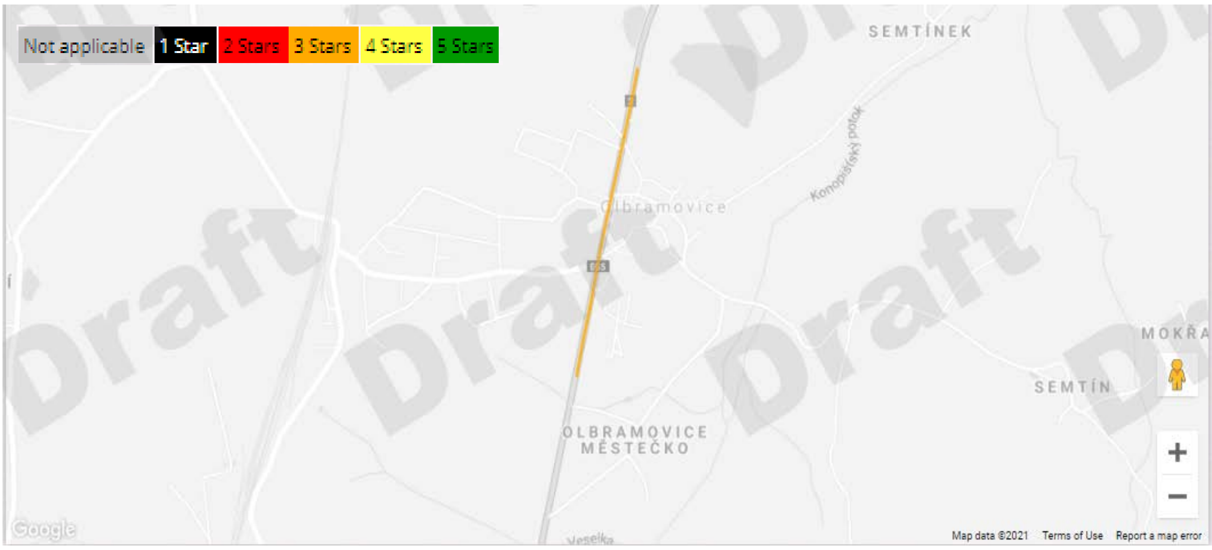

Figure 71 – Star rating vehicle occupants + motorcyclists – upgraded layout

Star rating score for vehicle occupants = 6,79 – 7,83 (smoothed)

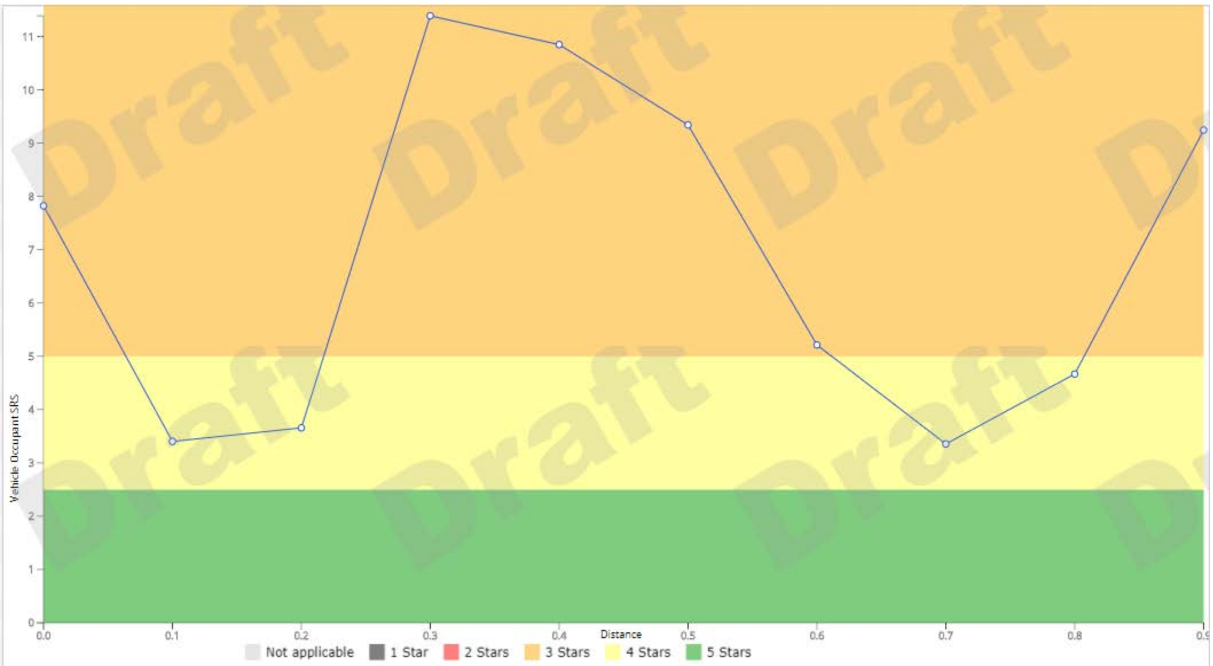

Figure 72 – Risk worm vehicle occupants (raw)

Star rating score for motorcyclist = 8,78 – 10,37 (smoothed)

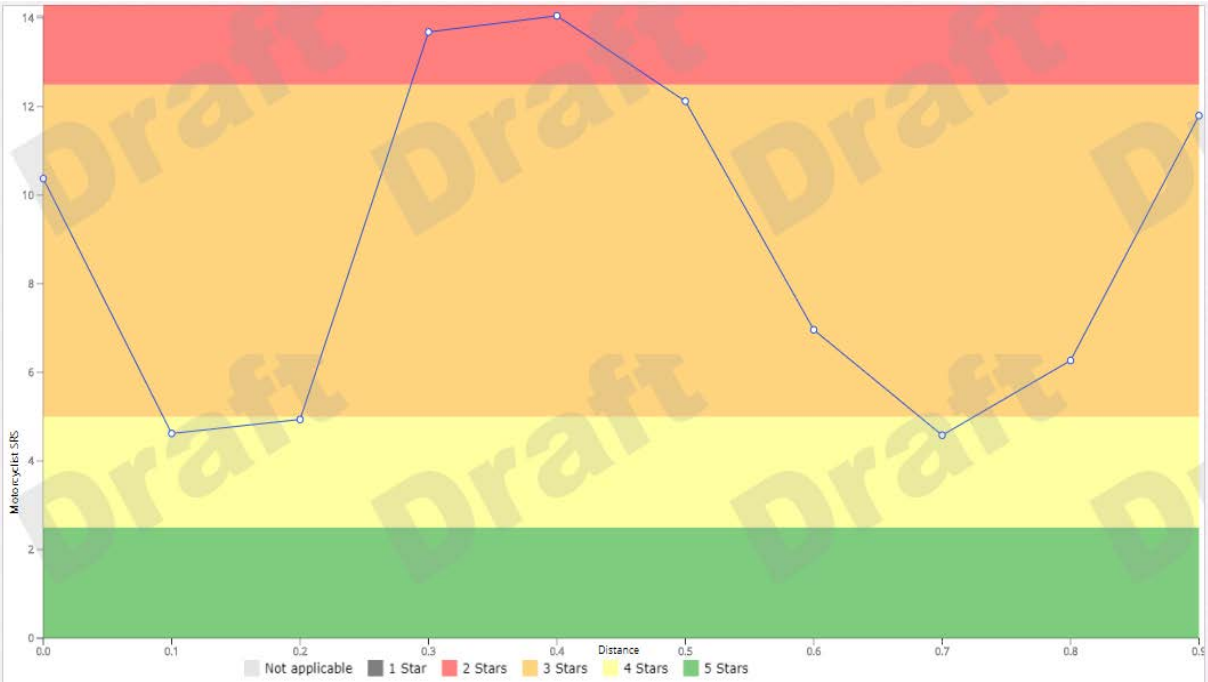

Figure 73 – Risk worm motorcyclists (raw)

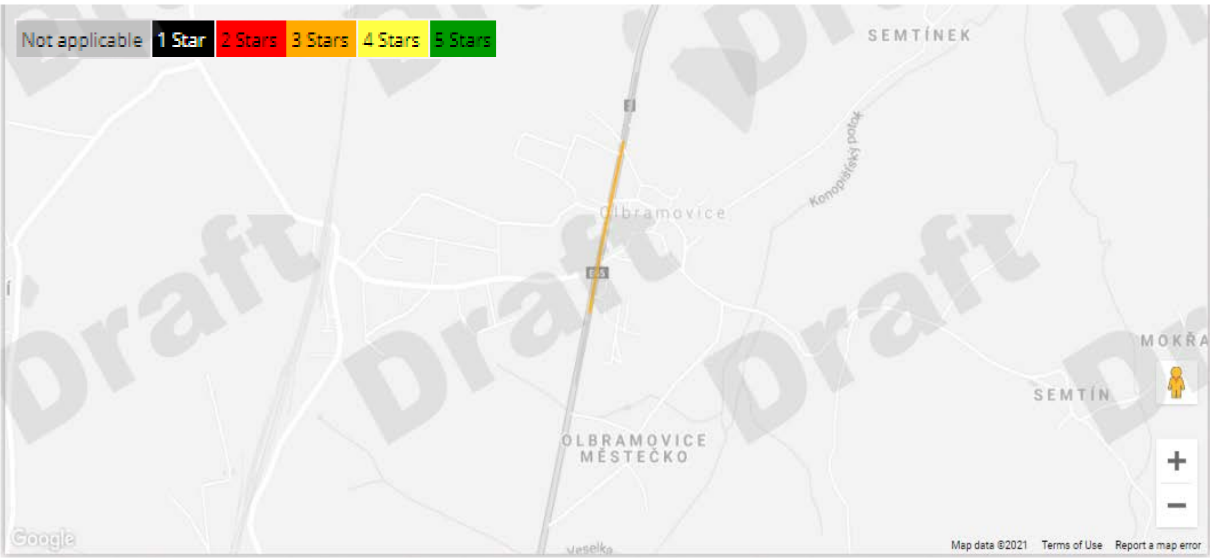

Figure 74 – Star rating vehicle pedestrians – upgraded layout

Star rating score for pedestrians = 12,7 (smoothed)

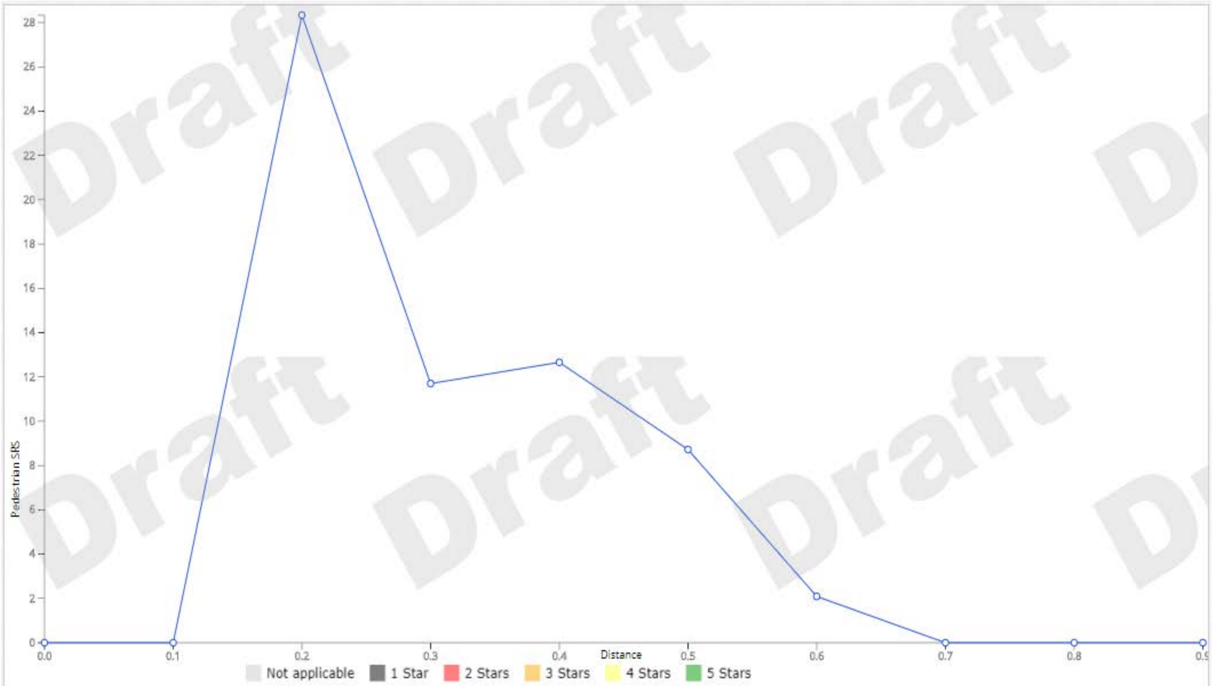

Figure 75 – Risk worm pedestrians (raw) Note: ViDA is not producing coloured background for pedestrian star rating scheme.

6.2.6. Assessment summary

Existing layout and safety provisions of the Olbramovice through-road suffer from major shortcomings and unacceptably high risk for VRUs. Identified deficits particularly include discontinuous and unsatisfactory sidewalks, which do not provide enough safety to pedestrians (no raised edges), insufficiently equipped cross-roads and a low level of traffic calming. Obviously, high transit traffic volumes create a strong barrier effect in the municipality, which is considered as quite a negative precondition.

A complex humanization of the through-road has been proposed, which consists particularly of implementing safe and continuous sidewalks on both sides along the whole urban road section. Several new pedestrian crossings have been added, both on the through-road and several side roads. Existing pedestrian crossings have been equipped with additional safety provisions (refuge islands or even signals in one case) and new traffic calming measures have been proposed for both entries to the municipality (central islands). There have been proposed additional psychological traffic calming measures applied in the upgraded layout (specific road markings), which are approved by Czech road traffic code. **Road markings** are aids to control traffic by exercising **psychological** control over the road users. They are made use of in delineating the carriage way as well as marking obstructions, to ensure **safe** driving. They also assist safe pedestrian crossing.

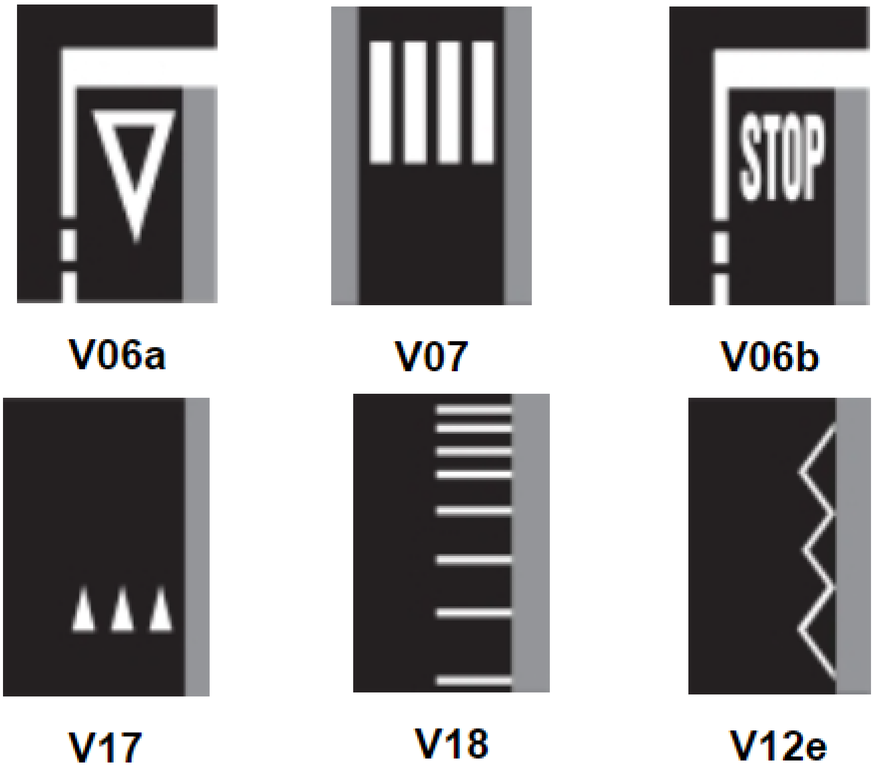

Figure 76 – Road marking applied according to Czech road traffic code, detail

According to the iRAP assessment applied in this demonstration pilot, the new scheme enabled a decent increase of safety for motorized traffic, but a significant safety upgrade for pedestrians (from 1 star to 3 stars). Further improvement would perhaps require the reduction of transit traffic flows (i.e. by-passing), since it is clear that such loads of traffic will always represent a safety risk for intra-urban mobility in Olbramovice.

7. Generalized findings and recommendations for higher safety of VRUs

7.1. Summarized findings of the pilot study investigations

As the scope of the pilot study analysis on provisions for VRUs is extensive and the amount of examined locations and features quite high, the findings have been summarized into the following key messages for the purposes of this executive report.

Observed conditions for VRUs based on the inspection of selected cities

- POSITIVE:
  - relatively satisfactory conditions for pedestrian mobility in city centres;
  - growing installations of equipment for cyclists at points of destination (schools, shops, authority offices, hospitals, etc.);
  - visible efforts to develop cycle transport;
- NEGATIVE:
  - very often missing or wrongly implemented tactual features;
  - low level of barrier-free accessibility and continuation of sidewalks outside the central areas;
  - frequent sidewalks on one side only;
  - discontinuous cycling infrastructure in larger municipalities;
  - numerous risky installations and solutions of cycling facilities in large cities (mainly along high-volume trunk streets).

Further expert assessments:

- POSITIVE:
  - Quality and scope of pedestrian networks (both sidewalks and paths) is significantly better than infrastructure for bicyclists, particularly due to the historic development (pedestrian infrastructure treated for decades, while cycling infrastructure in the Czech Republic has come into focus in recent year only).
  - Good continuity of pedestrian facilities can be observed in larger cities and their centres.
  - Attempts to implement barrier-free solutions (lowered edges, tactual features) are clearly visible.
  - Cycling infrastructure is undergoing a rapid increase in implementation.
- NEGATIVE:
  - discontinuity of pedestrian facilities in smaller municipalities;
  - quality of sidewalks along main through-roads, mainly in smaller municipalities;

- insufficient or even dangerous pedestrian crossings – especially long ones and those with limited sight conditions;
- mistakes in implementation of barrier-free solutions – particularly ever-repeating wrong installations of tactual features
- discontinuous cycling infrastructure;
- inappropriate routing of cycle routes along high-volume urban roads;
- frequent risks appearing on cycling infrastructure – obstacles to passing through, solid obstacles, limited sight conditions, risky crossings or conjunctions with motorized traffic, problematic solutions of cycling facilities around public transport facilities);
- inhomogeneous solutions for cycling resulting in lower understandability for users;
- frequently missing infrastructure provision for non-motorized traffic and its safe movements in rural areas, particularly in between functionally interlinked municipalities with regular pedestrian and bicyclist journeys (risky contact with motorized traffic on roads of insufficient parameters, such as sight conditions, absence of lighting, hard shoulder treatments, etc.);
- similarly dangerous conditions on the outskirts of municipalities (industrial areas, offices, other services) – urban areas but with rather rural character and road characteristics;
- insufficient quality of transport and urbanistic strategies and planning with respect to VRUs

7.2. Generalized recommendations based on observations made

It is vital and appropriate to develop non-motorized traffic for many reasons – environmental (lower emissions, noise), urbanistic (lower demand for space), as well as medical (better physical condition and healthier population). However, it is not easy to implement infrastructure upgrades of VRUs provisions, as the compromise always has to be found with other transport modes and general pre-conditions. The support to non-motorized vehicles shall be supported by the following means:

- To create and maintain a unified national conception for non-motorized traffic development, which will be mandatory (if not legally, then – at least – properly considered in all public contracts related to its development).
- To increase the number of investments into building new (and maintaining existing) infrastructure for non-motorized traffic.
- To achieve the VRUs facilities are effectively used, it is necessary to build them conceptually and homogenously. All road infrastructure upgrades (incl. those for VRUs) need to be self-explaining and forgiving. A user shall understand the way to behave and what to expect at first glance. **Roads must also be built to minimize the consequences of accidents.**

- It is important to **increase safety of VRUs** not only on the side of infrastructure, but also on the side of its users. Raising public awareness of both children at school age (who do not know traffic rules yet) and adults, as the rules change in time and new features are being introduced, so that a part of population does not know how to behave when using them.
- To increase security of parked bicycles – there are ca. 10 000 bicycles stolen annually in the Czech Republic, with only marginal share of those being found and saved. This could be achieved e.g. by building guarded bicycle parks (in larger cities) or establishment of rent-a-bike “cyclo-boxes” in the vicinity of significant destinations (in smaller municipalities).
- To promote and provide actual information and regular updates on new VRUs facilities being put to operation, incl. raising awareness of the possibilities and benefits of non-motorized transport.
- To focus on the conditions of pedestrian crossings, their easy detection, visibility of pedestrians from vehicles and vice versa, sufficient number of safe crossings, support to implementation of signalized button-activated crossings, especially around schools and accesses to public transport facilities.
- To develop and expand a systematic assessment of conditions and facilities for accessibility of schools and playgrounds on the international methodological principles (such as SR4S – Star Rating for Schools).
- To increase the care and treatment of pedestrian connections from small settlements to catchment area centres, as well as of accesses to public transport facilities situated along rural class I and II road sections.

7.3. Conclusions of the iRAP model application

Selected iRAP methodological tools have been used for demonstrating the safety assessment in 2 specific cases – Road Attribute Coding, Star Rating and Star Rating for Design (SR4D). It has not been relevant and required to develop a Safer Road Investment Plan, as the tool is primarily targeted to network-wide analyses and would not generate reliable results in these 2 particular stand-alone pilot cases.

Case 1 application showed that iRAP methodology is less relevant for single blackspot treatment and gives less reliable results. Even quite a generous upgrade proposal (according to Czech traffic engineering practice) has not achieved to increase the number of stars in SRS and reach the 3-star safety level. This is presumably due to the fact the iRAP assessment is highly sensitive and dependent on traffic flow figures and speeds. While the existing layout assessment is considered as relevant, there were better results expected for the new layout assessment.

Case 2 application onto the continuous 1km class I through-road section showed much more promising results in terms of iRAP scoring, both for the existing layout and the upgraded layout. The complex countermeasures have been assessed as effective in terms of increasing safety for VRUs (particularly pedestrians) and the SRS shift from 1 star to 3 stars for pedestrians has been achieved. In this case the model application of iRAP methodology was evaluated as relevant, providing sound and promising results for both the existing and upgraded layouts.

8. Sources

- Information on road traffic accidents in the Czech Republic in 2020; Czech Police
- Road traffic accidents overview map portal
  - Location 1
  - Location 2
- GLOBAL STATUS REPORT ON ROAD SAFETY 2018 (WHO)
- National traffic counting results 2016 (Directorate of Roads and Motorways CR)
- Road stationing (Directorate of Roads and Motorways CR)
- Maps: geoportal.rsd.cz
- Information obtained by project surveys, inspection on place