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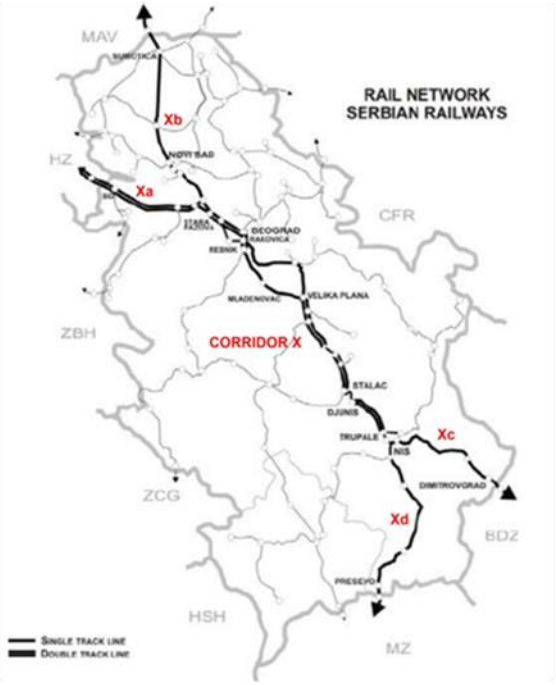

SUPPLEMENTARY STUDY

Gap Analysis for Corridor X Railway – Belgrade-Nis: Stalac-Djunis Section, Republic of Serbia

18 July 2022

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List of Abbreviations

CM	Cadastral Municipality
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIB	European Investment Bank
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
GD	General Design
GHG	Greenhouse gases
H&S	Health and Safety
LC	Location Conditions
OHS	Occupational Health and Safety
PFS	Preliminary Feasibility Study
PIU	Project Implementation Unit
PR	Performance Requirement
RAP	Resettlement Action Plan
RoS	Republic of Serbia
SEA	Strategic Environmental Assessment
SEP	Stakeholder Engagement Plan
SRI	Serbian Railway Infrastructure
WBIF	Western Balkans Investment Framework
WMP	Waste Management Plan

1 Introduction

Project background. The European Bank for Reconstruction and Development (EBRD) is considering providing finance to the Republic of Serbia (RoS) for the benefit of Serbian Railways Infrastructure (SRI). The loan will be used to finance the rehabilitation and upgrade of the approx. 243 km-long railway line connecting Belgrade to Nis ("Corridor X") with the aim to increase the speed while enhancing quality of passenger and freight rail services. The entire project will involve a combination of upgrading the design speed to up to 160/180/200 km/h (depending on the section) and doubling of the single tracks. The Belgrade-Nis rail route will be fully electrified. Thanks to improved infrastructure, the travel time between Belgrade and Nis will be significantly reduced, safety will be improved, as well as the capacity and comfort of the passenger and freight services. This will increase competitiveness of rail transport, especially for international and transit freight traffic, allowing significant modal shift to rail as low carbon intensity sector. This modal shift from road-based transport will have a significant impact in terms of lowered carbon emissions.

The project is expected to be co-financed by the European Investment Bank (EIB) and the European Union (EU) through the Western Balkans Investment Framework (WBIF) or other EU mechanism. The loan will be tranched based on a schedule of subsection rehabilitation.

The first tranche will be committed to finance the works of the **Stalac-Djunis subsection** (the Project). The existing 18.6 km railway line from Stalac to Djunis is a single-track subsection on the part of Corridor X between Belgrade and Nis[1]. Construction of a new double-track railway line 17.7 km long for speeds up to 160 km/h is planned. The alignment will be significantly changed as the Project plans almost complete abandonment of the existing railway route and use of a new corridor. Stalac and Djunis railway stations will be fully reconstructed. A detailed description of the Project is given in Chapter 2 of this Study.

The construction of the Stalac-Djunis subsection will be implemented by two separate "design and build" contracts, one for LOT 1 (tunnelling works for Tunnel 4) and one for LOT 2 (all other civil works and track superstructure for the entire subsection).

Project category. As the Project involves greenfield development and is part of an extensive wider linear infrastructure development on Corridor X, the EBRD has classified it as a **Category A project**. This means that a comprehensive Environmental and Social Impact Assessment (ESIA) and review of associated documents must be carried out, followed by their public disclosure for a minimum period of 120 days.

Purpose and objectives of the Supplementary Study. An international ESIA was developed in 2016, followed by a national EIA (Environmental Impact Assessment) in 2018. An independent gap analysis review of the ESIA and other relevant documentation was completed in 2022 against EBRD, EIB and EU standards and best practice. The review revealed that additional collection of information/data was needed in order to define additional potential Project impacts and required mitigation actions. Therefore, this Supplementary Study was developed as described in Chapter 4. All identified impacts and proposed mitigation measures in both the ESIA and this Supplementary Study are included in the Environmental and Social Management Plan (ESMP) which is an Annex to this Study, as well as the Environmental and Social Action Plan (ESAP). They contain specific-time bound actions with clear responsibilities for implementation allocated between SRI and the Contractor(s), aimed at achieving compliance with national legislation and the Lenders' requirements.

[1] The subsection itself is 18.6 km long. However, if the sections before Stalac and after Djunis are included in order to fit into the existing railway line, it is about 22 km long.

2 Description of the Proposed Project

2.1 Project Significance

With the aim of connecting European countries with the Turkish railways, the importance of development Belgrade-Nis railway line was recognised at the Berlin Congress in 1878. The development of Corridor X, and one of the key subsections - Stalac-Djunis, is recognised as **one of the strategic priorities in both the previous Spatial Plan of RoS (2010-2020) and the new Draft Spatial Plan (2021-2035).** The new Spatial Plan includes planning solutions for the reconstruction, construction and modernisation of the existing railways of the Corridor X (E-70 and E-85) through Serbia in double-track electrified high-performance railways for speeds up to 200 km/h.

Modernisation of the Corridor X as the backbone of the railway infrastructure system of the country is also **recognised as a priority in country-level strategies and programs**, such as the Strategy of Railway, Road, Inland Waterway, Air and Intermodal Transport Development in the Republic of Serbia (2008-2015), the Railway Master Plan (2012-2021) and National Public Railway Infrastructure Program (2017-2021)[2].

For the subsection Stalac-Djunis, a **Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Line Stalac-Djunis and accompanying Strategic Environmental Assessment Report** were adopted in 2017 by the Government of the RoS and published in the Official Gazette, with a planning horizon up to 2036. It is acknowledged that the construction of the new two-track subsection will eliminate the bottleneck on the Belgrade-Nis railway line.

2.2 Project Documents

Previously developed Project documentation includes:

For the entire Corridor:

- Preliminary Feasibility Study (PFS) and General Design (GD) for Reconstruction and Modernisation of the Railway Line Belgrade-Nis (2007)
- Corridor-level PFS (2022), including:
  - Scoping Report,
  - Stakeholder Engagement Plan, and
  - Resettlement Policy Framework.

For the Stalac-Djunis subsection:

- ESIA Study (2016)
- National EIA Study (2018)
- Preliminary Design (2018) and Conceptual Design of the Stalac-Djunis subsection (2021)
  Location Conditions and opinions of relevant authorities for the Stalac-Djunis subsection (the list is given in Appendix A of this Study).

Under Lenders' requirements, the following will comprise the **Project's disclosure package for the Stalac-Djunis subsection**:

- ESIA Study (2016)
- National EIA Study (2018)
- This Supplementary Study and its annex Environmental and Social Management Plan (ESMP)
- Environmental and Social Action Plan (ESAP)

[2] This program specifically stipulates that the performance parameters for the main railway line development must be in accordance with Commission Regulation (EU) 1299/2014 (TSI relating to the 'infrastructure' subsystem of the rail system in the EU).

- Resettlement Action Plan (RAP) for LOT 23
- Non-technical Summary (NTS) of the Project
- Corridor-level Stakeholder Engagement Plan (SEP) whose annex will refer specifically to the Stalac-Djunis subsection

2.3 Key Project Milestones

The history of the Project development is presented in Table 1.

Table 1: Project milestones

Year	Activity	Description
2007	*Preliminary Feasibility Study (PFS) and General Design (GD) for Reconstruction and Modernisation of the Railway Line Belgrade-Nis*	These were developed by the Traffic Institute CIP. The GD evaluated the possibilities for reconstructing the existing single-track sections into two-track sections (including Stalac-Djunis subsection) to increase speed up to 160 km/h, with an analysis of E&S impacts of construction and operation. The GD consists of: (1) Analysis of the current state of infrastructure capacities on the Belgrade-Nis line, (2) Geotechnical study, (3) Traffic technology project, (4) Technical solution of infrastructure capacities of the Belgrade-Nis line, (5) Climatic, hydrographic and hydrological characteristics, (6) Preliminary EIA, (7) PFS.
2015	*Adoption of the General Design*	The General Design was adopted by the State Audit Institution.
2015	*Field geotechnical investigations*	For the purpose of developing the international ESIA Study (see the item "2016" below), field geotechnical investigative works were performed in the period July-September 2015 and resulted in recommendations regarding geotechnical works, drainage of surface and groundwater, disposing of materials, as well as recommendations for the construction of supporting structures.
2015	*Scoping of national EIA Study*	The Ministry of Environmental Protection issued a decision on the scope and content of the EIA Study in December 2015.
2016	*Development of international ESIA Study*	In February 2016, the ESIA study was developed under the WBIF by the consultant Mott McDonald.
2017	*Adoption of the Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Stalac-Djunis Railway Section*	The Spatial Plan (for speeds up to 160 km/h) was developed in the period 2014-2016 and adopted in 2017, with a planning horizon of 20 years (until 2036). A Strategic Environmental Assessment (SEA) was also performed. The Plan analyses the baseline E&S conditions in the area, as well as the impact of the construction of the railway on various E&S aspects.
2017	*Location Conditions (LCs) and Opinions*	The necessary LCs and opinions of various authorities for the reconstruction of the Stalac-Djunis subsection were obtained for the purpose of developing the national EIA Study.
2018	*Preliminary Design for Stalac-Djunis*	In January 2018, the Preliminary Design was developed by CESTRA (former CeS COWI d.o.o.). In addition to the railway route (upper and lower part of the railway line), the design covered other structures (stations, viaduct, bridges, underpasses, overpasses, culverts, supporting structures, noise protection walls, tunnels, local and access roads), and the necessary hydraulic works, electrical installations, signal safety installations and devices, telecommunication installations and devices, mechanical installations and traffic signals and equipment.
2018	*Development and approval of national EIA Study*	In January 2018, the national EIA Study was developed by CESTRA. In May 2018, the Ministry of Environmental Protection approved the EIA Study with a validity period of two years. *Note*: Under Serbian law, an approved EIA Study is equivalent to an environmental permit.

[3] There has been no land acquisition needed for LOT 1 of the Project – the land needed for the exit and entrance portals to Tunnel 4 was already owned by SRI, whereas land needed for access roads is public land. Therefore, a RAP was prepared for LOT 2 only. However, possible changes to the location of Tunnel 4 can be expected and therefore acquisition of privately owned land will be required.

Year	Activity	Description
2021	*Tender for Tunnel no. 4 construction*	In July 2021, a tender for the construction of Tunnel no. 4 on the Stalac-Djunis subsection (LOT 1) was announced.
2021	*Conceptual Design (based on the Preliminary Design from 2018)*	In August 2021, the PPF9 consulting team developed the Conceptual Design for the Stalac-Djunis subsection. It was submitted to relevant institutions in the process of obtaining renewed Location Conditions.
2021	*Renewed Location Conditions (LCs) and other Opinions*	By the end of 2021, the necessary LCs and opinions of various authorities for the Stalac-Djunis subsection were reissued. The list of obtained LCs and opinions is given in Appendix A.
2022	*Pre-Feasibility Study (PFS) for the Corridor, including a SEP, Scoping Report and Resettlement Policy Framework*	The PF) for the entire railway line Belgrade-Nis (including the Stalac-Djunis subsection) was developed by PPF9 consultants in February 2022.
2022	*Signing of contract for Tunnel no. 4 (LOT1)*	In February 2022, a contract for the design and execution of works on the construction of Tunnel no. 4 on the subsection Stalac-Djunis (LOT 1) was signed between SRI and China Railway 21st Bureau Group Co. LTD.
2022	*RAP for the Stalac-Djunis subsection (LOT 2)*	In May 2022, the RAP was developed to cover resettlement related impacts on LOT 2 and is part of the E&S Disclosure Package.

2.4 Current Status of Permits and Authorisations

The national EIA Study was approved by the Ministry of Environmental Protection in 2018 and this initial approval was valid for 2 years. The approval was extended by the Ministry in April 2022, which confirmed that it is not necessary to update the EIA Study as no significant changes have occurred and it is in line with the renewed Location Conditions (2021).

After the Contractor completes the so-called "Design for Construction Permit", SRI will submit a request for a Construction Permit. Since the Project will be implemented by means of two separate "design and build" contracts (for two lots), two construction permits will be obtained.

An overview of all national legal requirements relevant to this Project is provided in Chapter 3.

2.5 Existing and Planned Railway Line from Stalac to Djunis

Current situation. The existing railway line from Stalac to Djunis is a single-track subsection on the part of Corridor X between Belgrade and Nis, with small radius of horizontal curves and low maximum speeds of the trains due to poor infrastructure conditions. The subsection is 18.6 km long. The permitted axle load is 22.5 t. The railway line passes through the Stalac Gorge.

Planned investments. The Project plans almost complete abandonment of the existing railway route and use of a new corridor. The Stalac and Djunis railway stations will be fully reconstructed.

Figure 1: Stalac station

Figure 2: Djunis station

The Project involves the following components:

- Construction of a new double-track railway line 17.7 km long for speeds up to 160 km/h,
- Upgrade of the railway stations in Stalac and Djunis,
- Construction of an overhead contact line, signalling safety and telecommunications installations,
- Decommissioning of the existing single-track railway on the part of the section where the replacement by the double-track railway is planned.

The proposed two-track railway route starts at about km 174+700 and ends at about km 196+500 of the existing railway line (about km 191+500 of the new railway line). The works on reconstruction will start about 1 km before the Stalac station in order to fit into the existing railway line.

Figure 3: Existing railway at the entrance to the settlement of Stalac

The total length of the new railway route (including the sections before Stalac and after Djunis) will be about 17.7 km long. The length of the railway line through tunnels is 6.9 km which is about 40% of the proposed line, and one of them is 3.3 km long. The proposed railway route will intersect with the existing one at four locations.

Figure 4 shows the planned two track railway in the settlement of Trubarovo, where it will intersect the existing one.

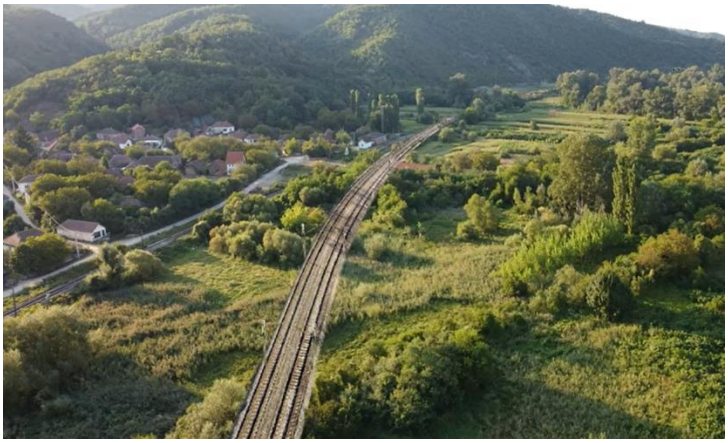


Figure 4: Planned two-track railway in the Trubarovo settlement

Table 2 below provides a comparative overview of the characteristics of the existing and planned railway, while Figure 5 shows the subsection with all the structures and the planned access roads.

Table 2: Comparative overview of the characteristics of the existing and planned railway with ancillary structures

Characteristics	Existing Railway	Planned Railway
Railway surroundings	The existing railway route passes through and/or nearby the following 7 settlements: Stalac, Stalac Town, Braljina, Mojsinje, Cerovo, Trubarevo and Djunis. The route is located within the ecologically important area "Mojsinje Mountain and Stalac Gorge of the Juzna Morava (South Morava) River"[4]. The route runs parallel to the Juzna Morava River (Stalac Gorge) at a greater or lesser distance, on the entire subsection. The river is designated as an ecological corridor of international importance[5]. The route crosses the following 10 streams or rivers: Vinogradski stream, Pajin stream, Razanska river, Krnji stream, Jabucki stream, Vetrenjski stream, Bucina stream, Juzna Morava River, Zmijarnik river, Ribarska river.	The new railway route will avoid and/or will be moved away from 2 settlements: Braljina and Cerovo. It will pass under the Mojsinje settlement with a tunnel. The new route will go through the ecologically important area "Mojsinje Mountain and Stalac Gorge of the Juzna Morava River" almost entirely in tunnels, the only exception being the one 30 m-long half-buried gallery between tunnel 4 and tunnel 5, south of Mojsinje village. The route will leave the Juzna Morava River watercourse and the Stalac Gorge in the length of almost 10 km. The new route will avoid crossing the Pajin stream, Razanska river, Krnji stream, Jabucki stream, Vetrenjski stream and Bucina stream.
Length	18.6 km (22.0 km including the sections before Stalac and after Djunis in order to fit into the existing railway line)	17.7 km (including the sections before Stalac and after Djunis in order to fit into the existing railway line)
Number of tracks	1	2
Trains	*Number of trains in passenger services:* International trains – 4 Regional and local trains – 8 International agency trains – 4 *Number of trains in freight services:* International trains – 11 Domestic trains – 4	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 14 Local trains – 18 *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)	120 km/h	160 km/h
Max. permitted speed	65 km/h Stalac-Braljina 85 km/h Braljina-Djunis	160 km/h
Stopping places	Stalac (station) Stevanac (passing loop) Braljina (station) Cerovo Razanj (halt)	Stalac (station) Djunis (station)

[4] The Decree on Ecological Network, 2010
[5] Ibid.

Characteristics		Existing Railway	Planned Railway
		Staro Trubarevo (passing loop and halt)[6] Djunis (station)	
Level crossings		8	--
Ancillary structures	Bridges	15	6
	Viaducts	--	1
	Galleries	--	1
	Tunnels	1	5
	Overpasses	--	--
	Underpasses	3	2
Fencing		No fencing	Fencing[7]
Access roads		Dr Ilije Nagulica street (Stalac Station) Zeleznicka street (Braljina station) Zeleznicka street (Cerovo Razanj halt) Kralja Petra Prvog street (Staro Trubarevo passing loop) State road No. 215 (Djunis station)	Dr Ilije Nagulica street (Stalac Station) State road No. 215 (Djunis station)
Municipalities		Cicevac Krusevac	Cicevac Krusevac

[6] The Preliminary Design mentions Staro Trubarevo as a passing loop only but it is both a passing loop and a halt.
[7] Although both the EIA and ESIA studies state that the Stalac-Djunis subsection will not be fenced, this entire subsection will indeed be fenced with a wire fence.

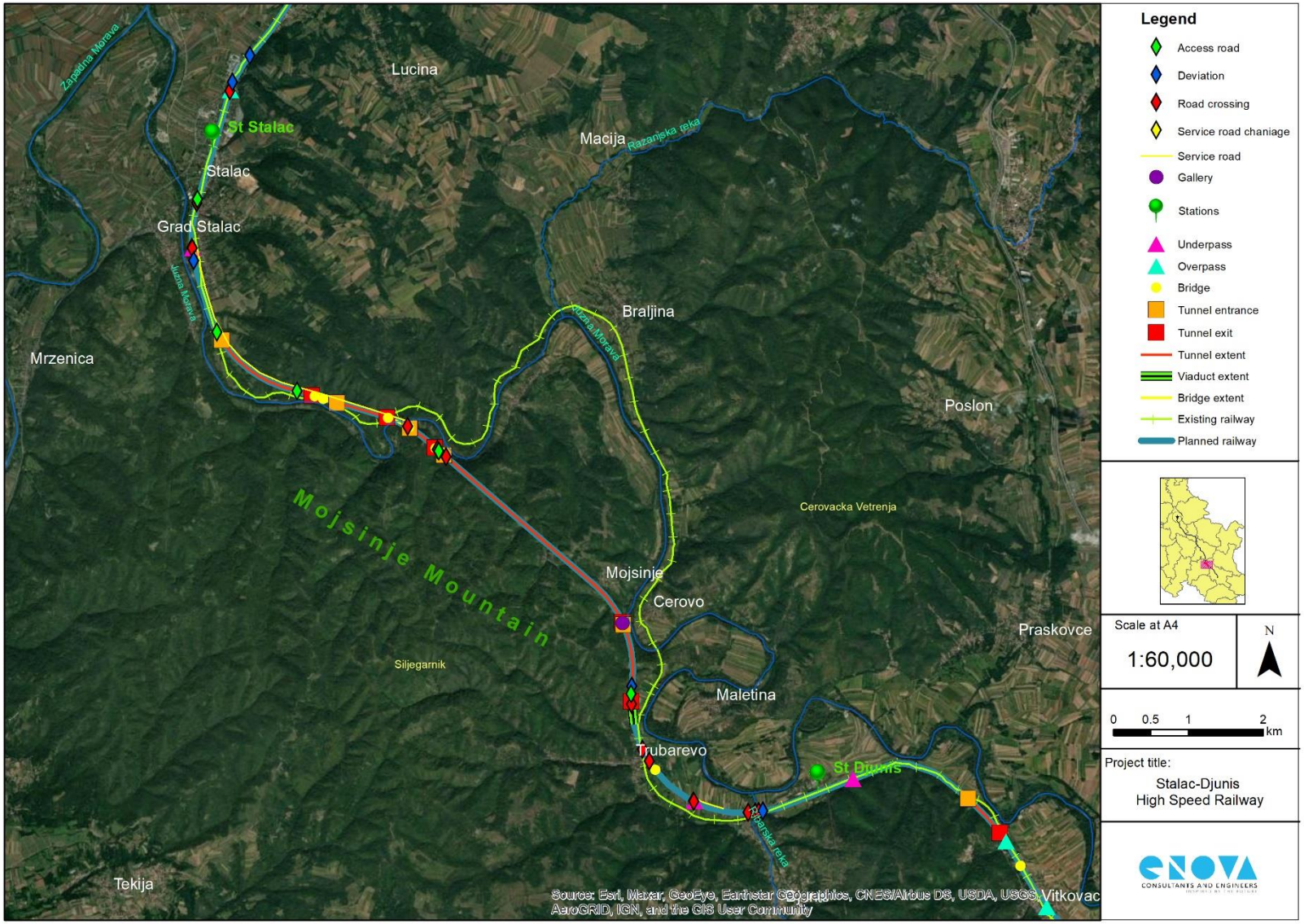


Figure 5: Existing and planned railway with ancillary structures

2.6 Planned Access Roads and Road Deviations

The railway design requires:

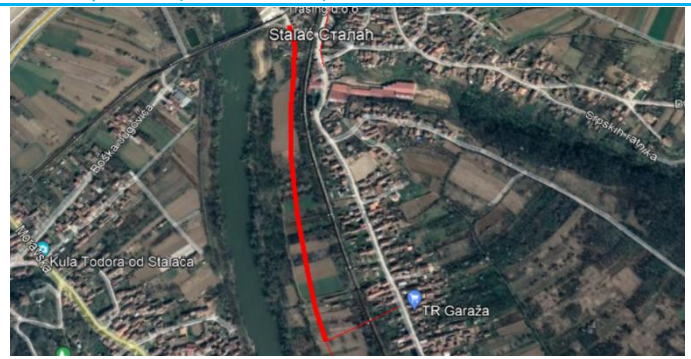
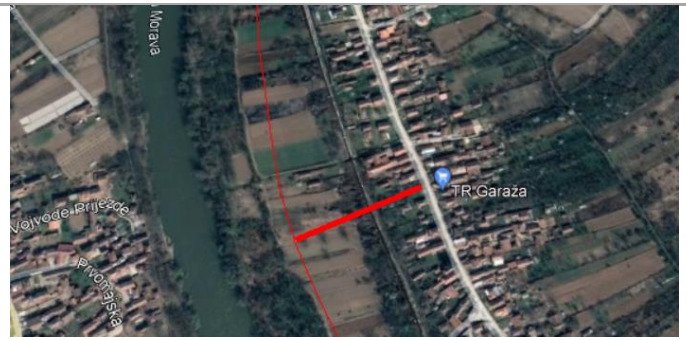
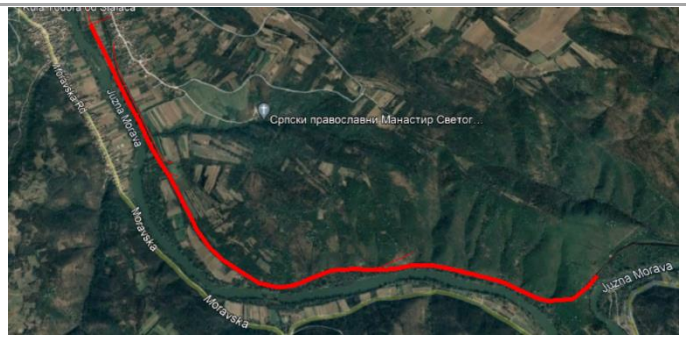
- realignment of 6 existing roads (due to railway design requirements related to safety distances between the rails and roads as well as the track geometry),
- construction of 8 new access roads (two of which with underpasses), and
- reconstruction of 1 existing access road.

For the purpose of impact identification, the area of influence has been generally defined to be within 250 m of the boundary of road deviation and/or the new access roads. Table 3 below describes the planned access roads and road deviations, and the possible impacts on the surrounding receptors. Since the existing situation will not be changed significantly for most of the planned roads, **most impacts have been assessed as minor**. However, there are **two exceptions where the potential impact has been assessed as high** and elaborated further in this Supplementary Study: 1) the planned new access road which will lead to the Church of "Sveta Nedelja", elaborated in Chapter 16) The new relocated part of state road no. 215 will intersect the local road which currently leads to nearby agricultural plots, which is described in more detail in Chapter 15.

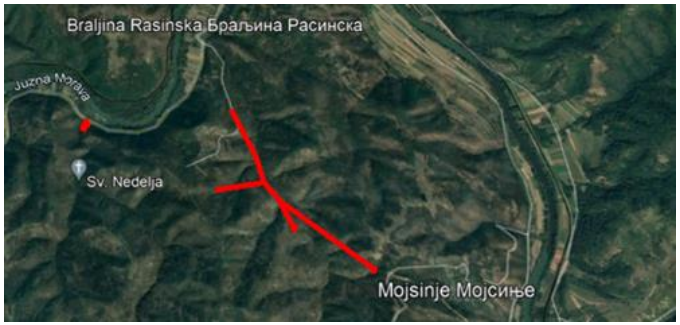
Table 3: Analysis of access roads and road deviations for the Project

Facility	Main characteristics	Planned road position (marked in red)
Proposed road deviations		
Local dirt road in Mirka Tomica Street *(Stalac and Lucina settlements)*	The local dirt road will be relocated from km 174+445 to km 175+250 in the length of 815 m. The relocated road will be on the right side of the new railway line and go parallel to the new railway in its entire length. The existing traffic will be redirected to the new road. In the defined area of influence there are some residential buildings (but the road route does not pass over them). There are no cultural heritage sites. Since the new road is located in the vicinity of the old road and the new railway line, road traffic volumes are not expected to change.	
Local asphalt road in Ilije Nagulica Street *(Stalac settlement)*	The local asphalt road will be relocated from km 175+060 to km 175+360 in the length of 296 m. It will be on the left side of new railway line and go parallel to the existing street in its entire length. The existing traffic will be redirected to the new road. In the defined area of influence, there are some residential buildings (but the road route does not pass over them). There are no cultural heritage sites. The new road is located in the vicinity of the existing street, and road traffic volumes are not expected to change.	
Local asphalt road in Ilije Nagulica Street *(Stalac settlement)*	The local asphalt road will be relocated from km 176+919 to km 177+055 in the length of 153 m. It will be on the left side of new railway line and go parallel to the existing street in its entire length. The existing traffic will be redirected to the new road. In the defined area of influence, there are some residential buildings (one or two houses will need to be demolished as elaborated in the RAP). The new road is located in the vicinity of the existing street, and road traffic volumes are not expected to change.	

Facility	Main characteristics	Planned road position (marked in red)
Local dirt road along the existing railway *(Stalac settlement)*	The local dirt road will be relocated from km 177+758 to km 178+758 in the length of 1,070 m. It will go along the existing railway line in Stalac. The existing traffic will be redirected to the new road. In the defined area of influence, there are some residential buildings (but the road route does not pass over them). There are no cultural heritage sites. Since the new road is located in the vicinity of the old road and the new railway line, as well as within the existing railway line corridor, road traffic volumes are not expected to change.	
Local road – part of the local road Stalac-Djunis, aka Veselina Nikolica street *(Stalac settlement)*	The local road will be relocated from km 186+499 to km 186+780 in the length of 331 m. It will be on the left side of the new railway line and go along the old road line. It will be within the ecological network "The Mojsinje Mountains and Stalac Gorge on the Juzna Morava River". The negative impact on the ecological network are not expected because the affected habitats are anthropogenic. The existing traffic will be redirected to the new road. In the defined area of influence, there are no buildings or any cultural heritage sites. The new road is located in the vicinity of the existing local road, and the road traffic volumes are not expected to change.	
State road no. 215 *(Djunis settlement)*	The state road no. 215 will be relocated from 189+067 to km 189+750 in the length of 1,235 m. De-levelling is planned at km 189+067. The new relocated part of state road no. 215 will intersect the local unpaved road which currently leads to nearby agricultural plots, as described in more detail in Chapter 15. The new road will be moved away from existing residential houses. There are no cultural heritage sites nearby. Road traffic volumes are not expected to be changed.	
Proposed new access roads		

Facility	Main characteristics	Planned road position (marked in red)
Asphalt road as an extension of the Prijezdina street *(Stalac settlement)*	A new local asphalt road is planned from 176+943 to km 177+623 in the length of 681 m. It will be located between the right side of new railway line and the Juzna Morava river. The existing traffic from Prijezdina street to and from Ilije Nagulica street across a level crossing will be redirected to the new road and the new underpass at km 177+593 (see item below). In the defined area of influence, there are residential buildings (but the road route does not pass over them) and a local church. The new railway line will be between the new local asphalt road and residential buildings, and road traffic volumes are expected to be low.	
Road as a connection between Prijezdina Street and Ilije Nagulica Street *(Stalac settlement)*	A new 154 m long road (with an **underpass** at km 177+593) will connect the extension of the Prijezdina street (item above) and Ilije Nagulica street. The existing traffic from the Prijezdina street to and from Ilije Nagulica street across the current level crossing will be redirected to the new road. In the defined area of influence, there are some residential buildings (but the road route does not pass over them). There are no cultural heritage sites. The new underpass will be located in the vicinity of existing residential buildings, as a new noise source with a small traffic volume.	
Main service access road to Tunnel 1 *(Stalac settlement)*	A new 4,177 m long access road will be built to the exit of Tunnel 1, over the existing railway alignment, from km 177+593 to km 181+400. In the defined area of influence, there are some residential buildings (but the road route does not pass over them) and no cultural heritage sites. The access road is on the margins of the ecological network area "Mojsinje Mountains and Stalac Gorge of Juzna Morava River" and is not located within said area; the habitats have already been altered by the existing railway and new negative impacts are not expected. From this road, connection with Tunnel 1 entrance and Tunnel 1 emergency exit is established. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	

Facility	Main characteristics	Planned road position (marked in red)
Access road from main service road to Tunnel 1 entrance *(Stalac settlement)*	A new 155 m long access road will be built to the entrance of Tunnel 1, from km 178+753 to km 178+900. It will be located on the right side of the new railway line. In the defined area of influence, there are no buildings or any cultural heritage sites. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	
Access road from main service road to Tunnel 1 exit *(Stalac settlement)*	A new 300 m long access road will be built to the emergency exit of Tunnel 1, from km 180+134 to km 180+350. The new road will be located on the right side of the new railway line. In the defined area of influence, there are no buildings or any cultural heritage sites. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	
Access road to Tunnel 4 entrance *(Stalac and Braljina settlements)*	A new 286 m long access road will be built to the entrance of Tunnel 4, from km 182+211 to km 182+300. It is connected with the local road Stalac-Djunis (Veselina Nikolica street). The new road will be located on the left side of the new railway line. It will be located within the ecological network "Mojsinje Mountains and the Stalac Gorge on the Juzna Morava River". The construction of the access road will affect woodlands and shrubs. Considering the proximity of the existing local road, it can be assumed that the vegetation is already under high pressure and degraded. Nonetheless, no net loss of natural and semi-natural habitats is allowed within the ecological network area. The same or larger area must be afforested as a compensation for the loss (as defined in Chapter 6.2.3 of this Supplementary Study and included in the ESMP). In the defined area of influence is only the church "Sveta Nedelja", which is described in more detail in Chapter 16. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	

Facility	Main characteristics	Planned road position (marked in red)
Access toad to Tunnel 4 evacuation plateau *(Braljina settlement)*	A new 1,445 m long access road will be built to the evacuation plateau of Tunnel 4. It will be connected with the local road Stalac-Djunis (Veselina Nikolica street). The new road will be located on the left side of the new railway line. It will be located within the ecological network "Mojsinje Mountains and the Stalac Gorge on the Juzna Morava River". The access road is going to be built in the heart of the Mojsinje Mts. No net loss of natural and semi-natural habitats is allowed within the ecological network area. Deforestation shall be restricted to the minimum width of the road necessary to enable normal passage of vehicles and machinery. The same or larger area must be afforested in compensation for the loss using autochthonous species. It is important to note that, due to the position of Tunnel 4 that is completely located in the ecological network area, it was not possible to design this access road outside of the area. In the defined area of influence there are no residential buildings or any cultural heritage sites. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	
Access road to Tunnel 5 exit *(Braljina settlement)*	A new 150 m long access road will be built to the exit of Tunnel 5, from km 186+545 to km 186+670. It will be connected with the local road Stalac-Djunis (Kralja Petra Prvog street). The new road will be located on the left side of the new railway line. It will be located within the ecological network "Mojsinje Mountains and the Stalac Gorge on the Juzna Morava River". The impact is negligible as the access road is built on anthropogenic habitat. In the defined area of influence there are no buildings or any cultural heritage sites. This will be the service road for tunnel maintenance and emergencies, with very small traffic volume. No public traffic is expected.	
Road as connection between two local roads *(Djunis settlement)*	A new 408 m long access road (with an **underpass** at km 188+342) will be built to connect two local roads. In the defined area of influence there are no buildings or any cultural heritage sites. A small volume of traffic is expected.	

Facility	Main characteristics	Planned road position (marked in red)
Access road to Djunis power substation *(Djunis settlement)*	A new 1,105 m long access road will be built to the Djunis power substation, from km 189+202 to km 190+275. It will be connected with state road no. 215. The new road will be located on the right side of the new railway line. In the defined area of influence there are some residential buildings (but the road route does not pass over them), and no cultural heritage sites. This will be the service road for Djunis power substation maintenance and emergencies, with a very small traffic volume. No public traffic is expected.	
Access road to Djunis station building *(Djunis settlement)*	A 200 m new access road to the Djunis station building from km 189+922 to 190+100 is planned by reconstructing the existing road connecting to state road no. 215 and expanding it with a new station parking space. In the defined area of influence, there are residential buildings (but the road route does not pass over them) and there are no cultural heritage sites. The road traffic volumes are not expected to change.	

2.7 Decommissioning of Existing Railway

The existing railway will be decommissioned only on the part of the route where the single-track railway will be replaced by the double-track. The decommissioning of the existing railway infrastructure on the abandoned railway segment is not envisaged by the Preliminary Design. SRI has confirmed that there is a possibility of removing the existing infrastructure if additional funding is secured. In such case, the issue of final waste disposal will be Contractors' responsibility.

There are no plans for land urbanisation around the abandoned railway alignment. On similar previous projects, SRI had transferred land ownership at the request of the RoS Government to the municipalities for future urbanisation activities. However, such a request was not received for the Stalac-Djunis subsection and is currently not foreseen by the financial agreement.

2.8 Safety Considerations

The new railway has been proposed with the following features that improve its safety:

- The subsection design complies with Technical Specifications for Interoperability (TSIs) which incorporate a number of important safety and accessibility features; as well as European technical parameters (as defined in the European Agreement on Main International Railway Lines and in the European Agreement of Important International Combined Transport Lines and Related Installations)
- The entire subsection will be fenced, which reduces the risk of trespassing and hence greatly reduces the risk of accidents to trespassers; and
- There will be no level crossings, all crossings are grade separated (underpasses or overpasses) and hence the risk of level crossing accidents has been eliminated.

2.9 Alternatives Considered

The 2007 General Design for the Belgrade-Nis railway considered four alternatives:

1. Reconstruction and keeping the existing railway route with an increase in speed up to 100 km/h,
2. Reconstruction and keeping the existing railway route with an increase in speed up to 120 km/h,
3. Abandonment of the existing railway route, for the most part, with an increase in speed up to 160 km/h,
4. Abandonment of the existing railway route, for the most part, with an increase in speed up to 200 km/h.

For each of the alternatives, railway length and costs were analysed. As indicated in the General Design, reconstruction of the Stalac-Djunis subsection to reach speeds up to 120 km/h following the existing route would cost approximately as much as the construction of a new railway for speeds up to 160 km/h following a new alignment. Therefore, the new alignment was proposed to enable greater speed and shorten travel time, as well as to better fit into the rest of the Corridor X.

The 2016 ESIA Study considered four alternatives for increasing speed up to 100/120/160/200 km/h in addition to the *"do nothing alternative"*:

- *Do Nothing Alternative.* The implementation of this alternative would not meet the strategic priorities defined by the spatial plans. If the railway line is not constructed, there will be no adverse environmental impacts typical for construction activities (e.g., permanent loss of land, degradation of landscape, water flow diversion). However, other adverse E&S impacts would remain such as generation of waste during the replacement and reconstruction of infrastructure or public and workers' safety.
- *Alignment alternatives.* Although the E&S criteria for selecting the final alignment variant are not explicitly specified in the ESIA, it can be concluded from the text that the following E&S issues were considered: number of intersections with the existing railway and roads, collision with the overpass pier (safety aspects); distance from the Juzna Morava River and number of river embankments (flood aspect); demolition of residential buildings; topographical conditions of the terrain; and hydrological settings at the site. For the selection of the appropriate location for ancillary structures, the following E&S issues were considered:

hydrological and hydrogeological settings, topographical conditions of the terrain, and number of intersections of the new railway line with the existing roads.

The 2018 national EIA Study considered the same alternatives as the General Design. The criteria are more explicitly stated as follows:

Soil pollution	Impact on landscape
Surface and ground water pollution	Exposure to noise and vibrations
Archaeological sites near the railway line	Impact on the built environment
Immovable cultural property near the railway	Impact on the population (No. of official points)

Emission reduction – the concentration of pollutants in the air for both construction and operation

Impacts on flora and fauna (length of the route passing through the protected area)

The alternative selected in both the ESIA and national EIA is the development of a railway line for speeds up to 160 km/h. Also, these studies emphasised that the route given in the General Design has been slightly changed in the 2018 Preliminary Design to avoid the otherwise unavoidable regulation of the Juzna Morava River and development of river embankments at 5 locations, as well as to avoid collision with the overpass pier at the entrance to the Stalac station. In addition, as a result of transport and traffic technology design, the two halts envisaged in the General Design (Braljina Krusevacka and Trubarovo) were removed from the route. The Djunis station has been moved 400 m to the east of the existing station due to unfavourable hydrogeological conditions. The new Conceptual Design from 2021 prepared by PPF9 Consultant keeps the Djunis station as a technical control centre and plans for construction of a small station building in the vicinity of the existing one.

The SEA Report accompanying the Spatial Plan of the Special Purpose Area of the Stalac-Djunis Railway Infrastructure Corridor identifies the positive and negative E&S impacts/risks of Project implementation along with identification of impacts in case of the "no-project alternative". A summary of these is presented in Table 4 below. The SEA concludes that the Project benefits outweigh the potential negative E&S impacts and gives positive opinion about the construction.

Table 4: Positive and negative impacts/risks of Project implementation and no-project alternative as per SEA

Alternative	Positive impacts	Negative impacts/risks
Project not implemented	If the Project and the Spatial Plan are not implemented, no positive environmental or social impacts can be identified.	> Emissions of hazardous substance into the air > Uncontrolled wastewater discharge in rural and peri-urban areas > Degradation of arable land, increasing risk of floods and landslides, as well as pollution of surface and ground water > Reduction and degradation of agricultural land quality > Unsafe handling of industrial waste > Soil pollution by solid waste and wastewater > Deterioration of drinking water quality > Irrational consumption of energy resources > Endangering ecosystems > High noise levels and air pollution > Construction in floodplains and landslides increases the risk to the lives of citizens and their property > Insufficient traffic accessibility of settlements accelerates depopulation > Reduction of employment > Construction of new facilities on agricultural land

Alternative	Positive impacts	Negative impacts/risks
Project implemented	> Reduction of hazardous emissions into the air > Efficient wastewater treatment > Preservation and improvement of agricultural land quality due to stopping the unplanned construction on quality agricultural land, and promoting rational and controlled use of construction land > Preservation of surface and groundwater quality by installing a wastewater drainage and treatment system before its final discharge into the watercourse > Reduced risk of floods, erosion and landslide > Reduction of waste production (finding alternative to temporary storage of used wooden sleepers along the railway alignment) and improved collection of waste generated in station buildings and its disposal > Safe handling of hazardous waste > Rational consumption of energy by reducing the number of stops and maintaining a constant train speed > Biodiversity conservation due to planned (re)construction of railway that will support existing biodiversity features > Development of railway transport and increasing the quality of roads will increase traffic accessibility of the area and contribute to development of the economy and employment, as well as reducing depopulation of rural areas > Avoiding construction in zones with increased air pollution and noise > Avoiding construction on floodplains and landslides	> Planned infrastructure will occupy agricultural land > Development of railway traffic will increase the exposure of the population to higher noise levels in the areas near the railway

2.10 Previous Stakeholder Engagement

Several stakeholder engagement activities were undertaken in the previous period within the national environmental permitting and spatial planning procedures as well as during the development of RAP, as follows:

Period	Topic of consultations	Brief description
2015	Request for EIA Scoping	Following the submission of the scoping request by SRI to the Ministry of Environmental Protection, the Ministry consulted with the public before issuing the Scoping Decision (as required by the national law). The request was publicised on the Ministry's website and newspapers, and the public was invited to submit comments. No comments were received.
2016	EIA Study	After the EIA Study was drafted, it was made available for public review (in the premises of the City of Krusevac and the Ministry). The public was invited to submit comments. A public hearing was then held in May 2016 in Krusevac to discuss the EIA Study. No comments from the public were received.
2016-2017	Spatial Plan for Stalac-Djunis and the SEA Report	The Spatial Plan for Stalac-Djunis and the SEA Report for the Spatial Plan were published to enable public review and comments in 2016, as required by national law. The public review period was 30 days. The documents were published on the website of the Ministry of Construction, Transport and Infrastructure, and were made available in hard copies at the premises of the City of Krusevac and the Municipality of Cicevac. During the public review period, the documents were also presented at a public hearing in the Municipality of Cicevac. In 2017, the Spatial Plan Committee also held a public session and invited all interested parties to participate in the session. There are no records of the public review process but the SEA Report states that all the opinions submitted by the interested public have been taken into account and incorporated.
2021	RAP	SRI and the RAP consultants organised meetings with local authorities in Cicevac and Krusevac during RAP development in August and October 2021. The local authorities confirmed that the Project is seen as a great economic opportunity but raised some concerns including impact of closure of stations/halts, proper maintenance of local roads to avoid any damages during and after railway construction, and flooding issues. Meetings with local residents were held in December 2021 in Trubarevo, Djunis and Stalac. The local residents also raised some concerns about Project impacts including the locations and design width of underpasses and impact of closure of stations/halts. More detailed information on these consultations is provided in the RAP.
2021	Preliminary Design/ Location Conditions	Relevant public bodies and public enterprises were officially consulted during the process of obtaining Location Conditions for the Stalac-Djunis subsection. These include the Ministry of Construction, Transport and Infrastructure; Institute for Nature Protection of Serbia; Institute for the Protection of Cultural Monuments; Ministry of Internal Affairs – Department of Emergency Situations; Republic Hydrometeorological Institute; Public Water Management Company Srbijavode and Morava Nis, etc.

3 Legal Aspects and Compliance with Relevant Laws and Policies

3.1 Relevant National Requirements

With regard to **railway design and management**, the key relevant laws are the *Law on Planning and Construction*, the *Law on Railways*, the *Law on Safety in Railway Operations* and the *Law on Interoperability of the Railway System*. These laws require that:

- environmental impacts of establishment and operation of the railway system must be assessed and taken into account at the design stage of system. Any used materials must prevent the emission of fumes or gases which are harmful and dangerous for the environment, particularly in the event of fires.
- rolling stock and energy-supply systems must be designed and built in such a manner as to achieve electromagnetic compatibility with the installations and equipment and public and private networks with which they might interfere.
- the design and operation of the railway system must not lead to unauthorised noise levels in the areas close to the railway infrastructure or in the driver's cab of a traction unit.
- the operation of the railway system must not give rise to an inadmissible level of ground vibrations for the activities and areas close to the infrastructure that is maintained in compliance with the regulations.
- the functioning of the electrical or thermal energy-supply systems must not interfere with the environment beyond the specified limits.
- the operation of technical installations and procedures in places where maintenance is conducted must not exceed the permissible levels of nuisance with regard to the surrounding environment.
- technical specifications for interoperability shall apply to newly built, upgraded or renewed railway lines covered by the comprehensive TEN-T (Trans-European Transport Network) network for Southeast Europe.

Since Corridor X is a project of particular importance to RoS, **procedural matters** such as financing, preparation of documentation, obtaining permits and the expropriation process are regulated by the *Law on Special Procedures for the Implementation of Construction and Reconstruction Projects of Linear Infrastructure of Particular Importance for Serbia*. The aim is to ensure more efficient implementation of such projects.

In addition, projects must meet the following basic requirements: (i) mechanical resistance and stability, (ii) fire safety, (iii) hygiene, health and environment, (iv) safety and accessibility during operation, (v) noise protection, (vi) energy saving and heat retention, (vii) sustainable use of natural resources.

The necessary **technical documentation** is defined in the national *Regulation on the Content, Manner and Procedure of Preparation and Control of Technical Documentation*. The following types of technical documentation must be prepared for projects such as railway projects:

- General Design,
- Conceptual Design,
- Preliminary Design,
- Design for Construction Permit,
- Main Design, and
- As-built Design.

With regard to **permitting requirements**, the *Law on Planning and Construction* defines that the Location Conditions (LC) must be obtained for the railway project. The LC is issued on the basis of a Conceptual or Preliminary Design. After obtaining the LC, a Design for Construction Permit is prepared. The design is based on the conditions from the LC, relevant regulations, measures for a facility prescribed in different studies developed at this stage (e.g. EIA) and rules of profession. The Design for Construction Permit is submitted together with an application for the Construction Permit. After construction is completed, a Use Permit is issued based on the Technical Acceptance of the project and its components.

The key laws related to the **national EIA procedure** are the *Law on Environmental Protection* and the *Law on EIA*. EIA is mandatory for projects with significant E&S impacts (construction of the railway subsection Stalac-Djunis). The EIA Study must be approved by the competent authority (this is equivalent to an environmental permit in Serbia). Measures from the EIA Study are mandatory for construction and operation phases. According to the *Law on Strategic Environmental Assessment (SEA),* SEA is required for planning and strategic documents.

Environmental protection is ensured through a set of laws which defined standards for quality of air, water, noise and soil, waste management and other environmental guidelines. The principles are set by the *Law on Environmental Protection* while specific laws address various components of the environment:

- **Air quality**: the *Law on Air Quality* and its by-laws require that measures must be taken to prevent or reduce air pollution emissions, and that air quality must be monitored and data collected in line with the relevant by-law
- **Protection against noise**: the *Law on Environmental Noise Protection* and its by-laws require that a system of protection against noise must be established and maintained; strategic noise maps and action plans must be developed; acoustic zones and noise measurement methods must be applied; limit values for outdoor and indoor noise must be respected; and environmental noise measurements must be done according to SRPS ISO 1996-1 and SRPS ISO 1996-2 standards.
- **Water and wastewater management**: the *Law on Water* and its by-laws require that water (i.e., all surface and groundwater) must be protected and managed adequately; and that limit values for certain groups or categories of pollutants in wastewater must be respected before it is discharged into the public sewer.
- **Waste management**: the *Law on Waste Management* and its by-laws require adequate management of all waste; classification of waste according to the waste catalogue (list of non-hazardous and hazardous waste classified by its origin and composition)
- **Nature protection**: the *Law on Nature Conservation* and its by-laws outline the objectives regarding protection, preservation and improvement of biological, geological and landscape diversity and sustainable use of resources.

In addition, a range of legislation covers other issues such as **labour** (the *Law on Labour*, the *Law on Prevention of Harassment at Work*), **health and safety** (the *Law on Safety in Railway Operations*, the *Law on OHS*, the *Decree on OHS at Temporary or Mobile Construction Sites*), protection of **cultural heritage** (the *Law on Cultural Heritage*) and **land acquisition** (the *Law on Expropriation*).

3.2 Lenders' Requirements

EBRD requirements. EBRD Environmental and Social Policy 2019 (ESP) details the commitments of the Bank's Funding Agreement to promote in the full range of its activities, environmentally sound and sustainable development. Bank-financed projects are expected to meet good international practice related to sustainable development. The Bank has defined specific Performance Requirements (PRs) for key areas of E&S issues and impacts as listed below:

- PR 1: Assessment and Management of E&S Risks and Impacts
- PR 2: Labour and Working Conditions
- PR 3: Resource Efficiency and Pollution Prevention and Control
- PR 4: Health, Safety and Security
- PR 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PR 7: Indigenous Peoples (not applicable to this project)
- PR 8: Cultural Heritage
- PR 9: Financial Intermediaries (not applicable to this project)
- PR 10: Information Disclosure and Stakeholder Engagement

EIB standards. EIB requires that all the projects it is financing are acceptable in E&S terms by applying appropriate safeguards to all its operations. The EIB Environmental and Social Handbook (2022) provides an operational translation of those standards grouped across 11 thematic areas, as follows:

- Standard 1: Environmental and Social Impacts and Risks
- Standard 2: Stakeholder Engagement
- Standard 3: Resource Efficiency and Pollution Prevention
- Standard 4: Biodiversity and Ecosystems
- Standard 5: Climate Change
- Standard 6: Involuntary Resettlement
- Standard 7: Vulnerable Groups, Indigenous People and Gender (Indigenous People – not applicable to this project)
- Standard 8: Labour Rights
- Standard 9: Health, Safety and Security
- Standard 10: Cultural Heritage
- Standard 11: Intermediated Finance (not applicable to this project).

3.3 Relevant EU Requirements

An overview of EU requirements applicable to the Project is presented in Table 5.

Table 5: Relevant EU requirements

Directive	Key requirements
Directive 2012/34/EU on establishing a single European railway area	The aim of this Directive is to provide efficient and effective rail services within EU. Therefore, Member States shall ensure that their main infrastructure managers participate and cooperate in, among others: (i) developing Union rail infrastructure, (ii) supporting the timely and efficient implementation of the single European railway area, (iii) exchanging best practices and (iv) monitoring and benchmarking performance.
EIA Directive (Directive 2014/52/EU on the assessment of the effects of certain plans and programmes on the environment)	The EIA must identify the direct and indirect effects of a project on the following factors: the population and human health, the biodiversity, the soil, the water, the air, the climate, the landscape, the material assets and cultural heritage, and the interaction between these various elements. All projects listed in Annex I (including construction of lines for long distance railway traffic) of the Directive are considered as having significant effects on the environment and require an EIA, while for projects listed in Annex II, the national authorities have to decide whether an EIA is needed.
Directive 2002/49/EC relating to the assessment and management of environmental noise	All Member States shall ensure that strategic noise maps for all agglomerations with more than 250,000 inhabitants and for all major railways which have more than 60,000 train passages per year have been made on an annual basis. Based on the same criteria, Member States shall develop action plans designed to manage noise issues and effects. Annex II of this Directive describes assessment methods for the noise indicators for railway noise.
Waste Framework Directive (Directive 2008/98/EC on waste)	This Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy: prevention, preparing for re-use, recycling, recovery, disposal. The Directive incorporates provisions on hazardous waste and waste oils.
Water Framework Directive (Directive 2000/60/EC establishing a Framework for Community Action in the Field of Water Policy)	This Directive establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater, subject to the use for the abstraction of water intended for human consumption and those bodies of water intended for such future use.
Flood Directive (Directive 2007/60/EC on the Assessment and Management of Flood Risks)	The aim of this Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on

Directive	Key requirements
	prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU.
Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action ('European Climate Law')	This Regulation establishes a governance mechanism to implement strategies and measures designed to meet the objectives and targets of the EU and the long-term Union GHG emission commitments consistent with the Paris Agreement[8], in particular the Union's climate-neutrality objective set out in Article 2(1)[9] of Regulation (EU) 2021/1119 of the European Parliament and of the Council. As a part of National Plans, the following GHG emissions and removal related indicators needs to be reported: (i) number of passenger-kilometres for railway traffic, (ii) freight transport tonnes-kilometres for railway traffic.
Birds Directive (Directive 2009/147/EC on the conservation of wild birds) and Habitat Directive (Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora)	The two principal EU Directives relating to nature conservation provide a legal framework for the protection of habitats and fauna and flora species. Both Directives promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The Habitats Directive led to the setting up of a network of Special Areas of Conservation to protect the 220 habitats and approximately 1,000 species listed in Annex I and II of the Directive which are considered to be of European interest following criteria given in the Directive. Together with Special Protection Areas which are designated under the Birds Directive, these form a network of protected sites across the European Union called Natura 2000.
Convention on the Conservation of European Wildlife and Natural Habitats (ETS No. 104)	The Convention on the Conservation of European Wildlife and Natural Habitats or Bern Convention is a binding international legal instrument in the field of nature conservation, covering most of the natural heritage of the European continent and extending to some States of Africa. It aims to conserve wild flora and fauna and their natural habitats. The Emerald network is an ecological network launched in 1998 by the Council of Europe as part of its work under the Bern Convention.
Directive 2016/798 on railway safety	This Directive lays down provisions to ensure the development and improvement of the safety of the Union rail system and improved access to the market for rail transport services. It defines common safety targets ('CSTs') and common safety methods ('CSMs'), and common principles for the management, regulation and supervision of railway safety. Safety supervision is centralised on EU level by making the EU Agency for Railways the single body for granting single safety certificates.
Directive 2016/797 on the interoperability of the rail system within the EU	This Directive defines the requirement for Technical Specifications for Interoperability (TSIs) in order to ensure interoperability between the different parts of the European Rail Network. Interoperability is about enabling trains, passengers and train crew from one EU country to operate safely and reliably in all other EU countries by ensuring compatibility of rail systems and minimum safety requirements. Even though Serbia is still not a member of the EU, national legislation stipulates that TSI will apply to newly built, upgraded or renewed railway lines covered by the comprehensive TEN-T (Trans-European Transport Network) network for Southeast Europe.
Regulation 2016/796 on the EU Agency for Railways and repealing Regulation No. 881/2004	This Regulation establishes the EU Agency for Railways. It supports the establishment of the single European railway area, and in particular the objectives relating to the two Directives mentioned above.
OHS Directives	EU has adopted several Directives to improve and guarantee OHS, the most significant of which are: > Directive 89/391/EEC on the Introduction of Measures to Encourage Improvements in the Safety and Health of Workers at Work (which encourages improvements in relating to the safety and health of workers at work) > Directive 89/654/EEC concerning the Minimum Safety and Health Requirements for the Workplace (which defines the minimum requirements for safety and health at the workplace)

[8] The Paris Agreement is an international treaty on climate change, adopted in 2015. The Agreement's long-term temperature goal is to keep the rise in mean global temperature to well below 2 °C (3.6 °F) above pre-industrial levels, and preferably limit the increase to 1.5 °C (2.7 °F). One of the aims of the Agreement is making finance flows consistent with pathways towards low GHG emissions and climate-resilient development.

[9] Union-wide GHG emissions and removals regulated in Union law shall be balanced within the Union at the latest by 2050, thus reducing emissions to net zero by that date, and the Union shall aim to achieve negative emissions thereafter.

Directive	Key requirements
	> Directive 92/57/EEC on the Implementation of Minimum Safety and Health Requirements at Temporary or Mobile Construction Sites (which lays down minimum safety and health requirements for temporary or mobile construction sites at which building or civil engineering works are carried out and intends to prevent risks by establishing a chain of responsibility linking all the parties involved).

4 Approach to Supplementing the ESIA Study

As stated previously, an international ESIA was developed in 2016. An independent gap analysis review of the ESIA and other relevant documentation was completed in 2022 against EBRD, EIB and EU standards and best practice. The review revealed that additional collection of information/data was needed in order to define additional potential Project impacts and required mitigation actions.

Therefore, the main objective of the Supplementary Study is to address the gaps identified in the 2016 ESIA, including update of the baseline E&S conditions of the Project area, to identify additional likely significant impacts associated with the Project construction and operation, and to propose suitable mitigation and monitoring measures to prevent, reduce or offset likely significant impacts.

The gaps that are identified in the 2016 ESIA, that were further assessed or clarified so as to meet the Applicable E&S requirements, are presented in Table 6.

Table 6: Summary of identified gaps in the 2016 ESIA

Thematic area	Summary of identified gaps in the 2016 ESIA
Information about the Project	The 2016 ESIA needs to be supplemented with new Project-related information that was not available at the time of its development.
Biodiversity	The ESIA does not contain habitat mapping which would enable a better understanding of habitats under pressure and calculating loss.
	No information on the most valuable biodiversity features - critical habitats and priority biodiversity features is given in the ESIA.
	Invertebrates (of conservation concern) are not addressed in the ESIA.
	Ecologically appropriate area of analysis (EAAA) has not been determined for the Project.
	General mitigation measures and monitoring programme relies heavily on the proposed Biodiversity Management Plan (BMP) that is to be developed without specification when the BMP shall be developed or by whom.
Protected areas	The ESIA is missing an Appropriate Assessment for Mojsinje Mountains and Stalac Gorge, areas in ecological network of Serbia and therefore potential Natura 2000 sites.
	Information regarding other areas of concern such as Emerald, IBA, IPA, PBA, Ramsar, KBA areas is not provided in the ESIA.
Water	Full information on public and local water supply in the Project area of influence is not given.
	The ESIA lacks information on exact locations and depth of groundwater (especially in places where tunnel construction is planned), as well as data on groundwater quality.
	Information on baseline surface water quality in the Project area of influence is not given.
	Monitoring plan for the construction phase is not focused on the Project area of influence and is not realistic. Monitoring parameters are not well defined.
Air quality	Mitigation measures and monitoring plan in the operation phase are not prescribed.
Climate	The time period to which presented information on Project area climate settings refers is not specified.
	The Project area climate change projections and scenarios are not analysed. There is no calculation of the baseline and Project GHG emissions using EBRD-approved methodology. The historical climate-related hazards regarding droughts and fires at the site are not mentioned. A Climate Risk Assessment was not carried out.
	The ESIA does not address impacts of the Project on climate/climate change. Mitigation measures and monitoring plan are not provided.
Noise and vibration	Noise measurements were not fully performed in compliance with Serbian legalisation and the standards SRPS ISO 1996-1 and SRPS ISO 1996-2. The noise impact analysis in the ESIA during operation was not done in accordance with the available design documents. The ESIA does not provide full information about vibration impacts, either in the construction or in the operation phase.

Thematic area	Summary of identified gaps in the 2016 ESIA
	Noise and vibration mitigation measures for both the construction and operation phases given in the ESIA are general (not-site specific). The obligation of the Contractor (or any other entity assigned by the Contractor) to prepare a report on noise and vibration impacts during work execution at the site is not mentioned.
Soil	The ESIA lacks information on seismological characteristics of the Project area.
	The ESIA does not contain the land use map.
	The status of soil quality in the Project area has not been addressed.
Landscape	There is no photomontage of the future railway design to help on understanding of the impacts.
Waste	The baseline information on SRI's current waste generation and management practices during railway operation and maintenance are not provided, as well as information on planned treatment and disposal of dismantled railway infrastructure.
	Information on estimated quantities of all types of waste to be generated in the construction phase is missing.
	The measures do not include appropriate disposal of construction waste during (re)construction activities.
	Monitoring for the operation phase is not proposed.
Access roads	The ESIA lists the proposed road realignments and new access roads, but does not discuss the impacts associated with these.
Population and nearest settlements	The social baseline lacks site-specific information for both the communities living along the existing railway line (which will lose direct access to the railway) and the communities along the planned railway line. Also, some specific impacts are not mentioned, such as the impact of closure of stations/halts on the local communities and other potential issues which will need to be analysed based on a more comprehensive community baseline.
Labour conditions and OHS	Two specific issues are not mentioned in the ESIA: worker accommodation and plans for dealing with employees of existing stations which will be closed.
Cultural heritage	There is no mention in the ESIA whether the two stations to be reconstructed (Stalac and Djunis) or the old station to be abandoned (Braljina) are protected buildings. There is also no mention of intangible cultural heritage. Opinions of relevant cultural heritage institutions in the Project area were obtained in 2017 and again in 2021 (after the ESIA was developed).
Gender	The ESIA does not provide any baseline information on gender aspects. There is also a lack of information on the legal framework and the implementation of gender mainstreaming in SRI key policies and procedures. The ESIA also does not address gender impacts or address GBVH.
Stakeholder engagement	The ESIA contains a Stakeholder Engagement Plan (Annex 6 of the ESIA) but it was developed six years ago, and there is a need to update the information on specific stakeholders.
Resettlement	The ESIA contains a Resettlement and Compensation Framework as the basis for the future RAP for this subsection. A RAP for the subsection Stalac-Djunis has now been developed and is part of the E&S Disclosure Package.
Cumulative impacts	The ESIA states that there are no cumulative impacts expected as a result of the proposed railway.

Appropriate measures have been included in the Project ESMP (which is an annex to this Supplementary Study and the ESAP).

The following chapters provide additional information on E&S assessment gathered throughout April and May 2022 through:

- Review of all available Project related information and data,
- Site visits to the Project area,
- Consultation meetings with SRI and SAFEGE/PPF9 consulting team,
- Consultation meetings with local authorities and local communities in Cicevac and Krusevac (more details provided in Chapter 15 - Population and Nearest Settlements), and
- Conducting the necessary calculations using the specified methodology and tools (vibration; climate risk assessment).

5 Biodiversity

5.1 Supplementary Baseline Information

5.1.1 Habitat Mapping

Habitat mapping has been performed in order to provide a better understanding of biodiversity baseline and potential impacts that may occur, with a focus on direct loss and proposal of mitigation. Habitat types have been identified using the EUNIS and Corine Land Cover (CLC) data to obtain the best possible understanding of baseline conditions.

The EUNIS mapping was carried out by a biodiversity expert based on the habitat data provided in the 2018 Study and Vegetation Maps of Serbia. The aim was to determine whether habitats identified on the entire Mojsinje Mountain and Stalac Gorge of Juzna Morava River are also present in the Project area and could potentially be impacted. The area that was investigated was the 1 km-wide buffer zone (500 m on each side) around the planned railway and access roads. The analysis indicated presence of nine habitat types as listed in Table 7. The EUNIS classification system was further compared to the habitat types listed in the Habitats Directive to screen for habitat types of conservation concern. The comparison was done using the revised Annex I of Resolution 4 (1996) of the Bern Convention on endangered natural habitat types (year of revision: 2014).

Table 7: EUNIS habitat types recorded in the analysed zone

EUNIS habitat type	Brief description	Habitats Directive
C2.2 – Permanent non-tidal, fast, turbulent watercourses	This habitat develops at the bottom of fast streams in clear oligotrophic water. Due to the speed of water, there are no conditions for more abundant development of a larger number of plant species. In addition to a small number of representatives of different groups of algae (Chlorophyta, Cyanophyta, Rhodopyta), the dominant representatives of these habitats are invertebrates from the groups: Ephemeroptera, Plecoptera, Trichoptera etc. Mosses are often present, e.g. *Fontinalis antipyretica*, *Calliergon cordifolius*, *Scapania undulata*, etc.	No
E2.1 – Permanent mesotrophic pastures and aftermath-grazed meadows	This type of habitat includes pastures that are used for grazing livestock or less often regularly mowed, where the physiognomy is determined mainly by species: *Cynosurus cristatus* L. and *Bromus racemosus* L. Also, there are many other mesophilic plants such as: *Agrostis stolonifera* L., *Agrosits capillaris* L., *Briza media* L., *Euphrasia rostkoviana* Hayne, *Festuca pratensis* Huds., *Filipendula vulgaris* Moench, etc. This type of habitat develops mainly in the plains and hilly regions, with a moderate type of humidity and the soil enriched with fertilizer. The *Bromo-Cynosuretum cristati* H-ić 1930 community dominates.	No
G1.1 – Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	This habitat type includes forests with sparse or almost folded floors of low or tall trees with tree heights of up to 30 m. Dominant species are: *Salix alba* L., *Populus alba* L., *Populus nigra* L. The following species also occur: *Fraxinus angustifolia* Vahl, *Ulmus laevis* Pall., *Frangula alnus* Mill., *Salix purpurea* L., *Robinia pseudoacacia* L. This type of habitat dominates on alluvial deposits, hydromorphic clay, pseudogley or alluvial semi-muddy soils. The lands are flooded for a longer or shorter period, and the groundwater level is usually high. Within the researched area, it occurs mainly within the communities: *Salicetum albae* Issler 1926, *Salici-Populetum nigrae* Parabućski 1965, *Populetum nigrae* (B. Jovanović 1965) B. Jovanović et Tomić 1979, *Populetum albae balcanicum* Karp. 1962, *Populetum nigro-albae* Slanić 1952	No
G1.7 – Thermophilous deciduous woodland	This habitat type includes mixed or less frequently monodominant light forests dominated by thermophilic oaks. It develops on flat or slightly sloping thermophilous terrains. Within the study area it occurs mainly within the communities: *Quercetum frainetto-cerris* Rudski (1940) 1949, *Querco-Carpinetum moesiacum* Rudski (1940), 1949.	No - the vegetation types corresponding to the Annex I habitat type are not found in the Project area
G5 – Lines of trees, small	This type of habitat includes natural or artificial habitats on an area usually less than 0.5 ha, crown cover usually greater than 10% and tree	No

EUNIS habitat type	Brief description	Habitats Directive
anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice	height usually greater than 5 m, under strong anthropogenic impact through maintenance and damage (small, intensively managed forests and small forests under the strong influence of anthropogenic activities, young tree plantations with a potential crown cover of more than 10%; rows of mature trees, such as avenues and windbreaks).	
I1.3 – Arable land with unmixed crops grown by low-intensity agricultural methods	Land used for commercial agriculture or horticulture, usually large areas (often larger than 25 ha, rarely about 1 ha) with little or no buildings. These habitat types are dominated by weed and segetal plant species such as: *Amaranthus retroflexus* L., *Linaria genistifolia* (L.) Mill., *Veronica agrestis* L., etc.	No
I1.5 – Bare tilled, fallow or recently abandoned arable land	Land used for commercial agriculture or horticulture, usually large areas. This habitat type includes sampled, harvested or almost abandoned arable land. As a result of intensive anthropogenic activities in the habitats of this level, plants with the life form of therophytes dominate.	No
I2.1 – Large-scale ornamental garden areas	This type of habitat includes cultivated areas dominated by ornamental plants, and invasive alien species occupy a significant place among them.	No
J1.2 – Residential buildings of villages and urban peripheries	This type of habitat includes primarily human settlements, more or less densely distributed buildings with accompanying infrastructure, on smaller or larger areas, and with a smaller or very large number of inhabitants.	No

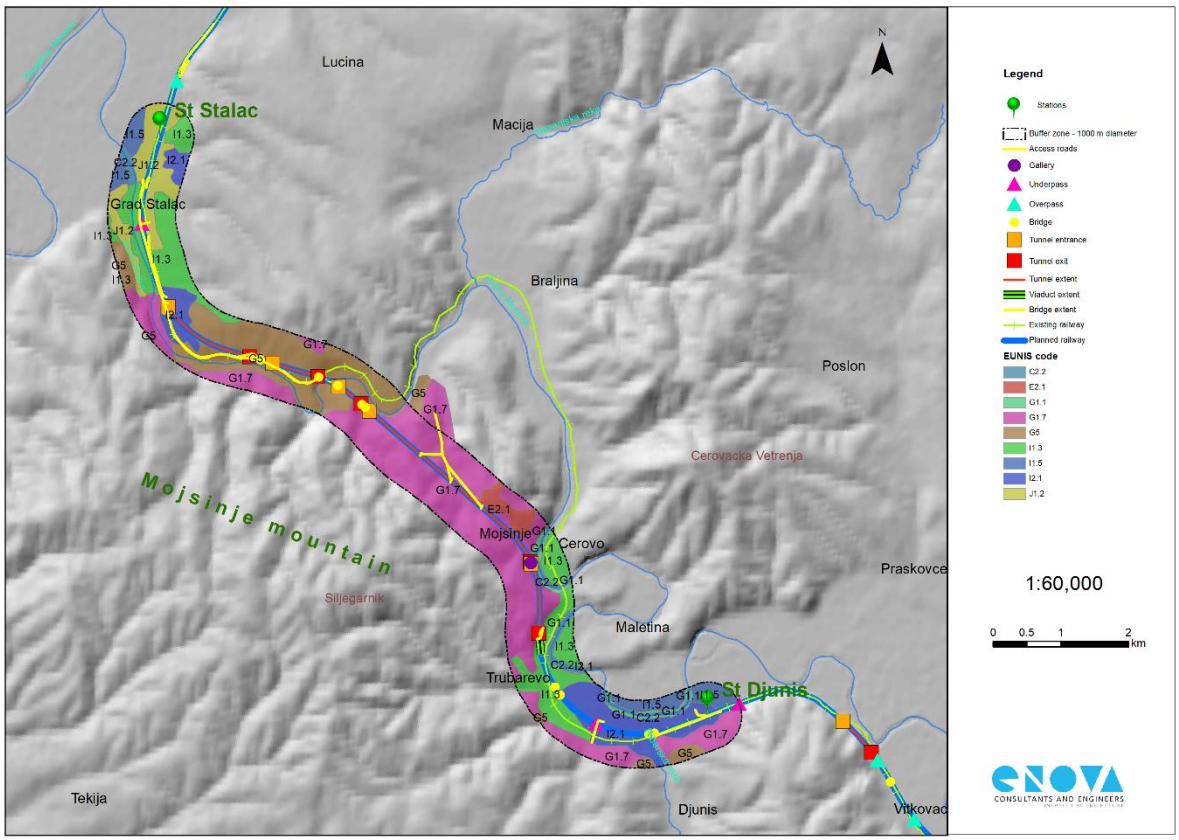


Figure 6: EUNIS habitat types identified in the buffer zone

Table 8: EUNIS classification and areas under impact from railway construction (in ha)

EUNIS code	EUNIS Name	Indirect impact	Direct impact	Total
C2.2	Permanent non-tidal, fast, turbulent watercourses	34	-	**34**
E2.1	Permanent mesotrophic pastures and aftermath-grazed meadows	26	0.58	**26.58**
G1.1	Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*	20	-	**20**
G1.7	Thermophilous deciduous woodland	554	14.23	**568.23**
G5	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice	289	10.26	**299.26**
I1.3	Arable land with unmixed crops grown by low-intensity agricultural methods	243	8.12	**251.12**
I1.5	Bare tilled, fallow or recently abandoned arable land	62	-	**62**
I2.1	Large-scale ornamental garden areas	163	10.79	**173.79**
J1.2	Residential buildings of villages and urban peripheries	104	3.53	**107.53**
	Total	**1,495.00**	**48.49**	**1,542.49**

The CORINE Land Cover (2018) classification has been used to additionally describe habitats present within the study area. The study area is dominated by the broad-leaved forest (CLC code 311), transitional woodland-shrub (CLC code 324) and land principally occupied by agriculture, with significant areas of natural vegetation (CLC code 243). Sparse villages (as a discontinuous urban fabric) are located in the river valley. Habitat type 211 Non-irrigated arable land was not presented in the 2018 Study. The map of habitat types based on CLC classification is given in Figure 7 below.

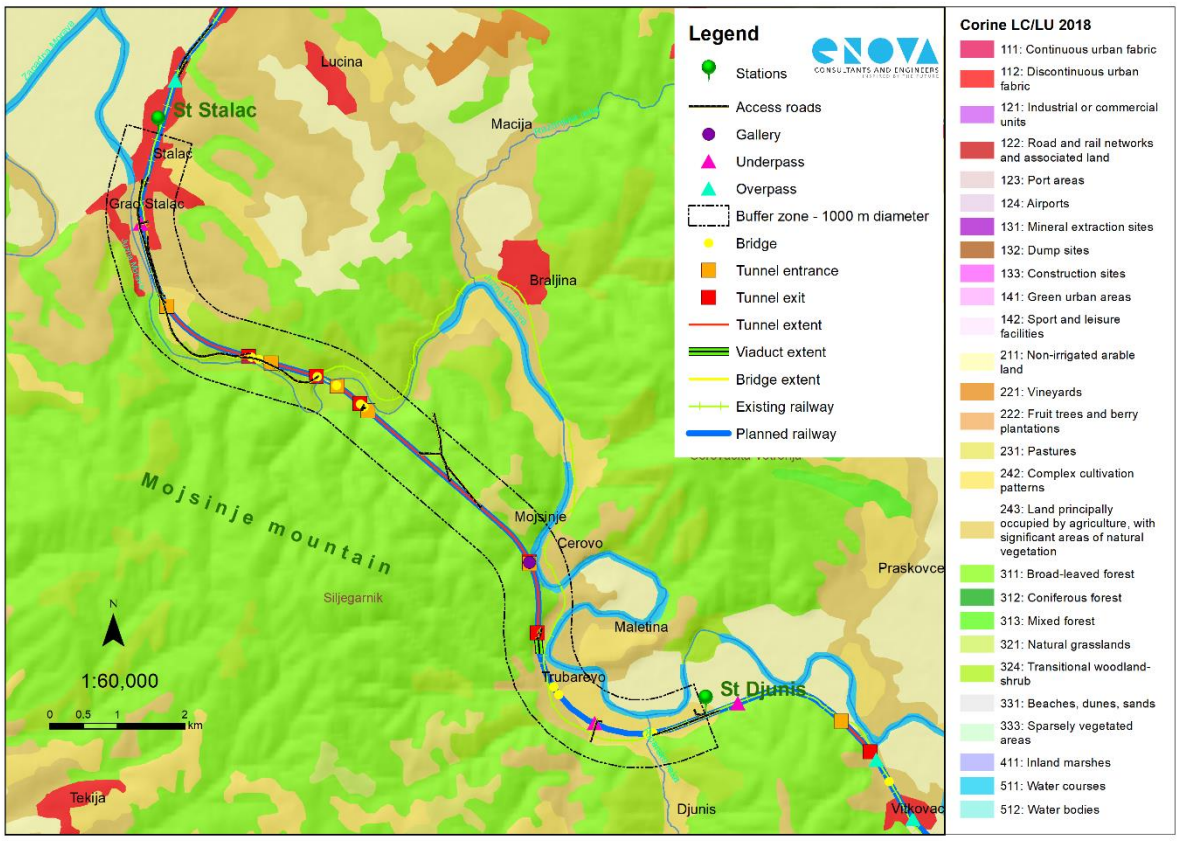


Figure 7: Map of habitat types based on CLC classification

Calculations of CLC areas within the analysed area of potential impacts and area of expected direct impacts were performed. Based on a precautionary approach and expected width of construction sites, the zone of direct impact was determined as a 25 m-wide corridor along the railway and a 15 m-wide corridor along the access roads. The areas of habitat types in the study area based on CLC characteristics are expressed in hectares (ha) and are given in Table 9.

Table 9: Corine Land Cover classification and areas under impact from railway construction (in ha)

CLC code	Description	Indirect impact	Direct impact	Total
112	Discontinuous urban fabric	83.45	3.50	**86.95**
211	Non-irrigated arable land	40.46	-	**40.46**
231	Pastures	26.60	0.57	**27.17**
242	Complex cultivation patterns	157.75	10.78	**168.53**
243	Land principally occupied by agriculture, with significant areas of natural vegetation	231.29	8.11	**239.41**
311	Broad-leaved forest	510.44	14.22	**524.66**
324	Transitional woodland-shrub	278.16	10.25	**288.41**
511	Watercourses	54.64	-	**54.64**
	Total	**1,382.80**	**1.382,80**	**1430.23**

In order to ensure compliance with EU legislation, and therefore PR 6, screening for habitat types of conservation concern was performed. Screening was performed using the revised Annex I of Resolution 4 (1996) of the Bern Convention on endangered natural habitat types using the EUNIS habitat classification. **No habitat types listed in Annex I of the Habitats Directive have been identified in the Project's area of potential impact, including the new railway and planned access roads.**

5.1.2 Invertebrate Survey

Invertebrate surveys focused only on invertebrate species of conservation concern in line with *Good Practices for the Collection of Biodiversity Baseline Data*[10] guideline. Invertebrates are not typically included within the scope of terrestrial baseline studies. However, since the area of Mojsinje Mountains is part of the ecological network and the presence of species of conservation concern is possible, the invertebrate survey was considered desirable for this area.

The invertebrate survey was conducted on three occasions in spring of 2022: April 27, May 15 and 27. Coordinates and brief description of surveyed localities are given in Table 10, while their position in relation to the railway route is shown in Figure 8.

The survey methods for invertebrates included active searching, flight interception, pitfall traps, and trapping using light or bait as attractants. The surveys done on April 27 and May 15 were focused on invertebrates active during the day, while the survey done on May 27 was performed after sunset so to include species active during dusk and night. The surveys were carried out around four general localities listed in Table 10, while the exact GPS coordinates were recorded for all individual specimens separately. The full list of registered species with coordinates of the place of their discovery is given in Appendix D. The data was digitalised by using Microsoft Office and Google Earth software to develop the map and table forms of species. The list of species of international conservation concern is based on relevant documents such as the Habitats Directive (Annexes II and IV), IUCN Red List, available Red Books of Serbia (available for only some butterfly families and Orthoptera) and national *Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi*[11]. All of the found species that were evaluated by either of the mentioned documents are given in Table 11.

[10] https://publications.iadb.org/en/good-practices-collection-biodiversity-baseline-data
[11] Official Gazette of RS, No. 5/2010, 47/2011, 32/2016 and 98/2016

Table 10: Localities visited in 2022 as part of invertebrate surveys

Locality	Coordinates	Brief description
L1	43°36'29.94"N 21°29'15.98"E	Open area of the railway. The site consists of mostly abandoned agricultural land and old orchards that have been mowed down. It is cut through by a very small creek and there is an occasional pond nearby. The first houses are about 200 m away.
L2	43°36'59.85"N 21°29'2.34"E	Exit of tunnel 5 and route moving away from Mojsinje Mountains. Steep forested slope along the asphalt road, there are bare rocks on the slope on the outskirts. On the other side of the road is agricultural land.
L3	43°38'50.15"N 21°27'9.56"E	Between tunnel 3 and tunnel 4. Mostly forest habitat through which an asphalt road passes. The locality itself is next to a river in a meadow located on private land.
L4	43°38'53.57"N 21°27'57.15"E	Located on the future access road towards the tunnel 4 going through the Mojsinje Mountains. Mix of woodland and shrubland.

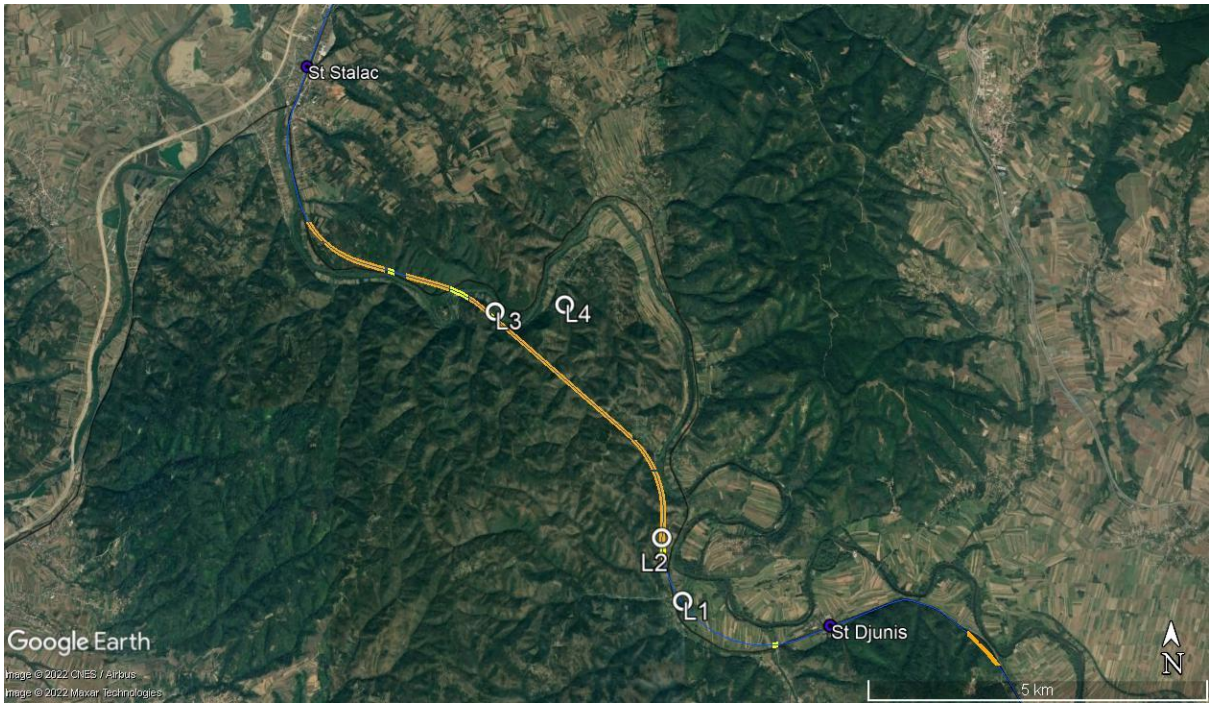


Figure 8: Position of surveyed localities in relation to the railway route

Table 11: Species registered during the field survey

Species of conservation concern	IUCN (Europe)	Bern Directive	Habitats Directive	Red Book of Serbia	Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi
Parnassius mnemosyne Clouded Apollo	NT	II	IV	LC	Strictly protected
Lucanus cervus Stag beetle	NT	III	II	NA	Strictly protected
Lycaena dispar Large copper	LC	II	II, IV	LC	Strictly protected
Zerynthia polyxena Southern festoon	LC	II	IV	LC	Strictly protected
Pseudophilotes vicrama Eastern baton blue	NT			LC	Strictly protected
Papilio machaon Swallowtail	LC			LC	Strictly protected
Zerynthia cerisy Eastern festoon	NT			LC	

Species of conservation concern	IUCN (Europe)	Bern Directive	Habitats Directive	Red Book of Serbia	Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi
Araschnia levana Map butterfly	LC			LC	
Aricia agestis	LC			LC	
Boloria dia	LC			LC	
Callophrys rubi	LC			LC	
Coenonympha pamphilus Small heath	LC			LC	
Colias crocea Clouded yellow	LC			LC	
Cupido minimus	LC			LC	
Erynnis tages	LC			LC	
Glaucopsyche alexis	LC			LC	
Hamearis lucina Duke of Burgundy fritillary	LC			LC	
Iphiclides podalirius Scarce swallowtail	LC			LC	
Issoria lathonia Queen of Spain fritillary	LC			LC	
Lasiommata megera	LC			LC	
Leptidea sinapsis Wood white	LC			LC	
Lycaena tityrus	LC			LC	
Melitaea athalia Heath fritillary	LC			LC	
Melitaea cinxia Glanville fritillary	LC			LC	
Neptis sappho Common glider	LC			LC	
Ochlodes sylvanus	LC			LC	
Pararge aegeria Speckled wood	LC			LC	
Pieris napi Green-veined white	LC			LC	
Pieris rapae Small white	LC			LC	
Plebejus argus	LC			LC	
Polygonia c-album Comma butterfly	LC			LC	
Pyrgus malvae	LC			LC	
Vanessa atalanta Red admiral	LC			LC	
Calopteryx splendens Banded demoiselle	LC			NA	
Calopteryx virgo Beautiful demoiselle	LC			NA	
Coenagrion puella Azure bluet	LC			NA	
Libellula depressa Broad-bodied chaser	LC			NA	

Species of conservation concern	IUCN (Europe)	Bern Directive	Habitats Directive	Red Book of Serbia	Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi
Platycnemis pennipes Blue featherleg	LC			NA	

NA – Not applicable; Red Books of Beetles, Dragonflies and Damselflies of Serbia have not been completed yet. The Table refers to Red Book of Butterflies only

An opportunistic survey of other fauna was also performed, with herpetofauna findings being the most prominent. No species new for the Project area were recorded. However, the findings have been used to identify measures in the ESMP aimed at protecting Hermann's tortoises (*Testudo hermanni*) that have been identified in significant numbers in the area of the Mojsinje Mountains.

5.1.3 Critical Habitat Assessment (CHA)

Methodology. Potential impacts on sensitive biodiversity features that could be considered a "Critical Habitat" and/or "Priority Biodiversity Feature" have been assessed in accordance with EBRD PR 6 and EIB Standard 4. The EIB's Standard 4 and EBRD's PR 6 have comparable definitions for CH. However, EIB does not introduce the term "priority biodiversity feature" in its policy nor the Guidance Note for Standard 3 published in 2018 (note: biodiversity was previously handled as a Standard 3). Therefore, EBRD's definitions are provided. Regarding criteria, CH criteria for EIB and EBRD Policies are comparable and have matching thresholds; therefore, they have been aggregated in the criteria table given below. EBRD's criteria for PBF determination are also provided.

Critical Habitat (CH) is a description of the most significant and highest priority areas on the planet for biodiversity conservation. It takes into account both global and national priority setting systems and builds on the conservation biology principles of 'vulnerability' (degree of threat) and 'irreplaceability' (rarity or uniqueness). Determination of CH is based upon quantitative thresholds of biodiversity priority which are largely based on globally accepted precedents such as IUCN Red List[12] criteria, local Red Books and Key Biodiversity Area (KBA) thresholds.

Under EBRD PR6, paragraph 14, the most sensitive biodiversity features are defined as CH and include the following:

- Highly threatened or unique ecosystems
- Habitat of significant importance to endangered or critically endangered species
- Habitats of significant importance to endemic or geographically restricted species
- Habitats supporting globally significant (concentrations of) migratory or congregatory species
- Areas associated with key evolutionary processes

While the EIB also introduces an additional criterion: Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups.

EBRD PR6 also uses the concepts of vulnerability and irreplaceability to define areas that, whilst not as globally important as CH, are still of significant ecological importance. Such areas are referred under the EBRD PR6 Guidance[13] as Priority Biodiversity Features (PBF).

PBFs are defined as "a subset of biodiversity that is particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats" by EBRD. They may include areas that contain threatened habitats, vulnerable species, significant biodiversity features identified by a broad set of stakeholders or governments and ecological structure and functions needed to maintain the viability of priority biodiversity features.

In line with EBRD Guidance Note 6, the identification and characterisation of critical habitat should include the following steps:

[12] All references to the IUCN Red List have been taken from the most recent update (Version 2021-3) which can be found at: http://www.iucnredlist.org/ (last accessed 30 May 2022)
[13] EBRD (2020). Guidance Note: EBRD Performance Requirement 6. European Bank for Reconstruction and Development

- Definition of the study area
- Stakeholder consultation and initial literature review
- In-field data collection and verification of available information
- Confirmation of biodiversity likely to meet critical habitat and
- Determination of critical habitat status (of each study area).

In order to conduct a CHA, a study area needs to be defined (critical habitats study area – CHSA). The extent of this is dependent on the biodiversity features of interest and ecological functions that support them which can be different for each feature. The CHSA is independent of the Project area and zone of Project influence and can include a larger geographical area in which impacts on biodiversity are expected.

CHA process starts along with initial screening and scoping to identify biodiversity features that might trigger CH or PBF. With the aim of supplementing rapid field assessment, review of publicly available studies and data regarding the ecological characteristics of the study area must be undertaken as well.

Species listed in the 2016 ESIA and found on-site during rapid biodiversity surveys done in 2022 were assessed with regard to CH and PBF criteria. Assessment of each biodiversity receptor against the CH and PBF/CH criteria uses both qualitative and quantitative thresholds. These are detailed in Table 12 below and summarise both EBRD and EIB requirements. Species that initially had the potential to trigger CH and PBF were brought forward for further assessment. Criteria used to select sensitive biodiversity features, namely species that need further assessment as part of the CHA, are as following:

- EU Habitats Directive[14] – Species listed in Annex II or IV
- EU Birds Directive[15] – Species listed in Annex I
- IUCN[16] Red List – Species with EN, CR or VU conservation status

On the other hand, threatened habitats are habitats considered under pressure by the national, regional or international assessments. These include natural and priority (*) habitats identified under the EU Habitats Directive (Annex I).

Table 12: Criteria and conditions for identifying Priority Biodiversity Features and Critical Habitats

Criterion	Priority Biodiversity Feature	Critical Habitat
1. Priority Ecosystems		
1i Threatened ecosystems		
a) Habitats listed in Annex 1 of EU Habitats Directive (EU members only) or Resolution 4 of Bern Convention (signatory nations only) **b) IUCN Red-List EN or CR ecosystems** **c) Areas recognised as priorities in official regional or national plans**	a) EAAA is habitat type listed in Annex 1 of EU Habitats Directiveor Resolution 4 of Bern Convention b) EAAA < 5% of the global extent of an ecosystem type with IUCN status of CR or EN c) Key Biodiversity Areas and Important Bird and Biodiversity Areas; nationally and internationally important species or sites for conservation of biodiversity	d) EAAA is habitat type listed in Annex 1 of EU Habitats Directive marked as "priority habitat type" e) EAAA ≥5% of global extent of an ecosystem type with IUCN status of CR or EN f) EAAA is ecosystem determined to be of high priority for conservation by national systematic conservation planning
2. Priority Species		
2i Threatened species		
a) Species and their habitats listed in EU Habitats Directive and Birds Directive (EU members only) or Bern Convention (signatory nations only)	a) EAAA for species and their habitats listed in Annex II of Habitats Directive, Annex I of Birds Directive, or Resolution 6 of Bern Convention	e) EAAA for species and their habitats listed in Annex IV of the Habitats Directive (See EU restrictions)

[14] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
[15] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009
[16] IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-1

Criterion	Priority Biodiversity Feature	Critical Habitat
b) IUCN Red List EN or CR species **c) IUCN Red List, or nationally/regionally VU species** **d) Nationally or regionally (e.g., Europe) listed EN or CR species**	b) EAAA supports <0.5% of global population OR < 5 reproductive units of a CR or EN species. c) EAAA supports VU species d) EAAA for regularly occurring nationally or regionally listed EN or CR species	f) EAAA supports ≥0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species g) EAAA supports globally significant population of VU species necessary to prevent a change of IUCN Red List status to EN or CR, and satisfies threshold h) EAAA for important concentrations of a nationally or regionally listed EN or CR species
2ii Range-restricted species		
	a) EAAA for regularly occurring range-restricted species	b) EAAA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species
2iii Migratory and congregatory species		
	a) EAAA identified per Birds Directive or recognized national or international process as important for migratory birds (esp. wetlands)	b) EAAA sustains, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population at any point of the species' lifecycle c) EAAA predictably supports ≥10 percent of global population during periods of environmental stress

Study area. Where trigger species were known or likely to be present (based on habitat suitability and the presence of field indications nearby or historic records), attempts were made to define the appropriate and relevant study area. It was assigned based on habitats present, species data, an understanding of the Project and expert opinion.

The ecologically appropriate area of analysis (EAAA) is determined to include the "wider distribution of potentially affected biodiversity features and the ecological patterns, processes and functions that are necessary for maintaining them throughout this distribution"[17]. Defining an appropriate EAAA is an important step in the CHA process as it ensures assessment of an ecologically relevant feature/area, rather than an area influenced only by the Project footprint. It also has inherent appreciation of ecological function across an area, and therefore avoids the risk of considering the specific areas in which a Critical Habitat trigger may be present discontinuously or seasonally. Determination of EAAA is done separately for every biodiversity receptor, unless species belonging to a certain group have significant EAAA-overlap and EAAAs can be aggregated. In case of uncertainty around distribution, conservative approach was applied and EAAA slightly enlarged as a part of precautionary measures. Further evaluation of EAAA was done with regard to the extent of occurrence (EOO) based on IUCN data (if available) and expert inputs to facilitate CHA.

Taking into consideration the above, the Project's EAAA is estimated at approximately 18,800 ha. It was designed to include all EAAAs of biodiversity features of concern (Figure 9).

[17] EIB Guidance Note for Standard 3 on Biodiversity and Ecosystems, 2018

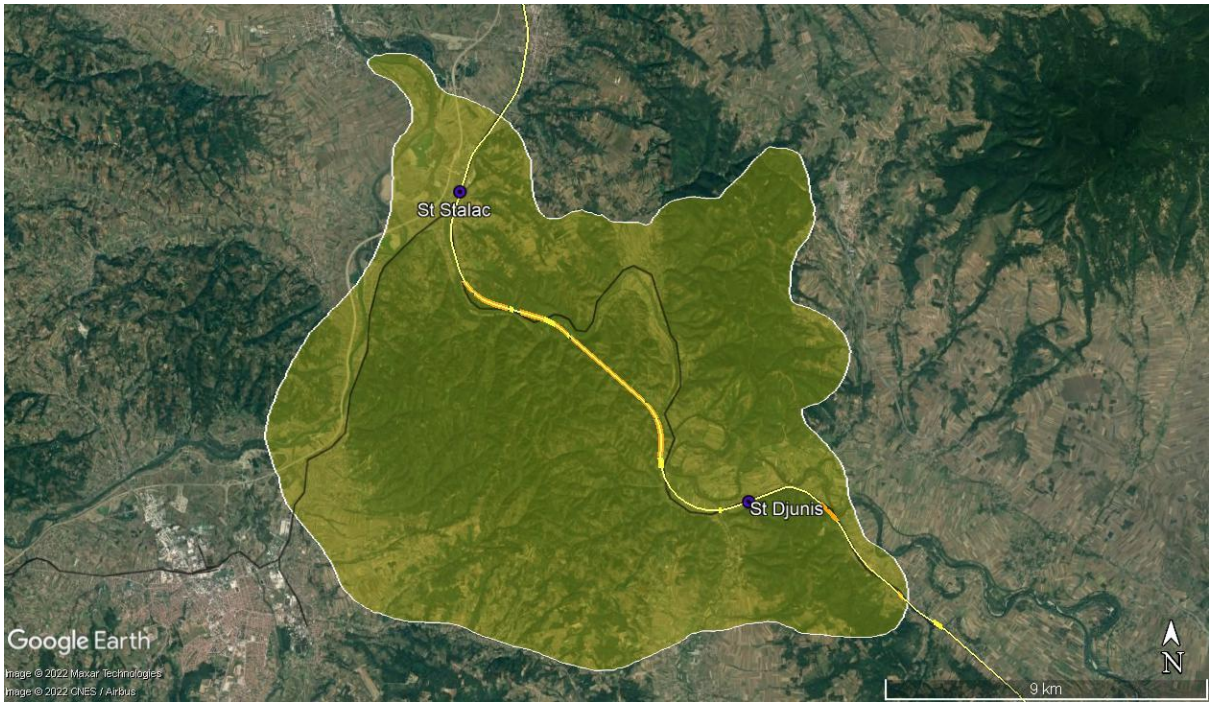


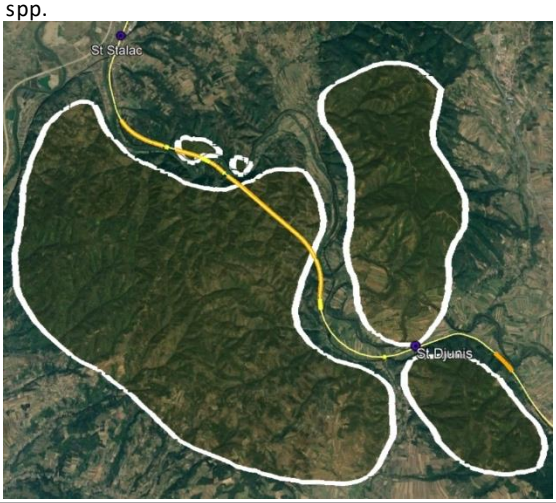
Figure 9: Project's ecologically appropriate area of analysis (EAAA)

Assessment of species. Conservation status and presence on HD/BD, red lists and Bern Convention of all species listed in the 2016 ESIA and species found during the 2022 survey was checked, as well as baseline data on protected areas. All of the species with conservation status other than LC and the ones listed in the directives and/or Bern convention were extracted for analysis. Since there are no Annex I habitat types in the Project's area of influence, habitats were not assessed. The table below also provides the EAAAs for said species. The EAAAs were designed to include all suitable habitats. In case of uncertainty, a conservative approach was used and EAAAs enlarged. On the prepared maps, the yellow line presents the planned railway line, while the tunnels are marked with a thicker orange line. In the context of EAAAs, tunnels are the most important railway structure; therefore, structures such as overpasses and underpasses are not shown. During the development of Construction Biodiversity Management Plan, the EAAAs shall be determined with more precision.

The45 following table contains a list of registered species that were brought forward for further assessment. The criteria designation is with reference to Table 12 where the PBF/CH qualifying criterion is defined. If the species met criteria for both PBF and CH, they were treated as CH. It is important to note that the Red Book of Fish of Serbia is not yet publicly available, but the expert provided the information about the conservation status. Presence of bats using the river as a flyway corridor is not excluded. Three species, common noctule (*Nyctalus 45octule*), Nathusius' pipistrelle (*Pipistrellus nathusii*), grey long-eared bat (*Plecotus austriacus*) have been found in pSCI Juzna Velika Morava. As noted, species are registered in a large pSCI extending far from the planned railway, and it cannot be known whether they inhabit the Project area. However, considering the present habitats and precautionary principle, they must be included in the assessment.

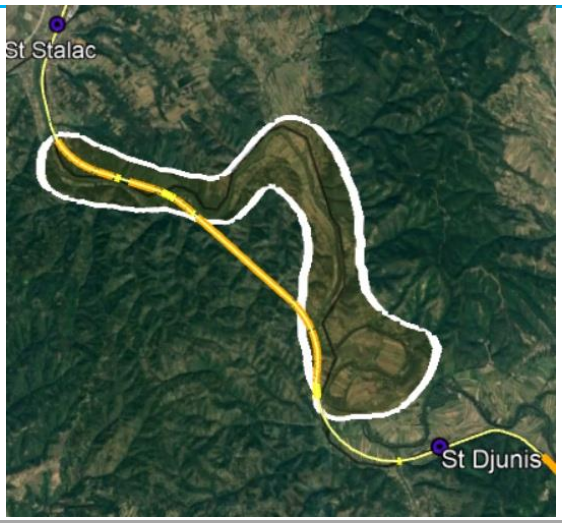
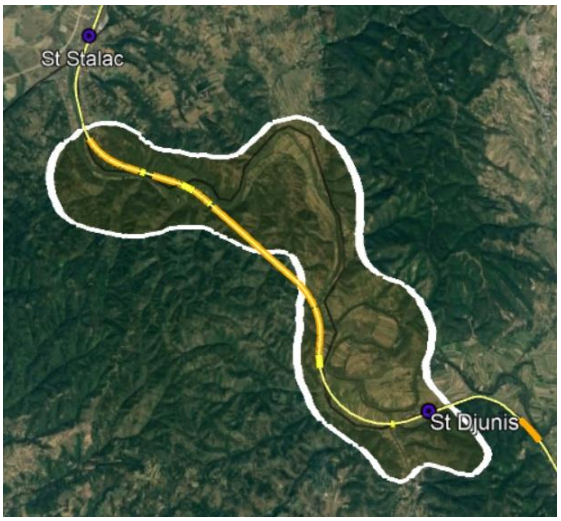
Table 13: Features brought forward for further assessment

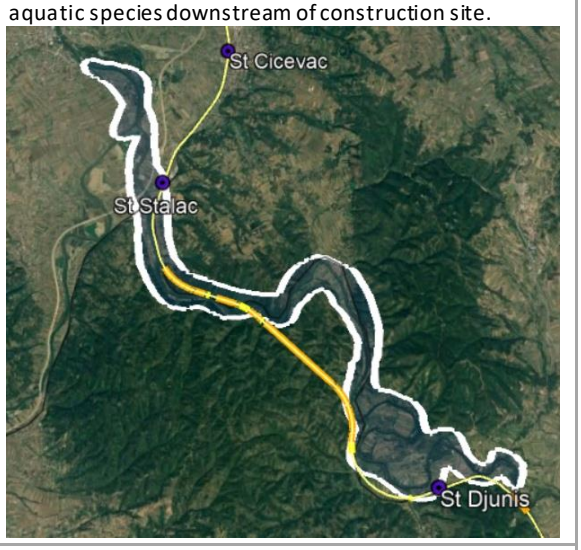
Species	Conservation status	CH/PBF	Criteria	Comment
Ecosystems				
Mojsinje Mountains and Stalac Gorge of Juzna Morava River	Not applicable	PBF	1icf	Mojsinje Mountains and Stalac Gorge of the Juzna Morava River is an ecological network area. Upon Serbia's accession to the EU, this area shall become a candidate Natura 2000 site. Further information on the status of this area is given in Chapter *6: Protected Areas* below.

Species	Conservation status	CH/PBF	Criteria	Comment
				The route passes through Stalac Gorge via tunnels, intersects the ecological corridor of the Juzna Morava River at the proposed bridge and enters the core area of Mojsinje Mountains. The route continues through the core area almost entirely in tunnels, the only exception being the 30 m-long gallery between tunnel 4 and tunnel 5, south of Mojsinje village. The Project design with tunnels dominating in sensitive areas has ensured avoidance and minimization of potential impacts.
Juzna Morava River	Not applicable	PBF	1icf	The area includes ecological corridor Juzna Morava and pSCI Juzna Velika Morava. The ecological corridor was designated because it is a major waterflow that enables ecological connectivity. Juzna Morava River is under substantial anthropogenic pressure originating from settlements and agricultural fields located along the entire river course. The pSCI is not officially protected but will become a Natura 2000 candidate site as soon as Serbia joins the EU. More details on the status of the pSCI is provided in Chapter *7: Protected Areas* below.
Invertebrates				
Parnassius mnemosyne Clouded Apollo	IUCN NT, RS LC, **HD IV**, SPS	CH	2iae	Clouded Apollo can be found in the majority of Palearctic, from Europe, Middle East to Central Asia. In Serbia, it is associated with hilly areas and can't be found only in the Pannonic region. The species inhabits forest roads, clearings, edges, glades, and belt along the upper forest border in the mountains. The Project will not impact species long-term survival. Due to species' preference for clearing and forest roads - building of new access roads, will increase the number of suitable habitats for this species. Additionally, if railway tracks are located in forests, they might successfully replace forest clearings. The EAAA is shown in the figure below. Size of the EAAA is approx. 8.5 ha. No direct loss of habitats is expected as a result of railway construction as disturbed areas from construction will be revegetated with plant species. Habitats under impact from construction of tunnels 3 and tunnel 4 shall be revegetated after completion of works with plant species supporting clouded Apollo: *Corydalis* spp. 
Lucanus cervus Stag beetle	IUCN NT, **HD II**, **BC Res. 6**, SPS	PBF	2iaa	Stag beetle inhabits Central and Southern Europe and Asia Minor. Most preferred habitats are urban woodland and forest. May also occur in grassland, heathland and

Species	Conservation status	CH/PBF	Criteria	Comment
				shrub. It can most often be found in old trees or stumps, especially in oak forests. Females lay eggs in old, fallen trees that are beginning to decay. The Project might have a minor impact on the population of stag beetle in Mojsinje Mts. due to forest removal. In order to provide habitat gain for the species, at least 5% of old oak trees that will be cut down in the process of inevitable forest clearance must be left in suitable areas not in immediate vicinity of the railway. The EAAA of *Lucanus cervus* is comparable to the EAAA of clouded Apollo. Please refer to the figure above.
Lycaena dispar Large copper	IUCN LC, RS LC, **HD** II, **IV**, BC Res. 6, SPS	CH	2iae	Large copper inhabits most of Europe and occurs in Central Asian countries. Colonies in Europe are localand declining. Serbian populations are still stable and inhabit mostly wetlands, habitats along river and lake shores, peatlands, ruderal habitats, canals, etc. In Serbia, large copper can usually be found from May to October in mountainous areas, meadows, darkened forests up to 1000 meters above sea level. Draining of wetlands and intensive conversion of habitats into arable land and increasing agriculture threaten this species. Some other important factors that can affect this species are the high-water level, which can destroy eggs and larvae from coastal plants. Drier habitats in railway tracks seem to be able to serve as alternative habitats for xerothermophilous butterflies such as large copper that may live and reproduce at such sites. Furthermore, all restoration work along railway tracks should be carried out with conservation aims in view, including the preservation or reconstruction of suitable plant species composition. Track verges should be mown with mowing schemes that are adapted to butterfly requirements. A single stretch of tracks and tracks verges should be mown every 2–3 years in order to increase the abundance of flowering plants, to prevent succession and to provide shelter sites with taller vegetation, as has been suggested. The sowing of plant species is also a recommended conservation action for the improved conservation value of railway tracks for butterflies[18]. The EAAA includes possible location and the approx. size is 1,485 ha. Habitats under pressure during construction will be habitats on the entrance to the first, second and fourth tunnel. Railway tracks must be maintained in a way that will ensure preservation of *Rumex* spp. along the Juzna Morava River (e.g., no mowing for 2-3 years). *Rumex* species are host species for large copper caterpillars and are used for oviposition.

[18] K. Kalarus & M. Bąkowski (2015). Railway tracks can have great value for butterflies as a new alternative habitat, Italian Journal of Zoology, 82:4, 565-572, DOI: 10.1080/11250003.2015.1078417

Species	Conservation status	CH/PBF	Criteria	Comment
				
Zerynthia cerisy Eastern festoon	IUCN NT, RS LC	No	-	The species does not meet the criteria for CH/PBF designation.
Zerynthia polyxena Southern festoon	IUCN LC, RS LC, **HD IV**, SPS	CH	2iae	The southern festoon is a widespread species in Serbia, most often found at low altitudes. In recent years, it started occupying habitats where it has not been previously recorded. The species is often found in forest and shrubby habitats but has also adapted well to habitats along derelict fields. At the edges of arable fields, there is usually an uncultivated part where *Aristolochia clematitis*, their host plant, can be found. *Aristolochia* spp. develop quickly, so it can be seen on neglected arable land as early as 2-3 years after cessation of use for agricultural purposes. Habitats near portals of Tunnels 1, 2, 3 and 4 must be re-established upon cessation of works and not mowed to allow southern festoon to inhabit them. The direct loss of habitats will be minor but *Aristolochia* spp. must be planted in habitats adjacent to existing ones in order to ensure net gain. When it comes to protection, it should be based on the protection of wetlands along rivers and other aquatic habitats, as they are natural habitats of *Z. polyxena*. Such habitats have been included in the EAAA. 
Pseudophilotes vicrama Eastern baton blue	IUNC NT, RS LC	No	-	The species does not meet the criteria for CH/PBF designation.

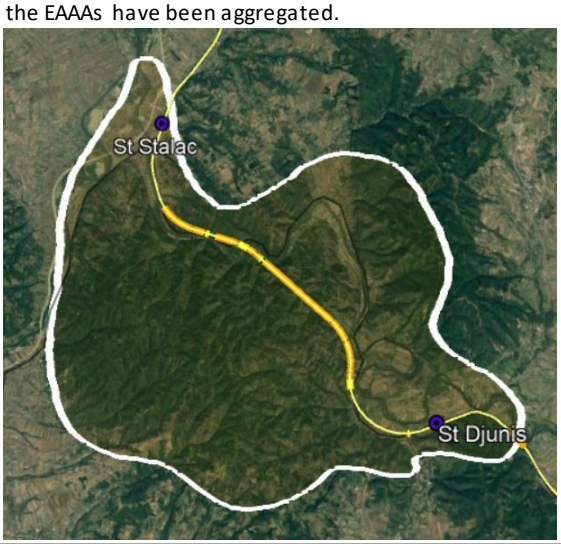
Species	Conservation status	CH/PBF	Criteria	Comment
Fish				
Esox lucius Pike	IUCN LC, RS NT, PS	No	-	The species does not meet the criteria for CH/PBF designation.
Alburnoides bipunctatus Bleak	IUCN LC, RS LC, **HD II**, PS	PBF	2iaa	The species is widespread throughout Europe, and is found in the Black Sea basins, the southern Baltic, the Sea of Azov, the Caspian Sea, as well as in a small number of rivers in the Mediterranean basin, including the Adriatic. It inhabits watercourses with faster flow and higher amount of oxygen, it is more common in smaller rivers of hilly character. According to the ESIA, it is not particularly numerous in Juzna Morava River. The Project will not affect its conservation status, nor will it lose habitat because of the railway construction. The EAAA for this species, and therefore all ichthyofauna, is shown below. The EAAA includes Juzna Morava River from upstream of Djunis (to account for local migrations and possible impacts) to Velika Morava River (to account for downstream impacts). The railway section Stalac-Djunis will cross the Juzna Morava River via a bridge at km 181+555. The bridge will have two piers located within the river. All other bridges' piers will be located outside the streams. The designed width of the bridge' piers foundations is 2.0 m. The Juzna Morava riverbed is about 60 m wide in that area so the piers footprint is estimated to occupy about 6% of the cross-sectional area of the river. The impact of bridges to fish is negligible for operation phase, but construction itself may increase sediment load. This is an impact possibly affecting all aquatic species downstream of construction site. 
Aspius aspius Asp	IUCN LC, RS LC, **HD II**, **BC Res. 6**, PS	PBF	2iaa	It is not clear whether the asp was confirmed during the ichthyofauna surveys for ESIA but, even if not, it is taken into consideration as a potentially present species. Asp occurs in open water of large and medium-sized lowland rivers and large lakes. It prefers to stay near bridge pillars, near tributaries, under weirs, in deep currents and overgrown parts of river and in quiet bays of river bends. The construction of the railway will not have a permanent impact on the adaptable asp.
Carassius carassius Crucian carp	IUCN LC, **RS VU**, SPS	PBF	2icc	The species is considered vulnerable in Serbia but not by the IUCN. Adults occur in shallow ponds, lakes rich in vegetation and slow moving rivers. Can survive at high temperatures and at very low oxygen concentrations

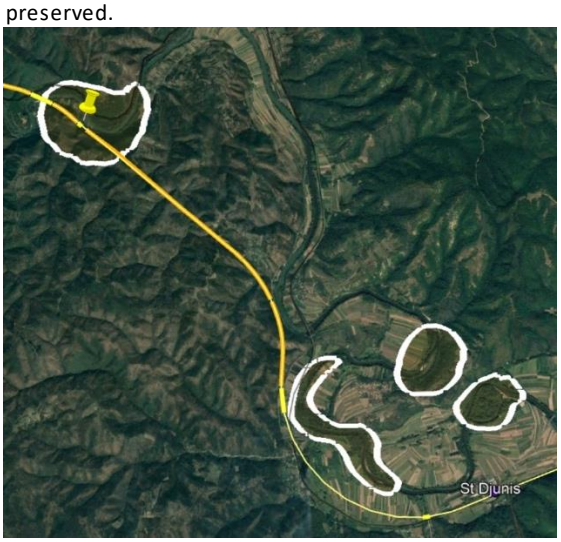
Species	Conservation status	CH/PBF	Criteria	Comment
				during summer. Tolerates cold, organic pollutants, and low oxygen levels in the water. Usually does not occur in waters with rich ichthyofauna and abundant predatory species, but very abundant in the absence of other fish species. EAAA does not support regionally important concentrations of the species and the species will not lose habitat.
Cyprinus carpio Common carp	**IUCN VU**, RS LC, PS	PBF	2icc	Inhabits warm, deep, slow-flowing and still waters such as lowland rivers and large, well vegetated lakes. Hardy and tolerant of a wide variety of conditions but thrives in large turbid rivers. EAAA does not support regionally important concentrations of the species and the species will not lose habitat.
Romanogobio vladykovi (*Gobio albipinnatus* in ESIA) White-finned gudgeon	IUCN LC, **RS VU**, **HD II**, **BC Res. 6**, PS	PBF	2iaa	It is listed as *Romanogobio albipinnatus* in Resolution 6 of the Bern Directive. However, in Serbian Red Book it is referred to as *R. vladykovi.* Inhabits bottom of moderately flowing large and medium size lowland rivers, preferring sand bottom. Also found in lakes. Can be locally threatened due to pollution and river engineering. Pollution will be prevented and minimised using mitigation measures and river engineering will not be performed.
Romanogobio kesslerii (*Gobio kesslerii* in 2018 ESIA) Kessler's gudgeon	IUCN LC, RS DD, **HD II**, **BC Res. 6**, PS	PBF	2iaa	Species systematics are not fully clarified yet. Adults inhabit fast-flowing piedmont rivers with large areas of sand bottom. They live in groups. Sensitive to organic pollution. Therefore, any change in environmental conditions caused by anthropogenic activity (deforestation on riverbanks, sedimentary pollution, wastewater, solid waste etc.) might negatively impact its population. Mitigation measures are proposed to (i) avoid and (ii) minimise the impact.
Romanogobio uranoscopus (*Gobio uranoscopus* in ESIA) Danubian longbarbel gudgeon	IUCN LC, RS NT, **HD II**, **BC Res. 6**, PS	PBF	2iaa	Adults inhabit riffles of small, fast-flowing rivers and bottom of large rivers with water velocities of 0.7 m/s and more, stone bottom, in submontane zone. Young individuals prefer areas with slow current and shallow shoreline on sand bottom. In Serbia, it is found in tributaries of the Danube which have favourable habitat characteristics.
Tinca tinca Tench	IUCN LC, **RS VU**, SPS	PBF	2icc	*Ordinance on measures for preservation and protection of fish stock*[19] has put a permanent ban on fishing of this species in 2019. Adults inhabit warm lakes and pools with weed and mud bottom. Tolerates low oxygen saturations.
Cobitis elongata Balkan loach	IUCN LC, RS LC, **HD II**, **BC Res. 6**, SPS	PBF	2iaa	Found in moderate to fast-flowing stretches of shallow rivers of Danube drainage, on sandy banks and shores, sometimes on rock bottom with submerged vegetation. *Ordinance on measures for preservation and protection of fish stock*[20] has put a permanent ban on fishing of this species in 2019.
Cobitis elongatoides (*Cobitis taenia* in ESIA) Spined loach	IUCN LC, RS LC, **HD II**, **BC Res. 6**, PS	PBF	2iaa	Present in the Danube basin from Serbia to Romania. Adults are found in flowing or still waters from small brooks to large rivers, springs, lakes and oxbows on sand, silt or mud bottom.
Misgurnus fossilis European weather loach	IUCN LC, RS VU, **HD II**, **BC Res. 6**, SPS	PBF	2iaa	Found in lower reaches of slow-flowing rivers, but can also be found in still pools, on sandy bottoms of ponds, pools and ditches. The species can be sensitive to

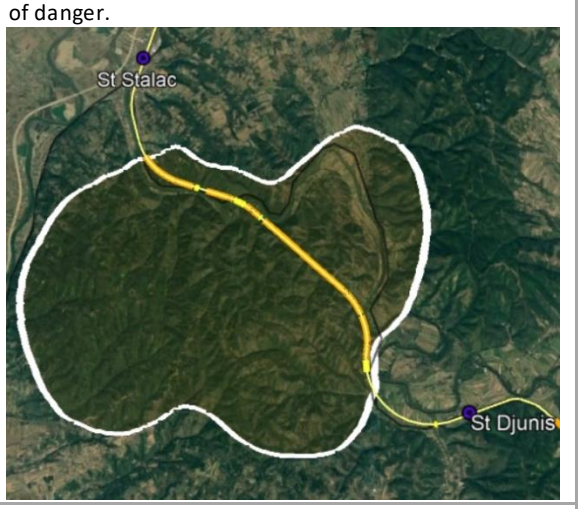
[19] Official Gazette of RS, No. 56/2015 and 94/2018
[20] Official Gazette of RS, No. 56/2015 and 94/2018

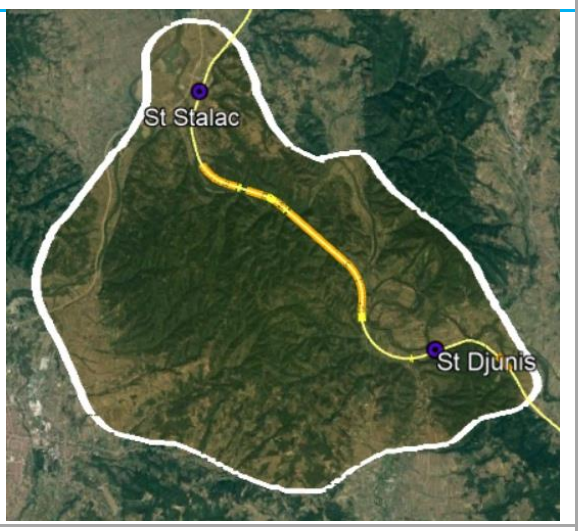
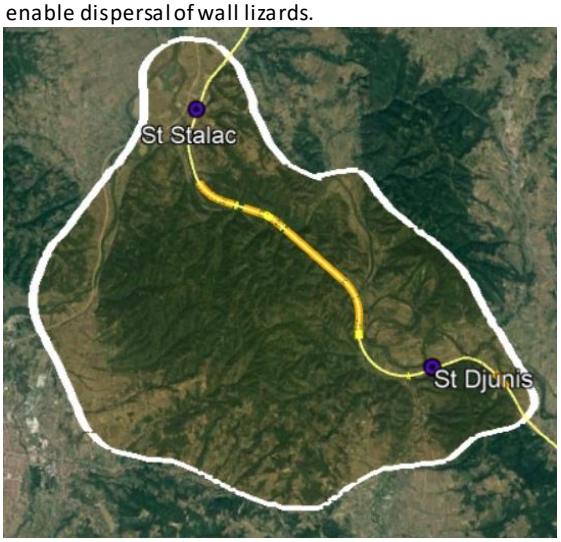
Species	Conservation status	CH/PBF	Criteria	Comment
				pollutants which accumulate in the sediment; therefore, sediment load must be controlled. On the other hand, it is a facultative air-breather and can survive buried in the mud for over a month. *Ordinance on measures for preservation and protection of fish stock*[21] has put a permanent ban on fishing of this species in 2019.
Sabanejewia bulgarica (*Sabanejewia aurata* in ESIA) Golden spined loach	IUCN LC, RS DD, **HD II**, SPS	PBF	2iaa	This species is listed as *Sabanejewia aurata* in Habitats Directive. However, in Serbia it is listed as *S. bulgarica*. The taxonomic status of *Sabanejewia* populations in Danube basin is still uncertain. *Ordinance on measures for preservation and protection of fish stock*[22] has put a permanent ban on fishing of this species in 2019. Found in large lowland rivers, usually in deep water of rivers in Danube basin.
Zingel streber Streber	IUCN LC, **RS VU**, **HD II**, **BC Res. 6**, SPS	PBF	2iaa	The streber is endemic to catchments of the Rivers Danube and Vardar. Adults occur in main course of small to large rives and in stretches with strong current. Low fecundity and highly specialized habitat requirements make *Z. streber* a vulnerable species that is very sensitive to perturbations in its environment. *Ordinance on measures for preservation and protection of fish stock*[23] has put a permanent ban on fishing of this species in 2019.
Zingel zingel Common zingel	IUCN LC, **RS VU**, **BC Res. 6**, SPS	PBF	2iaa	Found in moderately flowing river sections of the Danube, Prut, Dniester and some of their river branches. It prefers deep water and relatively fast flows but is not quite as sensitive to impoundment as *Zingel streber*. In Serbia, this fish inhabits the Danube River and its main tributaries (Sava, Tisa, Drina, Velika Morava, Zapadna Morava, etc). *Ordinance on measures for preservation and protection of fish stock*[24] has put a permanent ban on fishing of this species in 2019.
Amphibians				
Triturus ivanbureschi (*Triturus karelinii* in ESIA) Long-fingered newt	IUCN NE, RS VU, SPS	No	-	*Triturus ivanbureschi* was previously considered a part of *T. karelinii*. However, a survey of mitochondrial and nuclear DNA analyses revealed that there was a deep divergence between the two species. The eastern lineage is now considered *T. karelinii*, and the central/western lineage (e.g. Serbian populations) is considered *T. ivanbureschi*. The species does not meet the criteria for CH/PBF designation. It is considered vulnerable in Serbia but not by the IUCN.
Hyla arborea European tree frog	IUCN NT, RS LC, **HD IV**, SPS	CH	2iae	In Serbia, it inhabits the lower mountainous regions and Vojvodina. This small frog is an arboreal species, living mainly on trees in sunny parts of deciduous and mixed forests, in shrubs, orchards, floodplain meadows, floodplain forests, wetlands, reeds, gardens, lake shores and streams at altitudes up to 2300 meters. European tree frog is common and widely distributed in the area. European tree frog is sensitive to habitat fragmentation. Due to the planned construction of a number of tunnels habitat fragmentation will be minimized. However, the

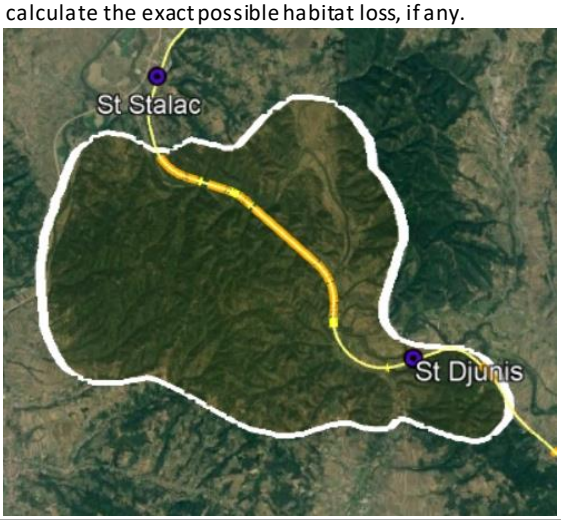
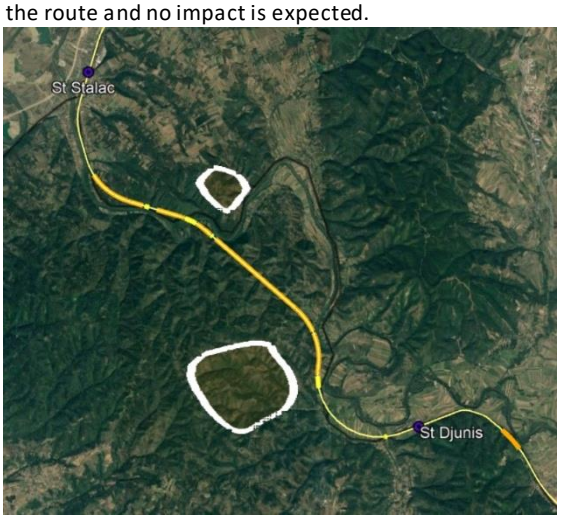
[21] Ibid.
[22] Ibid.
[23] Ibid.
[24] Ibid.

Species	Conservation status	CH/PBF	Criteria	Comment
				extent of impacts on the species is unclear. Rapid assessment and monitoring is needed as a part of Construction Biodiversity Management Plan preparation. The EAAA for this species is shown below. Due to the similarities of the habitats preferred by the amphibians, the EAAAs have been aggregated. 
Bombina variegata Yellow-bellied toad	IUCN LC, RS LC, **HD** II, **IV**, BC Res. 6, SPS	CH	2iae	The range of yellow-bellied toad covers most of western and central Europe. It usually lives in stagnant waters such as ponds and small lakes, but can also be found in small canals, especially in habitats along forest edges. In Serbia, it inhabits all hilly and mountainous areas. Due to the similarities of the habitats preferred by the amphibians, the EAAAs have been aggregated. Direct loss of habitat of yellow-bellied toad is not expected. It breeds in and inhabits small water bodies, often created by large machinery and damages to existing (forest) roads that will not be affected by the Project. There is a possibility that movement of machinery will create new habitats for the species.
Bufotes viridis (*Bufo viridis* in ESIA) Green toad	IUCN LC, RS LC, **HD IV**	CH	2iae	*Bufotes viridis* is one of the most polytopic amphibians of the Palearctic. It lives in the zones of forests, forest steppes, steppes, semi-deserts and deserts. It is more tolerant to dry conditions than many other amphibians. In the forest zone, the species tends to live in open areas and bushlands, often far away from water bodies, whereas in the southern dry parts of the range it primarily inhabits moist sites such as oases, the shores of irrigation ditches and lakes. It is common and widespread in Serbia. Due to the similarities of the habitats preferred by the amphibians, the EAAAs have been aggregated. Green toads are species resilient to changes in their habitats. Taking into consideration suitable habitats, it's distribution is mainly concentrated in the Mojsinje Mountains and riparian habitats along the Juzna Morava River. Revegetation efforts will ensure there is no direct loss of habitats caused by construction.
Rana dalmatina Agile frog	IUCN LC, RS LC, **HD IV**, SPS	CH	2iae	Agile frog inhabits parts of the Western and Central Europe, Apennine and Balkan peninsulas and northern Asia Minor. In Serbia, it is the most common and widespread brown frog, which can be found in all three altitudinal regions – Pannonian, Peripannonian and

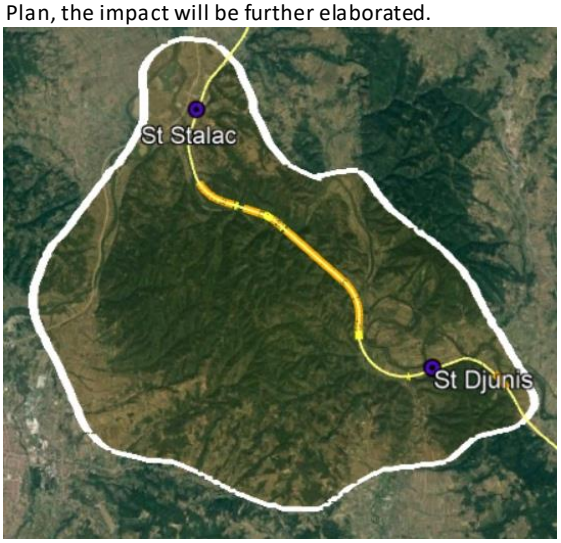
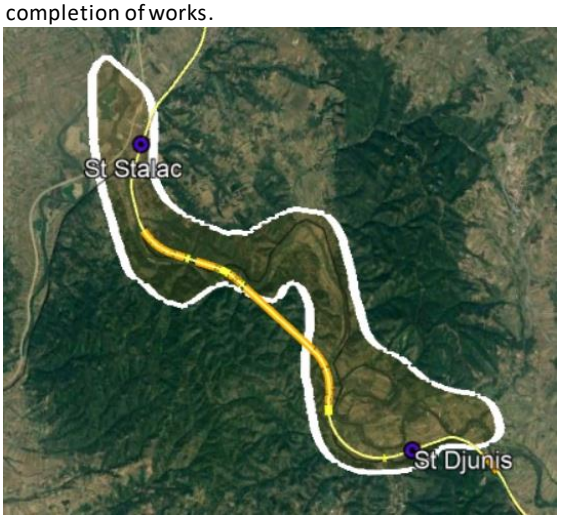
Species	Conservation status	CH/PBF	Criteria	Comment
				Mountain-valley. It is found mostly in open deciduous forests and damp meadows but also in all habitats with suitable shallow or ephemeral ponds, including steppe fragments, rural habitats, parks and edges of agricultural land. Due to the similarities of the habitats preferred by the amphibians, the EAAAs have been aggregated. Suitable habitats of the agile frog can primarily be found on Mojsinje Mountains. The extent of possible habitat loss caused by construction of tunnels and bridges over streams in Mojsinje Mts. is unclear at this stage. Rapid assessment and monitoring must be completed as a part of Construction Biodiversity Management Plan development and implementation.
Reptiles				
Emys orbicularis European pond turtle	IUCN NT, RS DD, **HD** II, **IV**, BC Res. 6, SPS	CH	2iae	*E. orbicularis* occupies a large part of the territory of the Republic of Serbia. It can be found in almost all types of aquatic biotopes with stagnant and slowly flowing waters. Its populations are particularly numerous in aquatic biotopes with abundant vegetation. Habitat conservation is one of the fundamental and most important direct protection measures. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. Minor direct habitat loss caused by railway construction can be expected as a result of construction of a bridge over Juzna Morava river (km 181+555). Installation of floating tree trunks at adjacent locations upstream from the bridge, along with ripatian habitat revegetation can create new sunbathing locations and habitat for the turtles. Small river island at the locality marked on the map (coordinates 43°38'50.15"N 21°27'9.56"E) must be preserved. 
Testudo hermanni The Hermann's tortoise	IUCN NT, RS NT, **HD** II, **IV**, BC Res. 6, PS	CH	2iae	The species prefers open patchy evergreen Mediterranean oak forest, but in its absence inhabits maquis, garrigue, dune scrub and maritime grassland, as well as agricultural and railway edge habitats, thus showing the adaptability to various range of habitats. The species is endemic to southern Europe. CHSA considered unlikely to support regionally important concentrations of the species and loss of habitat unlikely

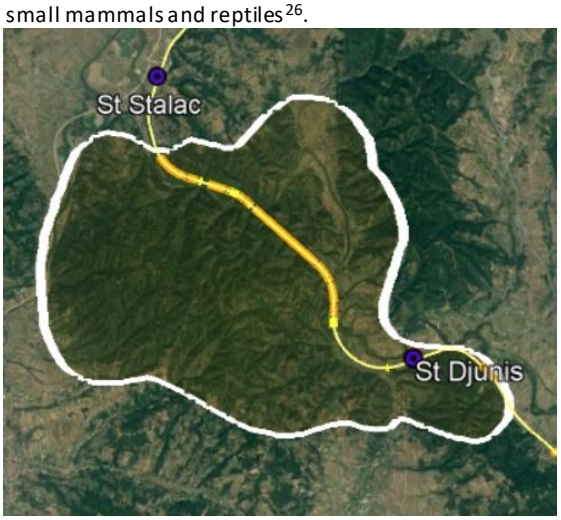
Species	Conservation status	CH/PBF	Criteria	Comment
				to significantly impact the long-term survival of the species. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. The exact magnitude of habitat loss and possible consequences cannot be precisely determined at this stage. Rapid assessment and monitoring of the Herrmann's tortoise must be doneas a part of Construction Biodiversity Management Plan. A number of tortoises were found during rapid 2022 surveys, indicating that the population at Mojsinje Mountains is considerable. Due to this species' conservation status, targeted mitigation is needed. It will be included in the ESMP but can be summarized as follows: fencing of access roads during construction is needed, daily walkover of construction sites should be done by an employed ecologist/environmental associate and if any tortoises are found they must be relocated to a suitable habitat and away from other roads and sources of danger. 
Lacerta viridis European green lizard	IUCN LC, **HD IV**, RS LC	CH	2iae	This species prefers warmer habitats, so it is widespread mainly in the southern part of Europe, but also in almost all of France and most of Eastern Europe. In Serbia, it is very common everywhere where habitats are open and dotted with bushes. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. The loss of habitat, if any, will be minor and will be offset by revegetation.

Species	Conservation status	CH/PBF	Criteria	Comment
				
Podarcis muralis Wall lizard	IUCN LC, HD IV, RS LC	CH	2iae	The species is considered to be widely spread in Europe and of least conservation concern. This is a very common and widespread species, well-adjusted to natural and urban habitats in majority of Serbia. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. It is scientifically established that railways are a desirable habitat and enable dispersal of wall lizards. 
Vipera ammodytes Nose-horned Viper	IUCN LC, HD II, IV, RS LC, PS	CH	2iae	The species is considered to be widely spread in Mediterranean and South Europe as well as East Asia and of least conservation concern. It is common and widespread in whole Serbia. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. The workers shall be educated on nose-horned viper and instructed not to upset or handle it. A large number of snakes is known to inhabit the Stalac Gorge (pers. comm. with the locals). Due to suitable habitats and common persecution of this species by the inhabitants, it is very likely nose-horned viper (along with the Aesculapian snake) is the most common in the terrestrial habitats. Considering the position of the railway in relation to the railway, no impact is expected near Stalac Gorge. The full scale of impact and expected habitat loss is not fully clear at this stage. Rapid

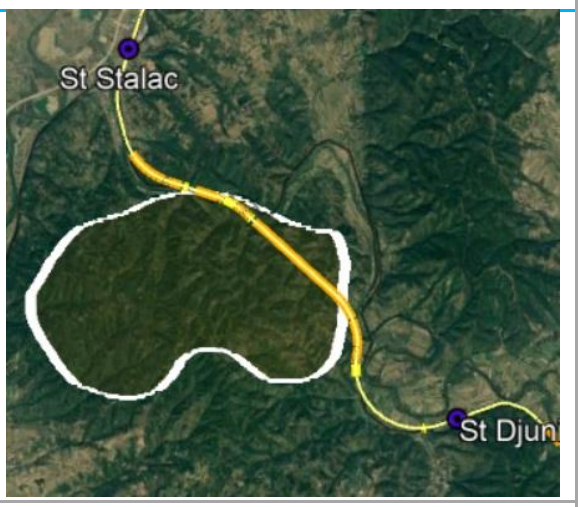
Species	Conservation status	CH/PBF	Criteria	Comment
				assessment and monitoring shall be done for the species during the development and implementation of Construction Biodiversity Management Plan in order to calculate the exact possible habitat loss, if any. 
Dolichopis caspius Caspian whipsnake	IUCN LC, RS DD, HD IV, SPS	CH	2iae	The species is listed in the HD under *Coluber caspius.* *D. caspius* is related to steppe and forest-steppe habitats, and occupies less than 50% of the Serbian territory. This snake should be of special conservation interest because its range is highly fragmented due to alterations of original steppes and forest-steppes into agricultural fields. The suitable habitats are away from the route and no impact is expected. 
Coronella austriaca Smooth snake	IUCN LC, RS LC, HD IV, SPS	CH	2iae	The species is found in northern and central Europe, but also as far east as northern Iran. It is a common and widespread species in Serbia present throughout the country. Some active lines in sunny areas of large valleys and some large switchyards, as well as unused railways not dismounted, have a particularly high richness of reptiles. In fact, those railways may have contributed to the local dispersal of smooth snake[25]. The species is present in a large variety of habitats and it is adaptable. The scale of potential habitat loss is not fully established at this stage. Through rapid assessment and monitoring during the pre-construction phase and

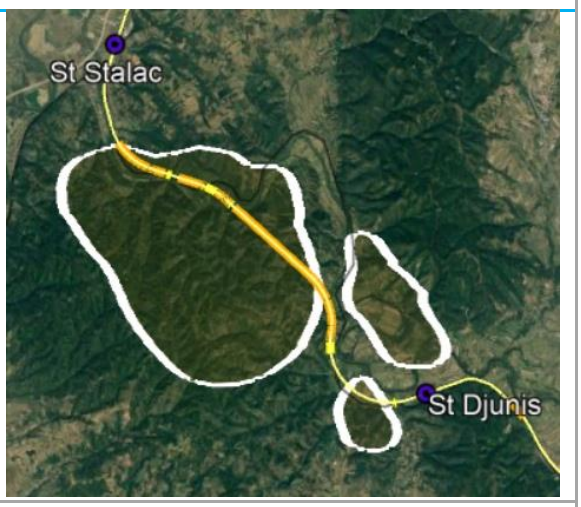
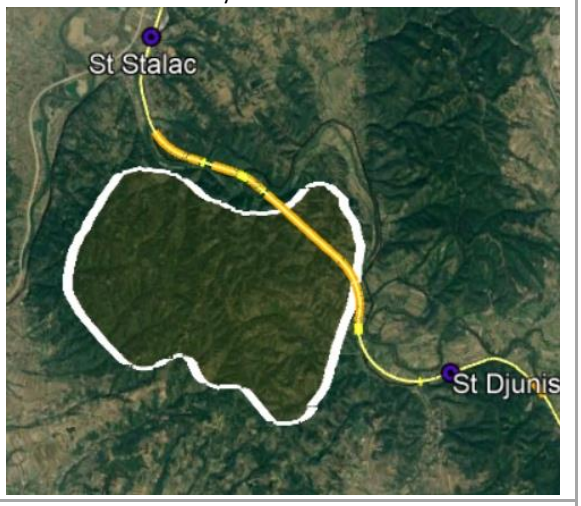
[25] Lucas, P.S., de Carvalho, R.G., Grilo, C. (2017). Railway Disturbances on Wildlife: Types, Effects, and Mitigation Measures. In: Borda-de-Água, L., Barrientos, R., Beja, P., Pereira, H. (eds) Railway Ecology. Springer, Cham. https://doi.org/10.1007/978-3-319-57496-7_6

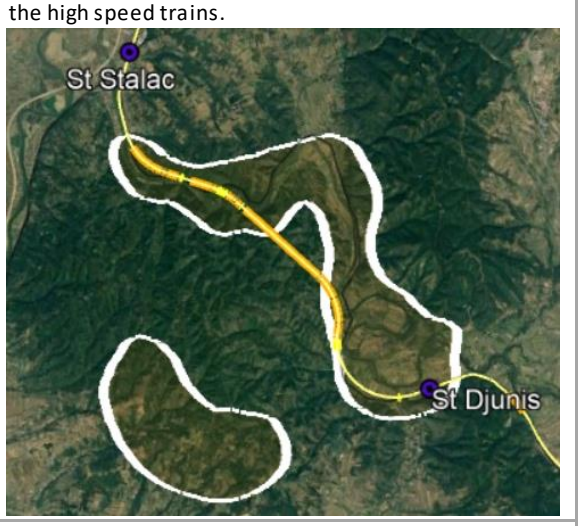
Species	Conservation status	CH/PBF	Criteria	Comment
				development of Construction Biodiversity Management Plan, the impact will be further elaborated. 
Natrix natrix Grass snake	IUCN LC, RS LC, BC Res. 6, SPS	PBF	2iaa	A very common and widespread species in Serbia present throughout the country. Present in various aquatic habitats, from lowlands to high mountains. Grass snake can be found throughout the Project area, but a special focus should be paid on river banks. The habitat loss is possible as a negative impact, however it can be successfully mitigated by preservation of impacted and adjacent river banks and their restoration upon completion of works. 
Natrix 57essellate Dice snake	IUCN LC, RS LC, HD IV, SPS	CH	2iae	A common and widespread species in Serbia present throughout the country. The presence is associated with rivers, coasts, streams, lakes, ponds and the surrounding terrestrial habitat. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species since such areas will not to be disturbed. The habitats and, therefore, the EAAA of the dice snake and proposed mitigation are comparable to the one of grass snake. Please refer to the figure and measures above.
Zamenis longissimus Aesculapian snake	IUCN LC, RS LC, HD IV, SPS	CH		The species prefers forested, warm but not hot, moderately humid but not wet, hilly or rocky habitats with proper insolation and varied, not sparse vegetation that provides sufficient variation in local microclimates. Frequented locations include places such as forest

Species	Conservation status	CH/PBF	Criteria	Comment
				clearings in succession, shrublands at the edges of forests interspersed with meadows. They avoid open plains and agricultural deserts. In Serbia, it is a very common species that can be found throughout the country. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. Clearings can be produced by cutting young trees and leaving branches, tops and other small woody material on the ground as deadwood. This practice is regulated to maintain fertility and protect soil from erosion, but also supports forest biodiversity, e.g., saproxylic species, small mammals and reptiles[26]. 
Birds				
Accipiter gentilis Northern goshawk	IUCN LC, RS VU, BC Res. 6, PS	PBF	2iaa	Northern goshawks are found throughout the mountains and forests of North America and Eurasia. The species inhabits mature woodland, particularly coniferous, but also deciduous or mixed, preferring areas near clearings and the forest edge. It is a regularly nesting bird in Serbia, whose population is estimated at 1,400-1,800 pairs. It is endangered due to the destruction of habitats, but also due to direct persecution and killing by humans. Due to suitable habitats being present at higher altitudes of Mojsinje Mountains, the expected negative impacts are mainly limited to disturbance during construction. Other impacts are mitigated by the railway design and the planned tunnel through Mojsinje Mts.

[26] Piccini I, Pittarello M, Gili F, Dotta A, Lorizzo R, Magnani C, Grieco P, Lonati M, Bertolino S, Bonelli S. (2022) Using Forest Compensation Funds to Reverse Biodiversity Loss: A Case Study of Turin–Lyon High-Speed Railway Line. Sustainability, 14(8):4411, https://doi.org/10.3390/su14084411

Species	Conservation status	CH/PBF	Criteria	Comment
				
Pernis apivorus Honey buzzard	IUCN LC, RS LC, BD I, BC Res. 6, SPS	PBF	2iaa	The species is a typical migratory bird. It inhabits various habitats in which there are preserved complexes of deciduous, coniferous or mixed forests and open terrains (meadows, pastures, steppes or agricultural areas), from the plains to the upper forest border. It builds nests on trees. It feeds mainly on social species of wasps, less often on other insects (locusts, etc.), small mammals and frogs. It is endangered due to the disappearance of suitable habitats, reduction of the amount of available prey and suffering on migration. Honey buzzard is a regular nesting bird in Serbia, whose population is estimated at 800-1,000 breeding pairs. Inspection of trees for nests before cutting must be done. 
Streptopelia turtur Turtle dove	IUCN VU, RS VU, PS	PBF	2icc	It inhabits mosaic habitats with shrubs and trees in the hills and plains, forest edges, floodplains of large rivers, orchards, degraded forest complexes and the like. It builds its nests in the canopy of trees and shrubs. In addition, it is threatened by modern agriculture. The turtle dove population is declining for most of the area. This is also the case in Serbia, where the population is estimated at 50,000-80,000 nesting pairs. Still, it is fairly common and widespread in Serbia. Mosaic habitats of dense vegetation along the railway and agricultural areas are excellent nesting places for this species. Revegetation efforts in disturbed and adjacent habitats will mitigate potential negative impacts.

Species	Conservation status	CH/PBF	Criteria	Comment
				
Dendrocopos syriacus Syrian woodpecker	IUCN LC, RS LC, BD I, BC Res. 6, SPS	PBF	2iaa	It is widespread in the wider area of Southeast Europe and Asia Minor. It is a resident bird. Inhabits semi-open habitats of plains and hills, old orchards, tree lines, bans, hedges, parks and gardens. It nests in holes in tree trunks that it makes itself. European population is declining slightly. However, in Serbia, the population is slightly growing and is estimated at 23,000-30,000 breeding pairs. Regarding the Project area, it is mainly limited to the higher altitudes of Mojsinje Mts. therefore, no direct habitat loss is expected. Minor impact may arise from disturbance caused by the construction. 
Dendrocopos major Great spotted woodpecker	IUCN LC, RS LC, BC Res. 6, SPS, SPS	PBF	2iaa	Widespread throughout Europe, the Caucasus and temperate Asia. It is a resident bird. It inhabits almost all types of forest and semi-forest habitats (deciduous, coniferous and mixed forests), in the plains, hills and mountainous areas, and also inhabits gardens, orchards, tree lines and parks. The European population is stable. It is the most numerous species of woodpecker in Serbia, with a stable population of 140,000-210,000 nesting pairs. The EAAA for this species, along with expected impacts, is comparable to the EAAA of Syrial woodpecker.
Lullula arborea Woodlark	IUCN LC, RS LC, BD I, BC Res. 6, SPS	PBF	2iaa	It is widespread in most of Europe, from the Atlantic coasts to eastern Scandinavia and the Ural; in Asia Minor, the Middle East and northwest Africa. It inhabits glades and sparse parts of coniferous, deciduous, and mixed forests, young tree plantations, mosaic areas with

Species	Conservation status	CH/PBF	Criteria	Comment
				meadows, pastures, forests and orchards. In Serbia, it inhabits only hills and mountainous areas. It builds nests on the ground. It is endangered due to the disappearance of favourable habitats due to the intensification of agriculture. Woodlark is a regular nesting bird in Serbia, whose population is estimated at 8,000-12,000 nesting pairs. The EAAA for this species, along with expected impacts, is comparable to the EAAA of Syrial woodpecker.
Lanius collurio Red-backed shrike	IUCN LC, RS LC, BD I, BC Res. 6, SPS	PBF	2iaa	It inhabits most of Europe except Great Britain, parts of the Iberian and Scandinavian peninsulas. It inhabits open habitats (meadows, pastures, etc.) with hedges, shrubs, and bushes, and is regular in mosaic agricultural areas. Europe's population is declining slightly due to intensified agriculture and habitat loss. 60,000-85,000 pairs nest in Serbia, with a declining trend. One of its preferable habitats are scrubs along the railway lines. Therefore, revegetation of disturbed habitats along the rails will enable red-backed shrike to inhabit the area. On the other hand, the fencing will prevent collision with the high speed trains. 
Mammals				
Erinaceus roumanicus Northern white-breasted hedgehog	IUCN LC, RS NT, PS	No		The species does not meet the criteria for CH/PBF designation.
Talpa europaea European mole	IUCN LC, RS NT, PS	No	-	The species does not meet the criteria for CH/PBF designation.
Neomys anomalus Mediterranean water shrew	IUCN LC, RS NT, PS	No	-	The species does not meet the criteria for CH/PBF designation.
Crocidura suaveolens Lesser white-toothed shrew	IUCN LC, RS NT, PS	No	-	The species does not meet the criteria for CH/PBF designation.
Canis lupus Grey wolf	IUCN LC, RS VU, HD II, IV, BC Res. 6, SPS	CH	2iae	Carpathian and Dinaric-Balkan populations can be found in Serbia. Dinaric-Balkan population has 800-900 wolves with constant slight growth in size and range, while the Carpathian population is still undefined. Intensive forestry practice and infrastructure development are one of the main threats, along with illegal killings and poor management. It is estimated that the number of wolves in Serbia is between 800 and 1,000. The closes known grey wolf habitat is Bukovik Mountain that is located over

Species	Conservation status	CH/PBF	Criteria	Comment
				10 km northeast from the planned motorway. The habitats in the Project area are not optimal for feeding and breeding of wolves and they may only occasionally move towards Mojsinje Mountains. The EAAA is based on known presence on Bukovik, Rtanj and Ozren Mountains. 
Nyctalus noctula Common noctule	IUCN LC, RS LC, HD IV, SPS	CH	2iae	Common noctule is the most widely distributed vespertilionid bat, common throughout Europe, most of temperate Asia to Japan and Taiwan, North Africa, and possibly Mozambique and Singapore. Noctule bats are generally reside in forests but may forage in open areas and dwell in or near human habitation. Roosting sites include hollow trees, buildings, and caves. In Serbia, they are found near forests and shrubs, especially near water surfaces. They can have numerous colonies on the underside of bridges, therefore the bridge over Juzna Morava River may create new suitable habitat. It is a common and numerous species well adapted to urban and suburban habitats. There is no Red Book of Mammals/Bats of Serbia; however, the status in Serbia is estimated to be LC[27]. The EAAA for this, as well as other bat species, encompasses area around the Juzna Morava river and forested area of Mojsinjske Mts. Pre-clearance survey must be done before cutting down of old trees to ensure no loss of bats or disturbance to their roosts. Reforestation, afforestation efforts and installation of bat boxes will enable them to gain habitat.

[27] Paunovic, M. (2016). Rasprostranjenje, ekologija i centri diverziteta slepih miševa (Mammalia, Chiroptera) u Srbiji62 [Distribution, ecology and centres of bat diversity in Serbia]. Doctoral dissertation.

Species	Conservation status	CH/PBF	Criteria	Comment
				
Pipistrellus nathusii Nathusius' pipistrelle	IUCN LC, RS LC, HD IV, SPS	CH	2iae	Nathusius' pipistrelle favours habitats of riparian forests, mixed woodlands and often close to waterbodies. During summer *P. nathusius* roost in tree holes, buildings and bat boxes. It is common and widespread in most of Europe and Caucasus. Conservation measures and protection of riparian woodlands and old trees in forests, along with decreased pesticide use. The species is also widespread in Serbia and population trend is stable. It is regularly found in urban and suburban areas. The status is estimated to be LC[28].
Plecotus austriacus grey long-eared bat	IUCN LC, RS LC, HD IV, SPS	CH	2iae	Grey long-eared bat is common in central and southern Europe. Frequently spotted in human settlements, open agricultural landscapes and lowland valleys, *P. austriacus* roosts in fissures and cavities of buildings during summer. Is it commonly found in Serbia, on altitudes lower than 500 m. Pressures on the species are disturbances in urban areas and forestry. The status is estimated to be LC[29].

BC Res. 6 – Bern Convention Resolution 6; SPS - Strictly protected species and PS - Protected species as per *Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi* of Serbia

Summary. The CH assessment process was based on literature data given in the 2016 ESIA and records collected during the field survey in 2022. EAAs have been designated for all biodiversity receptors; however, in order to adequately present EAAAs for PBFs and CHs in an effective and concise manner, they will be presented in this subchapter along with brief comments and proposed further actions. The main principle of EIB Standard 4 and EBRD PR 6 and, by extension the CHA, is mitigation hierarchy – avoiding and minimising impacts, ensuring no net loss and, whenever possible, net gain. For priority biodiversity features, the minimal requirement is to ensure no net loss. However, when it comes to critical habitats, net gain is mandatory. The mitigation measures and further conservation actions will build on brief information on species given in Table 13.

The findings can be summarised as follows:

- Two areas of conservation concern were evaluated, both met the criteria for PBF.
- Six invertebrates were brought for further assessment, two did not meet the criteria, one is a PBF and three are CH.
- Fifteen fish species were assessed, one did not meet any of the PBF/CH criteria, while 14 are PBFs.
- Five amphibians were assessed, one of which did not meet the criteria for PBF/CH, and four are CH.
- Ten reptiles were assessed, one met the criteria for PBF and nine for CH.

[28] Ibid.
[29] Ibid.

- Seven birds were assessed, all of which were assessed as PBFs.
- Eight mammals were assessed, four did not meet any of the PBF/CH criteria, while four met the criteria for CH.
- In total, 41 biodiversity receptors (areas, species, and their habitats) were assessed, 23 are PBFs and 21 CH.

If more data become available during pre-construction phase, the Critical Habitat Assessment will be updated and required actions will be taken within the scope of the ESMP.

5.2 Identification of Impacts

The ESIA identifies the following potential impacts/risks on biodiversity:

Construction phase	> permanent loss of natural and semi-natural habitats within the railway footprint > temporary disturbance and fragmentation of fauna habitats and construction collisions
Operational phase	> permanent fragmentation of habitats > potential disturbance of specific biological functions (nesting, breeding, foraging) by noise or light effect, > electrocution on power lines or collision with the railway, > potential contamination of vegetation by herbicides

The Critical Habitat Assessment (CHA) done as a part of the Supplementary Study identifies the potential of the Project to impact species and habitats that trigger Critical Habitat and/or Priority Biodiversity Feature criteria.

5.3 Mitigation Measures

The measures for mitigation of construction and operation related impacts on biodiversity are defined in the ESMP.

In the **construction phase**, the Contractor will develop and implement a Construction Biodiversity Management Plan, which will include set of measures to mitigate the negative impacts of railway construction on biodiversity features. The Plan will be mainly focused on measures to limit habitat loss and fragmentation, along with fauna disturbance and collisions with machinery. Measures include controlled vegetation clearance and handling of cut down trees, timing of works, actions in case of nest/roost finds and construction site organization.

In the **operational phase**, the SRI will develop and implement an Operational Biodiversity Management Plan, which will address actions to safeguard and conserve biodiversity that could be affected during the railway operation. The Plan must include detailed maintenance and monitoring guidelines for the first year of railway operation and reporting protocols.

6 Protected Areas

6.1 Supplementary Baseline Information

Protected areas. In Serbia, protected areas are recognised in the *Law on Nature Protection*[30]. Seven types of protected areas are listed: national parks, nature parks, strict nature reserves, special nature reserves, outstanding natural landscapes, monuments of nature, and protected habitats. A total of 474 areas of special importance for the conservation and improvement of nature in Serbia have been protected, of which 5 are national parks, 16 nature parks, 58 outstanding natural landscapes with specific natural and cultural-historical values, 71 strict and special nature reserves, and 313 monuments of nature. The total protected area is 531.279 ha, which makes 6% of Serbian territory[31].

[30] Official Gazette of RS, No. 36/2009, 88/2010, 91/2010 – corrigendum, 14/2016, 95/2018 – state law and 71/2021
[31] http://www.natura2000.gov.rs/en/protected-areas/

The planned railway section Stalac-Djunis does not pass through established protected areas. The two officially proclaimed protected areas are in the 15 km buffer zone around the Project area: oak tree in village Setka at 8.3 km northeast and pedunculate oak Rasina at 10.1 km southwest of the planned railway (Figure 10). Both protected areas are **monuments of nature and are protected as individual trees**. **No impact on these protected features is expected.**

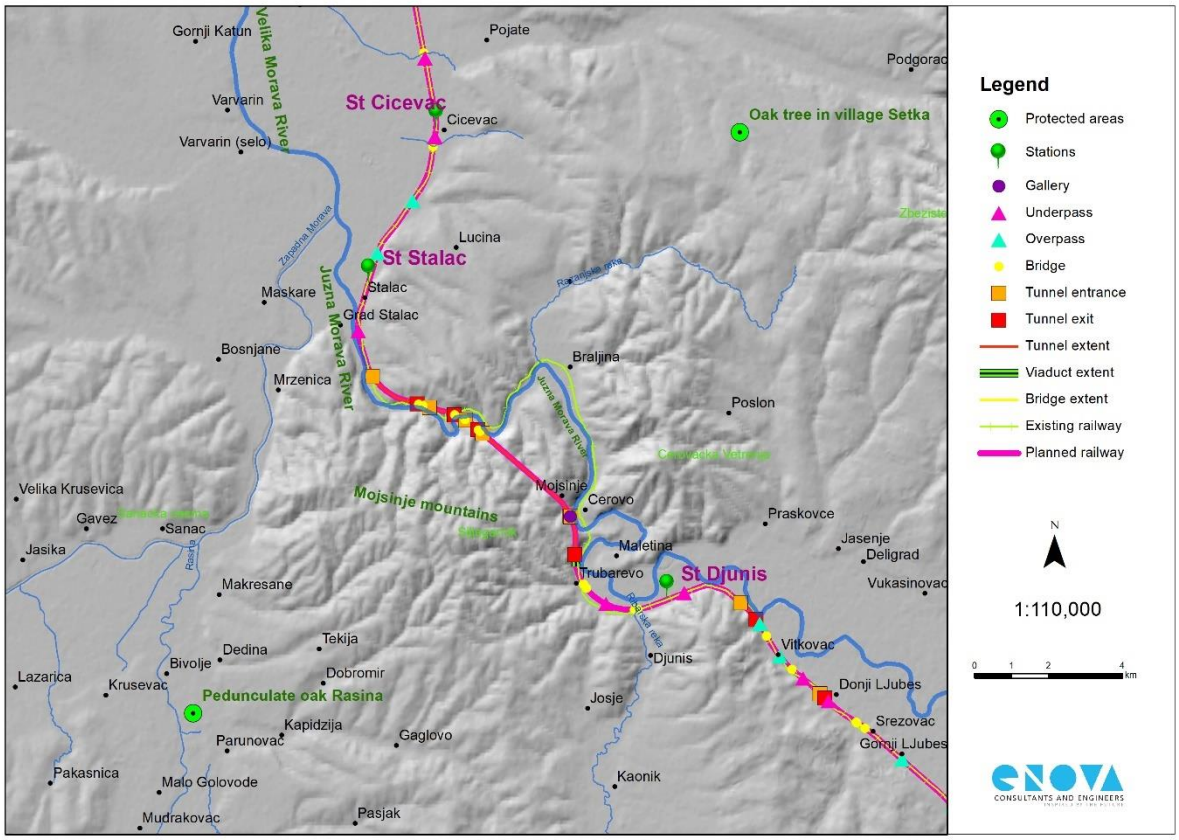


Figure 10: Position of protected oak trees in relation to the railway route

Ecological network of Serbia. Ecological network in Serbia was established in 2010 by the *Decree on the ecological network*[32] according to the same concept as the EU ecological network Natura 2000. The ecological network of Serbia includes 101 ecologically important areas covering 1,849,201.77 ha, which represents 20.93% of its territory. These areas include the spatial units in which certain protected areas are located, along with the areas defined by international programs for the identification of the Important Plant Areas (IPA), Important Bird Areas (IBA), Prime Butterfly Areas (PBA), Ramsar areas (according to the Convention on Wetlands of International Importance), Emerald Areas (according to the Council of Europe Convention on the Conservation of European Wildlife and Natural Habitats), etc. In addition to these areas, the ecological network is composed of certain watercourses with riparian belts (Danube, Tisa, Sava, Drina, Juzna and Velika Morava, Tamis, Keres, Zlatica, Karas, Nera, Brzava, Moravica, Bosut and Studva) representing ecological corridors of international importance since they enable connection with the ecological networks of neighbouring countries.

The desktop analysis of the ecological network and the above-mentioned areas defined under international programs refined by international conventions and agreements has shown that not all such areas were included in the ecological network of Serbia; therefore, the lists are not fully harmonised.

The planned railway passes through the area of Mojsinje Mountains and Stalac Gorge of the Juzna Morava River that is part of the ecological network of Serbia (Figure 11). The size of this area is 3,833 ha. The route enters the

[32] Official Gazette of RS, No. 102/2010

area in the northern part, traverses Mojsinje Mountains in the form of a long tunnel, and exits in the south-eastern part of the area. The ecological network also includes ecological corridors that are predominantly large rivers. The railway section Stalac-Djunis will cross the ecological corridor Juzna Morava River via a bridge at km. 181+555.

There are no IPA, PBA, Ramsar and Emerald sites in the 15km buffer zone around the Project.

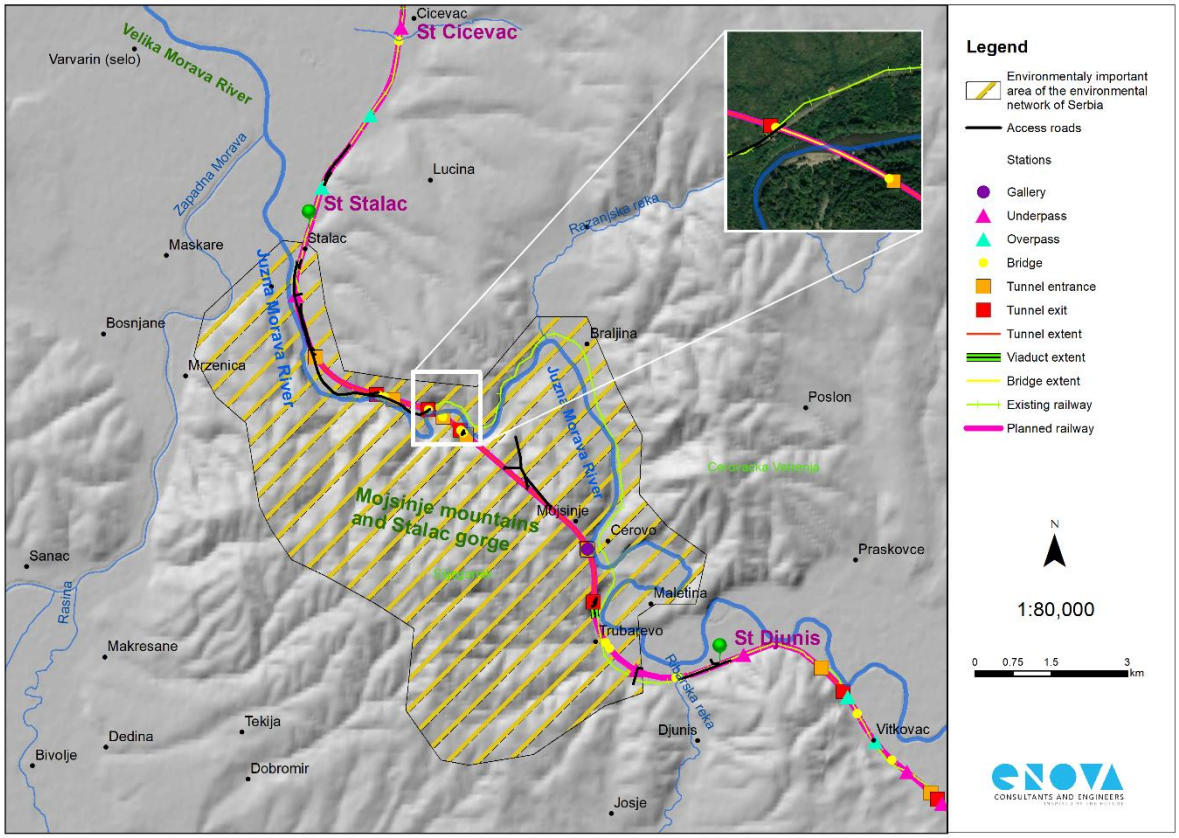


Figure 11: Ecological network area Mojsinje Mountains and Stalac Gorge of the Juzna Morava River and ecological corridor Juzna Morava River (shown zoomed in)

Natura 2000 network in Serbia. The Ministry of Environmental Protection and the Institutes for Nature Conservation of Serbia and Vojvodina have been working on identification and designation of the Natura 2000 network for several years. One of the main and important requirements that accession countries have to prepare in the Natura 2000 network is a list of sites designated by each Member State in the framework of two European Directives: the Birds Directive (BD) and the Habitats Directive (HD). The implemented project "EU for Natura 2000 in Serbia (2019-2021)", through five key results, has provided the first list of potential sites Natura 2000 with development of information data system, database and GIS for Natura 2000[33]. One of the most important results of this project was the first list of potential Sites of Community Importance (pSCIs) and Special Protection Areas (pSPAs) for Natura 2000. This list of sites is based on the BD and HD criteria finalised and agreed with Serbian experts responsible for their implementation in Serbia. Each potential site is justified by the presence of reference list habitats and/or species that fulfil the agreed criteria. The correct coverage of each species and habitat according to the requirements of the Directives has also been verified. However, all experts agree that more fieldwork and specific data on some species and habitats are necessary to confirm this information with greater certainty. The boundaries of potential Natura 2000 sites are delineated roughly according to the distribution of species and habitat types. Their exact specification will be completed subsequently.

[33] Available on: https://daphne.sk/Natura2000Serbia/. Date of access: 29.5.2022.

Currently, all national and nature parks overlap with the proposed Natura 2000 sites; however, for the rest of the protected areas, not all of them fulfill the established criteria for the designation of Natura 2000 sites because the geological or biodiversity values are different. On the other hand, several new sites have been proposed as the Natura 2000 sites that are not currently overlapping with any recognised protected area. When the Natura 2000 network is established, between 20 to 30% of Serbian territory will be protected, improving the conservation of biodiversity and natural values of Serbia. The Natura 2000 network exists in parallel to the ecological network established by the previously mentioned *Decree on ecological network*.

All available information and data of the "EU for Natura 2000 in Serbia" project was evaluated. Regarding the proposed SCIs (areas designated based on the Habitats Directive, e.g., presence of habitats listed in Annex I and/or species listed in Annex II), the railway route passes through the pSCI Juzna Velika Morava. The pSCI encompasses two large waterflows – Juzna Morava River and Velika Morava River. The locality was selected because it has an important habitat type (91M0 Pannonian-Balkanic turkey oak – sessile oak forests) and 7 species (otter *Lutra lutra*, large copper *Lycaena dispar*, common noctule *Nyctalus noctule*, Nathusius' pipistrelle *Pipistrellus nathusii*, grey long-eared bat *Plecotus austriacus*, striped nerite *Theodoxus transversalis* and the thick sheller river mussel *Unio crassus*). Size of the pSCI is substantial and covers 12,745 ha. The Juzna Morava River is generally under influence of various types of pressures, primarily organic and nutrient pollution. The river is also under the influence of industrial pollution as well as hydromorphological pressure (riverbed degradation, channelling, gravel and sand extraction).

The planned railway will also pass next to the pSCI Poslon Mountains. The locality was selected because it has an important habitat type, 91M0 Pannonian-Balkanic turkey oak – sessile oak forests. The closest point to the railway alignment is 580m away from this pSCI with Juzna Morava flowing in-between. No direct loss or impact is expected.

One more pSCI is identified in the zone of 15 km around the planned railway route: Bukovik II (3,724 ha) at 5.7 km, while additional three are in the wider zone: Bukovik I (3896 ha) and Bukovik – Mratinja (4,816 ha) that were all selected because of the habitat type 91W0 Moesian beech forests and Juhor (11,892 ha) that is selected because of the presence of species *Carabus variolosus*. Due to the position in relation to the railway and features for which the sites were proposed, the Project will not have an impact on mentioned areas.

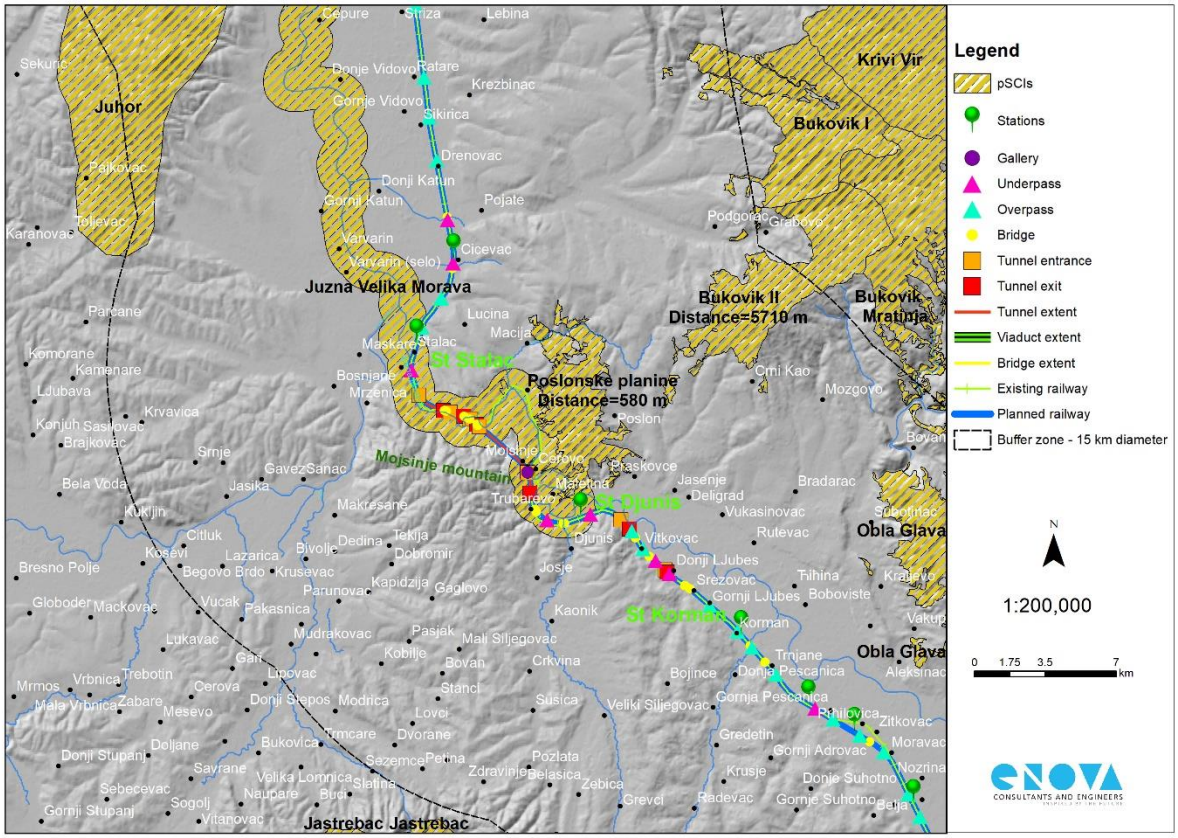


Figure 12: pSCIs registered within 10km of distance from the planned motorway route

Regarding pSPA areas designated based on the Birds Directive, the planned railway section does not pass through any of them. The closest pSPA site is the pSPA Gornje Pomoravlje at 1.15 km north of the section. It is important to note that the pSPA significantly overlaps with the IBA site Gornje Pomoravlje (code RS044). The main difference between pSPA and IBA sites is in the slight enlargement of the northern area of pSPA compared to the IBA. No other IBAs are found within the 15km radius. The pSPA is elongated and stretches in the north-south direction away from the Project area. The occurrence of 40 bird species listed in the Birds Directive was confirmed in pSPA from 2000 to 2021 (of those, 26 species are on Annex I). The IBA triggering species were: common tern *Sterna hirundo* (IUCN LC, BD Annex I, max 20 breeding pairs), common kingfisher *Alcedo atthis* (IUCN LC, BD Annex I, 20-40 breeding pairs) and collared sand martin *Riparia riparia* (IUCN LC, 1,500-2,500 breeding pairs).

The common tern may nest in similar habitats, including sand or shingle lakes shores, shingle banks in rivers, sandy, rocky, shell-strewn, or well-vegetated islands in lakes and rivers, sand- or gravel-pits, marshes, ponds, grassy areas and patches of dredged soil. Common kingfisher prefers still or gently flowing water with plenty of small fish, and with reeds, rushes, or shrubs on the banks for perches. Streams, small rivers, canals, and ditches are favoured to open waterbodies, but it also uses lakes, ponds and flooded gravel pits. Collared sand martin species nests colonially in newly eroded banks of rivers, streams, lakes, reservoirs, and coastal cliffs. Birds may use other man-made habitats including road and railway cuttings and building work excavations. Based on habitat preference of these species, it is possible they are found in the Project area and that railway construction may create new habitats for these species, depending on the works performed on the riverbanks.

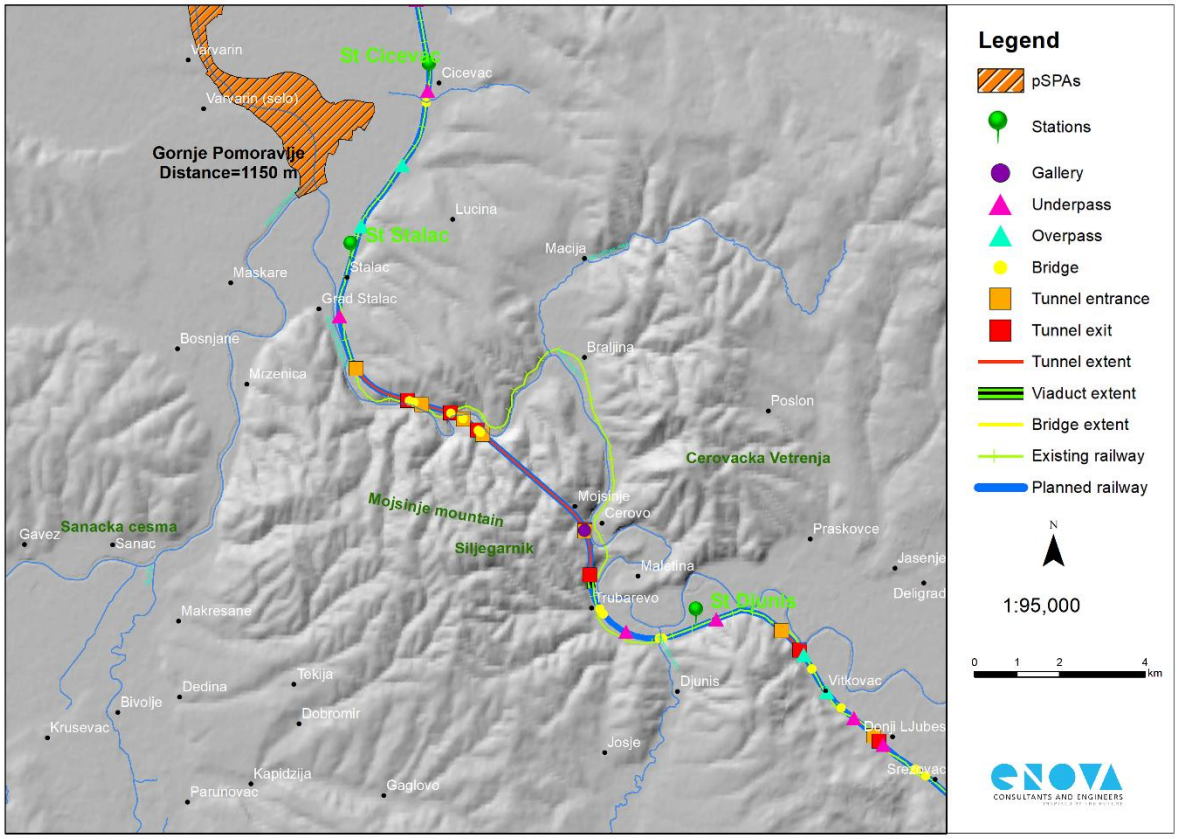


Figure 13: Gornje Pomoravlje as the only pSPA in the 15 km radius from the Project area

6.2 Identification of Impacts

6.2.1 Introduction

Baseline data collected for the 2016 ESIA and this Supplementary Study has shown that the Project will pass through three areas of concern:

- Ecological network area "Mojsinje Mountains and Stalac Gorge of Juzna Morava River",
- Ecological corridor "Juzna Morava River", and
- pSCI "Juzna Velika Morava"

The ecological network of Serbia is comprised of ecological network areas of concern and ecological corridors. On the other hand, as a result of the previously mentioned "EU for Natura 2000 in Serbia" project, a network of pSCIs and pSPAs has been established. These two networks exist in parallel independently of each other and are not fully harmonised. pSCIs and pSPAs are not officially included in the *Law on Nature Protection* or its by-laws as such. The Law (Art. 130) states that the ecological network will be established and will become a part of Natura 2000 upon Serbia's accession to the EU. Based on this, the *Regulation on ecological network*[34] (Regulation) was adopted. Despite the fact that 'Mojsinje Mountains and Stalac Gorge of the Juzna Morava River' is an ecological network area and shall become a candidate Natura 2000 site, they are not classified as pSPA as a part of the "EU for Natura 2000 in Serbia" project. pSCIs and pSPAs are, generally, areas that countries nominate for Natura 2000 but the Regulation precedes the "EU for Natura 2000 in Serbia" project. Therefore, it is unclear whether Art. 130 refers only to the ecological network established by the 2010 Regulation, or it includes the pSCI/pSPA network as well. Still, considering the usual process of Natura 2000 nomination as well as Art. of the Law and the Regulation, all three areas will be considered and referred to as potential Natura 2000

[34] Official Gazette of RS, No. 102/2010

sites. Based on this approach, an Appropriate Assessment (AA) is necessary. AA is currently included in the *Law on Nature Protection* of Serbia in Articles 8 to 10, but a specific Regulation should be adopted.

An AA involves a case-by-case examination of the implications of a development or activity for a Natura 2000 site and its conservation objectives.

The key steps in the AA process include screening, which establishes whether a plan or project could have significant effects on a Natura 2000 site either on its own, or in combination with other plans or projects. Where potential impacts are identified, a complete AA is undertaken, which will inform and assist the planning authority in their decision to grant or refuse permission. If a proposed plan or project is considered likely to have a significant effect on a protected habitats site (either individually, or in combination with other plans or projects) then an AA of the implications for the site, in view of the site's conservation objectives, must be undertaken. A risk, or a possibility of such an effect, is enough to warrant the need for an appropriate assessment. Stage three and four of the AA process are assessment of alternative solution and imperative reasons of overriding public interest.

The competent authority must determine whether the proposal will not adversely affect the integrity of the site(s). The relevant authority for questions regarding our areas of concern is the Institute for Nature Conservation of Serbia. It already issued a Location Conditions (LCs) for railway section Stalac-Djunis in 2021. The LCs were issued due to the fact that railway passes through ecological network area. Proposed mitigation measures are mainly general measures and were included in further assessment, proposal of mitigation and the ESMP.

Where it cannot be concluded that there will be no adverse effects on a site's integrity, there is a need to consider mitigation measures.

6.2.2 Stage 1: Appropriate Assessment Screening

The methodology and procedures of the European Commission's recommendations were followed. All available information about the Project was gathered in order to analyse whether it is likely to have any significant effects on the European sites. ESIA data, field and desktop survey results, the state of preservation of sites of concern (whether there are existing settlements, roads, arable lands) and an assessment of other plans and projects in the area were used to prepare this document and assess the magnitude of the impacts. This is the first stage of the Appropriate Assessment process, undertaken to determine the likelihood of significant impacts as a result of a proposed project or plan, in which case there is a need for a full Appropriate Assessment. If it can be concluded that no significant impacts to Natura 2000 sites are likely (or, in this case, other protected areas) then the assessment can stop here. If not, it must proceed to Stage 2 for a more detailed assessment.

The AA screening process that has been conducted can therefore be summarised as follows:

- Determination of whether the Project is directly affecting a potential Natura 2000,
- Description of whether the Project could potentially affect the identified sites,
- Summary of the potential for likely significant effects of the Project 'in combination' with other projects and plans,
- Identification of potential impacts on potential Natura 2000 sites,
- Assessment of the significant of effects to the sites and establishing whether stage 2 is needed.

Determination of areas to be included in AA. The screening done as a part of baseline has discovered that three areas of concern are within the Project area (Mojsinje Mountains and Stalac Gorge, Juzna Morava River and pSCI Juzna Velika Morava). There are also eight other areas of concern located up to 15 km from Project's boundaries:

- pSCI Poslon Mountains at 580 m east,
- pSPA/IBA Gornje Pomoravlje at 1.15 km north,
- pSCI Bukovik II at 5.7 km northeast,
- Protected oak tree in village Setka at 8.3 km northeast,
- Protected pedunculate oak Rasina at 10.1 km southwest,

- pSCI Bukovik I at 14.8 km northeast,
- pSCI Juhor at 14.9 km northwest, and
- pSCI Bukovik – Mratinja at 15 km northeast.

Adverse effects from the Project are considered unlikely to extend far beyond the Project boundary. There are unlikely to be significant emissions to air or discharge to water which could be generated by the operation of the railway. The eight areas that will not be directly impacted have therefore been excluded from the AA process as it is extremely unlikely that there would be any significant effects on these sites given their distance from the Project boundary.

Obtaining information on sites with the potential to be affected. The next step in the screening process would be collecting data on the areas chosen for further assessment from managing bodies. However, these areas are currently not managed, therefore there are no management plans nor conservation objectives which is a large obstacle in performing AA. *Law on Nature Protection* Article 40 states that ecologically important areas and corridors that are not under protection as protected areas should be managed by a legal entity chosen or established by the municipality. Additionally, they must create a management plan and perform conservation actions. However, to the best of our knowledge, the local municipalities are not managing the areas in the AA process. Therefore, to be able to perform AA, information on present habitats and species has been taken into consideration when assessing impacts and proposing mitigation. There is also a need to consider the potential for likely significant effects of the Project in combination with other projects and plans; therefore, information on other projects in the vicinity of the planned railway was collected.

Assessing the impacts. Following the gathering of information on the sites, an assessment has been undertaken to predict the likely significant effects of the Project alone. The screening assessment has been carried out considering the following impacts that might lead to significant effects:

- Habitat loss and fragmentation,
- Disturbance of fauna,
- Electrocution on power lines or collision with trains,
- Contamination of vegetation by herbicides,
- Invasive species, and
- Water quality.

These impacts were identified through consideration of the potential impact and the vulnerabilities of the sites identified. At the screening stage, the details of the impacts are not provided.

Assessing "in combination" impacts. A total of five other projects in the vicinity of the planned Stalac-Djunis section have been identified as part of the search for other projects and plans undertaken in support of the Stage 1 Screening to ensure that the assessment of "in combination" effects reflect the most up to date information. The findings are given in Table 14 below.

Table 14: Screening in-combination assessment

Project	Findings
Construction of the Pojate-Preljina motorway (so called Morava corridor)[35] with access roads	The Morava Corridor is located west and downstream of the planned railway. One bridge over the Juzna Morava River is planned on that section and it is currently being built. The bridge pillars will not be located in the riverbed. The cumulative effect regarding Juzna Morava River as a potential Natura 2000 site is minimal and can only appear as temporary increased sediment load. The Morava corridor will not affect Mojsinje Mountains and Stalac Gorge area.
Reconstruction and electrification of the Lapovo-Kragujevac-Kraljevo-Raska-Novi Pazar and the Stalac-Krusevac-Kraljevo-Pozega railways[36]	The assessment concluded no likely significant effects.

[35] https://www.slobodnaevropa.org/a/30326583.html
[36] Information from the *Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Stalac-Djunis*

Project	Findings
Construction of mini-hydro powerplants in the settlement of Stalac	The construction of five mini-hydro powerplants (mHE) was planned on Juzna Morava River in Stalac. However, Cicevac Municipality decided to vote against the Project, and it will not proceed. The mHE were planned on Juzna Morava River and were not close to the Mojsinje Mts.
Reconstruction of the municipal road Stalac-Trubarevo[37]	The assessment concluded no likely significant effects. The road already exists.
Construction of a chicken farm in Stalac	The assessment concluded no likely significant effects.

Screening conclusion. The precautionary principle has been taken into account during this AA. The precautionary principle is used when an AA cannot objectively demonstrate that there will be no likely significant effects on the (potential) Natura 2000 sites. If this occurs the subsequent stages of AA must be completed for the project or plan. Therefore, due to the fact that screening identified potential impacts on the areas of concern, further assessment was undertaken and is reported as part of the following section, the Stage 2: Appropriate Assessment.

6.2.3 Stage 2: Appropriate Assessment

Mojsinje Mountains and Stalac Gorge of the Juzna Morava River. The ecological network area was designated in 2010 *Regulation* as it was supposed to be proclaimed as a protected area at the time. The Institute for Nature Conservation of Serbia prepared a Study of Protection of the Landscape of Outstanding Features „The Mojsinje Mountain and the Stalac Gorge on the Juzna Morava River" in 2012. However, in 2013, the proposal was not accepted by the relevant municipalities. The initiative for protection was revived in 2021 by the WWF.

The route passes through Stalac Gorge via tunnels, intersects the ecological corridor of the Juzna Morava River at the proposed bridge and enters the core area of Mojsinje Mountains. The route continues through the core area almost entirely in tunnels, the only exception being the 30 m-long gallery between tunnel 4 and tunnel 5, south of Mojsinje village and access roads. The access roads that encroach the ecological network area are: access road to tunnel 4 entrance, access road to tunnel 4 evacuation plateau, along with the relocation of existing local road Stalac-Djunis. The total of 2,212 m of new access roads will be built within the Mojsinje Mts and Stalac Gorge area. The main service access road to Tunnel 1 will be built along the existing railway line that goes along the margins of the ecological network area and is not in the area. The Project design with tunnels dominating in sensitive areas has ensured avoidance and minimization of potential impacts.

Ecological corridor Juzna Morava and pSCI Juzna Velika Morava. The ecological corridor was designated because it is a major waterflow that enables ecological connectivity. There is no data on biodiversity of the river in the Regulation through which it was designated. The pSCI includes two major waterflows – Juzna Morava River and Velika Morava River and their shoreline. The locality was selected due to presence of an important habitat type (91M0 Pannonian-Balkanic turkey oak –sessile oak forests) and 7 species (otter *Lutra lutra*, large copper *Lycaena dispar*, common noctule *Nyctalus noctule*, Nathusius' pipistrelle *Pipistrellus nathusii*, grey long-eared bat *Plecotus austriacus*, striped nerite *Theodoxus transversalis* and the thick sheller river mussel *Unio crassus*). It covers 12,745 ha.

Habitat mapping has shown that 91M0 habitat type is not present in the Project area but large copper has been confirmed during 2022 invertebrate surveys.

Identification of impacts and mitigation measures. The impacts for the areas were aggregated because Juzna Morava River is part of Mojsinje Mountains and Stalac Gorge area; therefore, any impact identified for one area can be applied to the others. The difference in impacts may arise due to variation in topography and vegetation cover in certain localised areas.

The Juzna Morava River is generally under high anthropogenic pressure, primarily from organic and nutrient pollution. On its course through Serbia, it runs along several towns and numerous villages. The towns do not have wastewater treatment in place, so the River has been the main recipient of wastewater from each of them.

[37] Ibid.

Additional pressures on the River are related to lack of sewage treatment in villages and the presence of septic tanks of an unknown integrity, waste dump sites along rivers and streams, illegal extraction of sand and gravel from the River and a low control of private use of pesticides. The described conditions have resulted in deterioration of the Juzna Morava River water quality. The results of the assessment of ecological status based on phytobenthos and macroinvertebrate community parameters indicate "moderate" ecological status in 2012 and 2013. However, the monitoring in 2014 indicated "bad" ecological status.

The Juzna Morava River and adjacent riparian habitats belong to the designated ecological corridor and support aquatic fauna and amphibian species and some wading birds. The river is inhabited by at least 15 fish species confirmed during surveys done for the ESIA. The railway section Stalac-Djunis will cross the Juzna Morava River via a bridge at km 181+555. The bridge will have two piers located within the river. All other bridges' piers will be located outside the streams. The bridge will be situated about 200 m from the meander bend. The designed width of the bridge' piers foundations is 2.0 m. The Juzna Morava riverbed is about 60 m wide in that area, so the piers footprint is estimated to occupy about 6% of the cross-sectional area of the river. This is not an obstacle for fish. Construction of the bridge on the Juzna Morava has a potential to increase the sediment load and temporary degrade the water quality at this stretch and to reduce the fish and aquatic invertebrate habitat diversity and quality. The effect on fish habitats would be short-term and reversible. There shall be no direct discharge into water resources. Project-related wastes shall be collected at designated waste storage areas, and periodically removed from work areas.

Location Conditions provided by the Institute for Nature Conservation of Serbia say that during the construction of bridges and overpasses and regulation works on watercourses, it is prohibited to perform activities that may cause substantial turbidity of the Juzna Morava River, Ribarska River, Zmijarnik River, Trubarevacki Stream, Toplik Stream, Vinogradarski Stream, Papradina Stream, Gorcilovac Stream, Livadski Stream, for no longer than three days and whose intensity may adversely affect aquatic organisms.

Potential impacts of habitat loss and habitat fragmentation can be expected during construction and operation but can be partially mitigated. Habitats on Project footprint will be permanently lost, and the loss must be offset by revegetation measures. Construction of bridges' abutments will require removal of riparian vegetation and destruction of riparian habitats. The permanent habitat loss will be limited to the narrow area around the abutments and piers. However, to compensate for the decrease in habitat quality, the appropriate measures should be implemented. Preservation of marginal habitats, hedges, borders, individual trees, moist ecosystems with natural or semi-natural woody, shrubby, meadow or wetland vegetation is of high importance. Natural habitat must be restored upon completion of construction activities and suitable microhabitat created to enable species to re-inhabit these areas.

In forest areas, at least 30 bird nest boxes will be installed for different adapted species birds.

The area of Mojsinje Mountains (km 181+725 to km 186+670) is the natural woodland habitat supporting diversity of flora and fauna some of which have conservation significance in Serbia (Table 13). Construction of tunnels' portals, shafts and the 30 m-long gallery will affect woodland on the slopes of the Mojsinje Mountain. Woodland is a high value resource and is important for the ecological value of the whole designated area. Major land clearance required for construction of the railway substructure, superstructure and access roads will result in permanent destruction and loss of terrestrial habitats within the footprint. The significance of this effect will vary along the route, depending on the sensitivity and ecological value of the affected habitats. The tunnelling option is the least disruptive when construction in a sensitive area is concerned. However, a new 1,445 m long access road within Mojsinje Mts. will be built to the evacuation plateau of Tunnel 4. This will be the service road for tunnel maintenance and emergencies, with a very small traffic volume. No net loss of natural and semi-natural habitats is allowed within the ecological network area. Land preparation and construction activities will be limited to designated work areas and impacts on natural habitats outside the Project route will be prevented. Deforestation shall be restricted to the minimum width of the road necessary to enable normal passage of vehicles and machinery. The control measures will be needed to restore the affected woodland areas by plantations of native vegetation and offset the effects locally by revegetation and reforestation efforts. The area of revegetated and afforested must be equal or larger than the area affected. The species, area size and location of afforestation must be determined by the Biodiversity Management Plan (BMP). Chosen species must be

autochthonous in order to preserve domestic gene pool and ensure suitability of habitats. At this stage, it can be suggested for offset to be done in area adjacent to the Project area through revegetation and improvement of riparian habitats along the Juzna Morava river and afforestation of habitats on Stalac Gorge (the most perturbing piece of land creating a meander on the Juzna Morava River downstream from the bridge).

If present in the area, notable plant species could be affected during vegetation clearance which could have a permanent adverse effect. Mojsinje Mts. are potentially inhabited by purple cyclamen (*Cyclamen purpurascens*), a protected and rare plant in Serbia. It was not possible to confirm the presence of this species in the area affected by tunnel construction and access roads because the 2022 survey was conducted outside its flowering period. If the species is found during pre-construction and construction phases in areas where construction will take place, it is necessary to appoint a qualified ecologist to assess the possible impact and propose relocation to a suitable nearby location or other mitigation measure. The species has an underground bulb and replanting can be performed without major issues.

Vegetation clearing, disturbance and construction-related noise, light and vibration will be the main sources affecting local fauna, including fish, reptiles, birds and mammals. The effect would be short-term and would remain only for the duration of the construction at a certain location and therefore is not considered significant in the long-term. It will be of the highest priority to avoid disturbance of sensitive periods of fauna life cycles (e.g. breeding, spawning and breeding grounds, nesting and nursery areas, summer or winter refuge areas). The point at which such impacts are considered likely to result in a significant adverse effect on conservation status will differ according to the species concerned. Vegetation clearance must be avoided during bird breeding season (March- June), where this is not possible pre-clearance checks will be undertaken to identify any active nesting sites. Project construction will not be undertaken at dusk, dawn and at night to avoid disturbance to nocturnal and crepuscular fauna (i.e. bats) from increased noise and vibration. Pre-clearance checks must also be undertaken to avoid causing disturbance to roosting bats. Any tree above 100mm in diameter is to be checked by the appointed expert ecologist for the potential of roosting bats prior to removal (i.e the presence of potential roosting features). If possible no trees will be felled in the period March to August.

Data given in the ESIA and collected during invertebrate surveys have confirmed the presence of large copper (*Lycaena dispar*) that was listed as a designation species for the pSCI. As addressed in Table 13, drier habitats in railway tracks seem to be able to serve as alternative habitats for xerothermophilous butterflies such as large copper that may live and reproduce at such sites. As one of the main mitigation measures is restoration of affected habitats, that should be carried out with conservation aims in view, including the preservation or reconstruction of suitable plant species composition. Habitats under pressure during construction will be habitats on the entrances to the first, second and fourth tunnel for invertebrate species of concern. Maintenance of railway tracks must be done in a way that will ensure preservation of *Rumex* spp. along the Juzna Morava River, species of the genus are resistant to anthropogenic pressure and can colonize

Besides large copper, other invertebrates of concern are present within the Mojsinje Mts. Clouded Apollo (*Parnassius mnemosyne*) inhabits forest roads, clearings, edges, glades, and belt along the upper forest border in the mountains. Due to species' preference for clearing and forest roads - building of new access roads, will increase the number of suitable habitats for this species. Additionally, railway tracks in forests might successfully replace forest clearings. Stag beetle (*Lucanus cervus*) prefers forests and urban woodlands, especially oak forests. In order to preserve the population on Mojsinje Mts, at least 5% of oak trees that will be cut down during vegetation clearing must be left in the forest. Dead wood should be retained on site. Southern festoon (*Zerynthia polyxena*) is found in forest and shrubby habitats but has also adapted well to habitats along derelict fields. Habitats near portals of Tunnel 1, Tunnel 2, Tunnel 3 and Tunnel 4 must be re-established upon cessation of works and not mowed to allow southern festoon to inhabit them. The species' host plant is *Aristolochia* spp. that develops quickly.

Track verges should be mown with mowing schemes that are adapted to butterfly requirements during operation. A single stretch of tracks and tracks verges should be mown every 2–3 years in order to increase the abundance of flowering plants, to prevent succession and to provide shelter sites with taller vegetation, as has been suggested. The sowing of plant species is also a recommended conservation action for the improved conservation value of railway tracks for butterflies.

Amphibians prefer habitats close to water bodies – Juzna Morava River and (intermittent) streams on Mojsinje Mts. Pillars of the planned bridges will not be placed in streams. However, riparian habitats around the Juzna Morava River will be inevitably affected by the construction. The BMP must provide information on size of the affected area and give clear guidance to Contractor on how to minimize impact. Vegetation for clearance must be clearly marked and machines shall not leave the designated access roads.

The reptile species present in the area are of a high sensitivity and could be affected by loss of grassland and hedgerows thus reducing the extent of habitat available for foraging and sheltering. This includes winter snake refuges (hibernaculums) that might be discovered during the earthworks. The species of the greatest concern are Hermann's tortoise (*Testudo hermanni*) and European pond turtle (*Emys orbicularis*). Invertebrate expert registered a number of Hermann's tortoises on Mojsinje Mts during 2022 surveys indicating a substantial population in the area. In order to preserve its habitat, the revegetation of affected habitats must be done. European pond turtle can be found in stagnant and slowly flowing waters. It was registered between planned tunnels 3 and 4. Small river island located between tunnels (coordinates 43°38'50.15"N 21°27'9.56"E) must be preserved. If snake hibernaculums, tortoise or turtle eggs are found, an expert ecologist must be engaged to determine mitigation and relocate snakes or eggs if necessary.

Where lighting is required, it will be directional. Only non-UV lighting sources shall be employed. The use of lighting sources with low intensity, with vapors of sodium (without UV lighting) in order to avoid the attraction of insects and bats who feed on them. This way, the potential impact on the species of bats is reduced. Also, strong lighting sources shall be avoided as much as possible so not to disturb light-sensitive species.

Fauna mortality during construction poses a big pressure on biodiversity features of the Project area. In order to prevent fauna from entering, the construction site must be fenced with a wire fence at least 1,5 m tall. The bottom 30 cm of the fence must be made of preformed metal sheets, recycled plastic lumber or (perforated) scored plastic[38] and will prevent smaller fauna from entering the site. The fence must be maintained regularly. In the time frame from 48 to 24h before commencing vegetation clearing, qualified ecologist shall do a walkover of the site. On-site speed limits must be enforced to avoid direct mortality of animals.

The ecological value of the Project area for bats has not been determined but given their confirmed presence in the wider region, it cannot be excluded that bats use linear structures (the Juzna Morava waterway, local roads) as flyway corridors and that the forest habitats are possible roost sites. Vegetation clearance will be carried out during the hours of daylight when bats are not active. The removal or disturbance of woodland potentially utilised by bats will amount to only a small proportion of the wider available resource. Although there is a risk of individual roosts being destroyed the risks are considered to be minimal.

Presence of bats using the River as a flyway corridor is not excluded. Three species, common noctule (*Nyctalus noctula*), Nathusius' pipistrelle (*Pipistrellus nathusii*), grey long-eared bat (*Plecotus austriacus*) have been found in pSCI Juzna Velika Morava. As noted, species are registered in a large pSCI extending far from the planned railway, and it cannot be known whether they inhabit the Project area. However, considering the present habitats and precautionary principle, they must be included in the assessment.

Bat species are of great importance and are listed in the Annex IV of the HD. As such, they meet the criteria for CH. Considering desktop survey findings and potential presence, targeted mitigation must be applied to nsure net gain. To ensure net gain for bat species old trees must be preserved as much as possible, new ones must be planted and at least 30 bat boxes shall be installed in forested areas of Mojsinje Mts. The found bat species are well adapted to habitats under anthropogenic pressure and may colonize underside of bridges. However, fencing of the bridge is necessary to prevent collision with trains. Fencing of the whole section is already envisaged by the Project design.

Workers will be made aware of the ecological sensitivities of the areas and will be trained in mitigation for unforeseen events, including the presence of uncommon habitats and species. Health and safety

[38] The Wildlife Fencing Guide: Amphibians, Reptiles & Small Mammals. 2021. Version 1 https://www.wildlifefencing.com/

recommendations regarding poisonous or otherwise dangerous plants or animals will also be provided by the appointed ecologist.

Statuses of habitats and associated species populations must be monitored throughout land preparation and construction. Where necessary, habitat and species-specific measures will be developed and implemented with an adaptable management approach.

Spread of invasive species is a potential negative impact. Transport infrastructures often act as "corridors" for the natural dispersal of non-native biodiversity. Survey of invasive species has not been performed; however, local beekeeping NGOs rely hevality on production of black locust honey and state there is an abundance of black locus (*Robinia pseudoacacia*) in the area of Stalac gorge. Black locust is an invasive plant species that spreads aggressively in suitable habitats. All vehicles must be washed and have wheels and wheel arches cleaned prior to being mobilised to site to prevent spread invasive plant species. Natural vegetation will be conserved to the best possible extent during land preparation, and native species will be used in restoration after completion of the construction phase. A site wide ban on workers bringing vegetation or soil from outside the site area must be imposed to prevent dispersion of non-native invasive species. During the land preparation and construction phase biodiversity monitoring, presence of invasive alien species in the area must also be monitored.

The proposed construction works are not expected to involve permanent groundwater level reduction or change to surface water regime that would result in alteration of abiotic factors and thus affect the quality of water-dependant habitats. The crystalline massif consisting of schists present on Mojsinje Mts. is characterised as impermeable geological structure. Consequently, the surface run-off is the predominant type of water drainage forming the dense network of mostly intermittent surface water flows. Groundwater vulnerability in the area of fractured aquifer is considered low, given the very low permeability of present geological structures and absence of significant groundwater aquifers. Nonetheless, hydrological risks should be properly monitored during construction, starting with performing exploratory drills.

The main pressure during operation, along with habitat fragmentation, is wildlife mortality caused by collisions with trains and electrocution on powerlines during operation. From the assessment of bird carcasses found on railway tracks, it has been frequently deduced from monitoring studies that the cause of mortality was due to collisions, although collisions with the catenary, electrocution and barotrauma induced by the train movement are also possible bird mortality causes related to the railways[39]. Rotating mirror perch deterrents or perch deflectors such as spikes and brushes should be used to prevent birds from perching on power-poles.

The proposed mitigation measures will be given in the ESMP as well. The ESIA mentions that, to ensure conservation of the ecological network the Mojsinje Mountain and the Stalac Gorge on the Juzna Morava River, a Biodiversity Management Plan should be be prepared and implemented. It should include individual habitats or species management plans, including the IUCN Red List of Threatened Species. The Supplementary Study has identified additional impacts and mitigation that must be included as well. The BMP must be prepared prior to commencement of construction works. It will be approved by SRI and the Lenders before start of works.

AA is an iterative process. Where necessary, suggestions can be made of how to amend the Project to avoid likely significant effects on a site of concern. Considering extensive tunnelling through the most sensitive and natural habitats, it can be concluded that the significant adverse impacts have been avoided by Project design. Through implementation of mitigation measures, the impacts can be further minimized. The habitats on the Project footprint will be permanently and irreversibly lost, therefore revegetation and reforesting action must be performed in order to offset the impacts and bring the Project in full compliance with EBRD's PR 6 and EIB's Standard 4.

[39] Santos S.M., Carvalho F., Mira A. (2017). *Current Knowledge on Wildlife Mortality* in Railways in L. Borda-de-Água et al. (eds.), Railway Ecology, Springer.

6.3 Mitigation Measures

Mitigation measures regarding protected areas and their biodiversity will be encompassed by Construction Biodiversity Management Plan and Operational Biodiversity Management Plan. The measures have been presented in the Chapter 6.2.3 *Stage 2: Appropriate Assessment*, while the summarized content of Biodiversity Management Plans can be found in Chapter *5.3. Mitigation measures.*

7 Water

7.1 Supplementary Baseline Information

The 2016 ESIA contains general information on the waters in the Stalac area. Specific information including the exact locations and depth of groundwater are not included.

The information presented in the 2016 ESIA has been supplemented to provide an updated water related baseline based on additional desktop research and discussions with municipal/city authorities and local communities.

Water supply system. The settlement of Stalac is connected to the Rasina-Pomoravlje regional water supply system. The system receives water through the artificial accumulation of "Celije". The catchment area of the Celije Lake is 598 km^2, while the average distance of Stalac from this lake is 45 km. In addition to this, there are two water springs Seliste (above Stalac settlement, at ca. 213 m asl) and Toplik (near the occasional stream Toplik, at ca. 257 m asl), which are important for the water supply of the municipality of Cicevac[40]. More information on the use of these two springs is not available.

In Djunis as well as other settlements in the Project area, water is supplied either through smaller rural systems that serve a group of households or single water intake systems/wells that serve individual households. These rural water supply systems are managed by the local communities; thus the monitoring of water quality, exploitation, control, protection and use is their responsibility. Individual wells are the responsibility of their owners. There are some plans to connect Djunis to the Rasina-Pomoravlje water supply system[41] but concrete activities have not started yet.

The settlements Braljina, Mojsinje and Trubarevo do not have organised water supply. Due to topographic and demographic-development characteristics, these settlements will most probably continue to use local water supply systems.

Hydrogeology. There are no precise data on the abundance and territorial distribution of groundwater sources in the Project area. The estimated potential of groundwater reserves in Central Serbia is 9,930 m^3/s. In the period July-September 2015, field investigations were performed in the Project area, which included the determination of groundwater levels. The groundwater level was registered at the following depths:

- 1.3 m at the location of the planned bridge near Trubarevacki stream
- 2.3 m at the location of the planned bridge near Ribarska River
- 5.4 m at the location of the planned underpass in Stalac settlement
- 2.5 m at the location of the planned underpass in Djunis settlement
- 9 m at the site of the planned underpass within the Stalac station.

Groundwater vulnerability to overexploitation in the Project area is assessed as low to medium[42].

7.2 Identification of Impacts

The 2016 ESIA identifies the following potential negative impacts on water:

Construction phase	Groundwaters: - Temporary decreasing of groundwater levels - Reduction in groundwater quality due to accidental release of fuels, oils, chemicals or hazardous materials to the ground with subsequent leaching to subsurface Surface waters: - Reduction of water quality as a result of: erosion, riverbed modification and sediment run-off; uncontrolled discharge of effluent from construction areas; inadequately and

[40] Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Stalac-Djunis
[41] http://www.vodovodks.co.rs/vodovodni-sistem-2/2596-dir-r-v-d-v-d-s-s-r-dnici-bish-z-v-li-gr-lj-n-i-dunis
[42] D. Polomcic, Z. Stevanovic, P. Dokmanovic, P.Papic, Groundwater supply in Serbia – current state and perspectives, 2011

	uncontrolled discharge/ treatment of sanitary wastewater from the workers domestic facilities; surface run-off and washout at worksites
Operational phase	Groundwater: > Groundwater contamination due to accidental spillages or leaks from freight trains or accumulation of heavy metals from herbicides along the railway line, as well as minor leaking of oil, grease and other chemicals from the rolling stock Surface waters: > Reduction of natural flood plain capacity due to the embankment passing along the low-lying flood plain of the Juzna Morava River > Accumulation of sediment in the area of bridge piers in the Juzna Morava River > Discharge of accidentally contaminated run-off from the track drainage system and during the bridge maintenance works, as well as discharge of untreated sanitary wastewater or contaminated run-off from station facilities > Contamination of surface water during application of herbicides

Based on the provided supplementary information, the additional negative impacts on water have been identified for the construction phase including:

1. Impacts on the ground water regime (direction of flow and velocity) as well as on spring yield due to tunnel construction, particularly Tunnel 4 which is 3.3 km long,
2. Reduction in surface or ground water quality resulting from emissions of drainage water from tunnel tubes generated during construction activities,
3. Reduction in water quality in river systems in case of depositing of municipal and other special waste categories into the rivers,
4. Sediment release into river systems in case of depositing of spoil into the rivers.

7.3 Mitigation Measures

Measures for minimising construction-related impacts and risks on waters are defined in the ESMP.

In the **construction phase,** the Contractor will be responsible for development and implementation of a *Construction Water and Soil Management Plan* and a *River Crossing Plan* to mitigate construction impacts on both water and soil. Within the *Construction Water and Soil Management Plan*, the Contractor will adequately identify the work corridor and limit haul routes for material supply, clearly indicating the no-go areas and sensitive locations. Suitable site drainage system will be constructed, and oil separators installed if required by the national authorities. Works within or adjacent to the watercourses will be avoided as far as practicable. Fuel storage and handling will be performed in a way to avoid any possible impact on waters, while spill kits will be kept on site in event of an accidental spillage. Appropriate sanitary and drainage facilities for workers will be provided and regularly maintained. Direct access of vehicles to watercourses will be minimised. Erosion control measures will be implemented. Monitoring of surface water quality during execution of works and regular visual inspection of pollution control and treatment measures will be undertaken throughout the construction period. Appropriate modification of work practices in line with monitoring results will be done. Any damage caused to ground and surface water infrastructure such as supply systems, irrigation systems, flood defences and drainage ditches will be rectified by the Contractor. In the *River Crossing Plan*, the Contractor will include environmental requirements and control measures during the construction works near the waterways, including the in-water works, as well as other requirements set in the Water Consent issued by the Ministry of Agriculture, Forestry and Water Management-Water Directorate (2021). The River Crossing Plan will cover both accidental and intended impacts due to water crossings and define roles and responsibilities.

In the **operational phase**, the responsibility of SRI is to develop and implement an *Operational Water and Soil Management Plan* to prevent water and soil pollution. The focus of the Plan in on control of use of herbicides in the maintenance of right-of-way and harmful substances for maintenance of bridges (paints, de-icing fluids, track grease), regular control and maintenance of drainage structures, sediment traps, basin and treatment system. Monitoring of water quality in case of spills will be required in accordance with the national Law on Waters.

8 Air Quality

8.1 Supplementary Baseline Information

The ESIA identifies the main sources of air emissions in the Project area: (i) traffic on the municipal road and the state road no. 215, (ii) existing trains using diesel on the line from Stalac to Djunis (these trains are rare), and (iii) individual heating units in villages.

Both human and ecological receptors in the Project area, potentially susceptible to adverse air quality, are identified: (i) properties in Stalac and Djunis along the road and railway route in the vicinity of construction works, (ii) properties in the vicinity of haulage roads as well as (iii) the Juzna Morava River, Mojsinje Mountain and Stalac Gorge designated as the ecological network.

Additional field data are not necessary at this stage, considering the nature of the Project and the pre-construction monitoring requirements included in the ESMP.

8.2 Identification of Impacts

The main potential negative impacts on air quality during the construction phase, identified in the 2016 ESIA, are related to emissions of dust and harmful particles as a result of demolition works, earthworks, transport and disposal of excavated materials, movement of construction mechanisation and transport vehicles.

Since the railway will be fully electrified, the ESIA did not analyse the potential negative impacts on air quality during the operation phase. However, negative impacts from reconstruction and maintenance works should also be considered in the operation phase and appropriate mitigation measures and monitoring plan should be prescribed. The identified additional impacts are:

1. Deterioration of air quality (dust emissions, hazardous emissions from waste materials) as a result of demolition works,
2. Deterioration of air quality (dust emissions, fossil fuel emissions) as a result of earthworks and associated activities (transport and disposal of excavated materials).

8.3 Mitigation Measures

The measures for mitigation of construction and operation related impacts on air quality are defined in the ESMP.

In the **construction phase**, the Contractor will develop and implement a *Construction Air Quality and Dust Management Plan*, which will include set of measures to mitigate the negative impacts of railway construction on air quality. The plan will be focused on measures to control dispersion of dust from the construction activities to the nearby receptors, emissions for the machinery and measures for stockpile management. Beside good construction practices, regular daily visual monitoring of dust deposition will be required especially on locations where higher levels of dust are likely.

In the **operational phase**, the SRI will develop and implement an *Operational Air Quality Management Plan*, which will address maintenance and reconstruction works that may include demolition and reconstruction activities. Similar mitigation measures as in the construction phase are foreseen. In case SRI subcontracts reconstruction and maintenance activities, it should transfer the obligation to the Contractor to prepare an Operational Air Quality Management Plan.

9 Climate

9.1 Supplementary Baseline Information

The ESIA 2016 provides information on climate in the Project area. However, the representative period to which information on climate settings refer is not specified. The Project area climate change projections and scenarios analysis, calculation of GHG emissions and climate risk assessment were not performed.

The information presented in the 2016 ESIA has been supplemented to provide an updated climate baseline based on the desktop research. This chapter also includes relevant analyses and calculations of GHG emissions using appropriate online tools/calculators.

9.1.1 Climate Characteristics

The Project area has a moderate continental climate, characterised by warm and dry summers and cold winters. Since there is no meteorological station in the Project area, data from the nearby meteorological station – Krusevac (ca. 13 km from Stalac and Djunis) were used for the climate characteristics analysis.

The average annual temperature in Krusevac in 2021 was 12.3°C and the year is assessed as warm compared to the reference period 1981-2010. The recorded average monthly temperatures and their climate assessment in relation to the reference period 1981-2010 are shown in the following table[43].

Table 15: Average monthly and average annual temperature in Krusevac in 2021

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
3.3	5.0	5.2	9.6	16.9	21.6	24.5	22.4	17.6	9.9	8.4	3.6	12.3

Legend: very cold | cold | normal | warm | very warm | extremely warm

The average annual rainfall was 735.7 mm. The month with the highest rainfall was January, while three months during the year were assessed as dry (Table 16). One day, with a rainfall of more than 50 mm, was recorded in 2021[44].

Table 16: Average monthly and average annual rainfall in Krusevac in 2021

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
113.6	16.8	85.7	59.7	57.2	33.7	124.8	20.0	39.5	62.7	29.6	92.4	735.7

Legend: extremely rainy | very rainy | rainy | normal | dry

In 2021, the average number of sunny hours in the Project area was 2,150.

The *Meteoblue website* provides data on climatic characteristics of Stalac and Djunis settlements, modelled based on data from the nearest meteorological stations for the 30-year period, as well as terrain relief and topography.

Since the modelling results for both settlements are very similar due to their proximity, the values of average temperatures and annual precipitation only for Stalac are shown below[45].

[43] Republic Hydrometeorological Service of Serbia, Annual Bulletin for Serbia 2021, Belgrade 2022
[44] Ibid.
[45] https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/stala%c4%87_serbia_785594

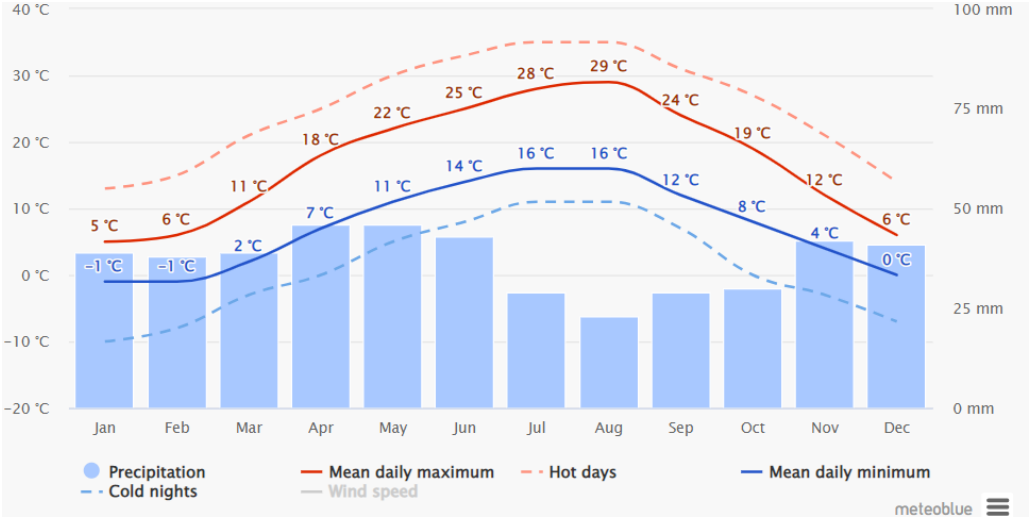


Figure 14: Average temperatures and precipitation in Stalac for the period 1979-2021

Figure 15 shows the number of sunny, partly cloudy and overcast days in Stalac. As expected, the number of sunny days is highest in the summer months and lowest in winter months when the number of cloudy days increases[46].

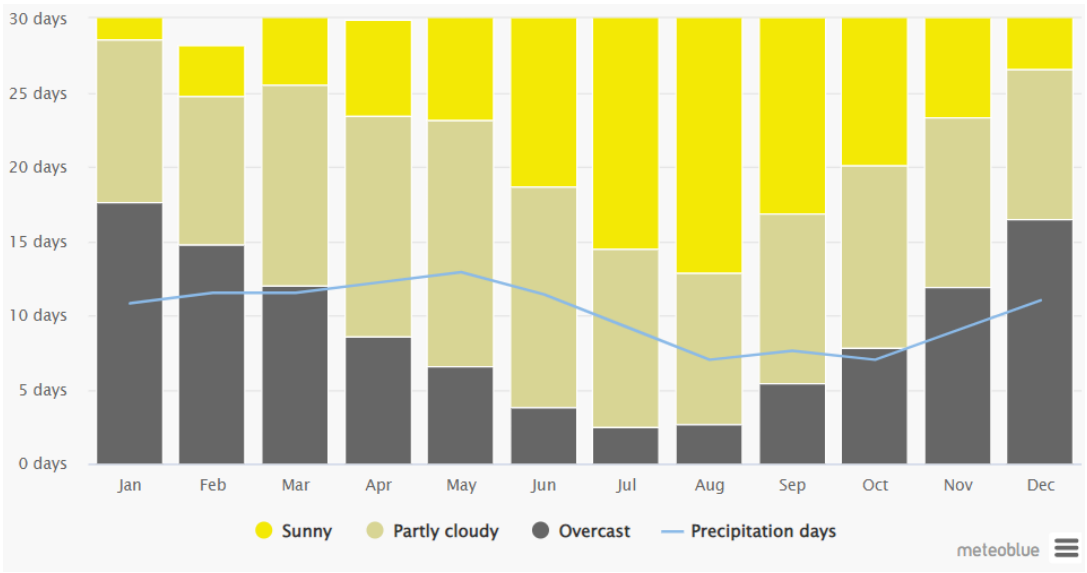


Figure 15: Average number of cloudy, sunny and precipitation days in Stalac in the period 1979-2021

The wind rose for Stalac shows how many hours per year wind blows from the indicated direction. Most of the year, wind blows from west to east with a speed between 5 km/h and 12 km/h[47].

[46] Ibid.
[47] Ibid.

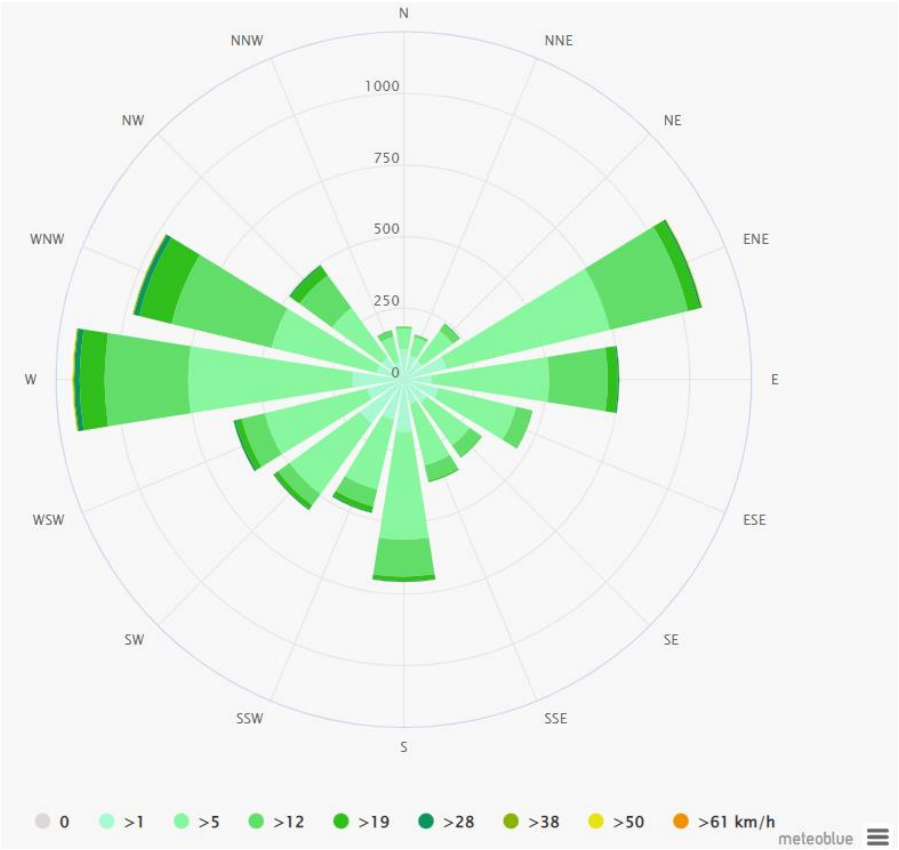


Figure 16: Wind rose for Stalac

9.1.2 Climate Change

Climate Change Observed

The analysis of mean temperature for the 1998-2017 period (left panel) and the 2008-2017 period (right panel) shows an increase in temperature compared to the mean temperature values for the 1961-1990 reference period. It can be concluded that there was an increase in temperature in the Project area between 1.0°C and 1.5°C compared to the reference period[48].

Figure 17: Spatial distribution of observed temperature changes (°C) in Serbia

The recorded amounts of precipitation show an increase of approx. 5% in the period 1998-2017 (left panel) and 10% in the period 2008-2017 (central panel) compared to the reference period 1961-1990. On the other hand, the Project area is characterised by a decrease in the amount of precipitation in the summer period by about

[48] UNDP, Climate Changes Observed in Serbia and Future Climate Projection Based on Different Scenarios of Future Emissions, 2018

15% (right panel) compared to the reference period[49]. These changes in the amount of precipitation, as well as temperature, are an indication of the increasing frequency of floods in the winter and spring months, as well as the increasing frequency of droughts and fires in the summer months, which is analysed in detail in Chapter 9.1.3.

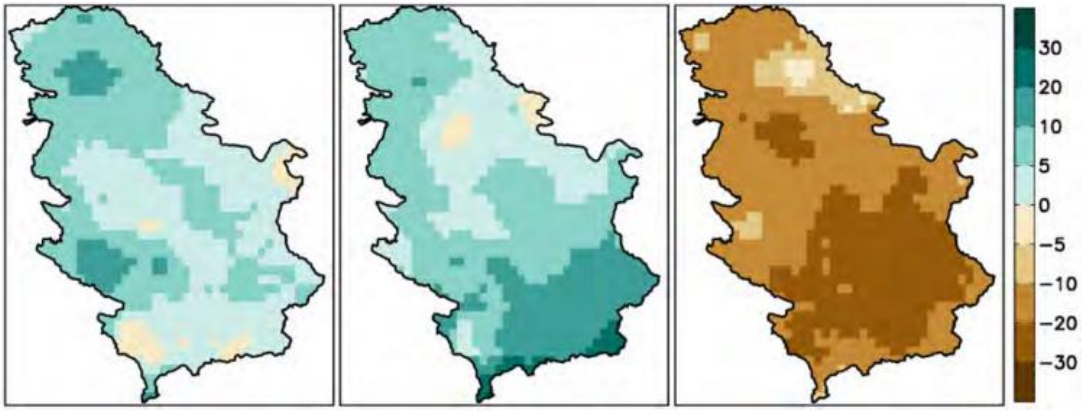


Figure 18: Spatial distribution of the observed precipitation changes (%) in RoS

The average number of ice days in the Project area in the period 2008-2017 decreased by 6 compared to the reference period 1961-1990, while the average number of tropical days increased by 20. On the other hand, the average number of days with precipitation greater than 40 mm increased by approx. 4 in the period 2008-2017 compared to the reference period 1961-1990.

Future Climate Changes

Temperature change projections

By the end of 21st century, a continuous increase in average annual temperature in the Project area is predicted. Seasonal analyses in average maximum and minimum temperatures have shown that temperature increase during the colder part of the year may be slightly less than the temperature increase during the warmer part of the year. Increase in average annual temperatures for Serbia, according to the RCP4.5 scenario, is shown in Figure 19[50].

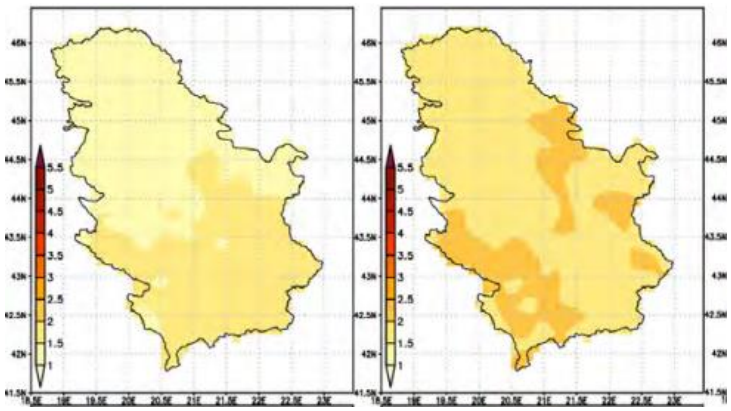


Figure 19: Average annual temperature (°C) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to the RCP4.5

As a result of more intense GHG emissions, a more intense increase in temperature is anticipated by the RCP8.5 scenario[51].

[49] Ibid.
[50] Ibid.
[51] Ibid.

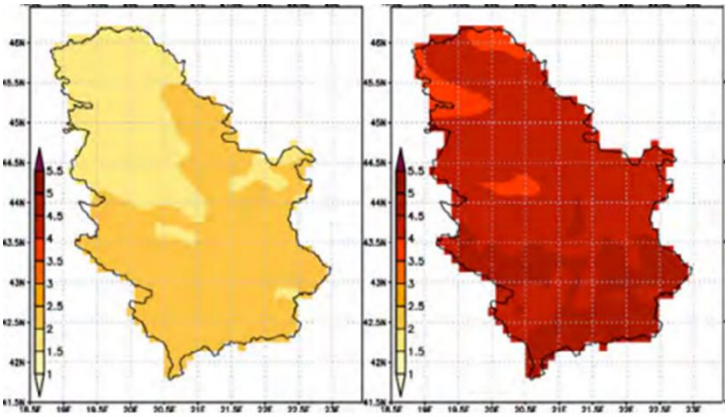


Figure 20: Average annual temperature (°C) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to the RCP8.5

Based on the shown maps it can be concluded that the average annual temperature in the Project area is expected to increase by about 2°C according to the RCP4.5 scenario and by about 4.5°C according to the RCP8.5 scenario, by the end of the century. As a result of temperature increase, the number of frost and ice days will progressively decrease in the future, while the number of hot and tropical days will continue to increase.

Changes in precipitation

Based on climate models for RoS, precipitation is predicted to increase by 10% according to the RCP4.5 scenario (Figure 21) and decrease by 15% according to the RCP8.5 scenario (Figure 22) by the end of the century[52].

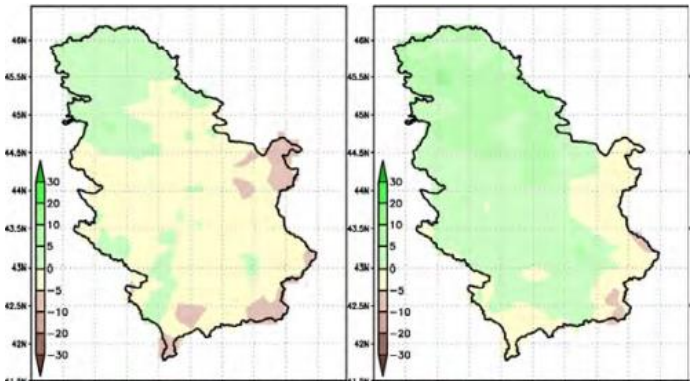


Figure 21: Anomaly of average annual precipitation (%) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to RCP4.5

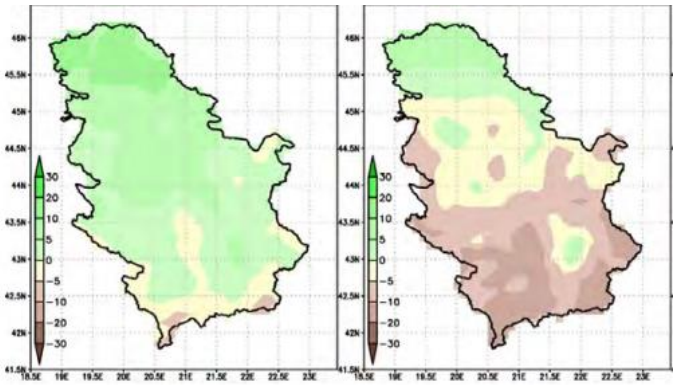


Figure 22: Anomaly of average annual precipitation (%) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to RCP8.5

[52] Ibid.

According to both scenarios, precipitation decrease that is already observed during the June-August is expected to continue in future. It is expected that changes in precipitation will be more seasonal than annual, with more frequent heavy precipitation events and higher precipitation accumulation.

9.1.3 Climate Risks

Over the past two decades, climate-related extreme events have caused major physical losses with significant impacts on Serbia's economy. Key natural hazards for the period 2007-2020 with the number of people affected[53] are shown in Figure 23.

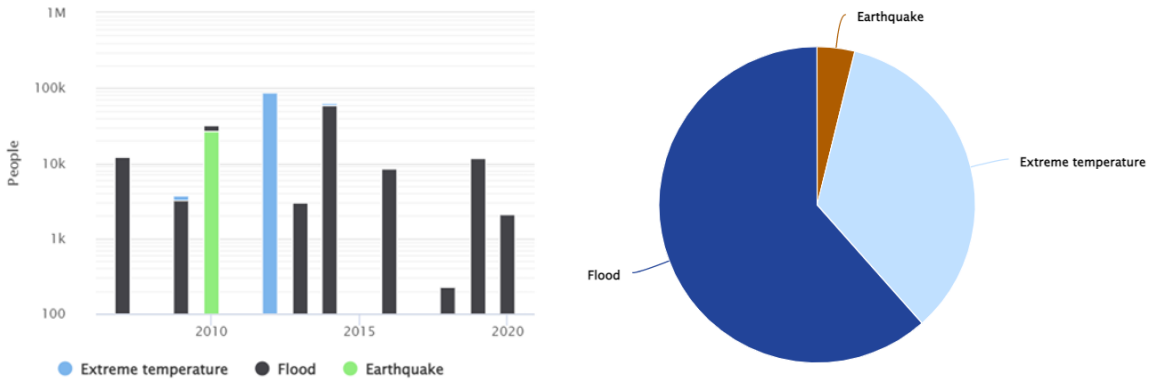


Figure 23: Key natural hazards in RoS for 2007-2020

Floods. Based on the Preliminary Flood Risk Assessment for RoS[54], the entire watercourse of the Juzna Morava River is assessed as a significant flood area. The future railway alignment mainly follows the course of the Juzna Morava River – at the entrance to the Stalac settlement and between the settlements of Mojsinje and Djunis.

Figure 24: Juzna Morava River near the current and future railway route (Trubarovo settlement)

Based on the flood modelling, the river flood hazard is classified as high, which means that potentially damaging floods are expected to occur at least once in the next 10 years[55].

[53] https://climateknowledgeportal.worldbank.org/country/serbia/vulnerability
[54] https://www.rdvode.gov.rs/doc/6.2.1%20Znacajna%20poplavna%20podrucja%20za%20teritoriju%20Republike%20Srbije.pdf
[55] https://thinkhazard.org/en/report/2648-serbia/FL

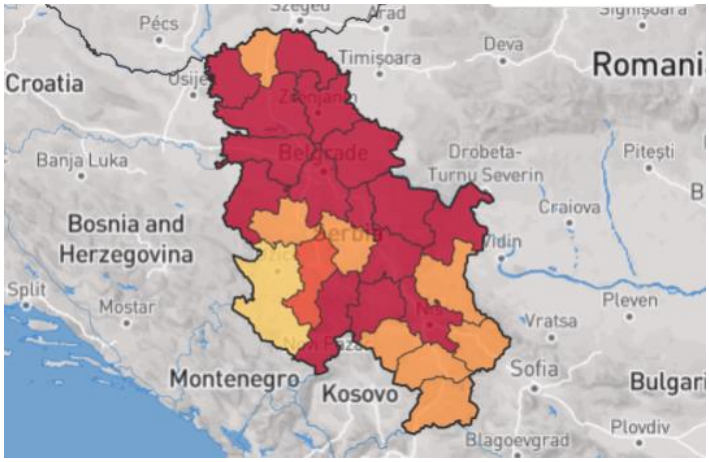


Figure 25: River flood hazard map of RoS

The most severe floods in RoS occurred in May 2014, when some parts of Corridor X were also under water. Although the area between the settlements of Cerovo and Djunis was significantly affected (mainly houses and agricultural land), the impact on the Stalac-Djunis subsection was not identified[56]. According to available data, 361 mm of precipitation was recorded at the Krusevac meteorological station in the spring of 2014, which is twice the average value and more than the record of the highest spring precipitation from 1970[57].

Figure 26: Flooded buildings and agricultural areas along the Stalac-Krusevac road in 2014[58]

The area of Krusevac was again hit by devastating floods in May 2016, when the average monthly level of precipitation in May was reached within a period of 4 days (2-5 May)[59]. As a result, the Juzna Morava River overflowed in the settlement of Djunis. The road Krusevac-Djunis was flooded.

Figure 27: Flooded buildings and Krusevac-Djunis road in 2016[60]

[56] SRI, Study after the May Floods, June 2014
[57] Republic Hydrometeorological Service of Serbia, Extraordinary Climatological Bulletin of Precipitations for the period 1-26 May 2014, 26 May 2014
[58] https://www.youtube.com/watch?v=UjH1SfJfzz4
[59] Republic Hydrometeorological Service of Serbia, Extraordinary Climatological Bulletin of Precipitations for the period 2-5 May 2016, 6 May 2016
[60] https://www.blic.rs/vesti/drustvo/zbog-poplava-bez-saobracaja-na-putu-krusevac-djunis/ypvpfdy

The overflow of the Juzna Morava River in the settlement of Djunis occurred again in the spring of 2018 because of large amounts of precipitation in a short time and melting snow. As a result, the state road Krusevac-Nis was flooded[61]. In June 2020, the surroundings of Krusevac were hit by significant floods.

Erosion and landslides. The occurrence of landslides and erosion in the Project area is mainly related to the previous occurrence of droughts and floods. After the 2014 floods, a preliminary map of the possibility of landslides occurrence was made. According to this map, the possibility of landslides occurrence was assessed as unlikely in Stalac, while going towards Djunis it increases and is assessed as 'likely' (Figure 28)[62].

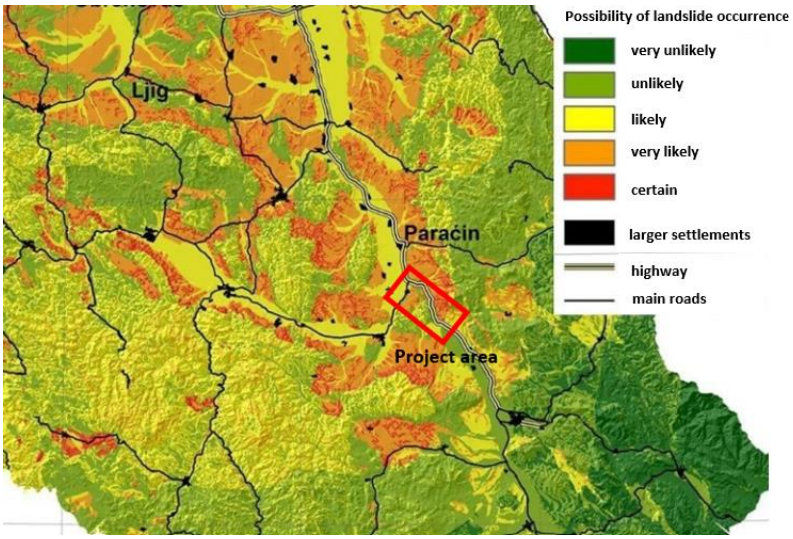


Figure 28: Map of potential landslides occurrence

After the floods that affected the Project area and the surroundings of Krusevac in 2014 and 2018, several landslides were activated that endangered the local roads.

Figure 29: Landslide on a local road near Krusevac after the 2018 floods[63]

Droughts. RoS ranks fifth in the risk of drought globally, while it is among the three European countries with the highest risk of drought[64]. Droughts have been more frequent since 1990, especially during summer months. The Standardised Precipitation-Evapotranspiration Index (SPEI) averaged over RoS for a 6-month period (from March to August) from 1950 to 2017 is presented in Figure 30.

According to the 2020 UNCCD Drought Initiative[65], RoS was hit by 5 droughts in the period 2000-2017, which negatively affected agriculture, population health and energy production from hydropower plants[66].

[61] https://pink.rs/vesti/60873/poplave-i-klizista-prete-i-krusevackom-kraju-izlila-se-ribarska-reka-u-unis u-poplavljen-drzavni-put
[62] https://www.juznevesti.com/Drushtvo/Karta-potencijalnih-klizista.sr.html
[63] https://www.pressek.rs/srbija/krusevac-proradilo-pet-klizista/
[64] https://www.statista.com/chart/25101/countries-by-drought-risk/
[65] Ibid.
[66] United Nations Convention to Combat Desertification, Drought Initiative – Republic of Serbia, February 2020

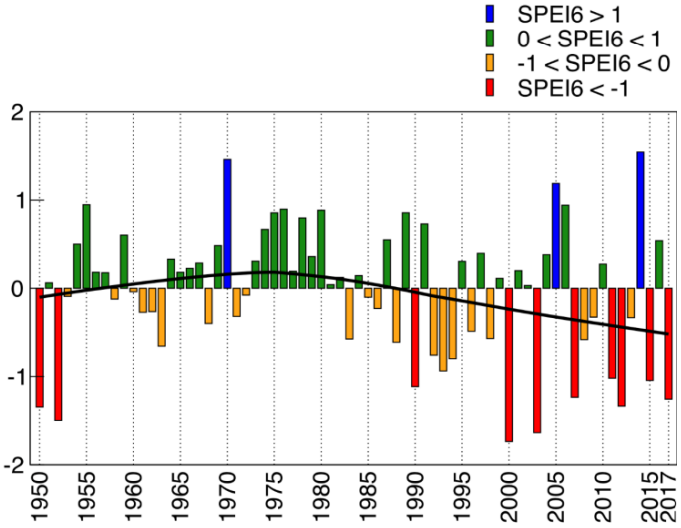


Figure 30: SPEI for a 6-month period – from March to August since 1950

Fires. Statistical data show that the frequency of fires, as well as the total area affected by fires in RoS, is increasing. The State Enterprise "Srbija sume" *(Serbia Forests),* which manages state forests and forest lands, reported 880 forest fires with 16,459.78 ha of affected area in the period 2000-2007. During the drought episode in 2012, 282 forest fires were recorded and 6,799.9 ha of forests burned (10,652.98 ha total burned area). The distribution of forest fires by size for the period 2012-2017 is shown in Figure 31. Based on the map, it can be concluded that the Project area was mainly affected by a small number of fires in the observed period[67].

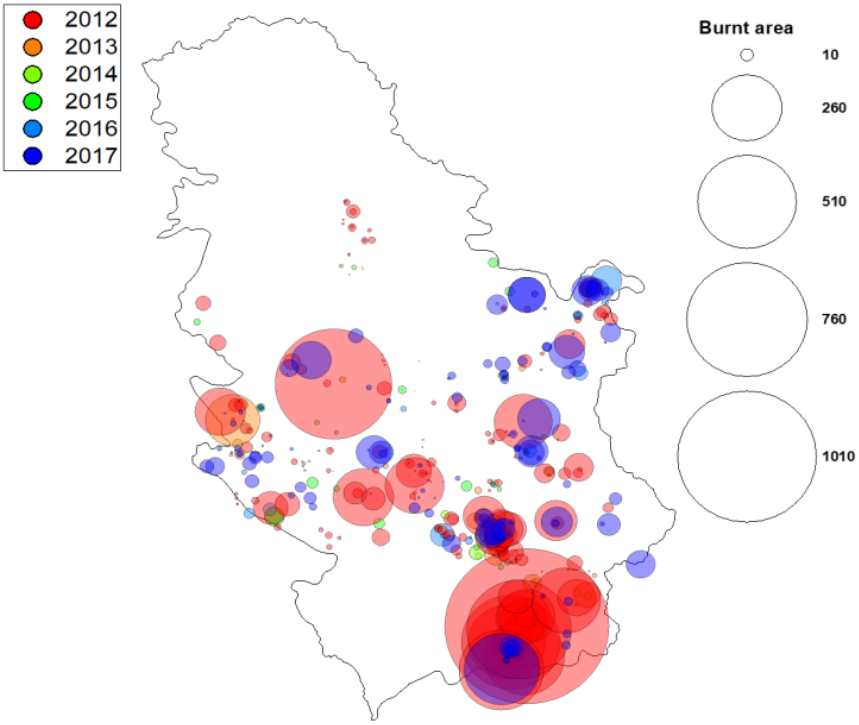


Figure 31: Distribution of forest fires by size for the period 2012-2017 in the RoS

According to the European Environmental Agency, projected forest fire danger changes under two climate scenarios, and an increase in the number of fires in the RoS is expected. According to the RCP 4.5 scenario, the

[67] University of Belgrade, Faculty of Forestry, Final report for the project "Improvement of forest fire protection systems in the Republic of Serbia", November 2017

expected increase in the number of fires is between 10-15%, while the expected increase in the number of fires according to the RCP8.5 scenario is 20%[68].

Earthquakes. In the last 100 years, the Project area was hit by several earthquakes, which were mostly of minor intensity. However, several major earthquakes caused significant material damage. There is no information regarding the impacts of the earthquakes on the Stalac-Djunis subsection.

9.1.4 GHG Emissions

Baseline GHG emissions

In 2016, fossil CO_2 emissions in RoS were estimated to be 41,168,058 t with an increase of 2.27% compared to the previous year. CO_2 emissions per capita in are equivalent to 4.65 t per person. Emissions from transport correspond to 11.7% of total emissions[69].

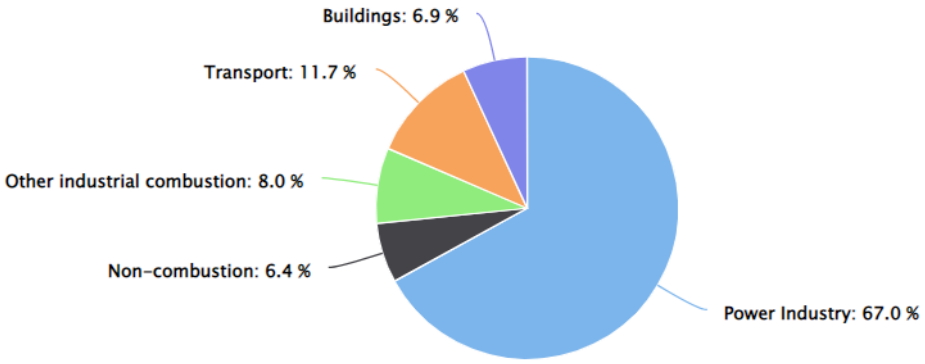


Figure 32: Fossil CO_2 emissions by sector in RoS in 2016

Project GHG emissions

The possible impacts of railway reconstruction on climate are related to emission of greenhouse gases (GHG) from the materials and equipment in the construction phase and rail transport in the operation phase. In order to determine the level of impact, a GHG assessment was carried out in line with the EBRD Protocol for Assessment of Greenhouse Gas Emissions (2017). The calculation of CO_2 emissions for the construction and operation phase of the railway is presented below.

Construction phase

The most significant CO_2 emissions during the construction phase come from materials extraction, material unloading (dust) and construction equipment (machines).

Calculation of CO_2 emissions from construction materials

In order to calculate CO_2 emissions caused by material extraction and use in (re)construction of the railway, as well as waste material from demolition activities, the corresponding input data were taken from the national EIA Study (Table 17). The most significant materials (and in significant quantities) that cause emissions are considered.

Table 17: Materials that should be removed and materials needed for railway construction

Material		Quantity
Materials/structures to be removed		
Excavation (land removal) on the open railway		546,000 m^3
Excavation (land removal) as a result of tunnel construction		500,000 m^3
Dismantling of existing infrastructure/facilities[70]	Low platforms	700 m^2
	Pavement structure	5,300 m^2

[68] https://www.eea.europa.eu/data-and-maps/indicators/forest-fire-danger-3/assessment
[69] https://www.worldometers.info/co2-emissions/serbia-co2-emissions/
[70] Emissions generated by the railway alignment removal are negligible compared to the emissions (amount of generated dust) caused by the removal of platforms and pavement structures.

Material	Quantity
Materials needed for railway (re)construction	
Embankment	535,000 m^3
Concrete – lower part of railway infrastructure	13,120 m^3
Concrete – tunnel construction	95,850 m^3
Gravel	94,800 m^3

For the purpose of calculating emissions resulting from the dismantling of existing structures, materials removal and the use of materials for reconstruction activities on the sections with the double-track railway, an online LIFE HULLEAS[71] software was used. The software was developed to evaluate the sustainability of railway projects. Figure 33 shows the results.

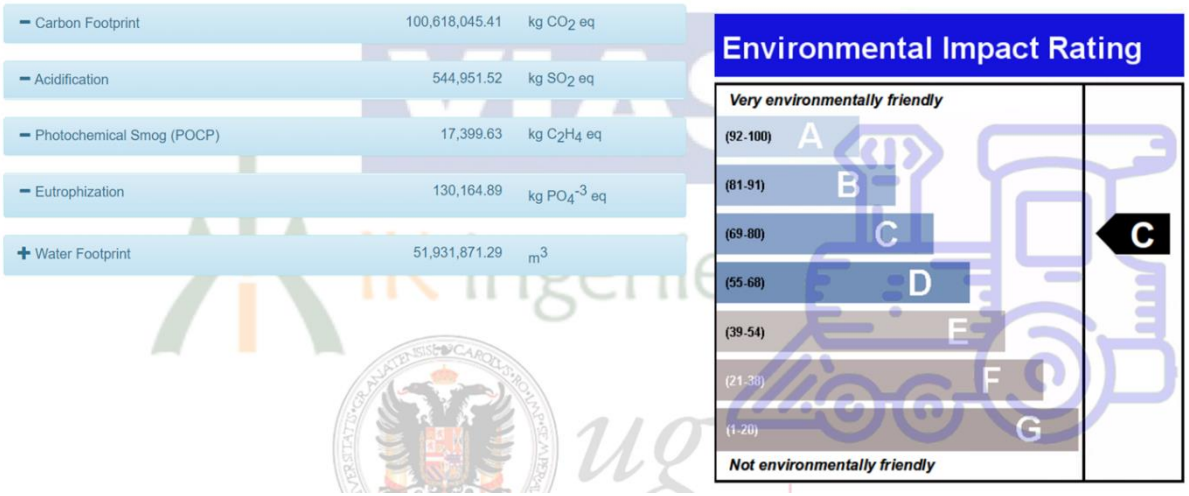


Figure 33: GHG emissions caused by material removal and material used for (re)construction of the railway, calculated through the LIFE HULLEAS online calculator

Dismantling of existing structures, removal of existing materials and use of materials for the (re)construction activities on the sections with the double-track railway will generate 100,618 tons of CO_2 emissions. Considering that these are total generated emissions, and the estimated duration of the construction works is about 2.5 years, the estimated annual CO_2 emissions amount **40,247.2 tons** which is approximately 0.1% of total annual CO_2 emissions in RoS.

Calculation of CO_2 emissions from construction equipment

Input data related to the construction equipment includes the type of equipment, the number of units in operation and operation hours. The input data for the construction phase (type of equipment, number of units) have been taken from the national EIA Study. The assumption is that construction equipment will be utilised six hours a day, five days a week. In addition, it is assumed that diesel is type of fuel used in this equipment as it is the case in highway construction[72]. The average fuel consumption for each type of construction equipment is determined from manufacturers' catalogues or available scientific research (Table 18).

Table 18: Input data for calculating CO_2 emissions from construction equipment

Equipment used in the construction phase		
Type of equipment	Number of units	Consumption [l/h]
Loader	3	15[73]

[71] https://www.life-huellas.eu/calc/index_en.php?fbclid=IwAR1dbQ_azWGGLkYkB0PZyVNgBtcyDu3MIQjEk3jaH-aelias54sXHyFJ3mQ
[72] M. H. Alzard, M. A. Maraqa, R. Chowdhury, Q. Khan, F. D. B. Albuquerque, T. I. Mauga & K. N. Aljunadi, Estimation of Greenhouse Gas Emissions Produced by Road Projects in Abu Dhabi, United Arab Emirates, 2019
[73] Mario Klanfar, Tomislav Korman, Tripmir Kujundzic, Fuel consumption and engine load factors of equipment in quarrying of crushed stone, 2016

Equipment used in the construction phase		
Type of equipment	Number of units	Consumption [l/h]
Excavator	2	22[74]
Bulldozer	5	33.16[75]
Grader	2	8[76]
Rollers	2	4[77]
Steel vibrating roller	8	8[78]
Tank truck	2	33[79]
Truck mounted crane	1	4.5[80]
Truck mixer	1	27.39[81]
Dump truck	24	15.2[82]

The CO_2 emission factor per litre of diesel fuel is 2.49[83]. Based on input data, using the following formula, CO_2 emissions generated as a result of the use of construction equipment were calculated:

$$E_{equipment} = Number\ of\ units\ (-) \cdot Consumption\left(\frac{l}{h}\right) \cdot Number\ of\ working\ hours\ per\ day\left(\frac{h}{day}\right) \cdot Number\ of\ working\ days\ per\ year\ \left(\frac{day}{year}\right) \cdot Emission\ factor\ \left(\frac{kgCO_{2e}}{l}\right)$$

For indirect emissions, it is assumed that the same number of dump trucks is used to transport materials to the construction site. Based on the empirical data, an average distance from the material collection site to the unloading site of 50 km was assumed, and transportation frequency of 270 days per year. CO_2 emissions generated from using dump trucks for material transport is calculated as:

$$E_{transport} = Number\ of\ units\ (-) \cdot Consumption\left(\frac{l}{h}\right) \cdot Distance\ of\ the\ material\ collection\ site\ to\ the\ unloading\ site(km) \cdot Number\ of\ working\ days\ per\ year\ \left(\frac{day}{year}\right) \cdot Emission\ factor\ \left(\frac{kgCO_{2e}}{l}\right)$$

Using these two formulas, the total annual CO_2 emissions generated from the use of **equipment** during railway reconstruction are **15,511.94 tons**.

Taking into account that CO_2 emissions in RoS from the transport sector in 2016 amounted to 4,816,662.79 tons[84], the use of construction equipment for the construction of this subsection would contribute to an increase in total annual emissions from the transport sector by 0.32%.

Operation phase

Since the railway will be fully electrified, direct sources of CO_2 emissions in the operation phase do not exist or are negligible (e.g., train maintenance). On the other hand, the main source of indirect emissions in the

[74] https://static1.squarespace.com/static/58877529414fb5283ed14a6b/t/5888f8df46c3c4d4d976a102/1485371615708/Fuel+Table+-+Compactors.pdf
[75] Ibid.
[76] https://www.scribd.com/document/271103107/Fuel-Consumption
[77] https://www.scribd.com/document/321246669/Fuel-Consumption-Sheet
[78] https://www.scribd.com/document/321246669/Fuel-Consumption-Sheet
[79] Calculated based on average consumption: https://www.webfleet.com/en_gb/webfleet/blog/do-you-know-the-diesel-consumption-of-a-lorry-per-km/ and average speed: https://www.matec-conferences.org/articles/matecconf/pdf/2017/01/matecconf_encon2017_02022.pdf
[80] https://www.internationalcranes.media/news/truck-cranes-trucks-away-/1138236.article#:~:text=Zoomlion%20says%20the%20crane%20has,to%204.5%20litres%20per%20hour
[81] Fuel consumption [l/h] is calculated based on fuel consumption [l/km] and maximum speed: https://e-katalog.lkpp.go.id/public/files/upload/produk_lampiran/2015/03/23/14270970277981.pdf
[82] https://postconflict.unep.ch/humanitarianaction/documents/02_08-04_06-04_02-22.pdf
[83] https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf
[84] https://www.worldometers.info/co2-emissions/serbia-co2-emissions/

operation phase is the use of electricity to power trains. The calculation of indirect CO_2 emissions is done for the base year (2022) and for three future projections – Project scenarios:

- Project scenario 1 – 2025, in case the railway has not been reconstructed
- Project scenario 2 – 2025, in case the railway has been reconstructed
- Project scenario 3 – 2040, considering projected changes in rail frequency and energy use, in case the railway has been reconstructed.

The calculation of emissions was made based on energy consumption, the current electricity grid emission factor and projected future electricity grid emission factor (considering the planned increase in share of renewable energy sources). Direct data on energy consumption from trains is difficult to collect, due to the large number companies that use the existing infrastructure. Therefore, energy consumption is calculated using the appropriate mathematical formula. Input data for calculation of CO_2 emissions from railway operation is shown in Table 19.

Table 19: Input data for calculation of CO_2 emissions in operation phase

Inputs required		Current railway alignment		Future railway alignment
N_{stops}	Number of intermediate stops	6		2
L	Trip length [km][85]	22		17.7
v_{ave}	Average speed [km/h][86]	75		160
V_{max}	Maximum speed [km/h]	120		160
B_0	Constant equating to rolling resistance[87]	2022.	2025.	0.001
		0.003	0.004	
B_1	Constant equating to friction resistance[88]	2022.	2025.	0,15
		0,5	0,6	
B_2	Constant equating to aerodynamic resistance	0.95[89]		0.36[90]
g	Gravitational constant [m/s²]	9,81		
D_h	Change in height [m][91]	3.8		3.6
Trains				
N_p	Number of trains in passenger services	16		78
N_f	Number of trains in freight services	15		32
m_p	Average passenger train weight [ton]	3,000[92]		380[93]
m_f	Average freight train weight [ton]	12,000[94]		5,000[95]
Average carbon emission factors (e) [gCO_2/kWh]:				
2022[96]		478		
2025[97]		462		
2040[98]		359		

Firstly, the energy consumption of each train was calculated using the following formula[99]:

[85] Including the sections before Stalac and after Djunis in order to fit into the existing railway line.
[86] The average speed of 75 km/h is used since the average speed for Stalac-Braljina Section is 65 km/h and for Braljina-Djunis section is 85 km/h
[87] http://coachrobmuller.blogspot.com/2017/11/rolling-resistance-revisited.html
[88] https://www.iitg.ac.in/rkbc/me101/Presentation/L09-12.pdf
[89] https://www.simscale.com/blog/2017/06/air-resistance-vehicle-design/
[90] https://www.computer.org/csdl/magazine/cs/2019/03/08656573/187Q8FqILxC
[91] Height reduction in modern trains has been taken into account. http://www.railway-technical.com/trains/rolling-stock-manufacture.html; https://www.researchgate.net/figure/Train-model-a-different-lengths-of-trains-b-train-cross-section-c-CRH380A-and_fig1_320774107
[92] https://www.mcnallyinstitute.com/how-much-does-a-freight-train-engine-weight/
[93] https://socialcompare.com/en/comparison/high-speed-trains
[94] https://www.mcnallyinstitute.com/how-much-does-a-freight-train-engine-weight/#:~:text=Depending%20on%20the%20number%20of%20cars%20in%20the%20train%20and,carry%20just%20a%20few%20tons
[95] https://www.emerald.com/insight/content/doi/10.1108/RS-04-2022-0009/full/html
[96] Average value in the last 24h on 18 May, 2022: https://app.electricitymap.org/zone/RS
[97] Based on the difference in the share of renewable energy sources between 2016 and 2021: https://www.worldometers.info/electricity/serbia-electricity/ https://www.statista.com/statistics/1237596/serbia-distribution-of-electricity-production-by-source/#:~:text=Much%20of%20Serbia's%20electricity%20generation,of%20the%20country's%20power%20mix
[98] https://balkangreenenergynews.com/rs/srbija-planira-da-duplira-udeo-obnovljive-energije-i-dostigne-40-odsto-do-2040/
[99] India GHG Program, India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport, 2015

$$E' = \frac{(N_{stops} + 1)}{L} \cdot \frac{v_{max}^2}{2} + B_0 + B_1 \cdot v_{ave} + B_2 \cdot v_{ave}^2 + \frac{g \cdot D_h}{L}$$

Then the total energy consumption was determined, based on the number of trains, their weight and the length of the subsection:

$$E = E' \cdot L \cdot (N_p \cdot m_p + N_f \cdot m_f)$$

Multiplying the total energy consumption by the emission factor, the total emissions for different scenarios were calculated using the following formula:

$$Total\ emissions = E \cdot e$$

The results are presented in Table 20.

Table 20: CO_2 emissions as a result of train operation

Total CO_2 emissions – train operation [tons CO_2]			
Baseline	2022	Current railway status	5,110.89
Scenario 1	2025	Railway is not reconstructed	4,944.64
Scenario 2	2025	Railway is reconstructed	4,915.70
Scenario 3	2040	Railway is reconstructed	3,819.77

*Note: The calculation is made for the worst (general) scenario – the maximum estimated number of trains is used for each year.

In order to take into account the reduction of emissions due to the increase/decrease in number of passengers in railway traffic and the consequent decrease/increase in the number of passengers in the road traffic, a projection of the number of passengers was made based on the latest available reports and projections made in the General Design.

Table 21: Number of passengers – projections[100]

Number of passengers		
2022	Current railway status	300,257
2025	Railway is not reconstructed	232,699
2025	Railway is reconstructed	338,390
2040	Railway is reconstructed	499,447

Also, in case of reconstruction, the use of railway infrastructure for the transport of goods is expected to increase. Projections of the amount of transported goods for different scenarios are shown in Table 22.

Table 22: Quantity of goods transported – projections[101]

Goods transported [ton]		
2022	Current railway status	471,832
2025	Railway is not reconstructed	395,481
2025	Railway is reconstructed	549,873
2040	Railway is reconstructed	849,769

[100] Projections of the number of passengers were made by interpolation and based on the available data on the number of passengers in 2018 (source: https://www.rts.rs/page/stories/sr/story/125/drustvo/3222685/srpske-zeleznice-godisnje-prevezu-tek-sedam-miliona-putnika.html) and the 2007 (source: General Design). Projections of the number of passengers in the future years are calculated based on the percentage increase in the number of passengers in the period of 3 and 18 years presented in the General Design. Considering that the majority of passengers on this route travel from Belgrade to Nis, it is assumed that the number of passengers on the section Stalac-Djunis is 2/3 of the total number of passengers from Belgrade to Nis.

[101] Projections of the number of transported goods by years were calculated on the basis of data on the quantity of goods transported in the first quarter of 2022 (Source: https://istokrs.com/izdvojeno/zeljeznice-rs-u-minusu-41-milion-km/) and the quantity of goods transported in 2006 (source: General Design) and taking into account the length of the Belgrade-Nis railway section. Projections of the goods transported in the future years are calculated based on the percentage increase in the goods transported in the period of 3 and 18 years presented in the General Design. Considering that Belgrade and Nis are among the three largest cities in Serbia, it is assumed that 2/3 of the total transported goods on the Belgrade-Nis route pass through the Stalac-Djunis section.

In order to calculate the mentioned decrease (or increase) of emissions in passenger road traffic, the input data shown in Table 23 were used.

Table 23: Inputs required to calculate emissions from passenger road traffic

Inputs required to calculate emissions from passenger road traffic	
Average car CO_2 emissions per passenger per kilometre [g CO_2/passenger-km]	182[102]
The shortest road distance Stalac-Djunis [km]	27.8
Average number of people in the car[103]	1

In order to calculate the reduction of emissions in freight road transport, the input data shown in Table 24 were used.

Table 24: Inputs required to calculate emissions from freight road traffic

Inputs required to calculate emissions from freight road traffic	
Average truck CO_2 emissions per kilometre [g CO_2/ km]	307[104]
Shortest road distance Stalac-Djunis [km]	27.8
Average truck capacity [ton]	10[105]

The decrease/increase in emissions was then calculated using the following formula for passenger road transport:

$$\Delta e = \frac{number\ of\ passengers\ in\ the\ baseline\ year - number\ of\ passengers\ in\ projected\ year}{average\ number\ of\ people\ in\ the\ car} \cdot average\ car\ CO_2\ emissions\ per\ passenger\ per\ kilometre \cdot the\ shortest\ road\ distance\ Stalac - Djunis$$

And for freight road traffic:

$$\Delta e = \frac{goods\ transported\ in\ the\ baseline\ year - goods\ transported\ in\ the\ projected\ year}{average\ truck\ capacity} \cdot average\ truck\ CO_2\ emissions\ per\ kilometre \cdot the\ shortest\ road\ distance\ Stalac - Djunis$$

The results of the change in emissions are shown in Table 25.

Table 25: Changes in emissions as a result of Project implementation

Changes is CO_2 emissions [tons CO_2]			
		Passenger road traffic	Freight road traffic
2022	Current railway status	0,00	0,00
2025	Railway is not reconstructed	341.82	65.16
2025	Railway is reconstructed	-192.94	-66.60
2040	Railway is reconstructed	-1,007.82	-322.55

Emissions as a result of train operation and potential modal shift from road to rail traffic are shown in Table 26.

Table 26: CO_2 emissions as a result of trains operation and modal shift from road to rail transport

Total CO_2 emissions – trains operation and modal shift from road to rail transport [tons CO_2]			
Baseline	2022	Current railway status	5,110.89
Scenario 1	2025	Railway is not reconstructed	5,351.62
Scenario 2	2025	Railway is reconstructed	4,656.15
Scenario 3	2040	Railway is reconstructed	2,489.40

[102] https://www.statista.com/statistics/1185559/carbon-footprint-of-travel-per-kilometer-by-mode-of-transport/
[103] Considering that most people use this section to transport to work.
[104] https://theicct.org/publication/co2-emissions-from-trucks-in-the-eu-an-analysis-of-the-heavy-duty-co2-standards-baseline-data/
[105] https://www.lynchtruckcenter.com/how-much-can-a-dump-truck-carry/

Therefore, if the Project is not implemented, it is evident that there will be an increase in CO_2 emissions. On the other hand, the reduction in emissions in the first year of operation (2025) compared to the baseline is 8.9%, while the **reduction in emissions in 2040 is expected to be 51.3%**.

Comparing the results of obtained GHG emission intensity of railway for 2040 (67.53 gCO_2/ passenger-km) with global GHG emission intensity factor (63 gCO_2/ passenger-km[106]) and considering the current energy mix and energy development plan, the results can be considered as valid. If the additional reduction of emissions from passenger road traffic is taken into account, then this indicator in 2040 would have a value of 44.01 gCO_2/ passenger-km.

Railway CO_2 emissions are expected to be further reduced in the future. Considering the fact that RoS strives to become climate neutral by 2050, CO_2 emissions from rail transport could be equated to zero.

[106] https://www.iea.org/fuels-and-technologies/rail?fbclid=IwAR3FK2mmcb5lak4p2g7mWJQAnx_ly1aEHvpaCuj1FTzj5Opg4od02nMr9mo

9.1.5 Climate Risk Assessment

Based on the previously presented information, a climate risk assessment for the Project area was performed using the *World Bank Climate and Disaster Risk Screening Tools*[107]. A summary of the assessment of the exposure, impacts and risk of climate change on the Project is shown in Table 27, while a detailed output of these tools is given in Appendix B. Based on the identified exposures and impacts, mitigation measures have been proposed as outlined in the Project ESMP and ESAP.

Table 27: Climate risk assessment for current and future climate conditions

Issue	Guiding questions used to access issue	Timeframe	Hazard	Rating
Exposure of Project location to climate and geophysical hazards	What have been the historical trends in temperature, precipitation and drought conditions? How are these trends projected to change in the future in terms of intensity, frequency and duration? Has the location experienced climate and/or geophysical hazards in the past that may occur again in the future?	Current climate conditions	Extreme temperature	Moderate exposure
			Extreme precipitation and flooding	Moderate exposure
			Earthquake	Moderate exposure
			Landslides	Low exposure
			Wildfires	Low exposure
		Future climate conditions	Extreme temperature	Moderate exposure
			Extreme precipitation and flooding	Moderate exposure
			Earthquake	Moderate exposure
			Landslides	Low exposure
			Wildfires	Low exposure
Impacts on the Project's physical components	Does the Project design take into account recent trends and future projected changes in identified climate and geophysical hazards? Does the Project design consider how the structural integrity, materials, siting, longevity and overall effectiveness of transportation infrastructure, if applicable, may be affected? In particular, does the design "lock in" certain decisions for the future?	Current climate conditions		Moderate potential impact
		Future climate conditions		Moderate potential impact
Risk to the outcome/ service delivery of the Project	The ratings are derived on the basis of hazard information, subject matter expertise, contextual understanding of the Project, and modulated on the basis of adaptive capacity, including the Project's non-physical component, transportation sector context and broader development context. Potential impacts to subsectors are evaluated separately for the current and future timeframes to capture changes in the exposure from climate hazards over time.	Current climate conditions		Low Risk
		Future climate conditions		Low Risk

From the aspect of **GHG emissions**, as previously confirmed by the calculation, Project implementation will contribute to the reduction of total GHG emissions in the transport sector. The negative impacts from emissions are expected in the construction phase and can be rated as **moderate**. Appropriate mitigation measures have been proposed in the ESMP and ESAP.

[107] https://climatescreeningtools.worldbank.org/

9.2 Identification of Impacts

The 2016 ESIA does not address the Project's impacts on climate and climate change, or climate change impacts on the Project. The 2018 national EIA Study states that impacts on climate change are not expected either during construction or operation of the railway, which has been demonstrated as incorrect by the calculation and analysis performed in the previous chapter. The general analysis of climate change impacts on the Project based on historical events is given in the national EIA Study.

This chapter summarises the potential impacts in both the construction and operation phases of the Project, derived from the conducted analysis and calculations, as well as the impacts of climate change on the Project described in the national EIA Study.

The main negative impact of the Project on climate change in construction phase is caused by emission of GHG gases from construction equipment and vehicles. The following potential negative impacts of climate change on the Project during the construction phase have been identified:

1. Heavy rains can result in flooding of the construction area and consequent damage to infrastructure and construction equipment.
2. Land subsidence caused by droughts and floods can cause damage to construction equipment, machinery and materials.
3. Heat stroke and increased risk of fire, especially during summer months, may temporarily suspend Project activities and cause damage to construction equipment including the ignition of equipment containing hazardous substances and melting of plastic parts.

Since the railway will be fully electrified, it is expected that the railway operation will have **positive impacts** on climate change. Potential negative impacts of climate change on the railway infrastructure during the operational phase are:

1. Physical damage of railway infrastructure as a result of floods, landslides and fires and the consequent closure of railway traffic.
2. Reduced visibility in case of fire; fire also generates GHG emissions.
3. Trains damaged by floods and fires, and disruption of railway flow.
4. Land subsidence in case of droughts can lead to damage of railway infrastructure.

9.3 Mitigation Measures

The mitigation measures for the construction and operation-related impacts on climate change, as well as climate change impacts on the Project are given in the ESMP.

In the **construction phase,** the Contractor will develop and implement a *Construction Emergency Preparedness and Response Plan* to eliminate hazards and reduce potential negative impacts including those arising from climate change.

In the **operational phase,** SRI will prepare a detailed O*perational Emergency Preparedness and Response Plan* to achieve appropriate and effective emergency preparedness and response activities for foreseeable emergency events should they arise. The Plan must also include requirements for consultation with the national emergency services and authorities and agreement of roles and responsibilities in the context of emergency response. SRI will review the Plan after any emergency or training exercise to provide opportunity for continual improvements.

10 Noise

10.1 Supplementary Baseline Information

The 2016 ESIA contains information on the background noise measurements in the project area of influence. The measurements were conducted at three locations near the residential facilities during the daytime. The first monitoring location was close to residential buildings in Stalac and in the vicinity of future works on the railway and access road. The second monitoring location was near residential buildings in Stalac that was selected because of its orientation towards the exit of the Stalac railway station. The third monitoring location was close to the first row of houses on the right side of the Stalac station, up to 25 m from the end of the reconstructed track. The measured noise levels were 52.0 dB(A), 44.5 dB(A) and 45.0 dB(A), which is within the limits prescribed by national requirements.

The information presented in the 2016 ESIA has been supplemented as presented below to provide an updated noise related baseline. The information is taken from the 2018 EIA Study that contains identification of the acoustic zones and noise calculations based on which the location, height and length of noise barriers was determined.

Acoustic zones. In order to analyse the potential impacts of noise on population in the operational phase, acoustic zones have been identified[108]. The sub-section belongs to zone 5[109], with the limit values for noise being L_{day} = 65 dB(A), $L_{evening}$ = 65 dB(A) and L_{night} = 55 dB(A). The acoustic zone was selected based on the category of railway line (the main line of importance to international and domestic service) and land purpose in railway vicinity.

Noise calculations. The noise barriers are foreseen as the primary protection measure. The height and length of noise barriers were determined based on noise calculation, using CadnaA software. Noise barriers are planned on both sides of the railway line in the total length of 748 m.

Table 28: Position and characteristics of noise barriers per the national EIA Study

Barrier No.	Railway line chainage		Position in relation to railway line	Length	Height*
	start point	end point			
	[km]	[km]		[m]	[m]
1	174+247.62	174+315.62	LEFT	68	2.50
2	174+315.62	174+371.51	LEFT	56	3.50
3	174+371.51	174+490.82	LEFT	120	2.50
4	175+102.54	175+216.24	LEFT	112	3.50
5	175+255.86	175+343.60	RIGHT	88	3.00
6	176+692.00	176+799.90	RIGHT	108	3.50
7	176+893.90	176+977.86	RIGHT	84	3.00
8	177+168.74	177+281.10	LEFT	112	3.50

*Relative to the head of rail

A graphic presentation of calculated noise indicators with proposed locations for noise barriers is given in Appendix C of this Supplementary Study. The noise levels shown on the maps are long-term average noise levels. All residential buildings exposed to noise levels greater than 65 dB(A) during the day and the evening, and noise levels greater than 55 dB(A) during the night, should be protected with appropriate noise barriers.

As for tunnels, noise is amplified at the exit due to multiple reflection in tunnels. To suppress noise in tunnel portals, absorbing wall cladding is foreseen in the direction of tunnel exits. The following should be taken into account when installing absorption lining of tunnel portals:

- The absorbing wall must not have influence on the tunnel clearance,
- The absorbing wall must provide tunnel clearance without losing its acoustic properties, and

[108] Based on the *Ordinance on noise indicators, limits, methods for their evaluation and harmful effects in the environment* ("Official Gazette of RS", No. 75/10)
[109] City centre, crafts, commercial, administrative-government zone with apartments, zone along motorways, main and city avenues

- Special attention should be paid to safe fixing of the lining.

The design of noise barriers must comply with provisions of national and EU standards, as well as corresponding standards[110].

10.2 Identification of Impacts

The 2016 ESIA identifies the following potential noise related impacts:

Construction phase	> Increased noise levels near residential buildings due to excavation works > Negative impacts as a result of increased noise levels generated from concrete batch plants, as a focal point for the delivery of aggregates and cements, as well as heavy vehicles and mixer truck movements > Increased construction-related noise will affect local fauna
Operational phase	> Negative impact as a result of increased railway noise in the zone with residential receptors in the vicinity of the proposed Stalac station > Potential disturbance of specific biological functions by noise effects > Impact on workers from increased level of noise from rolling stock and machinery

In addition to the impacts listed in the 2016 ESIA, the impact on workers from increased levels of noise during construction activities and use/movement of construction equipment should also be considered in the construction phase and appropriate mitigation measures defined.

10.3 Mitigation Measures

The mitigation measures for all identified noise related impacts in construction and operation phase are summarised in the ESMP.

In the **construction phase**, the Contractor will develop a *Construction Noise and Vibration Management Plan*, which will include the best construction practices to mitigate the negative impacts of noise. These will include activities like management of noisy construction equipment, implementation of adaptable working protocol as well as appropriate communication with public. The Contractor must determine the noise baseline levels of the Site and the surrounding area, by measurements which must be conducted by the accredited organizations. In case of local residents' and workers' complaints during construction works, periodical measurement of vibration shall be performed to determine whether the generated level exceeds permitted limit values, and by comparing the measurement results with the baseline data, and the degree of impact of works. Upon implementation of proposed mitigation measures, the residual impact of noise is assessed as minor to negligible.

In the **operational phase,** SRI will develop an *Operational Noise and Vibration Management Plan*. The Plan will include annual noise monitoring in zones of residential and other sensitive buildings located in the immediate vicinity of the railway as well as technical and visual control of noise barriers in accordance with relevant standards.

[110] Commission Regulation (EU) No.1304/2014, Technical specifications for interoperability (TSI) of subsystems "rolling stock – noise", SRPS EN 16272-1, SRPS EN 16272-2, SRPS EN 16272-3-1, SRPS EN 16272-3-2, SRPS EN 16727-1, SRPS EN 16727-2-1, SRPS EN 16727-2-2, SRPS EN 16727-3, SRPS EN 16951-1, SRPS EN 16951-2; as well as guideline: DB directive 804.5501

11 Vibration

11.1 Supplementary Baseline Information

The baseline vibration and/or low frequency noise measurements were not performed for the railway section Stalac-Djunis. Both the 2016 EISA and the 2018 national EIA Study do not contain relevant assessment of vibration caused impacts.

This chapter contains supplementary baseline information on vibration impacts that are gathered through desktop research and evaluated using appropriate calculations and international standards.

Methodology. The vibration and low frequency noise levels during railway construction primarily depend on the organisation of works at the site, the number and type of construction machines used at the site, and their position and distance from residential and other sensitive buildings in the impact zone. At this stage of the Project, information on the organisation of the construction site, the technology of works and information on which tools, equipment and machinery will be used are not available. All calculation and analyses given here are based on default values from referenced standards and literature, while the exact values can be determined after the method and technology of construction works decided upon.

Since the national laws do not stipulate the permissible values for vibrations and low frequency noise, the German standard DIN 4150-2 and 4150-3[111], the British standard BS 6472[112] and the Swiss Directive of the Federal Office for the -Environment[113] have been considered.

DIN 4150-2 provides the methodology for evaluation of vibrations within the frequency of 1 to 80 Hz, which is particularly critical for humans. The standard also specifies the maximum allowed vibrations to prevent impacts on people inside buildings. Reference values for the assessment of vibrations in dwellings and similar buildings are shown in Table 29.

Table 29: Reference values for assessment of vibrations in dwellings and similar buildings according to DIN 4150-2

Use	Day (6^{00}-22^{00})			Night (22^{00}-6^{00})		
	A_u	A_o	A_r	A_u	A_o	A_r
Mainly residential area	0.15	3	0.07	0.1	0.2	0.05

The vibration assessment is based on indicators KB_{Fmax} (maximum value derived from a running r.m.s. quantity with time constant fast) and KB_{FTr} (time-weighted mean quantity depending on traffic). The assessment procedure has two basic steps:

- Step 1: if $KB_{Fmax} \leq A_u$ the condition is satisfied.
- Step 2: when $KB_{Fmax} \leq A_0$ the condition is satisfied only if $KB_{FTr} \leq A_r$.

Human precipitation of vibration based on weighted maximum vibration velocity is presented in Table 30.

Table 30: Human perception of vibration according to DIN 4150-2[114]

Weighted maximum vibration velocity (KB values)	Perception
0.1	Threshold of perception, just noticeable
0.2	Weakly noticeable
0.4	Noticeable
0.8	Awakening threshold, clearly noticeable
1.6	Strongly noticeable
6.3	Very strongly noticeable

[111] Structural Vibration - Human Exposure to Vibration in Buildings
[112] Guide to Evaluation of Human Exposure to Vibration in Buildings. Part 1: Vibration sources other than blasting
[113] BEKS 1999 - Assessment of vibration and structure-born noise from railway traffic
[114] Review of existing standards, regulations and guidelines, as well as laboratory and field studies concerning human exposure to vibration, RIVAS Deliverable 1.4 (2011)

The DIN 4150-3 standard concerns the effects on structures. The short-term vibration are the most important types of vibration in the blasting operations, and they are included in this standard. The short-term vibration values that have an impact on building structures, according to DIN 4150-3, are shown in Table 31.

Table 31: Guideline values of short-term vibrations for the assessment of the impact on building structures according to DIN 4150-3 [mm/s]

Type of structure	Vibration based on a frequency		
	1 Hz-10 Hz	10 Hz-50 Hz	50 Hz-100 Hz
Building used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	**5**	**5 to 15**	**15 to 20**
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2, and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

The low frequency noise problem is especially pronounced indoors, because mid and high frequency noise from outside is reduced by the insulating effect of the building, while outdoors, it may be completely or partially masked by higher-frequency noise (e.g., traffic).

Assessment of vibration impacts on humans can also be performed based on the British standard BS 6472 – a guide to evaluate human exposure to vibration in buildings for vibration sources other than blasting (1-80 Hz). The BS 6472 standard is more tolerant to short-term vibrations that are very common during construction work, when much higher levels are allowed. The acceptable values of human exposure to continuous and impulsive vibration in residential buildings according to the BS 6472 standard and different periods of day are shown in Table 32.

Table 32: Criteria for exposure to continuous and impulsive vibration according to BS 6472 (8-80 Hz) [mm/s]

Location	Period	Continuous vibration		Impulsive vibration	
Residences	Day (7^{00} - 23^{00})	0,28	0,56	8,6	17,2
	Night (23^{00} - 7^{00})	0,20	0,40	2,8	5,6

The BEKS standard assesses the impact of low frequency railway traffic noise per type of built-up area. It specifies the noise levels for newly built and reconstructed railways. Permissible levels of low frequency noise by zone, the period of day and the railway line class are shown in Table 33.

Table 33: Guidance values for ground-borne indoor noise according to BEKS (1999)

Built-up area	Newly built railway line		Modernized railway line*	
	Day (6^{00}-22^{00})	Night (22^{00}-6^{00})	Day (6^{00}-22^{00})	Night (22^{00}-6^{00})
	L_{eq} (16h)	L_{eq} (1h)	L_{eq} (16h)	L_{eq} (1h)
	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
Residential areas, public interest areas of public interest (schools, hospitals)	35	25	**40**	**30**
Mixed areas, town centres, agriculture areas, residential areas already exposed	40	30	45	35
*Alteration or refurbishment of existing tracks, change in operating condition				

Construction phase. The following construction equipment will most likely be needed to carry out civil works: bulldozers, graders, excavators, scrapers, dumpers, rollers, backhoes, cranes and piles. For track works, the following will probably be needed: sleeper layer, track layer, ballast wagons, rail welding machine, tamper, excavators, and backhoes.

Typical vibration levels for some of the construction tools, equipment and machinery are shown in Table 34.

Table 34: Typical vibration levels of construction tools, equipment and machinery[115]

[115] RTA Environmental Noise Management Manual, Roads and Traffic Authority of New South Wales (2001)

Tool, equipment or machinery	Estimated vibration level @10 m [mm/s]
Piling	12-30
Loader	6-8
Roller (15 t)	7-8
Compactor (7 t)	5-7
Roller	5-6
Dozer	2,5-4
Backhoe	1
Jackhammer	0,5

The energy of tools, equipment and machines during the execution of works is transferred to the ground and transmitted in the form of vibrations. The transmission rate of vibrations depends on the geological characteristics of the soil, frequency, object construction and other factors, and, as a function of distance it decreases. Without data from a specific location, it is not possible to accurately calculate the rate of vibration reduction. A simplified method based on the following regression equation can be used for estimation purposes[116]:

$$PPV = PPV_{ref} * \left(\frac{D_{ref}}{D}\right)^{n}$$

where:

PPV – the peak particle velocity adjusted per distance [mm/s],

PPV_{ref} – the reference vibration level at a reference distance [mm/s],

n – the propagation coefficient based on soil class (1.5), and

D – the distance from construction activity to the receptor [m].

The calculated vibration values at a distance of 30, 50, 100 and 300 m for some tools, equipment and machines that will most likely be used for construction of the Stalac-Djunis section are shown in Table 35.

Table 35: Calculated vibration values [mm/s PPV]

Tool, equipment or machinery	Calculated vibration level				
	10 m	30 m	50 m	100 m	300 m
Piling	21.0	4.0	1.9	0.7	0.2
Loader	7.0	1.3	0.6	0.2	0.1
Roller (15 t)	7.5	1.4	0.7	0.2	0.1
Compactor (7 t)	6.0	1.2	0.5	0.2	< 0.1
Roller	5.5	1.1	0.5	0.2	< 0.1
Dozer	3.5	0.7	0.3	0.1	< 0.1
Backhoe	1.0	0.2	0.1	< 0.1	< 0.1
Jackhammer	0.5	0.1	< 0.1	< 0.1	< 0.1

The calculated vibration levels shown in Table 35, which meet the preferred requirements of the standard BS 6472 for day period (Table 32) are coloured green, and those that meet the maximum requirements of the standard BS 6472 for day period (Table 32) are coloured yellow. The pile driving makes impulsive vibration and was evaluated accordingly.

It can be concluded that the negative vibration impact can be expected at distances up to 50 m for the activities that engage loader and Roller (15t) machines. Other construction tools, equipment and machines will produce

[116] Transit Noise and Vibration Impact Assessment Guide, The United States (US) Federal Transit Administration's

lower vibration levels, and the distances at which exceedances occur are smaller (up to 10 m for Piling, Backhoe, Jackhammer, Heavy roadheading and Heavy rockbreaking; and up to 30 m for Compactor (7 t), Roller and Dozer).

All five tunnels will be built using the NATM (New Austrian Tunnelling Method). The only exception will be the first 100 m of Tunnel no. 1, which will be built by the cut-and-cover method (for which the same or similar machines will be used as for civil works).

The estimated maximum vibration levels that can occur during mechanical excavation of a tunnel (cut-and-cover) is shown in Table 36.

Table 36: Indicative maximum ground vibration levels for mechanical tunnel excavation methods [mm/s PPV][117]

Vibration source	Distance					
	5 m	10 m	20 m	30 m	40 m	50 m
Heavy roadheading	1,10	0,43	0,17	0,09	0,06	0,05
Heavy rockbreaking	4,50	1,30	0,40	0,20	0,14	0,10

The indicative maximum ground vibration levels for mechanical tunnel excavation methods shown in Table 36 which meet the preferred requirements of the standard BS 6472 for day period (Table 32) are coloured green, and those that meet the maximum requirements of the standard BS 6472 for day period (Table 32) are coloured yellow.

The estimated low frequency noise levels that can occur during mechanical excavation of a tunnel (cut-and-cover) are shown in Table 37.

Table 37: Indicative low frequency noise levels for mechanical tunnel excavation methods [dB(A)][118]

Low frequency noise source	Distance					
	5 m	10 m	20 m	30 m	40 m	50 m
Heavy roadheading	57	48	39	34	30	27
Heavy rockbreaking	67	58	50	45	40	37
Drilling (small percussive rig)	58	49	40	36	31	29

The indicative low frequency noise levels for mechanical tunnel excavation methods shown in Table 37 which meet the preferred requirements of the BEKS standard (which can be adopted for the low frequency noise assessment during construction works) for day period (Table 33) are coloured green.

The negative impact of low frequency noise during mechanical tunnel excavation (heavy rockbreaking) can be expected at distances up to 30 m. For all residential and other sensitive buildings which are in zones up to 50 m from the construction site (distance depends on the type of construction work and the tools, equipment and machines used), it is necessary to plan temporary mitigation measures to reduce the negative impact of vibration and/or low frequency noise. Furthermore, the construction of the railway is transient in nature, so the negative impacts of the vibration and low frequency noise will be reduced as the construction of the railway tracks progresses along the route away from sensitive receivers.

NATM is a standard method for building tunnels in mountainous areas, which uses the geological stress from natural ground around a tunnelling site to build a tunnel safely. NATM uses machines (e.g., drill jumbo, dump trucks, loaders) and explosives (blasting) to penetrate the ground. When an explosive is detonated, only a portion of the energy is consumed in breaking up and moving the rock. The remaining energy is dissipated in the form of seismic waves expanding rapidly outward from the blast, either through the ground (as vibration) or through the air (as air blast).

Using the following equation for the maximum particle vibration, resulting from an explosion, the maximum instantaneous charge can be found:

[117] Bus and Train (BaT) Tunnel, Environmental Impact Statement, Construction Noise and Vibration, Report Number 620, 2014
[118] Bus and Train (BaT) Tunnel, Environmental Impact Statement, Construction Noise and Vibration, Report Number 620, 2014

$$V = K_G * \left(\frac{R}{Q^{\frac{1}{2}}} \right)^{-B}$$

Where:

V – the peak vector sum ground vibration peak particle velocity [mm/s],

R – the distance from charge [m],

Q – the maximum instantaneous charge (MIC)[119] [kg],

B- constant related to the rock and site (usually -1.6), and

K_G – the ground constant[120].

The estimated values of the maximum instantaneous charge in function of distance and expected vibration levels are shown in Table 38.

Table 38: Estimated values of maximum instantaneous charge [kg]

Vibration level [mm/s PPV]	Distance to receiver [m]				
	10	30	50	100	300
0.10	0.00	0.01	0.02	0.08	0.76
0.20	0.00	0.02	0.05	0.20	1.82
0.28	0.00	0.03	0.08	0.31	2.77
2.80	0.05	0.49	1.37	5.47	49.21
5.00	0.11	1.02	2.82	11.29	101.58
8.60	0.22	2.00	5.56	22.23	200.09
10.00	0.27	2.42	6.71	26.85	241.61
15.00	0.45	4.01	11.14	44.56	401.07
20.00	0.64	5.75	15.96	63.85	574.64

Operation phase. The vibrations and low frequency noise generated by railway traffic were calculated with the aid of VIBRA-1 (Ziegler Consultants and Swiss Rail) software package. Vibrations were calculated based on individual train passing, while the total impact was equal to a sum of standardised procedures in DIN 4150-2.

The values of assessed impacts due to vibrations and low frequency noise are specified solely for dwelling houses. Permitted levels are given according to standards DIN 4150-2 and BEKS in bolded columns in Table 29 and Table 33. The calculated values are the best estimate according to available data and are sufficient for the ESIA and/or EIA level impact assessment.

The data on the prospective scope of railway traffic for modelling and analysis of vibration and low frequency noise were taken from the 2022 PFS, while the indicative traffic plan has defined the future number of trains on the Stalac-Djunis railway section.

Passenger trains are divided into four categories: high-speed trains, international trains, regional trains and local trains. 17 pairs of high-speed trains will operate between Belgrade and Nis, with one stop in Jagodina station. The planned operational time is between 06.00 and 22.00 hours. 6 pairs of international trains will operate between Belgrade and Sofia (Bulgaria) and between Belgrade and Skopje (North Macedonia). The itineraries will be distributed evenly during the day. 7 pairs of regional direct trains will be operated between Jagodina and Nis and 9 pairs of local trains will be operated between Jagodina and Aleksinac.

[119] Maximum instantaneous charge is the maximum amount of explosive in kg on any one specific delay detonator in any one blast hole.
[120] The standard AS2187.2 gives a ground constant for free face hard or highly structured rock K_G = 500; for free face average rock K_G = 1140; for heavily confined K_G = 5000. Free face is a rock surface that provides the rock with room to expand when blasted.

Freight trains are divided into three categories: international trains, direct trains and local (manipulative) trains. International freight trains will be operated between Belgrade and Bulgaria and between Belgrade and North Macedonia, with 5 pairs of trains in each direction. Direct freight trains in domestic transport will be operated on the following routes: Belgrade Ranzirna (Marshalling)-Popovac (3 pairs of trains per day), Lapovo Ranzirna (Marshalling)-Popovac (1 pair per day) and Stalac-Popovac (1 pair per day). One pair of local (manipulative) freight trains will be operated between Stalac-Popovac.

The Stalac-Djunis section is designed for a max. speed of 160 km/h. Depending on the operational technology, high-speed international and regional passenger trains will run at a max. speed of 160 km/h, while local passenger trains will run at max. speed of 120 km/h. Max. permitted speed of freight trains is 100 km/h. Only the impacts of railway traffic on the Stalac-Djunis section were considered.

The calculated values of vibrations and low frequency noise on the open track for day and night are shown in Table 39. The given values refer to both the left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

Table 39: Calculated values of vibrations and low frequency noise (open track)

Table 4.6.2-11 Calculated values of vibrations and low frequency noise (open track)						
Distance from track	KB_{Fmax}	KB_{FTr}	KB_{Fmax}	KB_{FTr}	Low frequency noise	
	Day		Night		Day	Night
[m]					Leq (16h) [dB(A)]	Leq (1h) [dB(A)]
5	0.799	0.088	0.799	0.055	31.5	33.3
10	0.446	0.053	0.446	0.033	26.1	27.9
15	0.317	0.039	0.317	0.024	22.9	24.7
20	0.249	0.031	0.249	0.019	20.6	22.4
25	0.207	0.026	0.207	0.016	18.8	20.6
30	0.177	0.023	0.177	0.014	17.4	19.1
35	0.156	0.020	0.156	0.012	16.1	17.8
40	0.139	0.018	0.139	0.011	15.0	16.7
45	0.126	0.016	0.126	0.01	14.0	15.7
50	0.115	0.015	0.115	0.009	13.2	14.8

The running of trains over switches increases levels of vibrations and low frequency noise. This impact (impact from the first switch to end of the last switch) is considered in the Stalac and Djunis stations' switch zone assuming that the switches, that are spaced not more than 100 m apart, will have a continuous effect on increase of vibration and low frequency noise. The calculated values of vibrations and low frequency noise in the switch areas for day and night are given in Table 40. They refer to both left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

Table 40: Calculated values of vibrations and low frequency noise (switching area)

Distance from track	KB_{Fmax}	KB_{FTr}	KB_{Fmax}	KB_{FTr}	Low frequency noise	
	Day		Night		Day	Night
[m]					Leq (16h) [dB(A)]	Leq (1h) [dB(A)]
5	1.597	0.178	1.597	0.110	35.0	36.9
10	0.892	0.104	0.892	0.064	29.5	31.3
15	0.595	0.072	0.595	0.044	26.0	27.7
20	0.436	0.054	0.436	0.033	23.3	25.0
25	0.336	0.042	0.336	0.025	21.1	22.8
30	0.266	0.033	0.266	0.020	19.2	20.8
35	0.214	0.027	0.214	0.016	17.5	19.1

Distance from track	KB_{Fmax}	KB_{FTr}	KB_{Fmax}	KB_{FTr}	Low frequency noise	
	Day		Night		Day	Night
[m]					Leq (16h) [dB(A)]	Leq (1h) [dB(A)]
40	0.174	0.022	0.174	0.013	15.9	17.5
45	0.142	0.018	0.142	0.011	14.4	16.0
50	0.115	0.015	0.115	0.009	13.2	14.8

On the Stalac-Djunis section there are five tunnels with a total length of 6.9 km[121]. The calculated values of vibrations and low frequency noise in tunnel area and periods of day are given in Table 41. The given values refer to both left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

Table 41: Calculated values of vibrations and low frequency noise (tunnel area)

Distance from track	KB_{Fmax}	KB_{FTr}	KB_{Fmax}	KB_{FTr}	Low frequency noise	
	Day		Night		Day	Night
[m]					Leq (16h) [dB(A)]	Leq (1h) [dB(A)]
5	0.534	0.059	0.534	0.036	27.8	29.7
10	0.286	0.034	0.286	0.021	22.0	23.7
15	0.199	0.024	0.199	0.015	18.5	20.3
20	0.153	0.019	0.153	0.012	16.1	17.8
25	0.125	0.016	0.125	0.010	14.1	15.8
30	0.106	0.014	0.106	0.008	12.5	14.2
35	0.093	0.012	0.093	0.007	11.2	12.8
40	0.082	0.011	0.082	0.007	10.0	11.6
45	0.074	0.010	0.074	0.006	9.0	10.6
50	0.067	0.009	0.067	0.005	8.0	9.6

The calculated values in Table 39, Table 40 and Table 41 are far below the levels that are reported to typically cause minor damages to buildings (5.0 mm/s)[122].

A negative vibration impact can be expected on open tracks at distances up to 25 m, in stations' switch areas at a distance up to 35 m from the switch, and in tunnels at distances up to 10 m. In the switch areas of the Stalac and Djunis stations, for all residential and other sensitive buildings which are in zones from 25 to 35 m, it is necessary to plan mitigation measures to reduce the negative impact of vibration.

According to the *Law on Railways*[123], in the zone of 8 m from the axis of the end track (6 m in the urban zone) on both sides, it is prohibited to build any structures except for those that serve some railway functions. Exceptionally, in the wider zone of 25 m from the last track axis on both sides, buildings which are not in the function of railway traffic can be built based on an official approval of the infrastructure manager, and provided that the construction of these buildings is foreseen by the municipal urban plan. The prescribed measures for the protection of these buildings are implemented by the building owner at his/her own expense.

Perceptible vibration is usually accompanied by noise. The cumulative effects of vibration and noise on people is a relatively unexplored area. Research has shown that in areas with high levels of vibration in order for annoyance to be equal as when there is no vibration, noise exposure should be lower. However, the calculated vibration levels inducted by railway traffic are relatively small and, in that sense, the cumulative noise and vibration effects are negligible.

[121] The Tunnel No. 1 is 1450 m long (from km 178+895 to km 180+345), Tunnel No. 2 is 690 m long (from km 180+700 to km 181+390), Tunnel No. 3 is 435 m long (from km 181+725 to km 182+160), Tunnel No. 4 is 3275 m long (from km 182+325 to km 185+600) and Tunnel No. 5 is 1040 m long (from km 185+630 to km 186+670).
[122] Railway induced vibration, State of the Art Report (UIC, 2017)
[123] Official Gazette of RS, No 41/18, Article 71

11.2 Identification of Impacts

The 2016 ESIA identifies the following potential vibration related impacts:

Construction phase	> Increased vibration levels near residential buildings due to ground-borne vibration, particularly from heavy vehicles when there are irregularities in the road surface > Increased construction-related ground vibration will affect local fauna
Operational phase	> Negative impact as a result of ground-borne vibration in the zone with residential receptors > Potential disturbance of specific biological functions by vibration effects > Impact on workers from increased level of vibration from the rolling stock and machinery

The 2016 ESIA has correctly identified all relevant negative impacts in the operation phase. However, for the construction phase, additional impacts on residential buildings due to ground-borne vibration caused by blasting, and impact on workers from increased levels of vibration during construction activities and use/movement of construction equipment also needs to be considered and mitigation measures defined.

11.3 Mitigation Measures

Mitigation measures for all impacts in the construction and operational phase are summarised in the ESMP.

In the **construction phase,** the Contractor will develop and implement a *Construction Noise and Vibration Management Plan*, which will include measures to mitigate negative impacts of vibration. These will include activities like use of low or non-vibratory piling equipment, use of static force compaction, managing the blasting process to reduce blasting vibration and selection of demolition methods not involving vibration impact, where possible. The Contractor must determine the vibration baseline levels of the site and the surrounding area, by measurements which must be conducted by the accredited organizations. In case of local residents' and workers' complaints during construction works, periodical measurement of vibration shall be performed to determine whether the generated level exceeds permitted limit values, and by comparing the measurement results with the baseline data and the degree of impact of works. Upon implementation of proposed mitigation measures, the residual impact of vibration is assessed as minor to negligible.

In the **operational phase,** the SRI will develop an *Operational Noise and Vibration Management Plan*. The Plan will include the vibration monitoring in the switching area of the Stalac and Djunis stations that shall be conducted once during year 1 of operation.

12 Soil

12.1 Supplementary Baseline Information

The information on geology, geomorphology and soil types, presented in the 2016 ESIA, can be considered as sufficient to provide adequate conclusions about the potential impacts. However, seismology and land use are not sufficiently addressed. Also, there is no information on soil quality in the Project area.

The information in the 2016 ESIA has been supplemented with new information on seismology (as provided in the national 2018 EIA Study) and information on land use (as provided in the General Design). Some information on soil monitoring practices at the SRI are added as well.

Seismology. In seismological terms, the subsection Stalac-Djunis is part of the Balkan Peninsula, as a seismically very active area of the Mediterranean-Trans Asian seismic belt. Neotectonics activity is occasionally expressed in complex fault zones in the area of the Mojsinje Gorge. It is manifested in seismic phenomena with the effects of earthquakes on hydrological characteristics of ground and surface water and morphological changes in relief.

On the seismological hazard map (RSZ 2010) for a return period of 475 years, the subsection is located in zone VIII° MSK scale, with seismicity coefficient of $K_s = 0.05$.

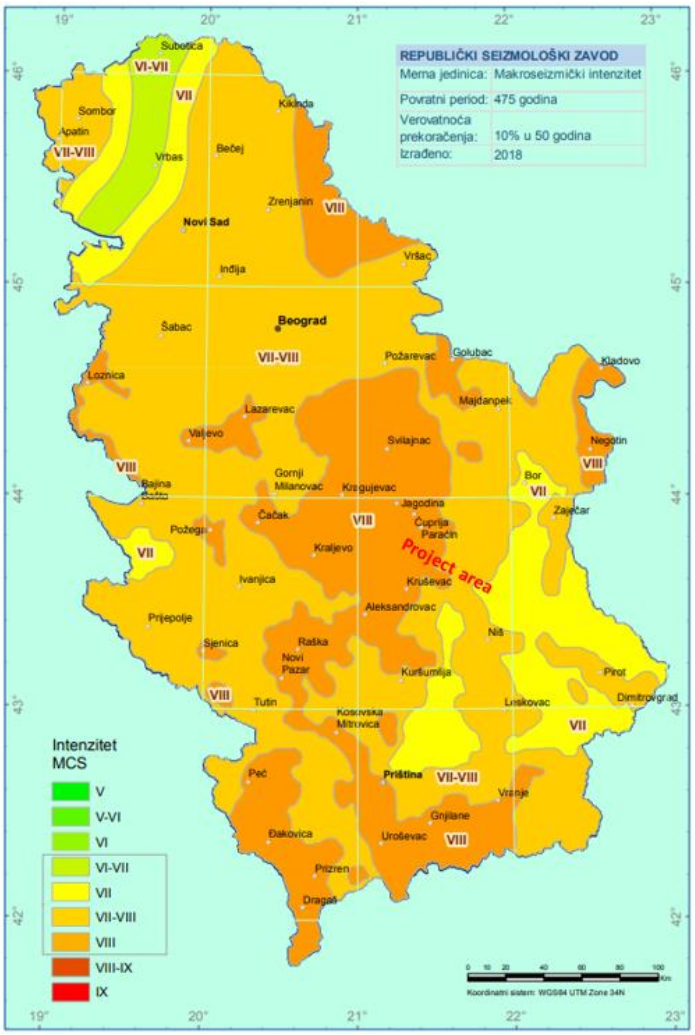


Figure 34: Seismic hazard map for a return period of 475 years[124]

[124] http://www.seismo.gov.rs/Seizmicnost/Karte_hazarda_I.htm

The intensity of earthquakes recorded so far in the Project area[125] did not exceed 5.5 MWu[126].

Land use. Based on the land use map presented in the General Design, the most common types of land use along the railway are arable land, forests, orchards and vineyards, and residential land.

According to data of the Environmental Protection Agency, agricultural land in RoS occupied 64.56% of the total area in 2013. Agricultural areas are mostly used for sowing grains, followed by industrial, fodder and vegetable plants. Based on the maps shown in the following figure, it can be concluded that in the Project area the percentage of agricultural land in relation to total area is in the range of 60-65%, and consists mostly of arable land and gardens.

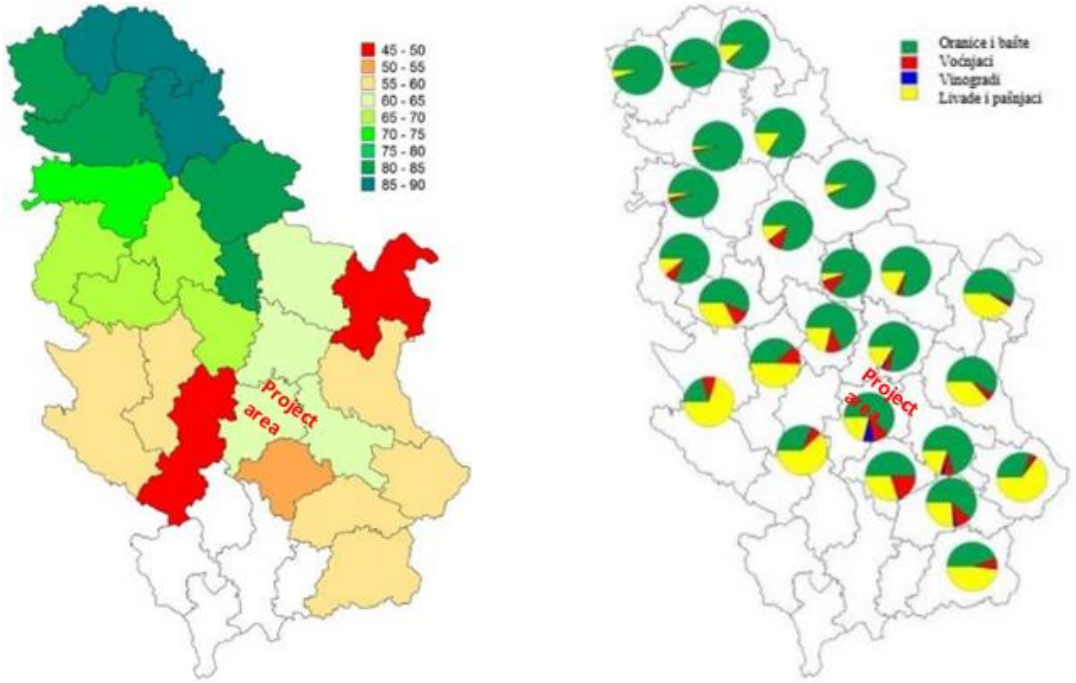


Figure 35: Percentage of agricultural land in relation to the total area (left) and agricultural land by type of use (right)[127]

** Note: In the right figure, arable land and gardens are marked in green; orchards in red; vineyards in blue; meadows and pastures in yellow.*

Soil quality monitoring. SRI is not required to conduct regular soil quality monitoring, but it does perform monitoring in case of accidents (e.g., spillage of hazardous substances) at the request of the Ministry of Environmental Protection. The most recent soil quality monitoring was conducted in May 2021 when a pure sulfuric acid spill occurred in the settlement of Bagrdan (approx. 100 km away from Belgrade and approx. 60 km away from Stalac), at a distance of some 0.5 m from the railway alignment[128].

12.2 Identification of Impacts

The ESIA identifies the following potential impacts/risks on soil:

Construction phase	>	Permanent loss of soil along the right-of-way
	>	Soil destabilisation and erosion in cuttings
	>	Degradation of soil resulting from topsoil removal and compaction
	>	Soil contamination in case of accidental release of fuels and chemicals
Operational phase	>	Soil erosion and soil contamination as a result of leakage of oil, grease and other chemicals from the roiling stock and during freight transport, as well as usage of herbicides

[125] http://www.seismo.gov.rs/Seizmicnost/Karta_epicentara_l.pdf
[126] Moment magnitude scale
[127] http://indicator.sepa.gov.rs/pretrazivanje-indikatora/indikatorilat/allfindp/441c7b391a064132b7a1dba5f4d87a2e
[128] Mining and Metallurgy Institute Bor, Monitoring Report 45837, June 2021

In addition to the impacts listed in the ESIA, the following potential negative impacts on land use during the construction phase have been identified:

1. Temporary disturbance to local land use due to land take for construction activities (transport and access roads, landfills, areas for workers),
2. Disruption of the use of nearby agricultural land that is not temporarily occupied as it may be affected by construction activities (e.g., negative impact of dust on crops).

12.3 Mitigation Measures

The measures for mitigation of construction and operation related impacts on soil are defined in the ESMP.

In the **pre-construction phase**, the Contractor must conduct soil quality monitoring along the railway alignment (at approx. 0.5-1.0 m from the alignment) to determine the baseline conditions before staring the construction works

In the **construction phase,** the responsibility of the Contractor is to develop and implement the *Construction Water and Soil Management Plan*. Measures relevant to the soil protection are the following:

- measures addressing the vegetation, topsoil and subsoil removal and handling to preserve the soil quality and prevent erosion,
- measures aimed at containing and removal of accidental spills and associated monitoring of soil quality,
- measures aimed at adequate storage and handling of fuel and other hazardous material,
- measures that will minimize the risk of erosion such as building temporary drainage canals and embankments,
- measures addressing adequate disposal of waste materials.

In the **operational phase**, the responsibility of SRI is to develop and implement an *Operational Water and Soil Management Plan*. Measures relevant to the soil protection are the following:

- Controlled application of herbicides to reduce unnecessary overuse and to reduce the risk of leaching to soil and groundwater,
- Regular maintain sediment traps and basins, drainage channels and treatment systems ,
- Regular maintain slope stability (cuttings and embankment),
- Verge vegetation will be planted along the affected waterways to minimise soil erosion and reduce suspended matter in surface run-off,
- Monitor the soil quality in case of spills.

In case of dismantling the existing railway (at locations where the new route deviates from the existing one) and land reuse for agricultural or sports-recreational purposes, it is first necessary to examine the soil quality to determine the possible level of contamination, and then conduct soil decontamination activities, if needed.

13 Landscape

13.1 Supplementary Baseline Information

As presented in the 2016 ESIA, the Project area landscape is characterised by the Juzna Morava River Gorge, which forms a narrow valley bordered by short steep slopes. Altitude varies between 140 and 500 m above sea level. The banks of the Juzna Morava River are covered with dense riparian vegetation. The settlements are in average about 2 km apart.

Even though information presented in the 2016 ESIA can be considered as sufficient to provide conclusions of the Project impact on landscape and visual values, figures showing a simulation of the positioning the railway in the surrounding environment [130] are included in this Supplementary Study for better understanding.

The natural component of the landscape along the railway is characterised by landform structure with hilly-zones from one side and plains from the other. The existing natural vegetation systems are forests and agricultural land adapted for food production. The Djunis settlement is located on the left side of the railway and is surrounded by mixed deciduous forest. The settlement is scattered and has a rural character, with a lower number of inhabitants who are usually engaged in agriculture. Alongside and above the railway, the construction of an overpass is being placed, passing over arable land and encompassing the settlement of Djunis.

Figure 36: Route of the future railway alignment with the construction of an overpass within the realignment of the state road in the Djunis settlement

The natural component of the landscape along the railway in the Trubarevo settlement is characterised by flat terrain with arable land. The subsection is prone to flooding of the Juzna Morava river, and the two-track railway will be placed further from the river and closer to arable land. The area around the railway is uninhabited, and the Djunis settlement is on the left side of the railway.

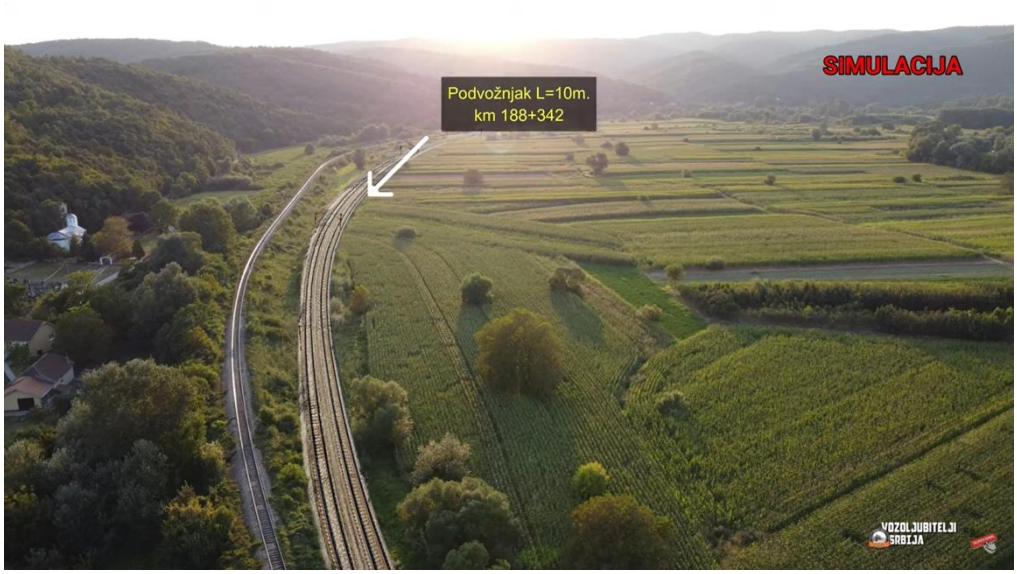


Figure 37: Simulation of a two-track railway on the Stalac-Djunis subsection in the settlement of Trubarevo

The intersection of the existing and new railway alignment is on the right side of Djunis. The terrain is characterised by shrubs and occasional meadows in-between. Higher slopes are covered by woodland and broadleaved forests.

Figure 38: Crossing of the existing railway with the new one in the settlement of Djunis

Figure 39 shows the exit portal of Tunnel no. 3 which will be located in a hilly uninhabited area covered in broadleaved forest.

Figure 39: Exit portal of Tunnel no. 3

The entrance of Tunnel no. 4 is shown in Figure 40. The tunnel entrance will be placed on a stable rock slope in hilly terrain. The dominant vegetation is broadleaved forest. The landscape is uninhabited because of harsh mountainous conditions. The Juzna Morava River is left to the railway. Access roads to the tunnel will be under the right side of the railway.

Figure 40: Entrance portal of Tunnel no. 4 with access road

A 30 m long gallery is planned at km. 185+615, between Tunnels no. 4 and 5. It is designed on a slope because of the very steep terrain. The landscape around the gallery is characterised by hilly, forested areas and steep slopes. The area is uninhabited because of harsh mountainous conditions. The main road passes to the right of the gallery.

Figure 41: Gallery between the entrance portal of Tunnel no. 4 and entrance portal of Tunnel no. 5

The exit portal of Tunnel no. 5 is shown in Figure 42. The landscape is characterised by the agricultural land in lower terrains and forested areas on the slopes on the left. The two-track railway passes through arable land and is placed further from the existing railway. The exit portal of the tunnel will be on a stable rock slope.

Figure 42: Exit portal of Tunnel no. 5 and viaduct near Djunis

13.2 Identification of Impacts

The ESIA identifies the following potential impacts/risks on landscape and visual values:

Construction phase	> Clearance of localised areas of tree and shrub vegetation and removal of land cover > Increased level of "urbanisation" due to construction mechanisation > Adverse changes in land use along the railway route
Operational phase	> Negative impact on the overall landscape due to land cuts for tunnel structures and introduction of vertical structures in the rural environment > Part of the currently used agricultural land will be expropriated > Negative impact on landscape of the nature designated area – ecological network of the Mojsinje Mountain and the Stalac Gorge on the Juzna Morava River

The 2016 ESIA has identified all relevant negative impacts in both the construction and operation phases.

13.3 Mitigation Measures

The measures for mitigation of construction related impacts on landscape are defined in the ESMP.

In the **construction phase**, the Contractor will develop a *Construction Planting Management Plan* to cover landscaping actions and restore the construction site to its original condition. The Plan will outline the following measures:

- preserving the structural intensity of the soil,
- timing of planting activities,
- tasks to establish and maintain the trees, grass and vegetation in the Project area, especially for returning to the original condition after the completion of construction works,
- replacement tree planting / woodland planting,
- planting measures will be designed to provide enhancement to local landscape character and connectivity within the wider landscape where possible.
- use of species of local/regional provenance,
- measures to mitigate landscape character effects,
- compensatory planting for ecological habitats lost to ensure net gain of sensitive habitats.

Landscape plans, including proposed habitat creation areas and species lists will be agreed with the Ecological Clerk of Works (Contractor), Environmental Expert (Supervision Engineer), and Environmental/Biodiversity Specialist (PIU).

No specific measures for the operational phase are foreseen.

14 Waste

14.1 Supplementary Baseline Information

The 2016 ESIA contains only general information on generation and disposal of municipal and construction waste. The Study does not provide any baseline information on types and quantities of materials needed for railway construction as well as information o waste generation and disposal during railway operation and maintenance.

Therefore, specific information on the estimated type and quantities of waste to be generated during construction activities (as presented in the national EIA Study) and information on current SRI waste management practices that are relevant for the operational phase are included in this Supplementary Study.

Current SRI waste management activities. The Sector for Environmental Protection within SRI develops three-year Waste Management Plans (WMP). The last version was published in May 2018 and is currently updated. The WMP defines the procedures for waste identification and managing, prevention of waste generation, rational use of natural resources, elimination of dangers and its harmful effects, as well as procedures and methods for waste disposal. In addition, the WMP defines in more detail the waste management methods in relation to the guidelines from the *Rulebook on the method of recording, storage, movement and sale of inactive stocks and materials obtained in the work process in the SRI*. The final disposal of (hazardous) waste is organised in cooperation with licenced waste management companies or the waste is sold on the market through tendering procedure.

The wooden sleepers that will be replaced during reconstruction are considered as hazardous waste. In accordance with the *Ordinance on the manner of storage, packaging and marking of hazardous waste*, the current practice is to temporarily store wooden sleepers on a solid stable base with equipment for collecting spilled liquids and degreaser. The options for their final disposal have not yet been defined, and SRI is working together with the Ministry of Environmental Protection to find the best option.

The following table presents the annual quantities of waste generated by SRI operations for the entire railway infrastructure under its management. The same types of waste can be expected as the result of the future operation and maintenance of the Stalac-Djunis subsection, only in smaller quantities.

Table 42: Annual Report on Waste Generation of Waste Producer – SRI for 2021

Waste type	Quantity of waste produces [t]
Waste engine oil	1.510
Waste sludge from the bottom of the oil tank	9.947
Metal packaging contaminated with fats and oils	0.020
Absorbents, filter materials, wipes, and protective clothing	0.480
Waste tires	4.970
Old waste railway wagons	1,151.140
Commercial plastic waste	0.670
Waste transformers with PCB oil	0.580
Parts of computers, monitors, keyboards; electric and electronic waste	7.265
Spent batteries and accumulators (Pb)	11.024
Spent batteries and accumulators (Ni-Cd)	6.260
Tiles and ceramics	0.330
Glass, plastic, and wood that contain hazardous substances or are contaminated with hazardous substances (waste impregnated wooden railway sleepers)	6,782.460
Copper, bronze, brass	0.130
Aluminium – old waste; Aluminium – sheet metal waste; Aluminium rope – old	0.159
Iron and steel (rails, track accessories, switch parts, bridge iron)	5,756.080
Asbestos-containing building materials	0.063
Paper and cardboard	0.010

Construction waste generation. The main types of waste generated during the construction of the Stalac-Djunis subsection will be waste generated from terrain preparation for the construction of the new railway and the

dismantling of the existing railway. At the locations where the double-track railway will be constructed, the existing rails will be removed and replaced with the new ones. At the sections which will be abandoned, the rails will not be removed. The expected quantities of generated waste materials are:

Preparatory phase:

- 100 trees, thickness of 10-50 cm
- 546,400 m^2 of humus
- 700 m^2 of existing low platforms
- 5,300 m^2 of road construction

Excavating activities:

- 500,000 m^3 of excavated material

Material from dismantling of the existing railway:

- 1,980,000 kg of used rails
- 4,727 m^3 of used railway sleepers (ca. 27,000 of wooden sleepers)
- 379 m^3 of used switch sleepers
- 40,590 kg of used copper cables
- 231,057 kg of used catenary poles
- 33,800 m^3 of dirty gravel

14.2 Identification of Impacts

The main negative impact identified in the 2016 ESIA is the generation of larger amounts of waste as a result of railway construction activities. The following negative impacts are identified:

Construction phase	> Demolition waste as a result of demolition of station buildings * > Excavated materials as a result of tunnel construction > Possible decommissioning of the existing railway > Construction site waste (food, packaging, office waste, sanitary waste)
Operational phase	Two types of waste are expected in the operation phase: > Municipal and packaging waste from passengers that will use the stations > Track maintenance waste and ancillary infrastructure waste during maintenance activities

*Even though this is stated in the ESIA, it is to be noted that the station buildings will not be demolished but reconstructed, and thus this type of demolition waste will not be generated.

The exact location(s) for final disposal of spoil are not yet known. Land for temporary storage of excavated material will be required during the earthworks, mainly at locations where large volumes of excavated material will be generated (e.g., tunnel portals). Temporary material stockpiles will be formed at certain sections along the route to limit the requirement for transportation.

Excavated material will most likely be used for embankments. In case that material is not suitable for the embankment, other possibilities for utilisation should be found in cooperation with the local authorities. Possible options are reuse in this project as an earthwork fill or as a construction material/flood protection bund material in some other project. Part of the material is likely to be used for construction of the access roads.

The 2016 ESIA emphasizes the importance for the SRI to require from the lead contractor to develop a Construction Waste Management Plan and implement it throughout the construction. The Contractor will dissemble wooden sleepers from track accessories. Waste sleepers will be stored on hard surface and covered against rainfall and fire. If all proposed waste management measures are implemented, the potential adverse effects will be reduced resulting in impacts of minor significance.

In addition to the waste sources and impacts listed in the ESIA, the following additional potential negative impacts of waste during the construction phase have been identified:

1. Contamination of the environment due to leakage and spillage of waste associated with inadequate spoil and waste handling and storage/ disposal arrangements,
2. Environmental damage caused by improper (non) hazardous materials management.

Similarly, in the operational phase, negative impacts on environment can occur as a consequence of improper waste handling and temporary storage arrangements for materials that are dismantled during maintenance activities.

14.3 Mitigation measures

The measures for mitigation of risks related to of improper waste management in construction and operation phases are defined in the ESMP.

In the **construction phase**, the Contractor will prepare a *Construction Waste Management Plan* to cover all activities associated with the production of wastes during construction and maximise reuse and recycling. The measures include:

- identification of specific types and quantities of waste likely to arise during the construction process,
- appropriate segregation and storage of hazardous and no-hazardous waste materials including purchase of containers for mixed and recyclable municipal waste in temporary settlement for workers
- reuse of excavated material either as engineering fill material or in the environmental mitigation earthworks,
- formation of temporary landfills for construction waste in accordance with the national requirements,
- removal of waste from site by licensed sub-contractors in compliance with the national requirements on transfer, treatment and disposal of waste and accompanied with appropriate documentation,
- in case of demolition works, undertaking a pre-demolition asbestos survey to identify the presence of any asbestos-containing materials, and where identified, removal by licensed asbestos removal contractor and managing in accordance with the national requirements on asbestos-containing waste,
- the Construction Waste Management Plan will contain the Decommissioning Waste Management Plan for the existing railway line that will be prepared and maintained by the lead contractors,
- management of waste rails, i.e. iron and steel is carried out in a manner and according to a procedure that does not pose a risk of pollution of water, soil or air that is framed by the national requirements,
- management of decommissioned wooden sleepers that shall be temporarily stored near the decommissioning areas, covered and protected from rainfall or lined with run-off collectors. Waste sleepers will be delivered to a licensed waste sub-contractor as soon as possible and in compliance to the national requirements on transfer, treatment and disposal of waste, accompanied with appropriate documentation.

In the **operation phase**, the SRI will update and continue to implement its three-year *Operational Waste Management Plan* in accordance with the national Law on Waste Management. The updated Plans shall include the following mitigation measures:

- public waste bins inside the stations' facilities will be provided,
- waste containers for use by the track maintenance personnel and railway station tenants will be provided and waste will be segregated,
- appropriate collection and disposal of waste products including oil from railway maintenance activities. Used oil should be sent for recycling to the Belgrade Oil Refinery,
- hazardous waste from the track maintenance will be segregated and temporarily stored inside a properly equipped space. Hazardous waste will be delivered to licensed subcontractors in a way compliant to the Serbian regulatory requirements on transfer, treatment and disposal of waste and accompanied with appropriate documentation,
- keep records of the annual amount of waste collected by types,

- in case of dismantling the existing railway (at locations where the new route deviates from the existing one) waste must be properly classified (hazardous and non-hazardous) and then adequately disposed by hiring an authorized company.

15 Population and Nearest Settlements

15.1 Supplementary Baseline Information

Supplementary field work. The information presented in the 2016 ESIA has been supplemented to provide an updated community profile based on additional site visits and consultations with municipal/city authorities and local communities as follows:

Cicevac	1. Discussions with representatives of Cicevac Municipality 2. Discussions with the Local Community Braljina 3. Discussions with the Beekeepers Association Cicevac
Krusevac	1. Discussions with representatives of Krusevac City 2. Discussions with the Local Community Djunis

Administrative structure. Administratively, the planned railway line will pass through an area mainly belonging to the Municipality of Cicevac (roughly 80% of the Project area) and in a smaller part to the City of Krusevac.

Type of Project area. The Project area is largely a rural, sparsely populated area which is unevenly populated, as is characteristic for hilly and mountainous terrains. The largest settlements are towns of Stalac and Djunis (the starting and end points of the railway line) where the two stations are planned to be reconstructed. Both are located in the lower and flat parts of the terrain with residential, industrial and public facilities but it should be noted that the railway line passes through only the outskirts of Djunis, so the only larger settlement in the Project area is Stalac. Between them are small villages with mostly scattered groups of individual houses. Along the railway line there are numerous uncultivated areas as well, as shown in the figure below.

Figure 43: Uncultivated areas along the railway route

Low population density, negative demographic trends, underdeveloped infrastructure and high rates of rural poverty and unemployment are characteristic for the Project area. The causes of depopulation are primarily migration to urban areas and the age structure of the remaining population, particularly in rural areas. To illustrate, the population dropped in rural areas of the Municipality of Cicevac by 33.4% in the period from 1971 to 2011.

Settlements affected by the Project. The **existing** railway route passes through and/or nearby the following 7 settlements: Stalac, Stalac Town, Braljina, Mojsinje, Cerovo, Trubarevo and Djunis. The least population density is in Braljina, Mojsinje and Trubarevo.

The **new** railway route will be moved away from two settlements: Braljina and Cerovo. These settlements will therefore lose direct access to the railway. The existing station in Braljina and the existing halt in Cerovo will both be closed.

A map showing all of the settlements which will be affected by the Project is given in Figure 44, whereas an overview of the characteristics of each settlement is provided in Table 43.

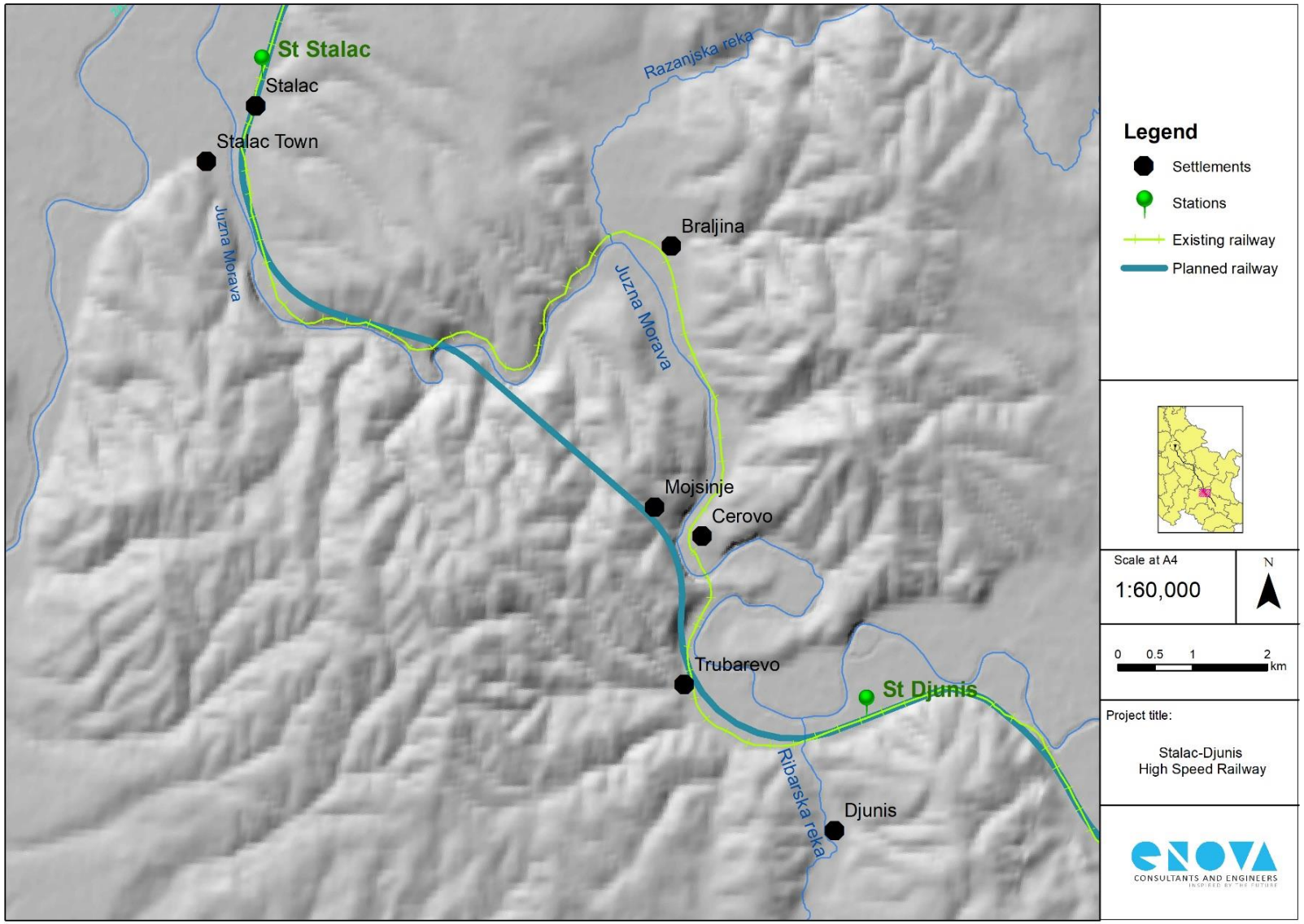
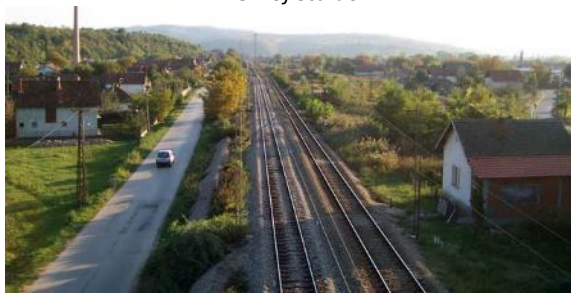


Figure 44: Seven settlements along the existing and planned railway lines which will be affected by the Project

Table 43: Community characteristics

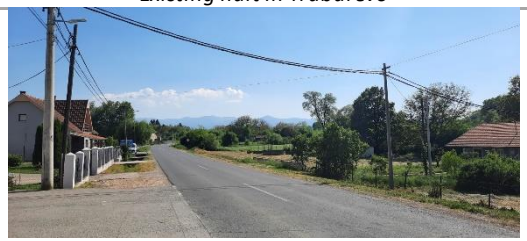
Note: It should be noted that the data on population numbers given in the table below is the official data from the most recent national census conducted in 2011 and there are no other official data or estimates for these settlements. The next national census is planned in October 2022. It is presumed, based on depopulation trends, that the population number is even lower now than in 2011.

Community	Key characteristics	Photographs
Stalac	Stalac is the main and largest settlement on the proposed route and the starting point of the Project. It has a railway station which will be reconstructed. It belongs to the Municipality of Cicevac. It has a population of around 1,500 with an average age of 44.5. There are some industrial activities in Stalac (companies for construction materials and metals, and transport companies). The local population is mostly Serbian; Roma people make up only 2% of the population in Stalac but there are no Roma settlements along the railway.	 *View of Stalac*  *Existing railway line in Stalac*
Stalac Town	Even though called a town, this is actually a village. It is located on the left bank of the South Morava River, opposite to the proposed route. It belongs to the Municipality of Cicevac. It has a population of around 690, with an average age of 46. There are no Roma people in the village.	 *Stalac Town*

Community	Key characteristics	Photographs
Braljina	This is an old village located at about 12 km from Stalac. The existing railway line passes through Braljina but **the proposed line will be moved about 3.5 km from the village. It has a station which will be closed**. There are **no other organised means of transportation such as bus or minibus lines**. Since the residents of Braljina are mostly elderly people, they often do not have private vehicles either. *Note*: There are actually two villages called Braljina – one is *Braljina Rasinska* and the other is *Braljina Razanj*. They are at about 1 km from each other and between them is the Juzna Morava River. The two villages are connected by a suspension bridge. The first village administratively belongs to the Municipality of Cicevac, and the second one to the Municipality of Razanj. Each has a population of around 50, with an average age of above 59. The current station (which will be closed) is located in Braljina Razanj. Braljina Rasinska is connected to Trubarevo with a recently reconstructed 5.7 long local road (Braljina-Trubarevo). There are no Roma people in these villages.	 *The station in Braljina which will be closed*  *Suspension bridge connecting the two Braljina villages*  *Recently asphalted local road Braljina-Trubarevo*

Community	Key characteristics	Photographs
Cerovo	This is an old village located on the right bank of the Juzna Morava River, north to the proposed route. The existing railway line passes through this village but **the proposed line will be moved about 1.7 km from Cerovo**. **It has a halt which will be closed**. There are **no other organised means of transportation such as bus or minibus lines**. It belongs to the Municipality of Razanj. It has a population of 48, with an average age of 63.5. There are no Roma people in the village.	 *Cerovo village*  *The halt in Cerovo which will be closed*
Mojsinje	Mojsinje is a very old village located on a hill on the left bank of the Juzna Morava River, at about 15 km from Stalac. By road, it is connected to both Braljina and Trubarevo. One of the planned tunnels will pass under Mojsinje with no direct impacts on the village. It belongs to the Municipality of Cicevac. It has a population of 17, with an average age of 66.5. Currently, the nearest station/halt for Mojsinje residents is in Trubarevo (even though the Cerovo halt is at around 600 m by air distance from the village, there is no direct road connection to Cerovo). After project implementation, the next nearest station will be the	 *View from Mojsinje village*[129]

[129] Source: Facebook, author Nebojša Ljubisavljević

Community	Key characteristics	Photographs
	Djunis station (7.7 km away). **There are no organised means of transportation such as bus or minibus lines.** People are mostly involved in agriculture. There are no Roma people in the village.	
Trubarevo	Trubarevo is a village on the left bank of the Juzna Morava River, at about 19 km from Stalac. The proposed route will pass through the outskirts of the settlement. **It has a halt (named as "passing loop" in the Preliminary Design but actually a halt and passing loop combined) which will be closed.** It belongs to the Municipality of Cicevac. It has a population of 108, with an average age of 56.5. There are no Roma people in the village.	 *Agricultural land in Trubarevo*  *Existing halt in Trubarevo*
Djunis	Djunis is the final point of the project, and the only settlement belonging to the City of Krusevac. It has a railway station which will be reconstructed. The proposed route will pass through the outskirts of the settlement. It belongs to the City of Krusevac. It has a population of 680, with an average age of 47.5. There are some small-scale industrial activities in Djunis (small metal workshops).	 *Djunis*

Community	Key characteristics	Photographs
	In the City of Krusevac, Roma makeup 1.9% of the entire city but there are no Roma people in part of the Project area belonging to the City.	 *Residential buildings in proximity of the railway line in Djunis settlement*

Use of the railway. The railway is of great importance for the local communities which developed around the existing railway line. Some local residents also work for the railway – for e.g., all train dispatchers in Stalac are locals. People travel for school and work purposes. The railway is used equally by men and women. Only in Djunis, buses are used more often than the railway.

Vulnerable households. The population in villages is mostly elderly, and the most vulnerable households are elderly people living alone. There are almost no female-headed households. This is particularly the case in villages which will lose direct access to the railway line (e.g., Braljina). The municipal social care centre keeps a registry of vulnerable households and provides cash assistance. In addition, the Red Cross cooperates with the social care centre and is very active in helping vulnerable people in the area (distributing packages of food and other products; organising doctor's visits to the villages).

Landfills. In both the Municipality of Cicevac and the City of Krusevac, there is a municipal landfill for disposal of municipal solid but will not be affected by the Project as it is located far away from the planned railway line. Very small illegal dumpsites occur at time along the planned railway line but are regularly cleaned by local authorities.

Public facilities. In part of the Project area belonging to the Municipality of Cicevac, some public facilities are located along the existing railway line or near the railway station in Stalac (for e.g., near the station are the health centre in Stalac, a primary school and a children's playground; the post office is within the station itself). There are several cemeteries near the planned railway line (only in part of the Project area belonging to the Municipality of Cicevac) – one of the cemeteries is near the Stalac station (around 100 m). In part of the Project area belonging to the City of Krusevac, there are no public facilities nearby.

Figure 45: Playground near the Stalac station

Natural resources. Forest resources (at locations near Stalac station) are used by the local population for logging, as well as gathering of mushrooms and forest fruits, both for personal consumption. There are no commercial activities related to these resources. The Juzna Morava River is used for recreational fishing, but not significantly used for irrigation or other recreational activities. There are no concessions for exploitation of natural resources granted by the municipal/city authorities.

Agricultural activities. **Farming** is the dominant economic activity in the Project area. It is a low-intensity activity as the majority of farmland plots are small (up to 3 hectares). The most frequently grown crops are corn, wheat and vegetables. Livestock breeding is not well developed. People engaged in agriculture currently use the level crossings on the existing railway to reach their farmland. Potential impacts on agricultural fields are described in more detail in Chapter 15.2 on identification of impacts below.

As confirmed by with the local authorities and the representative of the Beekeepers Association Cicevac, **beekeeping** as a commercial activity is particularly developed in this entire region. The Stalac area is particularly known for its beekeeping activities. Around 5000-6000 beehives are located at the Stalac Gorge area as it is abundant in acacia trees and is therefore favourable for beekeeping (producing acacia honey). Along the planned railway line, there is only some sporadic beekeeping. On part of the section from Trubarevo to Djunis there are no significant beekeeping activities. Potential impacts on beekeeping are assessed in more detail in Chapter 15.2 on identification of impacts below.

15.2 Identification of Impacts

The ESIA identifies the following potential impacts/risks for community health and safety:

Construction phase	> road and railway traffic disruption and safety > presence of temporary workers in the local area > safety risks due to unauthorised access to construction compounds and work sites
Operational phase	> general operational safety of the railway > transport of dangerous goods > pedestrian safety > electromagnetic interference (EMI)

In addition to the impacts listed in the ESIA, the following potential negative impacts on local communities have been assessed during the development of this Supplementary Study:

Closure of stations and halts. On the existing railway line, there are three stations (Stalac, Djunis, Braljina) and two halts (Cerovo and Trubarevo). However, the Project will only keep two stations (Stalac and Djunis) while the rest will be closed. As described in the baseline section. the Braljina, Cerovo and Mojsinje settlements have no other organised means of public transportation such as bus or minibus lines. It should be noted that the population in these settlements is mostly elderly and low-income. Measures regarding provision of alternative transport options are defined in the ESAP.

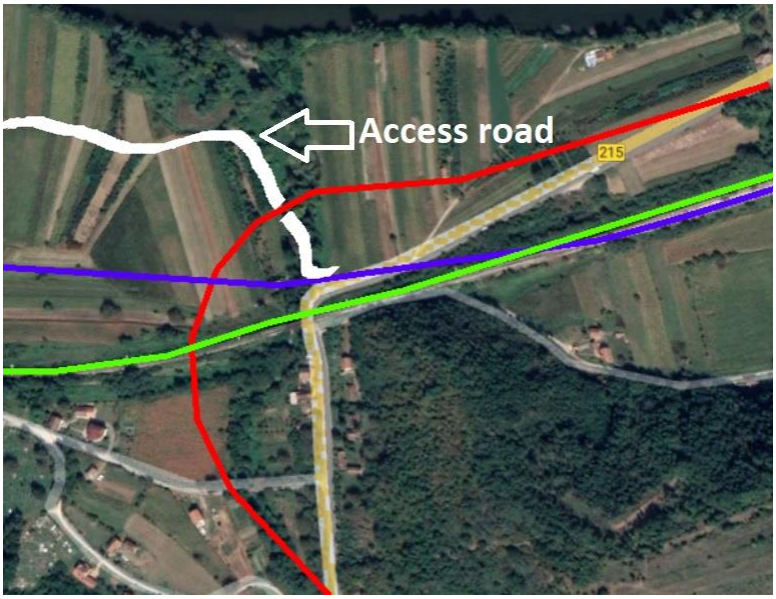
Impacts on agriculture. People engaged in agriculture currently use the level crossings on the existing railway. All level crossings will be closed, and two underpasses will be constructed. These underpasses have been designed in line with the 2012 Manual for Designing Roads in the Republic of Serbia (*Book*: Smaller Bridges and Underpasses, *Chapter*: Railway Underpasses). The Manual defines that underpass width must be 8-13 m and height must be 5-6 m. The width of underpasses designed for the subsection Stalac-Djunis is 12.90 m for the first one (at chainage 177+593,80), and 13.10 m for the second one (at chainage 188+341,02) which is deemed acceptable for passing of agricultural machinery.

However, consultations with local authorities conducted during the development of this Supplementary Study revealed their concerns about the planned underpasses (with regard to their dimensions and safety considerations). Therefore, mandatory consultations with local authorities during the final design stage are defined in the ESMP.

There are four specific locations with many cultivated land plots assessed for severance impacts (presented by order from the direction from Djunis to Stalac):

1) *Agricultural fields near the Djunis station:* The local unpaved access roads used by farmers currently connect with state road no. 215 (Kruševac–Djunis–Deligrad). This state road will be realigned. The planned railway will have a de-levelled intersection with this realigned road at one location. When the state road is realigned, it will be necessary to ensure connection between the mentioned local roads and the new (realigned) part of the state road in order to maintain the existing road communication and avoid cutting off of the local road which would endanger access to farmland. This is a proposed consideration included in the ESMP for the final design stage.

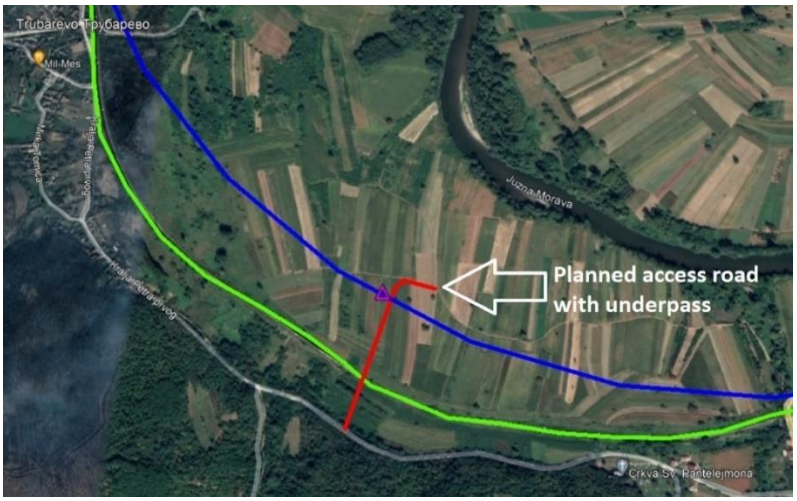
   The figure below shows:
   > the current route of the state road (yellow) and its planned realignment (red)
   > the current local road (white)
   > the existing railway line (green) and planned railway line (blue)



2) *Agricultural fields in Trubarevo:* The existing access roads in the Trubarevo settlement currently intersect with the existing railway by means of level crossings and enable access of local population to farmland on the other side of the railway. Since the new railway does not foresee any level crossings, an underpass to which a newly design access road will lead is planned on this location. The greatest distance from farmlands to the underpass will be around 1 km, which can be considered as a acceptable distance and therefore no impacts have been identified.

The figure below shows:

- the planned access road (red) with underpass (pink triangle)
- the existing railway line (green) and planned railway line (blue)



3) *Agricultural fields after Trubarevo:* A 290 m long viaduct leading into Tunnel 5 is planned above farmland in an unpopulated section after the Trubarevo settlement, so no access restrictions are expected.

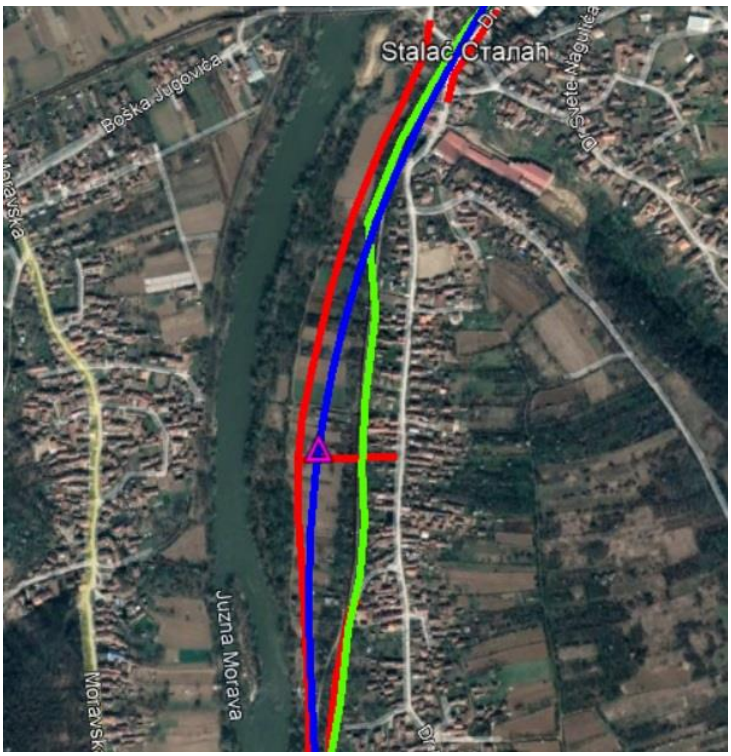
The figure below shows:

- the planned viaduct into Tunnel 5 (light blue)
- the existing railway line (green) and planned railway line (blue)

4) *Agricultural fields near Stalac:* Access to farmland will be enabled by means of an underpass. The greatest distance from farmlands to the underpass will be around 400-600 m, which is considered as appropriate and therefore no impacts have been identified.

The figure below shows:

> the planned access roads (red) and underpass (pink triangle)
> the existing railway line (green) and planned railway line (blue)



Furthermore, beekeeping is a highly developed activity in some parts of the Project area, specifically in the Stalac Gorge area where there are around 5000-6000 beehives. The bees fly from the Stalac Gorge to the Juzna Morava River to drink water or the Mojsinje Mountain. The railway will therefore be located on the path of bees' flight from the Stalac Gorge. However, this part of the railway will pass through multiple tunnels and therefore there will be no risks of collision with trains In terms of vibration and noise effects, it is not considered that these can impact significantly the beekeeping activities along the planned railway line as these are only sporadic, small-scale activities.

Construction-related impacts and risks. The Project area is not entirely a highly sensitive area in terms of community health, safety and security as the built-up area through which the railway line passes is mainly concentrated in Stalac (Municipality of Cicevac), while other areas are sparsely populated agricultural and forest areas. There are two other villages on the railway line (Trubarevo and Djunis) but the railway line passes through their outskirts. Since the identified vulnerable households live mostly in villages, it is not considered that construction activities will have a particular adverse effect on them. In addition, there are no Roma settlements along the planned railway line.

There will be some air pollution, noise and vibration impacts associated with construction and operation (the detailed assessments of air quality, noise and vibration effects are provided above in Chapters 8, 10 and 11 respectively) and a potential for impacts on water (the detailed assessment of is provided above in Chapter 7).

Construction activities may cause damage to local roads which is a concern that has been raised by the local communities during consultations carried out within the scope of this Supplementary Study.

Access to community infrastructure and cemeteries in part of the Project area belonging to the Municipality of Cicevac may be temporarily restricted during construction works.

Worker influx and GBVH risks are not expected to be significant based on the fact that the majority of the areas where construction works will be undertaken are areas distant from settlements and that the workforce is expected to be local to the extent possible.

15.3 Mitigation measures

Measures for minimising construction-related impacts and risks on surrounding communities are defined in the ESMP. The Contractor will be required to carefully plan the construction works by developing a Construction E&S Management Plan which will cover various topics such as noise and vibration management; air quality and dust management; traffic management; health, safety and security; and emergency preparedness and response.

Measures relevant to surrounding communities include (but are not limited to) the following:

- Construction compounds will be selected in consultation with affected communities.
- Local residents will be informed of the planned works and the potential periods of disruption.
- The construction site layout will be planned so that machinery and dust causing activities are, as far as reasonably practicable, located away from receptors (such as residential properties).
- Noisy construction equipment and equipment generating a lot of vibration will be located as far as possible from sensitive receptors.
- The Contractor will ensure access to all community infrastructure, roads and cemeteries in the Project area – in case of any unavoidable temporary access restrictions, the Contractor will inform the Municipality of Cicevac and City of Krusevac and the public in advance of works commencing.
- The Contractor will repair any damage caused by construction vehicles to public roads in a timely manner.
- A public grievance form will be available at construction sites.

16 Cultural Heritage

16.1 Supplementary Baseline Information

Assessment methodology. The 2016 ESIA provides a cultural heritage baseline for the wider area surrounding the Project. At the time of its development, the Location Conditions for the Project had not yet been issued, and only general information was available as provided by the Institute for Protection of Cultural Monuments in Kraljevo for the development of the Spatial Plan for this subsection. The ESIA lists nine cultural heritage and archaeological sites within 3 km of the proposed railway line, and only two are stated to be in the area of 250 m from the proposed route (the Church of "Sveti Pantelejmon" – cemetery church, and the archaeological site "Nikoljac" – remains of a medieval church). The impacts of building access roads were not analysed.

Due to the lack of more site-specific information and an assessment of possible impacts of not only the construction of the railway but also the planned access roads, the information has been supplemented to provide an **updated cultural heritage baseline** based on:

- visits to the Project area and discussions with municipal/city authorities in the Project area,
- review of the official opinions of cultural heritage institutions provided during the issuing of Location Conditions for the subsection in 2021,
- review of publicly available registries with georeferenced data on cultural heritage[130], and
- use of Google Earth imagery.

For the purpose of this assessment, a distance of approx. 600-700 m to the left and right from the axis of both the proposed new railway route as well as the planned access roads was considered. It is considered that significant effects are unlikely to occur beyond this distance.

Information received from cultural heritage authorities. For the purpose of obtaining the Location Conditions for this Project in 2021, the Institute for Protection of Cultural Monuments in Kraljevo was asked to provide an opinion on cultural heritage in the Project area. The Institute provided its official opinion in December 2021, stating that there are no sites on the route of the planned railway but listing three sites in its vicinity (along with defined measures needed to protect these sites). These sites are:

1. Archaeological site: Medieval Town of Trubarevo,
2. Protected church of "Sveti Pantelejmon" (cemetery church), and
3. Archaeological site "Nikoljac" with remains of a building thought to be a medieval church, in the immediate vicinity of the church of "Sveti Pantelejmon".

It should be noted that the Institute's opinion includes only sites in the vicinity of the planned railway, and not the planned access roads as well. No station buildings are listed as protected sites.

The Institute has also defined in its official opinion the following mandatory measures for the listed sites:

- SRI or the Contractor must inform the Institute about the planned earthworks not later than 15 days before the beginning of works;
- Supervision of all earthworks by an archaeologist must be ensured in the zones around the archaeological sites; the archaeologist is entitled to suspend the works in case of any chance finds and order protective archaeological research;
- If chance finds are encountered during any other works (which are not under the supervision of an archaeologist), the Contractor must immediately suspend works, take protection measures to prevent any damage and inform the Institute on the same day;
- The Institute is entitled to require additional measures for certain sites if deemed necessary based on site conditions;
- The Institute must be consulted for any additional works on railway facilities (such as station buildings);

130 www.a3.geosrbija.rs, www.heritage.gov.rs, www.nasledje.gov.rs

- Any changes in the Project will require the issuing of a new official opinion by the Institute.
- SRI must submit the Main Design to the Institute for review.

Information received from municipal/city authorities. The local authorities visited during the development of this Supplementary Study provided information that the area of the Mojsinje Mountain (through which the route of the new railway will pass for the most part through tunnels) is known for the fact that 77 churches and monasteries were built in that area in the Middle Ages. That is why this area is also called the "Little Serbian Holy Mountain". Unfortunately, only ruins of most of these buildings remain today.

The Municipality of Cicevac raised additional concerns regarding the impacts of building new access roads around tunnels on cultural heritage in the area (particularly the Church of "Sveta Nedelja" located near the exit of Tunnel 3 and entrance of Tunnel 4 – *please see the two tables below for further information on this church*). The Municipality requested to be consulted by the Project design team in the course of preparing the final design in order to discuss potential impacts.

The local authorities confirmed that none of the station buildings are protected buildings.

In addition, the Municipality of Cicevac noted that there is a regular kayaking competition held on the Juzna Morava River near Stalac, and expressed concern that construction works could potentially be negatively affected by construction works in case of an overlap in the schedule of the event and the beginning of works.

There are springs that are believed to cure blind and visually impaired people. According to representatives of the Municipality, these springs are located somewhere in the area between planned Tunnels no. 4 and 5.

Identification of cultural and archaeological sites. Based on all the collected information, the cultural and archaeological sites in the study area were identified, and their distance from the existing railway route as well as the distance from planned new railway route established. Table 44 right below provides a comparative overview of these cultural and archaeological sites in relation to the existing and planned route.

Note: Sites scoped in the further impact assessment based on their vicinity of the planned railway and/or access roads are additionally described in Table 45. It should be noted that assets located within the study area (600-700 m on both sides of the alignment) but which are on the opposite side of the river Juzna Morava (in relation to the planned alignment) are considered not to be under any significant risk and are scoped out from further assessment.

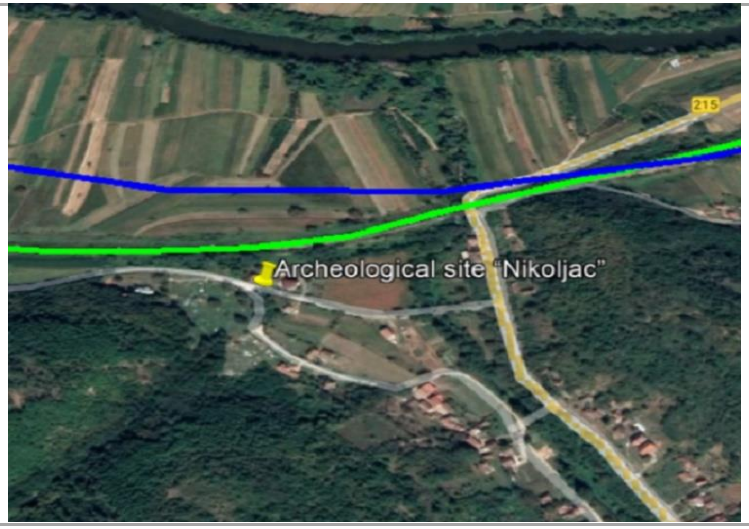
Table 44: Comparative overview of the position of cultural and archaeological sites in relation to the existing and newly planned railway route

Existing Railway	Planned Railway
The route currently passes near the following known cultural heritage sites of importance: > Church of "Duha Svetoga" (14th-15th century) on the opposite side of the river Juzna Morava approx. 550m away > Church of "Sveti Jovan" (14th century) on the opposite side of the river Juzna Morava approx. 400m away > Church of "Svetih Arhangela" (17th century) approx. 650m away > Church of "Sveti Nikola" (14th century) approx. 20m away > Church of "Sveti Pantelejmon" (cemetery church) approx. 50m away > Church of "Sveta Nedelja" on the opposite side of the river Juzna Morava approx. 400m away > Archaeological sites: 1) Church of "Sveti Sava" (Middle Ages) approx. 600m away, 2) Medieval Town of Trubarevo and remains of the medieval church (the narrower protection zone is approx. 400m away and wider protection zone is in the immediate vicinity of the existing railway approx. 50m); and 3) cemetery site	The new route will significantly be moved away (more than 500m) from the following cultural heritage/archaeological sites which were in the vicinity of the existing route: > Church of "Sveti Nikola" **(scoped out from further assessment)** > Archaeological sites: 1) Church of "Sveti Sava"; and 2) the narrower protection zone of Medieval Town of Trubarevo and remains of the medieval church **(scoped out from further assessment)** The new route will remain close to the following: > Church of "Duha Svetog" will remain at the same distance, i.e. 550 m away but on the opposite side of the Juzna Morava River **(scoped out from further assessment)** > Church of "Sveti Jovan" will be at approx. 200m away but on the opposite side of the Juzna Morava River **(scoped out from further assessment)** > Church of "Svetih Arhangela" (17th century) will remain at the same distance, i.e. 650 m away **(scoped in further assessment)**

Existing Railway	Planned Railway
"Nikoljac" including remains of the medieval church approx. 60m away (in the vicinity of the Church of "Sveti Pantelejmon")	> Church of "Sveti Pantelejmon" (cemetery church) at approx. 100m away **(scoped in further assessment)** > Church of "Sveta Nedelja" will be near the planned exit of Tunnel no. 3 and entrance of Tunnel no. 4, as well as the planned access road to Tunnel no. 4 **(scoped in further assessment)** > Archaeological sites: 1) the wider protection zone of Medieval Town of Trubarevo and remains of the medieval church will be approx. 200m away; 2) the cemetery site "Nikoljac" including remains of the medieval church approx. 150-180m away **(both scoped in further assessment)**

Table 45: Description of cultural and archaeological sites that may be affected by the planned route

Cultural heritage site	Location (GPS coordinates)	Heritage recognition	Description of Known or Potential Cultural Heritage Value or Interest	Digital Image (**blue line** = route of the planned new railway, **green line** = route of the existing railway, **red line** = planned access roads)
Archaeological site Medieval Town of Trubarevo – wider protection zone	Latitude: 43°37'14.52"N Longitude: 21°29'39.47"E	Archaeological site	The Institute for Protection of Cultural Monuments in Kraljevo has included this site among the three sites that are in vicinity of the railway and will need additional protection measures. This is a well-known archaeological site where the Institute has carried out previous archaeological research and conservation of found remains of walls. The narrower protection zone of the site is currently located at a distance of approx. 500m from the existing railway route. It sits on the southern side of the Gradište peak, surrounded by the Juzna Morava River on three sides, and on the existing Belgrade-Niš railway on the fourth (western) side. From the new railway, it will be approx. 1 km away (specifically, from planned Tunnel no. 5). The wider protection zone is currently in the immediate vicinity approx. 50m of the existing railway, but the new railway route will be moved 200m away from the site. However, it is important to emphasize that the new route in this part (200m away) passes through Tunnel no. 5, and that the distance from the closest point of wider protection zone from the entrance/exit of the tunnel will be approx. 700m. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site.	 

Cultural heritage site	Location (GPS coordinates)	Heritage recognition	Description of Known or Potential Cultural Heritage Value or Interest	Digital Image (**blue line** = route of the planned new railway, **green line** = route of the existing railway, **red line** = planned access roads)
Church of "Sveti Pantelejmon" (cemetery church)	Latitude: 43°36'5.18"N Longitude: 21°30'1.86"E	Cultural heritage under preliminary protection	The Institute for Protection of Cultural Monuments in Kraljevo has included this church among the three sites that are in vicinity of the railway and will need additional protection measures. The church was built at the beginning of the 20th century. It is located at approx. 50m from the existing railway from which it is separated by a local road. The new route of the railway is planned at a distance of about 100m from the church. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site.	
Archaeological site "Nikoljac"	Latitude: 43°36'5.04"N Longitude: 21°30'6.86"E	Archaeological site	The Institute for Protection of Cultural Monuments in Kraljevo has included this site among the three sites that are in vicinity of the railway and will need additional protection measures. The site is very close to the Church of "Sveti Pantelejmon" (see above), and is located at a distance of approx. 50m from the existing railway from which it is separated by a local road. The new route of the railway is planned at a distance of 150-180m from this site. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site.	

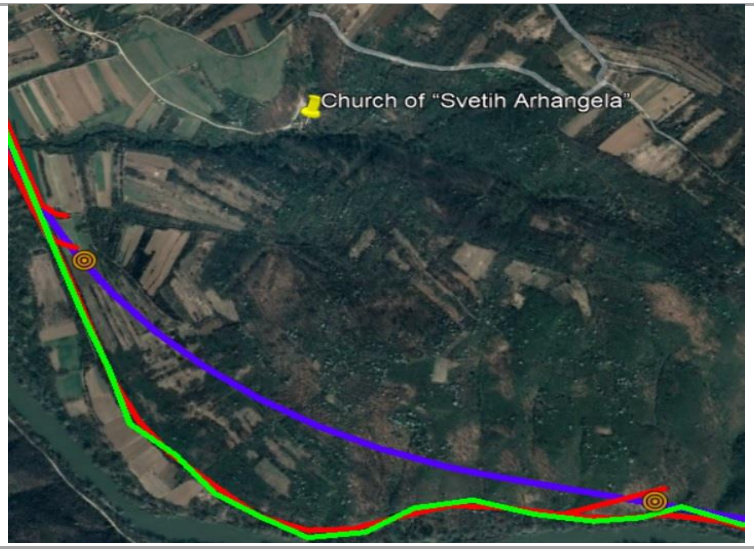
Cultural heritage site	Location (GPS coordinates)	Heritage recognition	Description of Known or Potential Cultural Heritage Value or Interest	Digital Image (**blue line** = route of the planned new railway, **green line** = route of the existing railway, **red line** = planned access roads)
Church of "Sveta Nedelja"	Latitude: 43°38'34.69"N Longitude: 21°27'1.76"E	Cultural heritage	This site is not listed in the official opinion of the Institute for Protection of Cultural Monuments in Kraljevo. The church dates back to the Middle Ages and is one of the rarest churches/monasteries (out of total of 77) that have been preserved in its original condition from that period. It is located near the planned exit of Tunnel no. 3 and entrance of Tunnel no. 4, as well as the planned access road to Tunnel no. 4. Due to this proximity, it will be necessary to pay particular attention to prevent cutting off of access to the existing road infrastructure which leads to the Church.	
Church of "Svetih Arhangela"	Latitude: 43°39'47.33"N Longitude: 21°25'22.66"E	Cultural heritage	This site is not listed in the official opinion of the Institute for Protection of Cultural Monuments in Kraljevo. The church dates to the 17th Century. The cultural event "Pod krilima Arhangela" (*Under the Wings of Archangel*) is held here every year in July. The church is currently located north-east from the existing railway at approx. 650m. Since the newly planned route follows the existing route in that area (to the point where Tunnel no. 1 is planned), the distance to the new alignment will remain the same.	

Table 46: Photographs of relevant cultural and archaeological sites that may be affected by the planned route

Cultural heritage site	Photograph
Archaeological site Medieval Town of Trubarevo – wider protection zone	 (walls of the fortress remains visible behind the trees)
Church of "Sveti Pantelejmon" (cemetery church)	
Archaeological site "Nikoljac"	
Church of "Sveta Nedelja"	 
Church of "Svetih Arhangela"	

16.2 Identification of Impacts

The 2016 ESIA Study does not anticipate any direct impacts on visible cultural heritage but assesses the sensitivity of the Project area in respect to archaeology as medium to high. Archaeological surveillance and a chance find procedure are proposed as measures to mitigate any potential impacts.

The analysis conducted within the scope of this Supplementary Study has confirmed that no cultural or archaeological sites are located on the route of the railway and that construction of new access roads will not lead to any direct impacts on cultural heritage. However, five known assets have been identified that could be potentially affected by construction activities and movement of machinery, and therefore require mitigation measures. These are:

1) Archaeological site: Medieval Town of Trubarevo,
2) Protected church of "Sveti Pantelejmon" (cemetery church),
3) Archaeological site "Nikoljac" with remains of a building thought to be a medieval church,
4) Church of "Sveta Nedelja", and
5) Church of "Svetih Arhangela".

With regard to the Church of "Sveta Nedelja" and the Municipality's concerns about the possible cutting-off of access to this church, it is considered that the possibility of endangering the access road to this church is high, so an adequate access road to this facility should be foreseen in the final design.

With regard to the Church of "Svetih Arhangela", it is considered that no construction related impacts such as dust or noise are likely as it is located approx. 650m from the planned Tunnel no. 1. However, there is an annual religious event held in front of the church every July titled "Pod krilima Arhangela" (Under the Wings of Archangel) - the access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the important dates to minimise any impacts.

In addition, the likelihood of encountering previously unfound archaeological heritage in the Project area is assessed as high.

It should be noted that based on calculations of vibration intensity, no vibration impacts on any known cultural assets are expected.

For the operational phase, the Project is not anticipated to have a significant effect on cultural heritage, but operational maintenance activities which could lead to disturbances or damage to cultural heritage will also need to be carefully planned.

16.3 Mitigation Measures

Measures for protection of both known and previously unrecorded heritage for the construction and operation phases are provided in the ESMP. The Contractor will be required to develop a Cultural Heritage Management Plan which will cover the following:

- consultations with the Municipality of Cicevac during the final design stage of the Project as well as the development of the Cultural Heritage Management Plan;
- supervision of all earthworks by an archaeologist;
- specific actions and measures to manage risks and impacts to the above listed cultural heritage sites as well as local cultural events in the Project area and water springs that are considered to be intangible cultural heritage; and
- development of a Chance Find Procedure detailing necessary steps to be taken should any culturally significant assets be found.

17 Gender

17.1 Supplementary Baseline Information

The 2016 ESIA does not provide any baseline information on gender aspects. There is also a lack of information on the legal framework and the implementation of gender mainstreaming in SRI key policies and procedures. Therefore, information on the established policies on prevention of harassment and violence in SRI as well as a gender analysis based on additional field work and discussions with municipal/city authorities and local communities is included in this Supplementary Study.

Established gender policies in SRI. SRI's Gender Equality Code was adopted in 2018[131]. Its provisions are in line with the National Strategy for Gender Equality 2016-2020, the Law on Prohibition of Discrimination[132] and the Law on Gender Equality[133]. In addition, recommendations of the national Commissioner for Equality and the Community of European Railway and Infrastructure Companies and European Transport Workers Federation were also taken into account when drafting the Equality Code. According to the Code, SRI employees are required to respect gender equality and combat all forms of discrimination. The Code allows employees to file gender discrimination grievances. SRI's Ethics Committee is responsible for monitoring the implementation of the Gender Equality Code. Furthermore, SRI has adopted a Code of Business Ethics which sets out the general rules for conduct of employees and the course of action in cases of workplace harassment.

Gender Equality Index in Serbia. According to the third Gender Equality Index[134] (2018), Serbia scored 58 points out of 100. Since 2014, Serbia has recorded an increase of 5.6 points indicating continuous but slow progress in achieving gender equality.[135] However, compared to the Western Balkans (EU candidate countries), Serbia recorded a lower index score than Albania and North Macedonia, but a higher score than Montenegro. Compared to the EU-27[136], Serbia has a gap of 9.4 points, with the largest gap in the domain of money (21.9) and time (16.2).[137]

Gender aspects of transport workforce. According to most recent statistical data, women make up more than half of the population (51.3%) while men account for 48.7%. An analysis of labour force participation in 2020 [138] showed that the employment rate of men amounted to 56.6% while the rate of women was 42.1% (14.5% lower than the men's employment rate).[139] In 2019, women were more interested in academic fields such as health (71%), arts (68%) and science (66%), while men were more represented in engineering, manufacturing and construction (57%), as well as information and communication technologies (66%).[140] Gender specific characteristics in the labour market are also present in the transport sector. In general, the transport sector in Serbia employs mainly men (80% of employees are men)[141]. Women make up 19.2% of SRI employees. Even though there were no women in SRI's Board of Directors in 2021, the proportion of women in managing positions showed an increase of 15.5% compared to the previous year. In the same year, the number of women at positions of Department/Centre Directors rose by 4.9%. A significant share of traffic management, electric and construction activities in SRI are carried out by women.

[131] Official Gazette of RS, No. 63/18
[132] Official Gazette of RS, No. 4/16
[133] Official Gazette of RS, No. 104/09
[134] The Gender Equality Index tracks achievement levels and gender equality in six domain areas: labour, money, time, knowledge, power, health and intersecting inequalities and violence against women.
[135] Gender Equality Index for the Republic of Serbia, 2021
[136] EU-27 represents 27 member states of the EU after the withdrawal of the UK from the EU.
[137] Gender Equality Index for the Republic of Serbia, 2021
[138] Statistical Office of the Republic of Serbia, Statistical Yearbook of the Republic of Serbia, 2021
[139] Statistical Office of the Republic of Serbia, Labour Force Survey 2020
[140] Statistical Office of the Republic of Serbia, Women and Men in the Republic of Serbia, 2019
[141] Gender Equality in Transport in Serbia, 2019

Gender mobility patterns. Gender mobility patterns are associated with different transport needs and purposes, as well as different transport modes, as highlighted in the Study on Gender Equality in Transport in Serbia[142]. In fact, both genders make more trips during the week than on weekends, but slight gender differences in mobility patterns are reflected in the fact that women make more trips (3.9 trips/day) per day than men (3.6 trips/day). Only 16% of women drive a car on their trips, compared to a higher proportion of men (40%) who prefer to drive themselves. This indicates that women in Serbia are more dependent on transportation service providers, suggesting that they use more different modes of transport. The Study on Gender Equality in Transport also found that public transport and walking are the most frequently used modes by women, 23% and 39%, respectively.[143] Driving licence ownership rates (for cars and motorcycles) are much higher among men than women, 71% and 35%, respectively.[144]

Importance of reliable public transport for women in rural areas. Mobility patterns contribute significantly to economic development, education, access to public services, etc. Due to their mobility patterns, women in rural areas depend on others for transport and are very often driven by a family member (42%).[145] A quarter of rural population (26%) - compared to the urban population (13%) - reported various obstacles in using public transport during commuting: poor public connections, lengthy public transport journeys and lack of reliability of public transport.[146] These obstacles have a significant impact on rural women, who happen to use transport service providers more frequently than men. In this context, 44% of rural women - compared to 29% of men - reported that public transport journeys take too much time. Regarding the reliability of public transport, 39% of women believe that public transport is unreliable, compared to 28% of men.[147]

Safety and security in transport. The study prepared by the Road Traffic Safety Agency shows that women are at risk as passengers in cars and pedestrians. Consistent gender differences contribute to perceptions of safety and security in transport. Namely, the Survey on Gender Equality in Transport found that on a scale 1 to 6 (1 not safe at all, 6 very safe) women feel less safe when using trains (4.1) than men, who gave a slightly higher score (4.3).[148]

Violence against women. The findings of the Survey on Violence Against Women conducted by OSCE-LED[149] show that five out of six of the women surveyed believe that violence against women is common.[150] After the age of 15, 42% of women reported having experienced some form of sexual harassment, while 23% of women reported having been subjected to the most severe forms of sexual harassment.[151]

Information obtained during field work. The results of discussions with local authorities and local communities in the Project area with regard to gender aspects are summarised as follows:

- Representatives of the local authorities in the Project area have reported that they do not perceive any differences in the needs and experiences of rail use between men and women. There are no gender differences in use of the railway in the Project area in terms of frequency of use - both men and women use the railway equally.
- Elderly and elderly single households in the villages are identified as the most vulnerable groups. There are rarely any households headed by women. The Community Social Work Centers work closely with humanitarian movements such as the Red Cross in distributing food and hygiene packages for these households. In addition, the Red Cross also provides health services in the villages.

[142] Gender Equality in Transport in Serbia, SeConS Development Initiative Group and Dornier Consulting International GmbH, 2019
[143] Gender Equality in Transport in Serbia, 2019
[144] Ibid.
[145] Gender Equality in Transport in Serbia, 2019
[146] Ibid.
[147] Ibid.
[148] Gender Equality in Transport in Serbia, 2019
[149] The conducted survey included women from various backgrounds (such as Roma women, etc.)
[150] Well-being and Safety of Women, 2019
[151] Gender Equality Index for Serbia, 2021

- As there is no organised public transport in these settlements and the majority of the elderly households do not own a car, they will be impacted by the closure of stations and halts.
- The importance of the safety of underpasses was highlighted (which is particularly important for women), which should be designed to be open and accessible, with adequate lighting, regular maintenance, and separation of pedestrians and motor vehicles.

17.2 Identification of impacts

The 2016 ESIA does not address the Project's impacts on gender except for the positive impact of employment opportunities for local communities that may arise within the Project supply chain because indirect employment is likely to provide more opportunities for women, as opposed to direct employment which will most likely involve more men.

Therefore, gender impacts have been assessed in this Supplementary Study. Gender dimensions of the Project require appropriate consideration in terms of needs, preferences and priorities, particularly in the design stage.

The following gender risks related could be expected during the construction and operation phase:

Construction phase	- Potential GBVH because of the influx of construction workers – applicable primarily to the settlement of Stalac
Operational phase	- Closure of stations/halts will potentially impact more women in rural areas since they often depend on transport service providers. This could also lead to further depopulation in villages if adequate alternative public transport options are not provided - Potential GBVH against women when walking to train stations/halts - Potential discrimination against SRI female workers as drivers - Possible concerns among women for use of underpasses as pedestrians, especially at night if the underpasses are not appropriately designed

On the other hand, **the Project has the potential to positively contribute** to the improvement of the following aspects:

- Safer public transport which is especially important for women as they often depend on transport service providers for travel. In addition, the two stations Djunis and Stalac will be reconstructed in line with European standards; the design features will likely contribute to greater perceptions of safety among women.
- More available, reliable and quicker transport for women who use the railway, particularly rural women (according to the 'Gender Equality in Transport in Serbia' study, almost half of rural women reported that public transport journeys take too much time, and more than two thirds believe that public transport is unreliable).
- Development of rural tourism and economic opportunities for women in rural areas – improved and quicker railway operations will likely contribute to more people visiting this area from different parts of the country. The area has a significant number of cultural heritage sites which are tourist attractions. Rural tourism would not only contribute to economic but social development as well. In addition to income generation, the development of agri-rural tourism would contribute to the improvement of the quality of life of the residents, prevent further rural exodus and isolation of rural women.

17.3 Mitigation Measures

Measures to address these impacts and risks have been included in the ESMP. The Contractor will include in its Construction Workers' Code of Conduct provisions on managing GBVH risks, and Contractor's staff will receive training on this issue. For the operation phase, SRI will develop a Gender Plan.

18 Labour and OHS

The ESIA considers the following potential labour and OHS impacts/risks:

Construction phase	> OHS risks (work at heights, slips and falls, moving machinery, workers struck by objects, dust and asbestos-fibres dust, confined spaces and excavations and biological hazards (poisonous snakes)) > Positive employment and procurement impacts (opportunities)
Operational phase	> OHS risks (train/worker accidents in the vicinity of rail lines, noise and vibration from rolling stock and machinery, electrical hazards during work on overhead wires or conductors, electric and magnetic fields due to working in proximity to electric power lines, fatigue in case of working irregular work hours, confined spaces and excavations, and biological hazards (poisonous snakes))

In addition to the impacts listed in the ESIA, the following potential negative OHS impacts and risks have been considered during the development of this Supplementary Study:

1. Workers' accommodation (camps) will be needed for the Project. Their locations have not been determined yet. This will be the responsibility of the Contractor. For LOT 1, the Contractor is currently in the phase of preparation for identifying a location. As defined in the ESMP, worker accommodation will need to be provided by the contractors in line with national legislation and the EBRD/IFC Guidance Note "Workers' accommodation: processes and standards".
2. SRI and the Contractor will be required to implement the provisions of the Labour Law of Serbia which regulates all issued related to employment and labour. To minimise any labour and employment related risks and ensure the Contractor adheres to labour procedures and policies, an independent labour audit at regular frequency during construction is proposed in the ESAP. In addition, to ensure full compliance with the Lenders' requirements, the ESMP requires the establishment of a grievance mechanism for workplace concerns both during construction and operation.
3. The Project will require the closure of some stations along the existing railway line. SRI is not planning any staff dismissals, so the current staff working at these stations will be prequalified and reallocated to other jobs. Since there are no specific plans developed yet for this reallocation, measures to minimise any impacts on the workforce that will be reallocated in terms of level of pay and other benefits, years of service, types of contracts, etc. have been included in the ESAP.

19 Land Acquisition

There has been no land acquisition needed for LOT 1 of the Project – the land needed for the exit and entrance portals to Tunnel 4 was already owned by SRI, whereas land needed for access roads is public land. However, some land acquisition and resettlement will be unavoidable for LOT 2. Land issues and impacts are described in detail in the **Resettlement Action Plan** (RAP) developed for this Project in line with EBRD and EIB requirements.

The design philosophy has been to avoid or, at least, minimise, Project-induced resettlement, where avoidance is not possible. Based on the Preliminary Design, an Expropriation Study was prepared but it was determined that some properties may be avoided by minimal changes to the expropriation line so the Expropriation Study has been submitted for redrafting and confirming the avoidance of impacts on identified properties. Its finalisation is pending.

The Project requires the acquisition and clearing of approx. 79 Ha of land, of which approx. 43% is privately owned. The total number of land plots which will be affected is 877, of which 86% are privately owned. It should be noted that a significant number of land plots are planned to be only partially acquired. The table below provides an overview of the Project's impacts within the expropriation corridor.

Table 47: Total affected land area and plots affected by land acquisition

Ownership	No. of land plots to be fully acquired	No. of land plots to be partially acquired	Total area (in Ha)	% of acquired area (average)
Privately owned	129	621	33,97	21%
Publicly owned	49	78	44,97	17%
TOTAL	*178*	*699*	*78,93*	*18%*

Some structures will be affected as well, all located on the territory of Municipality of Cicevac, summarised as follows:

Table 48: Structures affected by land acquisition

Inhabited privately owned houses, one with business space	2
Inhabited houses owned by SRI	2
Inhabited apartments owned by SRI	3 structures (5 apartments)
Uninhabited house or occasionally used weekend houses	1
Non-residential structures (barn, storage, shed, etc.)	15
Structure in ruins – privately owned	3
Structure in ruins – owned by SRI	3
Business structure/premises (operational business)	2
Municipal office space and empty business space	2
Football field on SRI land	1
TOTAL	*34*

Figure 46: Residential buildings near the Stalac station

The information presented in the tables above excludes any temporary land that may be required temporarily during construction (e.g., for construction camps, material laydown areas, storage of topsoil and excavated materials). As stated in the RAP, the preferred areas of land which will be used for these purposes are any unused public land plots and if this is not possible, the Contractor will purchase and/or rent land from private landowners, based on voluntary agreements. It is expected that additional temporary land required by the Contractor will be acquired through negotiation and amicable agreements with landowners and there will be no involuntary displacement.

Further information on land and persons affected by the Project are provided in the RAP which also describes the resettlement process for the Project in line with both the national legislation and Lenders' requirements.

20 Cumulative Impacts

Cumulative impacts which may arise from Project implementation are analysed from two aspects:

- cumulative impacts as a result of other projects developed or planned in the observed area, and
- cumulative impacts as a result of multiple actions and activities from railway construction and operation.

For the purpose of identifying other projects developed or planned in the Municipality of Cicevac and the City of Krusevac, the *Spatial Plan of the Railway Stalac-Djunis* and the *Spatial Plan of RoS 2021-2035* have been analysed. Additional information on planned projects in the observed area were gathered during site visits and through media search.

Table 49: Planned projects in the observed area

Project	Brief description	Time schedule
Construction of the Pojate-Preljina motorway (so-called Morava corridor)[152] with access roads	The planned highway length is 112.3 km, and it will pass through or near the towns of Cacak, Kraljevo, Vrnjacka Banja, Trstenik, **Krucevac**, **Stalac** and **Cicevac**.	The works started in December 2019 and are planned to be completed in 2024.
Reconstruction and electrification of Lapovo-Kragujevac-Kraljevo-Raska-Novi Pazar and Stalac-Krusevac-Kraljevo-Pozega railway lines[153]	It is planned to modernise the basic railway routes in order to connect important economic centres.	Timeframe is not known.
Construction of small hydropower plants in the settlement of Stalac	The construction of 5 mini hydropower plant on the Juzna Morava in the settlement of Stalac is planned[154].	In September 2021, the Municipality of Cicevac issued a decision to ban this proposed project on its territory so the project was suspended.
Reconstruction of the municipal road Stalac-Trubarevo[155]	Reconstruction of the 16.1 km long municipal road Stalac Town-Trubarevo is planned, together with the reconstruction and construction of a modern road surface in total length of approx 9 km, with widening of the road to 6 m and enabling appropriate drainage and renewal of signalisation.	Timeframe is not known.
Construction of a chicken farm	According to information from December 2021, it is planned to build a chicken farm in Mali Stalac in the Municipality of Cicevac[156].	Project implementation stage is not known.

Although some of the planned projects have been suspended or their stage of implementation is not known, these projects have nevertheless been scoped in the further assessment of cumulative impacts.

Based on the presented baseline information in the ESIA and this Supplementary Study, as well as potential impacts and identified planned projects in the vicinity, a final assessment of cumulative impacts has been carried out (Table 50) utilising the following scale:

Positive cumulative impact	Positive cumulative impacts as a result of multiple actions and activities are expected.
Negligible cumulative impact	There are no significant cumulative impacts.
Minor cumulative impact	The expected impacts are small in scope and will be localised in the Project area.
Moderate cumulative impact	The expected impacts are significant and distributed throughout the Project area.
High cumulative impact	The expected impacts are very significant and distributed throughout the Project (and wider) area.

[152] https://www.slobodnaevropa.org/a/30326583.html
[153] Information from the *Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Stalac-Djunis*
[154] https://krusevacpress.com/opstina-cicevac-stop-izgradnji-mini-hidroelektrana/
[155] Ibid.
[156] https://www.novosti.rs/drustvo/vesti/1065210/nova-farma-700-000-evra-velika-investicija-malom-stalacu

Table 50: Potential cumulative impacts as a result of Project implementation

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
Air quality	Construction	> Increased emission of exhaust gases generated during the simultaneous work of construction machinery engaged on this Project and other projects in the Project area of influence (especially during the transport of construction materials, movement of construction equipment and excavation works) > Increased dust emissions from the movement of vehicles on local dirt roads, when two or more projects use the same local infrastructure	> Population in settlements along the route > Workers > Flora and fauna along the route > Agricultural land/crops	Moderate
	Operation	> The railway will be fully electrified, so air emissions are not expected > Project implementation will have positive impacts on the environment due to the expected modal shift from road to rail traffic		Negligible
Noise and vibration	Construction	> Increased noise/vibration levels generated by simultaneous use of construction machinery, especially in case of nearby road/motorway construction > Increased noise/vibration levels generated by increased traffic through local settlements, when two or more projects use the same local infrastructure	> Population in settlements along the route > Workers > Habitats and fauna along the route > Small-scale beekeeping along the railway	Moderate
	Operation	> With construction of noise barriers, negative impacts from railway/motorway operation are not expected. > No vibration impact is expected.		Negligible
Soil quality	Construction	> Increased concentration of hazardous substances in soils due to accidental spills on the construction sites active at the same time. > Impact on soil texture and soil subsidence in case machinery on different projects uses the same dirt road for movement	> Groundwaters > Surface waters > Flora and fauna along the route > Population using the land for agricultural purposes	Minor
	Operation	> Increased concentration of hazardous substances in soil due to simultaneous use of pesticides in agriculture and maintenance of railway right of the way > Increased concentration of hazardous substances in soil in case of simultaneous accidental spillage of hazardous substances from trains and vehicles on the motorway. However, the probability that this impact will occur is very low.		Moderate
Water quality	Construction	> Increased concentration of hazardous substances in water due to accidental spills on construction sites active at the same time > Increase leakage from inappropriately disposed waste/spoil from construction activities	> Surface waters > Groundwaters and aquifers	Moderate

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
	Operation	> Increased concentration of hazardous substances in water, leaching from the soil due to simultaneous use of pesticides in agriculture and maintenance of railway right of the way > Increased concentration of hazardous substances in water, directly discharged or leaching from the soil, in case of simultaneous accidental spillage of hazardous substances from trains and vehicles on the motorway. However, the probability that this impact will occur is very low	> Local population and workers	Moderate
Biodiversity and nature	Construction	> Negative impact on biodiversity (habitat fragmentation and loss) due to simultaneous implementation of several linear projects that will require fencing (railway/motorway) > Negative impact on natural movement of animals as a result of temporary increase in population and equipment in the Project area	> Habitats > Fauna	Minor
	Operation	> Habitat fragmentation will remain as an impact in the operational phase. Due to a large number of bridges and tunnels, wildlife passages are not needed for the Stalac-Djunis section. Installation of wildlife passages and culverts is, however, planned for the Morava Corridor motorway. The significance is difficult to assess, and it is estimated that animals will adapt to new conditions and passages > Fauna disturbance by noise and light will be marginal		Negligible
Land use	Construction	> Only in case of simultaneous implementation with other projects, a negative cumulative impact on land use change (both temporary and permanent) can occur	> Agricultural land > Local population	Minor
	Operation	> No cumulative impacts are likely during operation		Negligible
Landscape	Construction	> Negative cumulative impact on landscape may occur due to simultaneous implementation of other projects in the vicinity – increased frequency in use of construction equipment and possible deforestation and removal of vegetation	> Forest and agricultural land > Visual receptors: Population in settlements along the railway alignment	Moderate
	Operation	> Negative impact on landscape in the zone where new several projects intersect. The landscaping activities (revegetation of the area) will be mandatory to compensate for visual impacts arising from a proposed Project.		Moderate
Waste/materials use	Construction	> Negative impacts on water and/or soil due to inappropriately handled/disposed waste/spoil from multiple construction activities > Inadequate materials storage on multiple construction sites can cause leakage of hazardous materials into water and/or soil > Increased generation of municipal waste in workers camps that are active at the same time	> Surface water > Soil > Population in settlements along the railway alignment > Workers	Moderate
	Operation	> During operation of the railway and roads/motorways, waste generation in greater quantities can be expected only in case of any major reconstruction activities occurring at the same time. However, the probability of any environmental impacts		Negligible

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
		caused by improperly disposed waste generated during maintenance activities is very low		
Community health and safety	Construction	> Negative cumulative impact on community health and safety can occur due to the simultaneous development of several projects in the observed area, which can lead to more frequent and prolonged interruptions in traffic flow and access to facilities > A negative potential impact may occur in the summer months when more tourists visit the Project area, as well as during religious holidays when the frequency of vehicles is increased	> Population > Local economy > Workers	Moderate
	Operation	> The main negative impacts that may occur during operation are related to traffic interruptions in case of train breakdowns and simultaneous disruption of road traffic due to construction works or accidents		Minor
Employment and procurement opportunities	Construction	> The simultaneous implementation of multiple projects, there may be an increase in employment in the Project area.	> Local population > Local economy	Positive
	Operation	> Railway infrastructure modernisation is expected to lead to better connections with other parts of the country which opens opportunities for the development of the local economy. Along with the implementation of other projects, there will be possibilities of employment of the local population.		Positive

21 Appendices

A. Location Conditions and Opinions

	Name	Date	Language
1.	Cicevac – Copy of cadastral plan of lines	2021	Serbian
2.	Krusevac – Copy of cadastral plan of lines	2021	Serbian
3.	Excerpt of cadastral plan of lines (dwg file)		
4.	Copy of cadastral plan of lines – CM Braljina 1 + dwg file	2021	Serbian
5.	Copy of cadastral plan of lines – CM Braljina 2 + dwg file	2021	Serbian
6.	Copy of cadastral plan of lines – CM Braljina 3 + dwg file	2021	Serbian
7.	Copy of cadastral plan of lines – CM Lucina + dwg file	2021	Serbian
8.	Copy of cadastral plan of lines – CM Mojsinje + dwg file	2021	Serbian
9.	Copy of cadastral plan of lines – CM Pepeljevac	2021	Serbian
10.	Copy of cadastral plan of lines – CM Stalac + dwg file	2021	Serbian
11.	Copy of cadastral plan of lines – CM Trubarovo + dwg file	2021	Serbian
12.	Response to the request for the issuance of location conditions for the (re)construction of the railway and facilities on the section Stalac-Djunis (Ministry of Construction, Transport and Infrastructure)	Nov 2021	Serbian
13.	CETIN (optical main infrastructure) – response to the request for the issuance of conditions for the (re)construction of the railway in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	Dec 2021	Serbian
14.	Electricity distribution of Serbia (Krusevac branch) – response to the conditions for crossing and parallel lining for the construction of the railway Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	Dec 13, 2021	Serbian
15.	Electricity distribution of Serbia (Krusevac branch) – response to the conditions for crossing and parallel lining for the construction of the railway Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	Dec 09, 2021	Serbian
16.	Ministry of Construction, Transport and Infrastructure – response to the request for the development of location conditions for the (re)construction of the railway Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	2021	Serbian
17.	Public utility company "Razvitak" Cicevac – response to the issuance of location conditions (water supply and sewerage network)	Dec 2021	Serbian
18.	Public utility company "Varvarin" Varvarin – response to the issuance of location conditions	Dec 2021	Serbian
19.	Public company Roads of Serbia – response to the issuance of location conditions for the (re)construction of the railway Stalac-Djunis	Dec 2021	Serbian
20.	Public company Serbia Gas – conditions for preparation of technical documentation and approval with conditions for conducting works in the protective belt of the gas pipeline, in order to issue location conditions for the (re)construction of the railway Stalac-Djunis	Dec 2021	Serbian
21.	Ministry of Environmental Protection – opinion at the request of the Ministry of Agriculture, Forestry and Water Management/Republic Water Directorate in the procedure of issuing water conditions and the procedure of development technical documentation for (re)construction of railway and facilities on the section Stalac-Djunis in CMs Lucina, Stalac, Braljina , Mojsinje, Trubarovo on the territory of the municipality of Cicevac and KO Djunis on the territory of the city of Krusevac	Dec 2021	Serbian
22.	Ministry of Internal Affairs – notification on the amount of the republic administrative fee to be paid from the applicant	Dec 2021	Serbian
23.	Ministry of Internal Affairs, Department for Emergency Situations in Krusevac – response to the request for issuing conditions regarding fire protection measures for	Dec 2021	Serbian

	Name	Date	Language
	the (re)construction of the railway and facilities on the section Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo on the territory of municipality of Cicevac and CM Djunis on the territory of the city of Krusevac		
24.	Ministry of Internal Affairs, Department of Emergency Situations, Directorate for Preventive Protection – Conditions regarding fire protection measures	Dec 2021	Serbian
25.	Ministry of Agriculture, Forestry and Water Management – Water conditions in the process of preparation of technical documentation for the construction of the railway and facilities on the section Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo in the municipality of Cicevac and CM Djunis in Krusevac	Dec 2021	Serbian
26.	Republic Hydrometeorological Institute – opinion at the request of the Republic Water Directorate of the Ministry of Agriculture, Forestry and Water Management for the (re)construction of the Belgrade-Nis railway, Stalac-Djunis section	Dec 2021	Serbian
27.	Republic Institute for the Protection of Cultural Monuments – Technical protection measures for the preparation of the project of (re)construction of electrical plants and installations on the railway Stalac-Djunis	Dec 2021	Serbian
28.	Serbian Cable Networks – Response to the request for issuance of conditions for the conceptual design of the railway Stalac-Djunis in CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	Dec 2021	Serbian
29.	Srbijasume – Response to the request for delivery of conditions for the needs of (re)construction of the railway Stalac-Djunis, CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis	Dec 2021	Serbian
30.	Public Water Management Company Srbijavode and Morava Nis – Issuing opinions in the procedure of issuing water conditions and the procedure of preparing technical documentation for the (re)construction of the railway and facilities on the section Stalac-Djunis	Dec 2021	Serbian
31.	Telecom Serbia – Technical conditions for the (re)construction of the Stalac-Djunis railway	Dec 2021	Serbian
32.	Public utility company for water supply and sewerage „Vodovod Krusevac“ – Preliminary conditions for (re)construction of the railway Stalac-Djunis (+ dwg file)	Dec 2021	Serbian
33.	Institute for the Protection of Cultural Monuments Kraljevo – conditions for undertaking technical protection measures in the process of issuing location conditions for the (re)construction of the railway Stalac-Djunis (CMs Lucina, Stalac, Braljina, Mojsinje, Trubarovo and Djunis)	Dec 2021	Serbian
34.	Institute for Nature Protection of Serbia – Issuance of nature protection conditions for the purpose of issuing location conditions for the (re)construction of the Stalac-Djunis railway	Dec 2021	Serbian
35.	Public utility company “Gradska toplana Krusevac” – Providing conditions for the railway Stalac-Djunis	Dec 2021	Serbian
36.	Public enterprise for urban planning and design Krusevac – conditions for connection to public roads, (re)construction of roads managed by the City of Krusevac, as part of the (re)construction of the railway Stalac-Djunis	Dec 2021	Serbian
37.	Ministry of Construction, Transport and Infrastructure – Location conditions for the (re)construction of the railway and facilities on the Stalac-Djunis section	Dec 28, 2021	Serbian
38.	Ministry of Defence, Sector for Material Resources, Directorate for Infrastructure – Conditions and requirements for adaptation to the needs of the country's defence	Dec 2021	Serbian

B. Climate Risk Assessment - World Bank Climate and Disaster Risk Screening Tool

Climate & Disaster Risk Screening Tools

Climate and Disaster Risk Screening Report for Stalac-Djunis High Speed Railway in Serbia[157]

Project Information

Project Title:	Stalac-Djunis High Speed Railway
Project Number:	014/22
Project TTL:	Stalac-Djunis High Speed Railway
Assessment completed by:	Sanita Dzino
Estimated timeline for PCN Year:	2022
Estimated timeline for PCN Quarter:	Q1
Screening Tool Used:	In-depth screening

The Climate and Disaster Risk Screening Tool provides a high-level screening to help consider short- and long-term climate and disaster risks at an early stage of project design. The tool applies an Exposure – Impact – Adaptive capacity framework to characterize risks. Potential risks are identified by connecting information on climate and geophysical hazards with users' subject matter expertise of project components (both physical and non-physical) and understanding of the broader sector and development context.

The tool does not provide a detailed risk analysis. Rather, it is intended to help inform the need for further consultations, dialogue with local and other experts and analytical work at the project location to strengthen resilience measures in the course of project design.

[157] This is the output report from applying the World Bank Group's Climate and Disaster Risk Screening Project Level Tool (Global website: climatescreeningtools.worldbank.org; World Bank users: wbclimatescreeningtools.worldbank.org). The findings, interpretations, and conclusions expressed from applying this tool are those of the individual that applied the tool and should be in no way attributed to the World Bank, to its affiliated institutions, to the Executive Directors of The World Bank or the governments they represent. The World Bank does not guarantee the accuracy of the information included in the screening and this associated output report and accepts no liability for any consequence of its use.

Summary Climate and Disaster Risk Screening Report

1. Exposure of the project location: This step assesses the current and future exposure of the project location to relevant climate and geophysical hazards.

Exposure ratings for climate and geophysical hazards that are likely to be relevant to the project location both in the present and in the future:

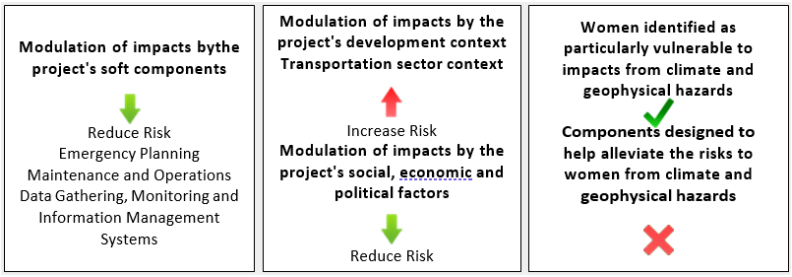
	Climate Change Hazards					Geophysical Hazards		
	Extreme Temperature	Extreme Precipitation and Flooding	Sea Level Rise	Storm Surge	Strong Winds	Earthquake	Landslides	Wildfires
Current								
Future								

2. Impacts on the project's physical components: This step assesses the current and future impacts of identified climate and geophysical hazards on the project's physical components as currently designed under relevant subsectors.

Impact ratings for relevant project subsectors:

Impact	
	Rail
Current	
Future	

3. Adaptive Capacity – modulating effect of the project's non-physical components and development context: This step assesses how the project's non-physical components, together with its broader development context, modulates potential impacts from climate and geophysical hazards. This step also considers particularly vulnerable groups, namely women, migrants and displaced populations.



4. Risk to the outcome/service delivery of the project: This step assesses the level of risk to the outcome/service delivery that the project is aiming to provide based on previous ratings.

Outcome/Service Delivery

	Rail
Current	
Future	

Key for risk ratings:

Insufficient Understanding	No Exposure	Low Exposure	Moderate Exposure	High Exposure
	No Potential Impact	Low Potential Impact	Moderate Potential Impact	High Potential Impact
	No Risk	Low Risk	Moderate Risk	High Risk

Guidance on Managing Climate Risks through Enhanced Project Design

By understanding which of your project components are most at risk from climate change and other natural hazards through initial screening, you can begin to take measures to avoid impacts by:

1. Enhancing the consideration of climate and disaster risks early in project design.
2. Using your risk screening analysis to inform follow-up feasibility studies and technical assessments.
3. Encouraging local stakeholder consultations and dialogue to enhance resilience measures and overall success of the project.

Table 1 provides some general guidance based on the risk ratings for Outcome/Service Delivery and Table 2 lists some climate risk management measures for your consideration. Visit the "Screening Resources" page of the tool for additional guidance and a list of useful resources.

Note: Please recall that that this is a high-level screening tool, and that the characterization of risks should be complemented with more detailed work.

Table 1: General Guidance Based on Risk Ratings for Outcome/Service Delivery

Insufficient Understanding	Gather more information to improve your understanding of climate and geophysical hazards and their relationship to your project.

No/Low Risk	If you are confident that climate and geophysical hazards pose no or low risk to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented.
Moderate Risk	For areas of Moderate Risk, you are encouraged to build on this screening through additional studies, consultation, and dialogue. This initial screening may be supplemented with a more detailed risk assessment to better understand the nature ofthe risk to the project.
High Risk	For areas of High Risk, you are strongly encouraged to conduct a more detailed risk assessment and to explore measures to manage or reduce those risks.

Table 2: Types of Climate Risk Management Measures for Typical Transportation Projects

OBJECTIVE	EXAMPLES
Changes in Operations	> Shift construction schedules to cooler parts of the day to address health and safety concerns and avoid vehicle overheating and deterioration > Develop redundant structures or services that can be relied upon if disruptions occur > Shorten maintenance periods to accommodate changes in precipitation and temperature > Increase inspection frequency to ensure structures are enduring climate change pressures > Increase financial and technical resources for more frequent maintenance and repairs > Shortening of season for use of ice roads to reduce removal costs and environmental impacts from salt and chemical use > Increase use of sonars to monitor stream-bed flow and bridge scour > Integrate emergency evacuation procedures into operations > Use bridge openings more frequently for ships in the event of severe storm surges > Increase payload restrictions on aircraft at high-altitude or hot-weather airports > Temporarily close airports and ports when extreme weather events occur
Changes in Infrastructure Design and Materials	> Develop new, heat-resistant paving materials for construction of roadways, runways,and rail tracks > Use improved asphalt/concrete mixtures for roads and runways > Increase use of heat-tolerant street and highway landscaping > Greater use of continuous welded rail lines to avoid rail-track deformities > Use insulation in road prism to reduce thawing of permafrost, which causes subsidence of roads, rail beds, bridge supports (cave-in), and pipelines > Elevate bridge, tunnel, and transit entrances to reduce inundation and severe flooding of low-lying infrastructure > Build and strengthen existing levees, seawalls, and dikes to protect high-value coastal real estate > Upgrade existing infrastructure drainage systems and increase standards for new transportation infrastructure and major rehabilitation projects (e.g., assuming 100-yearand 500-year storms) > Increase pumping capacity for tunnels > Increase culvert capacity > Use flexible, expandable materials in railway systems > Protect critical evacuation routes > Protect bridge piers and abutments with riprap > Change bridge design to tie decks more securely to substructure and strengthen foundations > Adopt modular construction techniques where infrastructure is in danger of failure(such as modular traffic features and road sign systems for easier replacement) > Use more dredging of channels > Raise docks, wharf levels, jetties, and seawalls to protect harbours and terminal andwarehouse entrances > Extend runway lengths at high-altitude or hot-weather airports
Retreat/Relocate	> Convert coastal land uses to establish natural buffer zones > Relocate roads, railways, and airport runways further inland
Build information collection and management systems	> Strengthen climate information systems, building on existing regional and national networks > Build capacity of national governments to harmonize data across regions > Build relevant national and/or regional research programs on the links between climateand transportation sector > Improve the ability to forecast landfall and trajectory of hurricanes > Track changes in maintenance needs and schedules over time as adaptation actions are implemented > Monitor changing environmental conditions affected by climate (e.g., land erosion patters, frequency and severity of inundation events) to understand evolving adaptation needs
Strengthen policies, planning and systems	> Identify transportation-related development goals important to the country, region, orcommunity > Identify inputs and enabling conditions necessary to achieving transportation-related development goals > Integrate climate information into system planning to assess climate impacts ontransportation infrastructure and understanding adaptation needs and economic implications > Design flood risk-management plans with both ecosystem- and construction-based adaptation options > Update design standards to elevate roadways to accommodate future sea level riseand high winds > Consider storm surge in coastal road planning > Improve coordination of policies and programs across government agencies to address the additional pressures imposed by climate change > Improve finance for transportation systems that are more adaptive and better designed for a changing climate, including through private sector investment and incentives; ensure consideration of climate risk in financing approaches > Strengthen disaster planning and response for transportation infrastructure andservices

Sources: USAID Climate Risk Screening and Management Tools: Infrastructure, Construction, and Energy; Addressing Climate Change Impacts on Infrastructure; TRS Special Report: Potential Impacts of Climate Change on Transportation

Climate and Disaster Risk Screening Report for Stalac-Djunis High Speed Railway in Serbia

1. Introduction

Building resilience to climate and geophysical hazards is a vital step in the fight against poverty and for sustainable development. Screening for risks from these hazards improves the likelihood and longevity of a project`s success. The project level **Climate and Disaster Risks Screening in Depth** provides early-stage screening for climate and disaster risks at the concept stage of project development. The tool uses an **exposure – impact – adaptive capacity** framework to consider and characterize risks from climate and geophysical hazards, based on key components of a project and its broader development context.

This report summarizes the results of the screening process for Stalac-Djunis High Speed Railway in Serbia, which was applied to the following selected subsectors:

✔ **Rail**

The potential risks flagged in this report were identified by connecting information on climate and geophysical hazards exposure with the user's subject matter expertise and understanding of the project components and sensitivity to rate the impacts. The in-depth screening does not provide detailed risk assessments, rather it flags risks to inform consultations, enhance dialogue with local and other experts, and define further analytical work at the project location.

This early-stage screening can be used to strengthen the consideration of climate and disaster considerations in key components of the project design, including the physical aspects (e.g., pavement, bridge joints, rail tracks, runways, etc.) and soft components (e.g., capacity building and training to help prepare for and cope with hazards, resource planning and institutional strengthening at community level, and education campaigns, etc.). The broader sectoral (e.g., availability of alternate means of transportation, emergency protocols are in place that enable the transportatio n authority to respond to natural disasters, etc.) and development context conditions (e.g., strong institutional capacity in the transport agency, climate related early warning systems, etc.) could help modulate the risks to the delivery of the outcome/service level. The results of the screening are presented below, with supporting narrative to guide their interpretation.

2. Exposure of the Project Location to Climate and Geophysical Hazards

The table below presents a summary description of exposure to climate and geophysical hazards at the project location for the Current and Future time frames. Exposure to climate hazards is evaluated in two-times frames, because past records are not necessarily indicative of future conditions.

The following guiding questions are used to assess exposure.

1. What have been the historical trends in temperature, precipitation and drought conditions?
2. How are these trends projected to change in the future in terms of intensity, frequency and duration?
3. Has the location experienced strong winds, sea level rise, storm surge, and/or geophysical hazards in the past that may occur again in the future?

The descriptions provide a summary of the key characteristics and some indication of the trends in exposure from each hazard, drawing on global, quality controlled data sets from the Climate Change Knowledge Portal (CCKP). It is useful, for example to understand the temperature range and the rate of annual or decadal increase in a region; or precipitation patterns for historical and future time frames and seasonality shifts. Understanding the trends of hazards is important as they act individually and collectively on components/subsectors of the project. Because geophysical hazards (such as earthquakes, tsunamis, landslides, and volcano eruptions) do not have associated future projections, exposure for those hazards is assessed only in the Historical/Current time frame.

Table 3: Summary of Exposure to Climate and Geophysical Hazards at Project Location

Hazard	Time frame	Description of hazards for the project location
Extreme Temperature	Current	There was an increase in temperature in the Project area in the 2008-2017 period between 1.0 °C and 1.5 °C compared to the 1998-2017 period.
	Future	By the end of 21st century, a continuous increase in average annual temperature in the Project area is predicted. Seasonal analyses in average maximum and minimum temperatures have shown that temperature increase during the colder part of the year may be slightly less than the temperature increase during the warmer part of the year. The average annual temperature in the Project area is expected to increase by about 2 °C according to the RCP4.5 scenario and by about 4.5 °C according to the RCP8.5 scenario, by the end of the century. As a result of temperature increase, the number of frost and ice days will progressively decrease in the future, while the number of hot and tropical days will continue to increase.
Extreme Precipitation and Flooding	Current	The recorded amounts of precipitation show an increase of approx. 5% in the period 1998-2017 and 10% in the period 2008-2017 compared to the reference period 1961-1990. On the other hand, the Project area is characterised by a decrease in the amount of precipitation in the summer period by about 15% compared to the reference period. These changes in the amount of precipitation, as well as temperature, are an indication of the increasing frequency of floods in the winter and spring months, as well as the increasing frequency of droughts and fires in the summer months. The average number of days with precipitation greater than 40 mm increased by about 4 in the period 2008-2017 compared to the reference period 1961-1990.

Hazard	Time frame	Description of hazards for the project location
	Future	The precipitation is predicted to increase by 10% according to the RCP4.5 scenario and decrease by 15% according to the RCP8.5 scenario, by the end of the century. According to the both scenarios, precipitation decrease already observed during the June-August will continue during the future period. It is expected that changes in precipitation will be moreenhanced by seasons than on an annual basis, with more frequent heavy precipitation events and higher precipitation accumulation.
Sea Level Rise	Current	The Project area is not exposed to sea level rise.
	Future	The Project area is not exposed to sea level rise.
Storm Surge	Current	The Project area is not exposed to storm surge.
	Future	The Project area is not exposed to storm surge.
Strong Winds	Current	The Project area is not exposed to strong winds.
	Future	The Project area is not exposed to strong winds.
Earthquake	Current	In the last 100 years, the project area has been hit byseveral earthquakes, which were mostly of minor intensity. However, several major earthquakes caused significant material damage.
Landslides	Current	The Project area was affected by landslides, butwithout great impact.
Wildfires	Current	The Project area was affected by wildfires, butwithout great impact.

Insufficient Understanding	Not Exposure	Slightly Exposed	Moderately Exposed	Highly Exposed

3. Impacts on the Project's Physical Components Under Relevant Subsectors

This section presents the detailed results of screening for relevant subsectors to the transportationproject, including the project's investments in physical structures. The impact ratings are based onthe exposure ratings and the understanding of the project's sensitivity by the user. Understanding the contribution of risks from the subsectors, both individually and collectively can help inform theprocess of dialogue, consultation, and analysis during project design.

The following guiding questions are used to assess potential impacts:

1. Does the project design take into account recent trends and future projected changes in identified climate and geophysical hazards?
2. Does the project design consider how the structural integrity, materials, siting, longevity andoverall effectiveness of transportation infrastructure, if applicable, may be impacted?
3. In particular, does the design "lock in" certain decisions for the future?

✔ Rail

The potential impact of climate and geophysical hazards on the project's rail investments is rated based on exposure ratings for the location, and an understanding of the project's historical and future sensitivity to these risks. Please note that for this step, the tool is helping judge the effectthese impacts may have on the investment, and the ability of the project to sustain and improve rail infrastructure under a changing climate. Projected increases in temperature and the related increases in the frequency and severity of extreme temperatures may decrease the service life ofthe rail systems. In areas where precipitation or storm surge is expected to increase, rail infrastructure can experience significant physical damage and service disruptions due to flooding, which can cause track washout and bridge scour.

The ratings are based on expert judgment and an understanding of the local development context.

	Potential Impact	
	Current	Future
Rail		

Description ofimpacts	Over the past two decades, climate-related extreme events have caused major physical losses with significant impacts on Serbia's economy. The most severe floods that hit the Republic of Serbia occurred in May 2014, when some parts of Corridor X were also under water. Although the area between the settlements of Cerovo and Djunis was significantly affected (primarily houses and agricultural land), the impact of these floods on the Stalac-Djunis subsection has not been identified according to the available SRI documentation. According to available data from the Republic Hydrometeorological Service of Serbia, 361 mm of precipitation was recorded at the Krusevac meteorological station (ca. 13 km from Stalac and Djunis) in the spring of 2014, which is twice the average value, and when the record of the highest spring amount of precipitation from 1970 was exceeded. The Project area was again hit by devastating floods in May 2016, when the average level of precipitation for the whole month of May in Krusevac was reached in a period of 4 days. Asa result of a large amount of precipitation, the Juzna Morava River overflowed in the settlement of Djunis. The road Krusevac-Djunis was flooded. The overflow of the Juzna Morava River in the settlement of Djunis occurred again in the spring of 2018 because of large amounts of	Based on the Preliminary Flood Risk Assessment for the Republic of Serbia, the entire watercourse of the Juzna Morava River is assessed as a significant flood area. The future railway alignment mainly follows the course of the river – at the entrance to the Stalac settlement and between the settlements of Mojsinje and Djunis. River flood hazard is classified as high based on modelled flood information, which means that potentially damaging river floods are expected to occur at least once in the next 10 years. According to the preliminary map of the possibility of landslides occurrence, the possibility of landslides occurrence was assessed as small in Stalac, while going towards Djunis it is increasing and is assessed as medium. The Republic of Serbia ranks fifth in the risk of drought globally, while it is among the three European

	precipitation in a short time and melting snow. As a result, the state road Krusevac-Nis was flooded. In June 2020, the surroundings of Krusevac were hit by significant floods. The occurrence of landslides and erosion in the Project area is mainly related to the previous occurrence of droughts and floods. After the floods that affected the Project area and the surroundings of Krusevac in 2014 and 2018, several landslides were activated that endangered the local roads. The decrease in summer precipitation since the beginning of the 21st century coincides with the more frequent occurrence of drought conditions in Serbia, especially during the summer months. Drought conditions bave ecome more frequent since 1990. According to the 2020 UNCCD Drought Initiative, Serbia washit by 5 droughts in the period 2000-2017, which negatively affected agriculture, population health and energy production from hydropower plants. Statistical data show that the frequency of fires, as well as the total area affected by fires in Serbia is increasing. The State Enterprise "Srbijasume", which manages state forests and forest lands, reported 880 forest fires with 16,459.78 ha of affected area in the period 2000-2007. During the drought episode in 2012, 282 forest fires were recorded and 6,799.9 ha of forests burned (10,652.98 ha total burned area). The Project area was mainly affected by a small number of fires in the 2012-2017 period.	countries with the highest risk of drought. According to the European Environment Agency's projected forest fire danger changes under two climate scenarios, an increase in the number of fires in Serbia is expected. According to the RCP 4.5 scenario, the expected increase in the number of fires is between 10-15%, while the expected increase in the number of fires according to the RCP8.5 scenario is 20%.

Insufficient Understanding	No Potential Impact	Low Potential Impact	Moderate Potential Impact	High Potential Impact

4. Adaptive Capacity: modulating effect of the project's soft components and development context

The potential impact on key components/subsectors due to exposure from hazards is modulated bythe project's non-physical components (enabling and capacity building activities). The right kind of capacity building measures could increase preparedness and longer-term resilience and reduce risks. An understanding of larger sector and development context with respect to key modulating factors helps to assess the climate risks in terms of adaptive capacity. For example, in the transportation sector, budgeting processes that account for additional maintenance costs to address increasing damages from hazards, and access to improved technology may help reduce risks; while weak institutional capacity of local transport authorities may aggravate the risks.

In addition, vulnerable groups, namely women, migrants and displaced populations may be particularly affected by climate and disaster risks. Non-physical components can be designed to help alleviate the risks to women from climate and geophysical hazards.

The table below presents a summary description of the modulating effect the project's non - physical components and broader development context, which includes the transportation sectorcontext and other social, economic and political factors.

Summary of Adaptive Capacity: Modulating effect of the project's non-physical components and development context

Adaptive Capacity		
Modulation of impacts by the project's soft components ↓ Reduce Risk Emergency Planning Maintenance and Operations Data Gathering, Monitoring and Information Management Systems	**Modulation of impacts by the project's development context Transportation sector context** ↑ Increase Risk **Modulation of impacts by the project's social, economic and political factors** ↓ Reduce Risk	**Women identified as particularly vulnerable to impacts from climate and geophysical hazards** ✓ **Components designed to help alleviate the risks to women from climate and geophysical hazards** ✗

Description of modulating effects of non-physical components: The p roject has a significant focus on capacity enhancement, drainage of wastewater and atmospheric water along the railway alignment (especially in tunnels), construction of embankments to prevent floods, and emergency preparedness planning. The project also includes a flood mapping update to reflect future climate impacts and for use in long-termtransport planning. Combined, these features will reduce the anticipated risk from climate and geophysical hazards.The Serbia Railways Infrastructure has developed an internal Disaster Risk Assessment document and procedures that define how to manage in emergency situations.

Description of modulating effects of the transportation sector context: In the project country's transportation sector, there is a limited access to weather monitoring technologies and information. This, combined with the lack of emergency response systems in place to bring in critical supplies for isolated communitiesand relief services in case of extreme weather events, increases the risk from climate and geophysical hazards.

Description of modulating effects of social, economic and political factors in the project country: The investment in this Project, including the planned embankments for flood protection, indicates that the Republic of Serbia is moving towards reducing the risk of natural disasters. In case of emergencies, there is an appropriate action plan, and it can be said

that policies are aimed at adequately addressing the problem in that case. However, Serbia needs to pay more attention to timely action and prevention of accidents at an early stage.

5. Risk to the Outcome/Service Delivery of the Project

This section provides information on the level of risk to the outcome/service delivery that the Project is aiming to provide based on previous ratings.

The actual ratings themselves, while instructive, should inform further consultations, dialogue, and future planning processes. Keep in mind that the greatest value of the tool is that it provides a structured and systematic process for understanding climate and disaster risks.

5.1 Level of Risk by Subsector

Table 4 below highlights the impact ratings on the project's components/subsectors, and the overall risk to the outcome/service level for both Current and Future time frames.

The ratings are derived on the basis of hazard information, subject matter expertise, contextual understanding of the project, and modulated on the basis of adaptive capacity, including the Project's non-physical component, transportation sector context and broader development context. The results indicate what components are most at risk. The results indicate where risks may exist within one or multiple components and where further work may be required to reduce or manage these risks. An ongoing process of monitoring risks, refining climate and other information, and regular impact assessment may also be appropriate.

Table 4: Summary of Risk to Outcome/Service Delivery by Subsector

Sub-sector	Potential Impact		Non-Physical Components		Development Context				Outcome/Service Delivery	
					Transportation Sector		Broader Context			
Timeframe	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Rail			↓ Reduce Risk		↑ Increase Risk		↓ Reduce Risk			

Insufficient Understanding	No Risk	Low Risk	Moderate Risk	High Risk

5.2 Level of Risk by Time Frame

Table 5 below draws attention to how climate impacts and risks shift from the Current to the Future time frame. Potential impacts to subsectors are evaluated separately for the Current and Future timeframes to capture changes in the exposure from climate hazards over time. For example, projections might indicate that extreme temperature conditions and flood risk are likely to increase significantly. Both of these changes would affect transportation infrastructure.

For investments with long operational lifetimes, such as physical infrastructure, considering future climate variability and change is critical to avoid "locking in" designs and features that are only suited to the current climate. For example, roads can be inundated from sea level rise and storm surge or experience damage from earthquakes, while sustained temperatures above 42°C may affect pavement integrity. Furthermore, increases in very hots days can result in rail track deformations. Tunnels and drainage systems capacity can be overwhelmed by excessive precipitation and flooding. These impacts may influence the resilience of transportation investments.

Table 5: Summary of Risk to Outcome/Service Delivery by Time Frame

	Current				Future				
Sub-sector	Potential Impact	Non-Physical Components	Development Context: Transportation-sector	Development Context: Broader Context	Outcome/Service Delivery	Potential Impact	Non-Physical Components	Development Context: Transportation-sector	Development Context: Broader Context	Outcome/Service Delivery
Rail		↓ Reduce Risk	↑ Increase Risk	↓ Reduce Risk			↓ Reduce Risk	↑ Increase Risk	↓ Reduce Risk	

Insufficient Understanding	No Risk	Low Risk	Moderate Risk	High Risk

5.3 Key Drivers of Risk

Table 6 below highlights the key drivers of risk for each project subsector ratings, in terms of hazards that are likely to pose the greatest challenge.

The ratings for the potential impact to each subsector reflect the aggregate rating across multiple hazards, drawing on all of the exposure information and expert judgment. For example, extreme temperatures can affect infrastructure and service delivery of multi-modal and transit systems, while sea level rise combined with storm surge can cause damage to port infrastructure.

Table 6: Key Drivers of Risk

	Historical/Current Drivers	Future Drivers

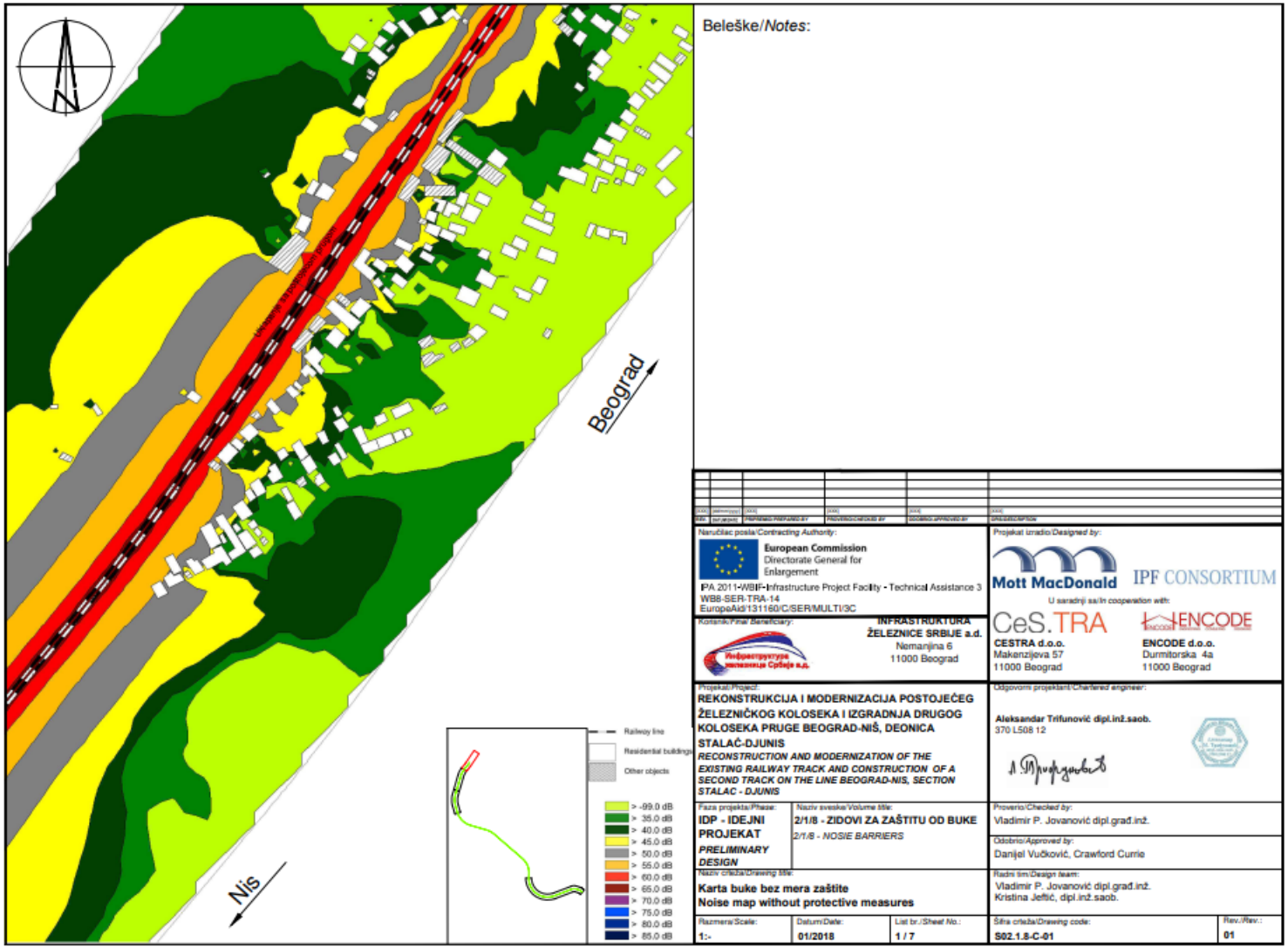
Hazards & Location	Extreme Temperature Extreme Precipitation and Flooding Earthquake	Extreme Temperature Extreme Precipitation andFlooding
Physical Components	Rail	Rail
Outcome/Service delivery	*	*

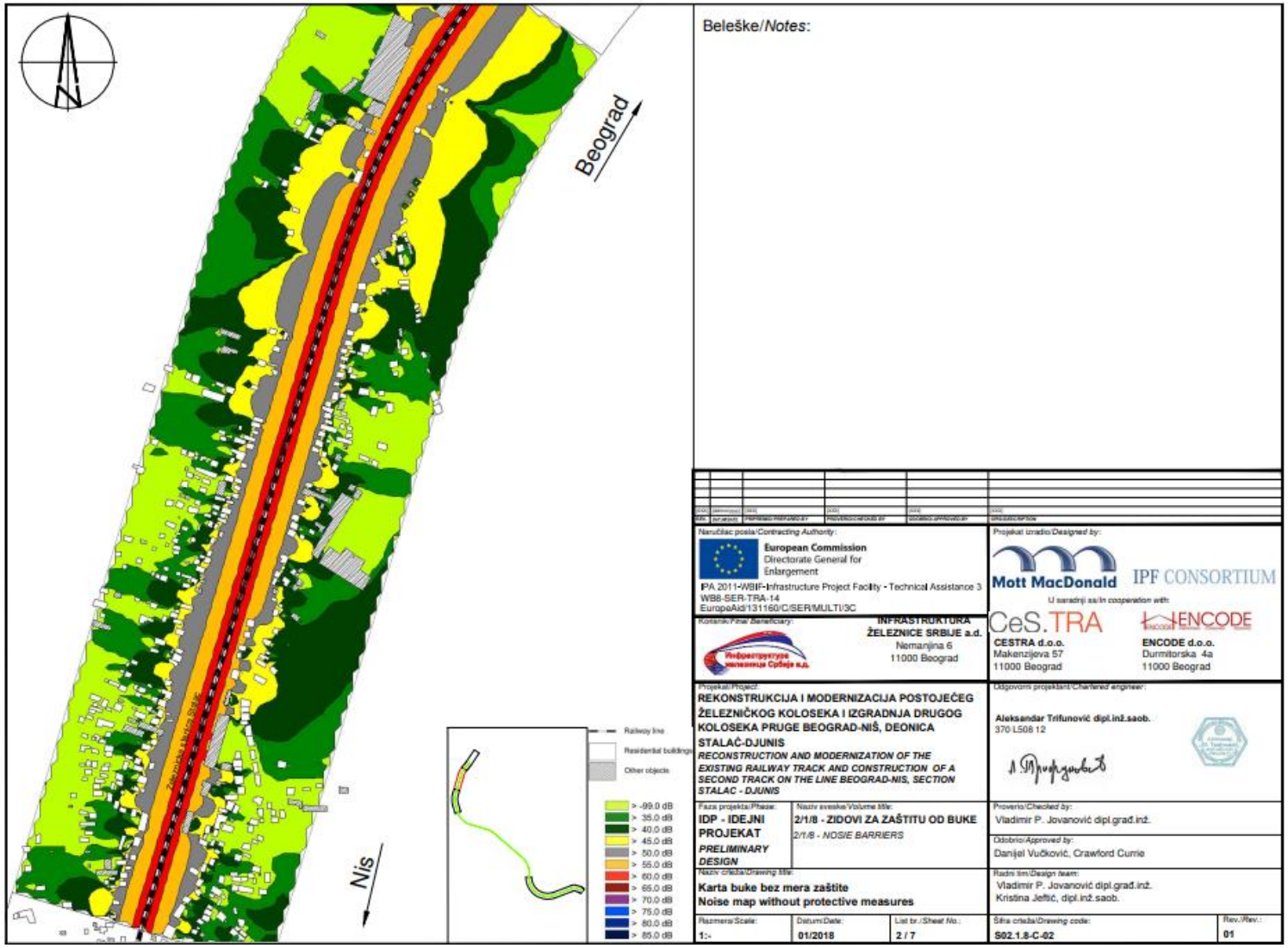
High Risk	Moderate Risk

*If a cell is blank it implies there are 'No high or moderate risks' identified for this aspect of theproject.

Specific consideration should be given to those hazards which have high ratings, or are moving frommoderate to high ratings over time. For example, sea-level rise may not be a key risk driver in the Historical/Currenttime frame; but may emerge as a key driver across multiple subsectors in the future time frame. Understanding which hazards are key drivers may help flag follow-on work to manage climate risks within the design and delivery of the project.

C. Noise Maps with/without protective measures

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RECONSTRUCTION AND MODERNIZATION OF THE EXISTING RAILWAY TRACK AND CONSTRUCTION OF A SECOND TRACK ON THE LINE BEOGRAD-NIS, SECTION STALAC - DJUNIS
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IDP - IDEJNI PROJEKAT
PRELIMINARY DESIGN
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Odobrio/Approved by:
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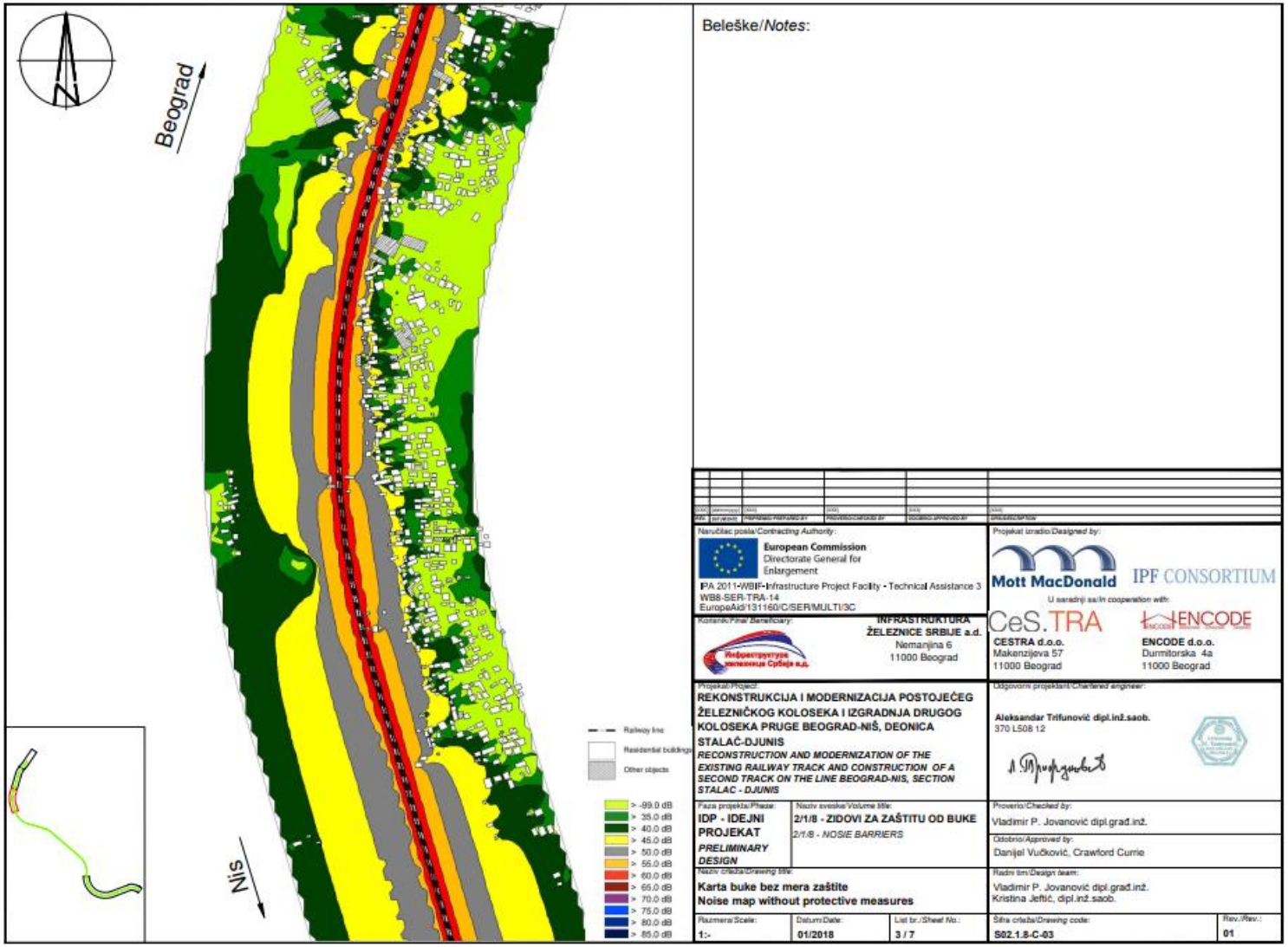
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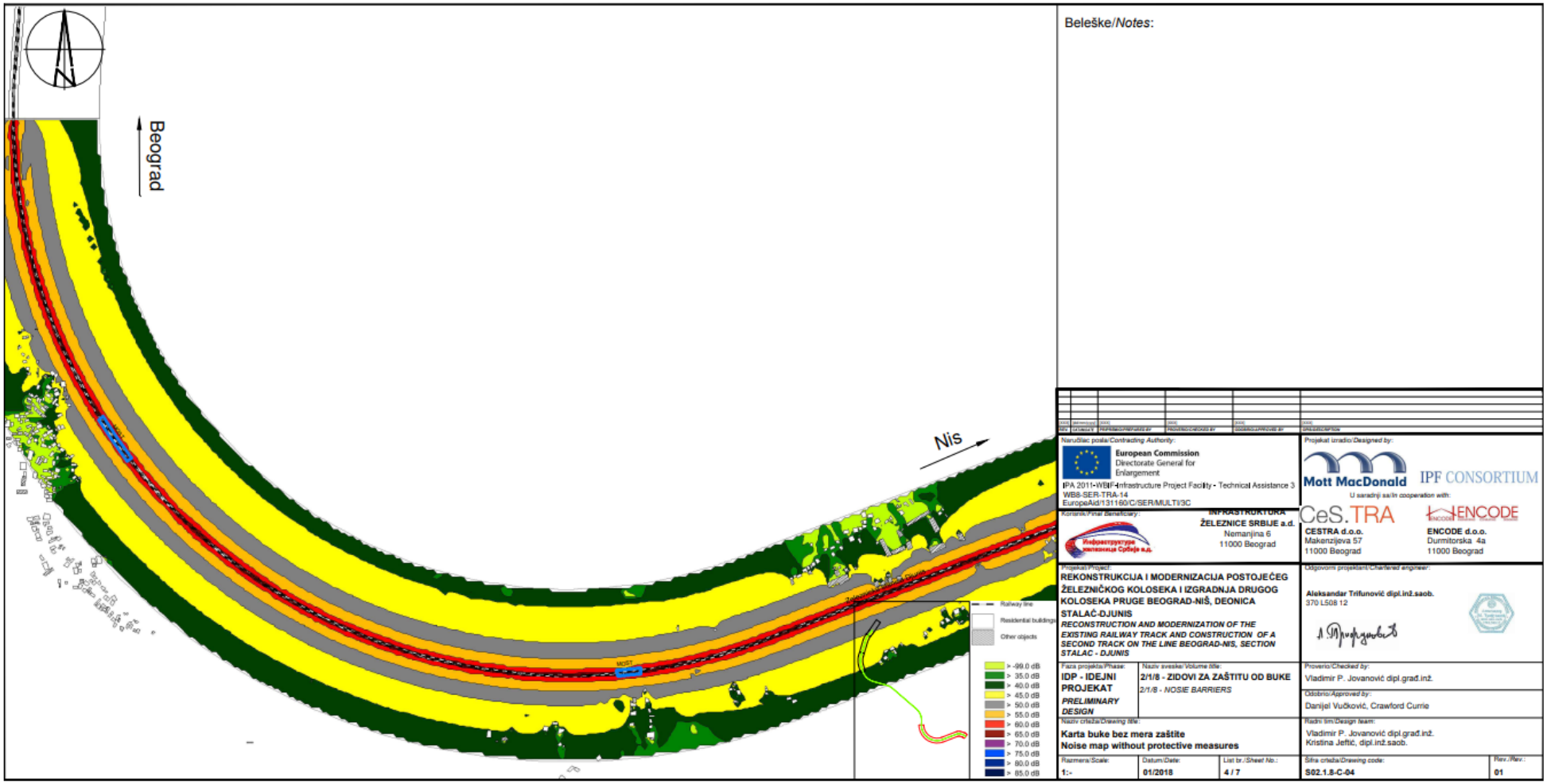
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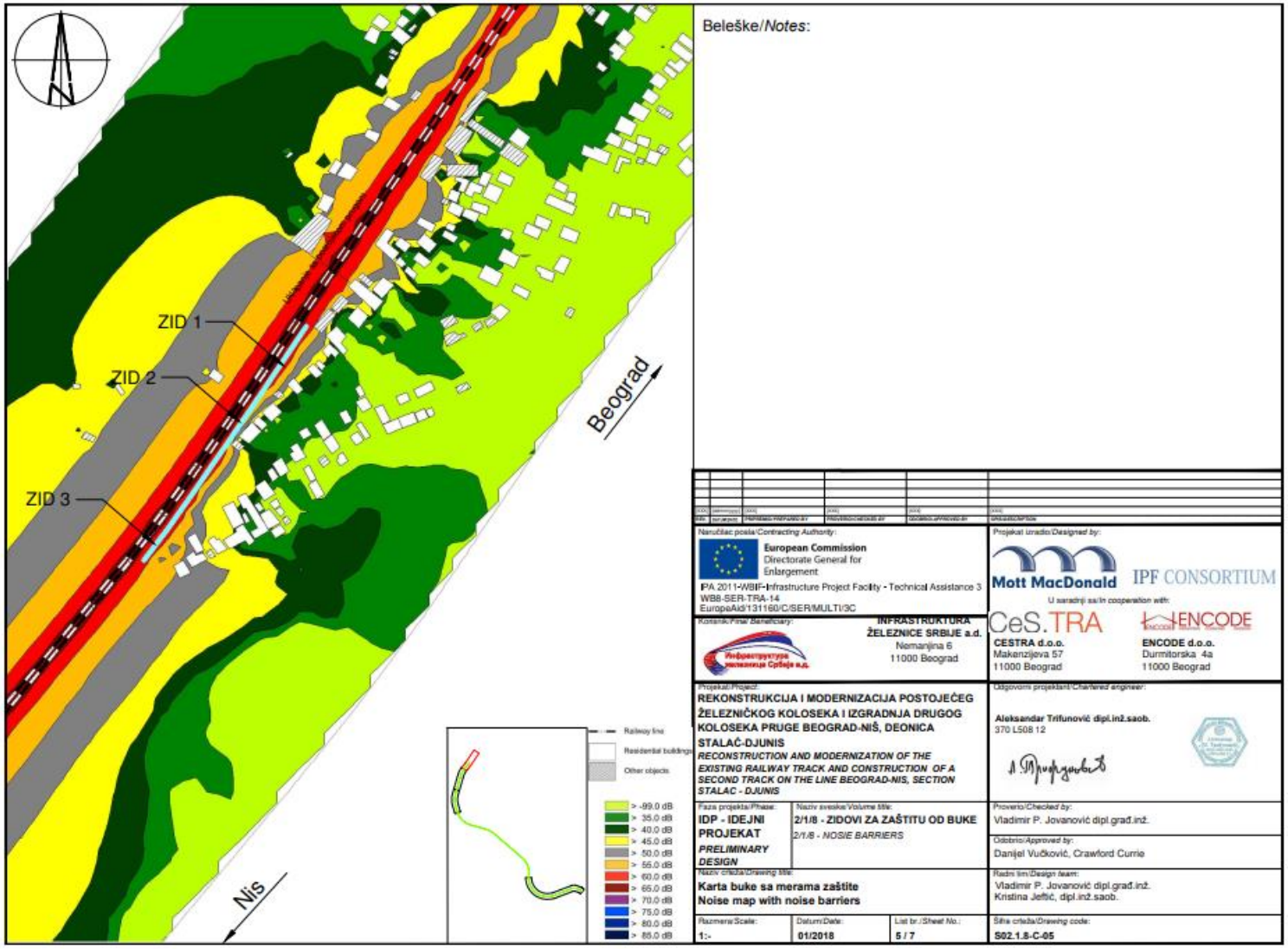
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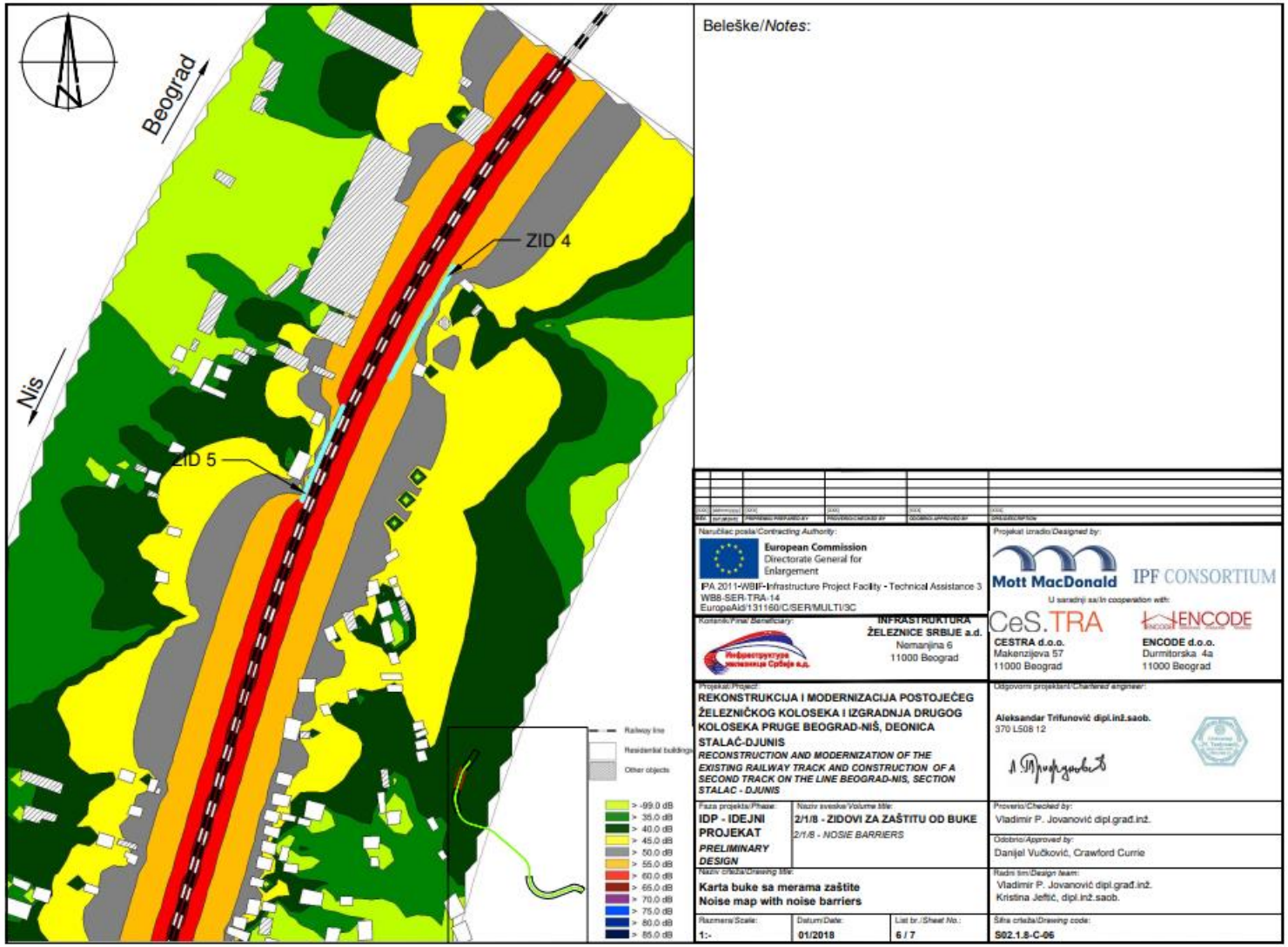
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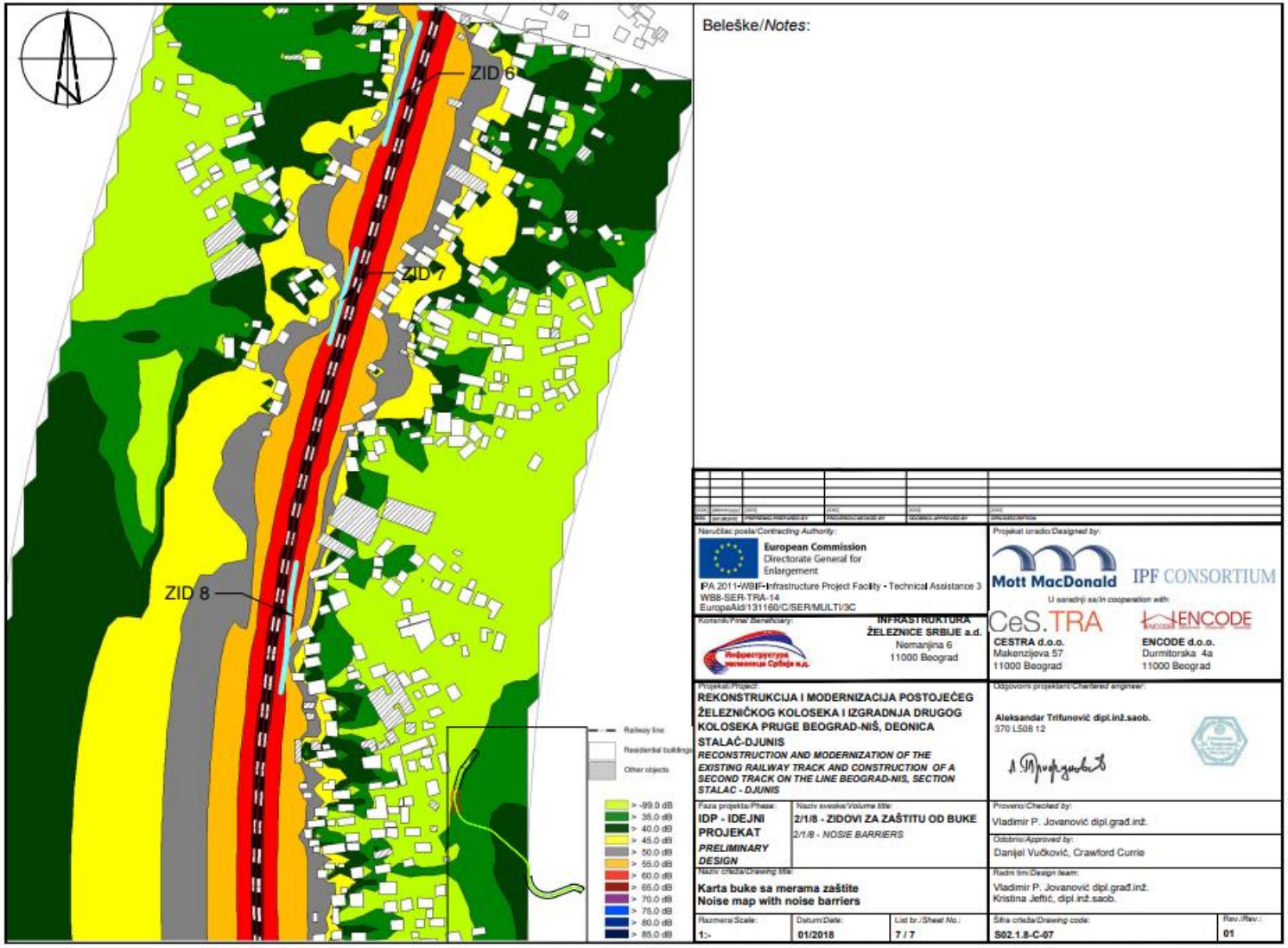
PRELIMINARY DESIGN
Naziv sveska/Volume title:
2/1/8 - ZIDOVI ZA ZAŠTITU OD BUKE
2/1/8 - NOISE BARRIERS
Proveriо/Checked by:
Vladimir P. Jovanović dipl.grad.inž.
Odobrio/Approved by:
Danijel Vučković, Crawford Currie
Naziv crteža/Drawing title:
Karta buke sa merama zaštite
Noise map with noise barriers
Radni tim/Design team:
Vladimir P. Jovanović dipl.grad.inž.
Kristina Jeftić, dipl.inž.saob.
Razmera/Scale:
1:-
Datum/Date:
01/2018
List br./Sheet No.:
6 / 7
Šifra crteža/Drawing code:
S02.1.8-C-06


ZID 6
ZID 7
ZID 8
Railway line
Residential buildings
Other objects
> -99.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB
> 85.0 dB
Beleške/Notes:
Naručilac posla/Contracting Authority:
European Commission
Directorate General for Enlargement
IPA 2011-WBIF-Infrastructure Project Facility - Technical Assistance 3
WB8-SER-TRA-14
EuropeAid/131160/C/SER/MULTI/3C
Korisnik/Final Beneficiary:
INFRASTRUKTURA ŽELEZNICE SRBIJE a.d.
Nemanjina 6
11000 Beograd
Projekat izradio/Designed by:
Mott MacDonald
IPF CONSORTIUM
U saradnji sa/In cooperation with:
CeS.TRA
CESTRA d.o.o.
Makenzijeva 57
11000 Beograd
ENCODE
ENCODE d.o.o.
Durmitorska 4a
11000 Beograd
Projekat/Project:
REKONSTRUKCIJA I MODERNIZACIJA POSTOJEĆEG ŽELEZNIČKOG KOLOSEKA I IZGRADNJA DRUGOG KOLOSEKA PRUGE BEOGRAD-NIŠ, DEONICA STALAĆ-DJUNIS
RECONSTRUCTION AND MODERNIZATION OF THE EXISTING RAILWAY TRACK AND CONSTRUCTION OF A SECOND TRACK ON THE LINE BEOGRAD-NIS, SECTION STALAC - DJUNIS
Odgovorni projektant/Chartered engineer:
Aleksandar Trifunović dipl.inž.saob.
370 L508 12
Faza projekta/Phase:
IDP - IDEJNI PROJEKAT
PRELIMINARY DESIGN
Naziv sveske/Volume title:
2/1/8 - ZIDOVI ZA ZAŠTITU OD BUKE
2/1/8 - NOISE BARRIERS
Proveno/Checked by:
Vladimir P. Jovanović dipl.građ.inž.
Odobrio/Approved by:
Danijel Vučković, Crawford Currie
Naziv crteža/Drawing title:
Karta buke sa merama zaštite
Noise map with noise barriers
Radni tim/Design team:
Vladimir P. Jovanović dipl.građ.inž.
Kristina Jeftić, dipl.inž.saob.
Razmera/Scale: 1:-
Datum/Date: 01/2018
List br./Sheet No.: 7 / 7
Šifra crteža/Drawing code: S02.1.8-C-07
Rev./Rev.: 01

D. Invertebrate Survey Results

Taxon	Year	Month	Day	Latitude	Longitude
Natrix tessellata	2022	5	27	43,611555	21,48392
Cychrus sp.	2022	5	27	43,648344	21,465799
Carabus montivagus	2022	5	27	43,648063	21,465888
Abax carinatus	2022	5	27	43,647798	21,466091
Carabus coriaceus	2022	5	27	43,651057	21,464301
Carabus coriaceus	2022	5	27	43,647014	21,452395
Testudo hermanni	2022	5	27	43,649396	21,449484
Carabus coriaceus	2022	5	27	43,642288	21,488527
Carabus coriaceus	2022	5	27	43,64126	21,488074
Natrix natrix	2022	5	27	43,639335	21,487858
Morimus asper	2022	5	27	43,630854	21,485686
Lucanus cervus	2022	5	27	43,611366	21,484206
Dorcus parallelipipedus	2022	5	27	43,609803	21,488673
Melanotus	2022	5	27	43,609263	21,487957
Morimus asper	2022	5	27	43,609249	21,486779
Zerynthia polyxena	2022	5	15	43,650518	21,465016
Libellula depressa	2022	5	15	43,650173	21,46524
Leptidea sinapis/juvernica	2022	5	15	43,650046	21,465318
Cupido minimus	2022	5	15	43,649849	21,465451
Natrix tessellata	2022	5	15	43,649805	21,465374
Issoria lathonia	2022	5	15	43,642679	21,466595
Pyrgus malvae	2022	5	15	43,638587	21,468276
Callophrys rubi	2022	5	15	43,638594	21,468275
Testudo hermanni	2022	5	15	43,638978	21,467991
Neptis sappho	2022	5	15	43,639067	21,467948
Testudo hermanni	2022	5	15	43,639195	21,467901
Melitaea cinxia	2022	5	15	43,63955	21,467656
Bombina variegata	2022	5	15	43,639995	21,467364
Neptis sappho	2022	5	15	43,640223	21,467236
Pararge aegeria	2022	5	15	43,640868	21,466671
Testudo hermanni	2022	5	15	43,641048	21,466659
Hamearis lucina	2022	5	15	43,641568	21,466364
Calopteryx splendens	2022	5	15	43,641769	21,466385
Melitaea athalia	2022	5	15	43,641972	21,466398
Pseudophilotes vicrama	2022	5	15	43,641972	21,466398
Callophrys rubi	2022	5	15	43,641925	21,46645
Libellula depressa	2022	5	15	43,641929	21,466465
Testudo hermanni	2022	5	15	43,641941	21,466478
Pieris napi	2022	5	15	43,6421	21,466587
Parnassius mnemosyne	2022	5	15	43,64215	21,466619
Lacerta viridis	2022	5	15	43,642301	21,466647
Zerynthia polyxena	2022	5	15	43,64249	21,466438
Papilio machaon	2022	5	15	43,642687	21,466622
Iphiclides podalirius	2022	5	15	43,642815	21,466685
Pyrgus malvae	2022	5	15	43,642815	21,466685
Calopteryx virgo	2022	5	15	43,643038	21,466587
Neptis sappho	2022	5	15	43,643038	21,466587
Testudo hermanni	2022	5	15	43,643406	21,466767
Hamearis lucina	2022	5	15	43,643424	21,466738
Natrix natrix	2022	5	15	43,643684	21,466934
Testudo hermanni	2022	5	15	43,644031	21,46694
Agapanthia villosoviridescens	2022	5	15	43,644201	21,466988
Callophrys rubi	2022	5	15	43,644226	21,46702
Pieris rapae	2022	5	15	43,644232	21,467035
Calopteryx splendens	2022	5	15	43,644231	21,467048
Lycaena tityrus	2022	5	15	43,644574	21,46703
Plebejus argus	2022	5	15	43,644542	21,466967

Taxon	Year	Month	Day	Latitude	Longitude
Coenonympha pamphilus	2022	5	15	43,645547	21,466809
Iphiclides podalirius	2022	5	15	43,645564	21,466788
Melitaea athalia	2022	5	15	43,645564	21,466788
Neptis sappho	2022	5	15	43,645669	21,466708
Testudo hermanni	2022	5	15	43,645688	21,466627
Pararge aegeria	2022	5	15	43,64595	21,46652
Testudo hermanni	2022	5	15	43,646111	21,466629
Hamearis lucina	2022	5	15	43,646681	21,466314
Neptis sappho	2022	5	15	43,647078	21,466382
Natrix natrix	2022	5	15	43,647501	21,465873
Natrix tessellata	2022	5	15	43,647654	21,465916
Pararge aegeria	2022	5	15	43,647971	21,465972
Plebejus argus	2022	5	15	43,648618	21,465694
Leptidea sinapis	2022	5	15	43,648656	21,465642
Callophrys rubi	2022	5	15	43,648656	21,465642
Neptis sappho	2022	5	15	43,648656	21,465642
Pararge aegeria	2022	5	15	43,649231	21,465655
Callophrys rubi	2022	5	15	43,649334	21,465539
Testudo hermanni	2022	5	15	43,649275	21,465243
Lycaena dispar	2022	5	15	43,649779	21,465417
Melitaea athalia	2022	5	15	43,649861	21,465475
Leptidea sinapis/juvernica	2022	5	15	43,649989	21,465364
Vanessa atalanta	2022	5	15	43,649989	21,465364
Pyrgus malvae	2022	5	15	43,649989	21,465364
Neptis sappho	2022	5	15	43,650166	21,465327
Aricia agestis	2022	5	15	43,650283	21,465209
Erynnis tages	2022	5	15	43,650283	21,465209
Testudo hermanni	2022	5	15	43,650341	21,465188
Plebejus argus	2022	5	15	43,650333	21,465206
Glaucopsyche alexis	2022	5	15	43,650754	21,464807
Parnassius mnemosyne	2022	5	15	43,650768	21,464722
Lycaena dispar	2022	5	15	43,650713	21,464636
Callophrys rubi	2022	5	15	43,650649	21,464576
Lacerta viridis	2022	5	15	43,648007	21,462263
Pararge aegeria	2022	5	15	43,647085	21,452409
Platycnemis pennipes	2022	5	15	43,647211	21,452549
Calopteryx splendens	2022	5	15	43,64756	21,452982
Lycaena dispar	2022	5	15	43,647446	21,452929
Coenonympha pamphilus	2022	5	15	43,647328	21,452618
Zerynthia polyxena	2022	5	15	43,647019	21,452326
Zerynthia cerisy	2022	5	15	43,620189	21,488296
Natrix natrix	2022	5	15	43,620189	21,488296
Calopteryx splendens	2022	5	15	43,616142	21,484114
Iphiclides podalirius	2022	5	15	43,616262	21,484333
Pyrgus malvae	2022	5	15	43,617049	21,48485
Pieris rapae	2022	5	15	43,616716	21,48452
Callophrys rubi	2022	5	15	43,61657	21,484508
Zerynthia polyxena	2022	5	15	43,616552	21,484412
Lasiommata megera	2022	5	15	43,616049	21,484093
Platycnemis pennipes	2022	5	15	43,615988	21,483931
Parnassius mnemosyne	2022	5	15	43,615924	21,484005
Coenonympha pamphilus	2022	5	15	43,616115	21,484163
Lycaena dispar	2022	5	15	43,609278	21,488009
Coenonympha pamphilus	2022	5	15	43,609922	21,488932
Leptidea sinapis/juvernica	2022	5	15	43,609192	21,488408
Zerynthia polyxena	2022	5	15	43,608962	21,488403
Lycaena tityrus	2022	5	15	43,608962	21,488403
Glaucopsyche alexis	2022	5	15	43,608927	21,488619
Pararge aegeria	2022	5	15	43,609594	21,48873

Taxon	Year	Month	Day	Latitude	Longitude
Polygonia c-album	2022	5	15	43,60952	21,489261
Callophrys rubi	2022	5	15	43,609829	21,488914
Colias crocea	2022	5	15	43,609831	21,488915
Plebejus argus	2022	5	15	43,609855	21,488786
Ochlodes sylvanus	2022	5	15	43,609855	21,488786
Melitaea athalia	2022	5	15	43,609855	21,488786
Zerynthia cerisy	2022	5	15	43,609266	21,488006
Zerynthia polyxena	2022	5	15	43,609255	21,487891
Coenagrion puella	2022	5	15	43,481273	21,769922
Anthocaris cardamines	2022	4	27	43,385015	21,27956
Erynnis tages	2022	4	27	43,385015	21,27956
Emys orbicularis	2022	4	27	43,385015	21,27956
Neptis sappho	2022	4	27	43,385015	21,27956
Leptidea sinapis/juvernica	2022	4	27	43,385015	21,27956
Zerynthia polyxena	2022	4	27	43,647446	21,452929
Pyrgus malvae	2022	4	27	43,650283	21,465209
Iphiclides podalirius	2022	4	27	43,650283	21,465209
Natrix natrix (belouška)	2022	4	27	43,647501	21,465873
Anthocharis cardamines	2022	4	27	43,650283	21,465209
Iphiclides podalirius	2022	4	27	43,647446	21,452929
Pieris rapae	2022	4	27	43,647446	21,452929
Boloria dia	2022	4	27	43,647501	21,465873
Pararge aegeria	2022	4	27	43,647501	21,465873
Pyrgus malvae	2022	4	27	43,647501	21,465873
Erynnis tages	2022	4	27	43,650283	21,465209
Araschnia levana	2022	4	27	43,650283	21,465209
Zerynthia polyxena	2022	4	27	43,650283	21,465209